# 7 Layer 2

## 7.1 NR Layer 2

### 7.1.0 Common test case specific values for Layer 2

For all layer 2 test cases, default values for periodicBSR-Timer, retxBSR-Timer and phr-Config shall be taken according to the table 7.1.0-1 unless test case specific values are given in the test case.

Table 7.1.0-1: MAC-CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.308 [6], clause Table 4.6.3-49 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | infinity |  |  |
| retxBSR-Timer | sf10240 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

### 7.1.1 MAC

#### 7.1.1.0 Default Pre-Test Conditions for all MAC test cases

The following pre-test conditions shall be applied in all MAC test cases until the test case explicitly over writes these conditions

System Simulator:

- The SS configures the test environment in accordance to the execution conditions in Table 7.1.1.0-1.

UE:

- None

Preamble:

- The SS performs the generic procedure in [4] to get UE in state RRC\_CONNECTED in accordance to the execution conditions in Table 7.1.1.0-2 and using the message condition UE TEST LOOP MODE A to return one PDCP SDU per DL PDCP SDU.

Table 7.1.1.0-1: Test environment

|  |  |  |
| --- | --- | --- |
| Execution Condition | Cell configuration | System Information Combination |
| IF pc\_NG\_RAN\_NR | NR Cell 1 | NR: System information Combination NR-1 |
| ELSE IF pc\_EN\_DC | E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NGEN\_DC | NG-RAN E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NE\_DC | NR Cell 1 is PCell,  E-UTRA Cell 1 is PSCell | NR: System information Combination NR-1  E-UTRA: N/A |

Table 7.1.1.0-2: Preamble parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Execution Condition | Multi-PDN / Multi-PDU Sessions Condition | Generic Procedure Parameters | Primary DRB used for Data testing |
| IF pc\_NG\_RAN\_NR | FALSE | Connectivity(*NR*),  Test loop function(*On*)  One DRB | Default DRB of the first PDU session on NR Cell |
| TRUE | Connectivity(*NR*),  Test loop function(*On*)  *N* DRBs (*N* ≥ 2) |  |
| ELSE IF pc\_EN\_DC | FALSE | Connectivity(*EN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*EN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NGEN\_DC | FALSE | Connectivity(*NGEN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*NGEN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NE\_DC | FALSE | Connectivity(*NE-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
|  | TRUE | Connectivity(*NE-DC*),  DC bearer(*N* ≥ 2 MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |  |

Table 7.1.1.0-3: Message conditions

|  |  |
| --- | --- |
| **Execution Condition** | **Message condition exceptions** |
| IF pc\_NG\_RAN\_NR | Message with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_EN\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NGEN\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NE\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.6 according to [4] |

Table 7.1.1.0-4: SDAP Configuration Settings for pc\_NG\_RAN\_NR and pc\_NE\_DC

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value DRB1 | Value DRB2 | Value DRB3 |
| default DRB | true | false | false |
| mappedQoS-FlowsToAdd | QFI 1 in Table 4.8.2.3-1 according to TS38.508-1 | QFI 2 in Table 4.8.2.3-2 according to TS38.508-1 | QFI 3 in Table 4.8.2.3-3 according to TS38.508-1 |

#### 7.1.1.1 Random Access Procedures

##### 7.1.1.1.1 Correct selection of RACH parameters / Random access preamble and PRACH resource explicitly signalled to the UE by RRC / contention free random access procedure

7.1.1.1.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected }

**ensure that** {

**when** { SS sends an RRCReconfiguration message including RACH-ConfigDedicated information element }

**then** { UE sends a prach preamble given in the RACH-ConfigDedicated on the target cell }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell received in RACH-ConfigDedicated on the target cell }

**ensure that** {

**when** { UE does not receive a matching Random Access response in ra-ResponseWindowSize (hence considers RACH attempt as failed) and PREAMBLE\_TRANSMISSION\_COUNTER is less than PREAMBLE\_TRANS\_MAX }

**then** { UE retransmits a PRACH preamble received in RACH-ConfigDedicated on the target cell }

}

7.1.1.1.1.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.2, 5.1.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

…

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

…

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured or indicated by PDCCH (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to clause 8.1 of TS 38.213 [6], corresponding to the SSB which is quasi-collocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collocated with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see clause 5.1.3).

NOTE: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access procedure for an SCell is performed on uplink carrier where *pusch-Config* is not configured:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

NOTE: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of contention-based Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behaviour is not defined.

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted; or

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on an SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see clause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response reception.

7.1.1.1.1.3 Test description

7.1.1.1.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except the following:

- 2 NR cells (NR Cell 1 and NR Cell 2) are configured.

- Test loop function(*Off*)

7.1.1.1.1.3.2 Test procedure sequence

Table 7.1.1.1.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an *RRCReconfiguration* message to handover NR Cell 1 to target NR Cell 2, including RACH-ConfigDedicated information element  (Note 1, Note 3) | <-- | *RRCReconfiguration* | - | - |
| 2 | Void |  |  |  |  |
| 3 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1 on NR Cell2? | --> | (PRACH Preamble) | 1 | P |
| 4 | Check: Does the UE re-transmits Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1 on NR Cell2? | --> | (PRACH Preamble) | 2 | P |
| 5 | The SS transmits Random Access Response on NR cell 2, with RAPID corresponding to *ra-PreambleIndex* in step 1 | <-- | Random Access Response | - | - |
| 6 | Check: Does the UE transmit an *RRCReconfigurationComplete* message?  (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_PSCell\_HO AND RBConfig\_NoKeyChange.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For FR1,PRACH preamble format 0 as per TS 38.211[24] Table 6.3.3.1-1 is configured (real network deployment). | | | | | |

7.1.1.1.1.3.3 Specific message contents

Table 7.1.1.1.1.3.3-1: *Void*

Table 7.1.1.1.1.3.3-2: *RRCReconfiguration* for EN-DC (step 1, Table 7.1.1.1.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-2A: *RRCReconfiguration* for NR/5GC (step 1, Table 7.1.1.1.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| radioBearerConfig | RadioBearerConfig as per TS 38.508-1[4] Table 4.6.3-132 with conditions DRBn and Recover\_PDCP | n set to the default DRB of the first PDU session | NR |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-3: *CellGroupConfig* for EN-DC (Table 7.1.1.1.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-3A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.1.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-4: *RACH-ConfigDedicated* (Table 7.1.1.1.1.3.3-3 and Table 7.1.1.1.1.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| cfra SEQUENCE { |  |  |  |
| occasions SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  | FR1, PRACH Preamble format 0 used |
| } |  |  |  |
| resources CHOICE { |  |  |  |
| ssb SEQUENCE { |  |  |  |
| ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource { | 1 entry |  |  |
| CFRA-SSB-Resource[1] SEQUENCE { |  | entry 1 |  |
| ssb | 0 |  |  |
| ra-PreambleIndex | 52 | Randomly selected |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-5: *RACH-ConfigGeneric* (Table 7.1.1.1.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 14 |  | FR1 |
|  | 149 |  | FR2 |
| zeroCorrelationZoneConfig | 12 |  | FR1 |
|  | 15 |  | FR2 |
| } |  |  |  |

Table 7.1.1.1.1.3.3-6: *ServingCellConfigCommon* (Table 7.1.1.1.1.3.3-3 and Table 7.1.1.1.1.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.1.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.1.1.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell.. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-9: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 AND SCS30 |
|  | 2 |  | FR1 AND SCS15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-10: ServingCellConfig (Table 7.1.1.1.1.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-11: *BWP-UplinkDedicated* (Table 7.1.1.1.1.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-12: *PUCCH-Config* (Table 7.1.1.1.1.3.3-11)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1.3.3-13: *SchedulingRequestResourceConfig* (Table 7.1.1.1.1.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-157 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 2 | With SCS = kHz15 results in repetition every 10 ms | SCS15 |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS30 |
| sl80 | 4 | With SCS = kHz120 results in repetition every 10 ms | SCS120 |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.1a Correct selection of RACH parameters / Random access preamble and PRACH resource explicitly signalled to the UE by PDCCH Order / contention free random access procedure

7.1.1.1.1a.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected }

**ensure that** {

**when** { PDCCH control command is received in NR SpCell providing Random Access Preamble }

**then** { UE sends a PRACH preamble given in the PDCCH Order in NR SpCell }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell received in PDCCH control command on NR SpCell }

**ensure that** {

**when** { UE does not receive a matching Random Access response in ra-ResponseWindowSize (hence considers RACH attempt as failed) and PREAMBLE\_TRANSMISSION\_COUNTER is less than PREAMBLE\_TRANS\_MAX }

**then** { UE retransmits a PRACH preamble received in PDCCH control command on NR SpCell }

}

7.1.1.1.1a.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.2, 5.1.4 and TS 38.212 clause 7.3.1.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

…

1> else if the *ra-PreambleIndex* has been explicitly provided by either PDCCH or RRC; and

1> if the *ra-PreambleIndex* is not 0b000000; and

1> if contention-free Random Access Resource associated with SSBs or CSI-RS have not been explicitly provided by RRC:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*.

…

1> if an SSB is selected above and an association between PRACH occasions and SSBs is configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above and an association between PRACH occasions and CSI-RSs is configured:

2> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> else:

2> determine the next available PRACH occasion (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion).

1> perform the Random Access Preamble transmission procedure (see clause 5.1.3).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

...

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers; and

1> if PDCCH transmission is addressed to the C-RNTI; and

...

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a Backoff Indicator subheader:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the Backoff Indicator subheader using Table 7.2-1.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for the SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *preamblePowerRampingStep*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

...

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or:

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTxMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if in this Random Access procedure, the Random Access Preamble was selected by MAC among the contention-based Random Access Preambles:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> delay the subsequent Random Access Preamble transmission by the backoff time.

2> perform the Random Access Resource selection procedure (see subclause 5.1.2).

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

[TS 38.212, 7.3.1.2.1]

If the CRC of the DCI format 1\_0 is scrambled by C-RNTI and the "Frequency domain resource assignment" field are of all ones, the DCI format 1\_0 is for random access procedure initiated by a PDCCH order, with all remaining fields set as follows:

- Random Access Preamble index – 6 bits according to *ra-PreambleIndex* in Subclause 5.1.2 of [8, TS38.321]

- UL/SUL indicator – 1 bit. If the value of the "Random Access Preamble index" is not all zeros and if the UE is configured with SUL in the cell, this field indicates which UL carrier in the cell to transmit the PRACH according to Table 7.3.1.1.1-1; otherwise, this field is reserved

- SS/PBCH index – 6 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission; otherwise, this field is reserved.

- PRACH Mask index – 4 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the RACH occasion associated with the SS/PBCH indicated by "SS/PBCH index" for the PRACH transmission, according to Subclause 5.1.1 of [8, TS38.321]; otherwise, this field is reserved

- Reserved bits – 10 bits

7.1.1.1.1a.3 Test description

7.1.1.1.1a.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*).

7.1.1.1.1a.3.2 Test procedure sequence

Table 7.1.1.1.1a.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0A | SS transmits an RRCReconfiguration message toconfigure specific parameters. Note 1, Note 3 | <-- | RRCReconfiguration | - | - |
| 0B | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 1 | The SS transmits a PDCCH order providing Random Access Preamble ID 37 on NR SpCell. | <-- | (PDCCH Order) | - | - |
| 2 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 1 | P |
| 3 | Check: Does the UE re-transmits Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 2 | P |
| 4 | Check: Does the UE transmit Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 2 | P |
| 5 | Check: Does the UE re-transmits Preamble on PRACH corresponding to *ra-PreambleIndex* in step 1? | --> | (PRACH Preamble) | 2 | P |
| 6 | The SS transmits Random Access Response on NR SpCell, with RAPID corresponding to *ra-PreambleIndex* in step 1 | <-- | Random Access Response | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For FR1, PRACH preamble format 0 as per TS 38.211[24] Table 6.3.3.1-1 is configured in order to provide coverage for PRACH preamble format 0 testing | | | | | |

7.1.1.1.1a.3.3 Specific message contents

Table 7.1.1.1.1a.3.3-1: *RRCReconfiguration* (step 0A, Table7.1.1.1.1a.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
|  | |  | TS 38.508-1 [4], 2 |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.1a.3.3-2: *CellGroupConfig* (Table 7.1.1.1.1a.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | RNTI-Value |  |  |
| t304 | ms2000 |  |  |
| rach-ConfigDedicated | Not Present |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-3: *ServingCellConfigCommon (*Table 7.1.1.1.1a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-4: *BWP-UplinkCommon (*Table 7.1.1.1.1a.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-5: *RACH-ConfigCommon (*Table 7.1.1.1.1a.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-6: *RACH-ConfigGeneric (*Table 7.1.1.1.1a.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| preambleReceivedTargetPower | -104 |  |  |
| preambleTransMax | n4 |  |  |
| prach-ConfigurationIndex | 14 |  | FR1 |
|  | 149 |  | FR2 |
| zeroCorrelationZoneConfig | 12 |  | FR1 |
|  | 15 |  | FR2 |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-7: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.1a.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 AND SCS30 |
|  | 1 |  | FR1 AND SCS15 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  |  |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 AND SCS30 |
|  | 2 |  | FR1 AND SCS15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-8: ServingCellConfig (Table 7.1.1.1.1a.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-9: *BWP-UplinkDedicated* (Table 7.1.1.1.1a.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-10: *PUCCH-Config* (Table 7.1.1.1.1a.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.1a.3.3-11: *SchedulingRequestResourceConfig* (Table 7.1.1.1.1a.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 2 | With SCS = kHz15 results in repetition every 10 ms | SCS15 |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS30 |
| sl80 | 4 | With SCS = kHz120 results in repetition every 10 ms | SCS120 |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.2 Random access procedure / Successful / C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the UL MAC PDU Size is less than messageSizeGroupA }

**then** { UE transmits a random access preamble using a preamble in group A of random access preambles }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

**ensure that** {

**when** { SS does not answer with a matching Random Access Response within ra-ResponseWindowSize }

**then** { UE retransmits a PRACH preamble from same group }

}

(3)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

ensure that {

**when** { UE receives while ra-ResponseWindowSizeTimer is running MAC PDU containing multiple RARs but none of the subheaders contains a RAPID corresponding to the UE }

**then** { UE retransmits a PRACH preamble from same group }

}

(4)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

**ensure that** {

**when** { SS sends a Random Access Response including a Backoff Indicator and the Random Access Preamble identifier is different from the value received from the UE }

**then** { UE triggers RA preamble after a random time between 0 and the indicated Backoff parameter from same group }

}

(5)

**with** { UE in RRC\_Connected state after transmission of a PRACH preamble on NR SpCell }

**ensure that** {

**when** { UE receives while ra-ResponseWindowSizeTimer is running MAC PDU containing multiple RARs and one of the subheaders contains a RAPID corresponding to the UE and containing Backoff Indicator }

**then** { UE stores Backoff Indicator UE transmits RACH procedure MSG3 }

}

(6)

**with** { UE in RRC\_Connected state after transmission of Msg3 on NR SpCell without dedicated preamble }

**ensure that** {

**when** { The SS does not schedule any PDCCH transmission addressed to UE C-RNTI before Contention resolution timer expiry }

**then** { UE transmits a random access preamble using a preamble in the same group of random access preambles as used for the first transmission of Msg3 }

}

(7)

**with** { UE in RRC\_Connected state after transmission of Msg3 on NR SpCell without dedicated preamble }

**ensure that** {

**when** { UE receive PDCCH transmission addressed to its C-RNTI before Contention resolution timer expiry }

**then** { UE considers RACH procedure as complete }

}

(8)

**with** { UE in RRC CONNECTED state and Random Access Preambles group B is configured }

**ensure that** {

**when** { UE has data available for transmission and the MAC PDU Size carrying this data is greater than ra-Msg3SizeGroupA and TimeAlignmentTimer expires }

**then** {UE transmits a random access preamble using a preamble in group B of random access preambles}

}

(9)

**with** { UE in RRC\_Connected state and having initiated a random access procedure in NR SpCell }

**ensure that** {

**when** { The SS transmits a Timing Advance Command in a Random Access Response message }

**then** {the UE applies the received Timing Advance value in the next transmitted MAC PDU }

}

7.1.1.1.2.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.2, 6.1.3.2, 6.1.5 and 6.2.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

…

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) –*preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> if the association between Random Access Preambles and SSBs is configured:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

2> else:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles within the selected Random Access Preambles group.

2> set the *PREAMBLE\_INDEX* to the selected *ra-PreambleIndex*.

…

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

[TS 38.321, clause 5.1.3]

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if SSB selected is not changed (i.e. same as the previous Random Access Preamble transmission):

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to subclause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX* and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the specified PRACH (0 ≤ s\_id < 14), t\_id is the index of the first slot of the specified PRACH in a system frame (0 ≤ t\_id < 80), f\_id is the index of the specified PRACH in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Msg1 transmission (0 for NUL carrier, and 1 for SUL carrier).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

…

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_B*I.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for the SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *preamblePowerRampingStep*).

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

…

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTxMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers.

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted, the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by a beam failure indication from lower layer and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

…

1> if *ra-ContentionResolutionTimer* expires:

2> discard the *TEMPORARY\_C-RNTI*;

2> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment PREAMBLE\_TRANSMISSION\_COUNTER by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTxMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the PREAMBLE\_BACKOFF;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

[TS 38.321, clause 5.2]

RRC configures the following parameters for the maintenance of UL time alignment:

- *timeAlignmentTimer* (per TAG) which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned.

The MAC entity shall:

1> when a Timing Advance Command MAC CE is received, and if a NTA (as defined in TS 38.211 [8]) has been maintained with the indicated TAG:

2> apply the Timing Advance Command for the indicated TAG;

2> start or restart the *timeAlignmentTimer* associated with the indicated TAG.

…

1> when a *timeAlignmentTimer* expires:

2> if the *timeAlignmentTimer* is associated with the PTAG:

3> flush all HARQ buffers for all Serving Cells;

3> notify RRC to release PUCCH for all Serving Cells, if configured;

3> notify RRC to release SRS for all Serving Cells, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> consider all running *timeAlignmentTimer*s as expired;

3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.

2> else if the *timeAlignmentTimer* isassociated with an STAG, then for all Serving Cells belonging to this TAG*:*

3> flush all HARQ buffers;

3> notify RRC to release PUCCH, if configured;

3> notify RRC to release SRS, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> maintain NTA (defined in TS 38.211 [8]) of this TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell except the Random Access Preamble transmission when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the pTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble transmission on the SpCell.

[TS 38.321, clause 6.1.3.2]

The C-RNTI MAC CE is identified by MAC PDU subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.



Figure 6.1.3.2-1: C-RNTI MAC CE

[TS 38.321, clause 6.1.5]

A MAC PDU consists of one or more MAC subPDUs and optionally padding. Each MAC subPDU consists one of the following:

- a MAC subheader with Backoff Indicator only;

- a MAC subheader with RAPID only (i.e. acknowledgment for SI request);

- a MAC subheader with RAPID and MAC RAR.

A MAC subheader with Backoff Indicator consists of five header fields E/T/R/R/BI as described in Figure 6.1.5-1. A MAC subPDU with Backoff Indicator only is placed at the beginning of the MAC PDU, if included. 'MAC subPDU(s) with RAPID only' and 'MAC subPDU(s) with RAPID and MAC RAR' can be placed anywhere between MAC subPDU with Backoff Indicator only (if any) and padding (if any).

A MAC subheader with RAPID consists of three header fields E/T/RAPID as described in Figure 6.1.5-2.

Padding is placed at the end of the MAC PDU if present. Presence and length of padding is implicit based on TB size, size of MAC subPDU(s).



Figure 6.1.5-1: E/T/R/R/BI MAC subheader



Figure 6.1.5-2: E/T/RAPID MAC subheader



Figure 6.1.5-3: Example of MAC PDU consisting of MAC RARs

[TS 38.321, clause 6.2.3]

The MAC RAR is of fixed size as depicted in Figure 6.2.3-1, and consists of the following fields:

- R: Reserved bit, set to "0";

- Timing Advance Command: The Timing Advance Command field indicates the index value *TA* used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6]. The size of the Timing Advance Command field is 12 bits;

- UL Grant: The Uplink Grant field indicates the resources to be used on the uplink in TS 38.213 [6]. The size of the UL Grant field is 27 bits;

- Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access. The size of the Temporary C-RNTI field is 16 bits.

The MAC RAR is octet aligned.



Figure 6.2.3-1: MAC RAR

7.1.1.1.2.3 Test description

7.1.1.1.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Short\_DCI condition is applied in NR Serving cell configuration.

7.1.1.1.2.3.2 Test procedure sequence

Table 7.1.1.1.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Step 0AA is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 0AA | The SS transmits an updated system information as specified in Table 7.1.1.1.2.3.3-1A. | - | - | - | - |
| 0A | SS transmits an RRCReconfiguration message toconfigure specific parameters. (Note 1) | <-- | RRCReconfiguration | - | - |
| 0B | The UE transmits RRCReconfigurationComplete message. (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 1 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 2 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU of size 56 bits, less then ra-Msg3SizeGroupA (208 bits) on SpCell. (Note 3) | <-- | MAC PDU | - | - |
| 3 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 4 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in CellGroupConfig in RRCReconfiguration (totalNumberOfRA-Preambles, ssb-perRACH-OccasionAndCB-PreamblesPerSSB and numberOfRA-PreamblesGroupA) on SpCell in frame number X meeting condition nSFN mod 8 =1, subframe number 2,6,9 (FDD FR1), frame number X meeting condition nSFN mod 2 =1, subframe number 8,9 (FR1 TDD) and frame number X meeting condition nSFN mod 4 =1 and slot number 8, 9, 18, 19, 28, 29, 38, 39 , 48, 49, 58, 59, 68, 69, 78, 79 (FR2 120 kHz)? | --> | PRACH Preamble | 1 | P |
| 5 | Check: Does the UE transmit a preamble on PRACH, in frame number X+8 subframe number 2,6,9 (FDD FR1), in frame number X or X+2 in subrame number 8,9 (FR1 TDD) and frame number X or X+4 and slot number 8, 9, 18, 19, 28, 29, 38, 39 , 48, 49, 58, 59, 68, 69, 78, 79 (FR2 120 kHz) using the same group A? | --> | PRACH Preamble | 2 | P |
| 6 | The SS transmits a MAC PDU addressed to UE RA-RNTI, containing multiple RARs but none of the MAC sub headers contains a matching RAPID on SpCell. | <-- | Random Access Response | - | - |
| - | EXCEPTION: In parallel with step 7, parallel behaviour defined in table 7.1.1.1.2.3.2-2 is executed. | - | - | - | - |
| 7 | Check: Does the UE re-transmit a preamble on PRACH on SpCell using the same group A? | --> | PRACH Preamble | 3 | P |
| 8 | The SS transmits a Random Access Response with the back off parameter set to value Index field '12' and with the Random Access Preamble identifier different from the value received from the UE in the Random Access Preamble.  The SS sets Timer\_T2 to the Back off value ‘960’ associated with the Index value ‘12’ and starts Timer\_T2. | <-- | Random Access Response(BI, RAPID) | - | - |
| 9 | Check: Does UE send a Random Access Preamble on SpCell while Timer\_T2 is running? | --> | Random Access Preamble | 4 | P |
| 10 | SS sends Random Access Response with an UL Grant of 56-bits, a back off parameter set to value Index field ‘13’ and the Random Access Preamble identifier value set to the same value as received from the UE in the Random Access Preamble. (Note 4) | <-- | Random Access Response(BI, RAPID) | - | - |
| 11 | Check: Does UE sends a msg3 in the grant associated to the Random Access ´Response received in step 10 on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | 5 | P |
| 12 | SS does not schedule any PDCCH transmission for UE C-RNTI.  The SS sets Timer\_T3 to the Back off value ‘1920’ associated with the Index value ‘13’ plus Contention Resolution Timer and starts Timer\_T3. | - | - | - | - |
| 13 | Check: Does the UE transmit preamble on PRACH using a preamble belonging to group A for time equal to Timer\_T3 on SpCell? | --> | PRACH Preamble | 6 | P |
| 14 | The SS transmits Random Access Response with an UL Grant of 56-bits and RAPID corresponding to the transmitted Preamble in step 13, including T-CRNTI. | <-- | Random Access Response | - | - |
| 15 | UE sends a msg3 using the grant associated to the Random Access ´Response received in step 14 on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 16 | SS schedules PDCCH transmission for UE C\_RNTI and allocate uplink grant. | <-- | Contention Resolution | - | - |
| - | EXCEPTION: In parallel with step 17, parallel behaviour defined in table 7.1.1.1.2.3.2-3 is executed. | - | - | - | - |
| 17 | Check: Does the UE transmit a MAC PDU with C-RNTI containing looped back PDCP SDU? | --> | MAC PDU | 7 | P |
| - | EXCEPTION: Step 17AA is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 17AA | The SS transmits an updated system information as specified in Table 7.1.1.1.2.3.3-1A. | - | - | - | - |
| 17A | The SS transmits an RRCReconfiguration message toconfigure specific parameters. (Note 1) | <-- | NR RRC: RRCReconfiguration | - | - |
| 17B | The UE transmits an RRCReconfigurationComplete message. (Note 2) | --> | NR RRC: RRCReconfigurationtComplete | - | - |
| 18 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T4 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 19 | 40 to 50 TTI before Timer\_T4 expires the SS transmits a MAC PDU containing a PDCP SDU of size > ra-Msg3SizeGroupA (208 bits). | <-- | MAC PDU | - | - |
| 20 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 21 | Check: Does the UE transmit preamble on PRACH using a preamble in group B defined in CellGroupConfig in RRCReconfiguration (ssb-perRACH-OccasionAndCB-PreamblesPerSSB, numberOfRA-PreamblesGroupA and numberOfRA-Preambles) on SpCell? | --> | PRACH Preamble | 8 | P |
| 22 | The SS transmits Random Access Response with an UL Grant of 56-bits and RAPID corresponding to the transmitted Preamble in step 21, including T-CRNTI. | <-- | Random Access Response | - | - |
| 23 | UE sends a msg3 using the grant associated to the Random Access ´Response received in step 22 on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 23A | SS schedules PDCCH transmission for UE C\_RNTI and allocate uplink grant. | <-- | Contention Resolution | - | - |
| 24 | Check: Does the UE transmit a MAC PDU with C-RNTI containing looped back PDCP SDU? | --> | MAC PDU | 9 | P |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: MAC PDU size of 56bits is selected to allow UE send status PDU and still stays below the limit of ra-Msg3SizeGrioupA.  Note 4: UL grant of 56bits is to make UE not send any loopback data in uplink with msg3. | | | | | |

Table 7.1.1.1.2.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit msg3 message on SpCell? | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | F |

Table 7.1.1.1.2.3.2-3: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit an PRACH preamble on SpCell? | --> | PRACH Preamble | - | F |

7.1.1.1.2.3.3 Specific message contents

Table 7.1.1.1.2.3.3-1: *MAC-CellGroupConfig* (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| tag-Config SEQUENCE { |  |  |  |
| tag-ToAddModList SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG { | 1 entry |  |  |
| TAG[1] SEQUENCE { |  | entry 1 |  |
| timeAlignmentTimer | ms750 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-1A: *SystemInformationBlockType1* (step 0AA and 17AA, Table 7.1.1.1.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.1.2.3.3-4 |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-2: *RRCReconfiguration* (step 0A and step 17A, Table 7.1.1.1.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
|  | |  | TS 38.508-1 [4], 2. |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.2.3.3-3: *CellGroupConfig* (Table 7.1.1.1.2.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| newUE-Identity | RNTI-Value |  |  |
| t304 | ms2000 |  |  |
| rach-ConfigDedicated | Not Present |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-4: *ServingCellConfigCommon (*Table 7.1.1.1.2.3.3-3, Table 7.1.1.1.2.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-5: *BWP-UplinkCommon (*Table 7.1.1.1.2.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-6: *RACH-ConfigCommon (*Table 7.1.1.1.2.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| totalNumberOfRA-Preambles | 42 |  |  |
| ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| One | n32 |  |  |
| } |  |  |  |
| groupBconfigured SEQUENCE { |  |  |  |
| ra-Msg3SizeGroupA | b208 |  |  |
| messagePowerOffsetGroupB | minusinfinity |  |  |
| numberOfRA-PreamblesGroupA | 28 |  |  |
| } |  |  |  |
| ra-ContentionResolutionTimer | sf48 |  |  |
| } |  |  |  |

Table 7.1.1.1.2.3.3-7: *RACH-ConfigGeneric (*Table 7.1.1.1.2.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 119 | As per Table 6.3.3.2-2: of TS 38.211 [24], this results in PRACH preamble transmission in a radio frame meeting nSFN mod 2=1, subframe number 2, 6, 9 and starting symbol 0 using preamble Format A2. | FR1 FDD |
| prach-ConfigurationIndex | 91 | As per Table 6.3.3.2-3: of TS 38.211 [24], this results in PRACH preamble transmission in a radio frame meeting nSFN mod 2=1, subframe number 4, 9 and starting symbol 0 using preamble Format A2. | FR1 TDD |
| prach-ConfigurationIndex | 6 | As per Table 6.3.3.2-4: of TS 38.211 [24] and clause 5.3.2 of TS 38.211 this results in PRACH preamble transmission in radio frame meeting nSFN mod 4 = 1, slot number 8, 9, 18, 19, 28, 29, 38, 39 , 48, 49, 58, 59, 68, 69, 78, 79 and starting symbol 0 using preamble format A1. | FR2 (120 kHz) |
| preambleReceivedTargetPower | dBm-104 |  |  |
| preambleTransMax | n10 |  |  |
| powerRampingStep | dB2 |  |  |
| ra-ResponseWindow | sl8 |  | FR1 FDD and FR2 (120 kHz) |
|  | sl20 |  | FR1 TDD |
| } |  |  |  |

Table 7.1.1.1.2.3.3-8: Void

##### 7.1.1.1.3 Random access procedure / Successful / SI request

7.1.1.1.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Idle State and need for Updated System information }

**ensure that** {

**when** { UE transmitted PRACH preamble and ra-ResponseWindow has expired}

**then** { UE retransmits the PRACH Preamble }

}

(2)

**with** { UE in RRC\_Idle State and transmitted PRACH preamble for System information request }

**ensure that** {

**when** { UE received a RAR message addressed to RA-RNTI and including matching RAPID only }

**then** { UE considers the RACH procedure to be successfully completed and informs the upper layer }

}

(3)

Void

7.1.1.1.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.2, 5.1.3, 5.1.4, and 6.1., 3GPP TS 38.331 clause 5.2.2.2.25. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by either PDCCH or RRC; and

1> if the *ra-PreambleIndex* is not 0b000000; and

1> if contention-free Random Access Resource associated with SSBs or CSI-RSs have not been explicitly provided by RRC:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided by RRC and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided by RRC and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> if the association between Random Access Preambles and SSBs is configured:

3> select a *ra-PreambleIndex* randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

2> else:

3> select a *ra-PreambleIndex* randomly with equal probability from the Random Access Preambles within the selected Random Access Preambles group.

2> set the *PREAMBLE\_INDEX* to the selected *ra-PreambleIndex*.

1> if an SSB is selected above and an association between PRACH occasions and SSBs is configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above and an association between PRACH occasions and CSI-RSs is configured:

2> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> else if Random Access procedure was initiated for beam failure recovery; and

1> if a CSI-RS is selected above and there is no contention-free Random Access Resource associated with the selected CSI-RS:

2> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

1> else:

2> determine the next available PRACH occasion (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

[TS 38.321, clause 5.1.3]

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if SSB selected is not changed (i.e. same as the previous Random Access Preamble transmission):

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to subclause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX* and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the specified PRACH (0 ≤ s\_id < 14), t\_id is the index of the first slot of the specified PRACH in a system frame (0 ≤ t\_id < 80), f\_id is the index of the specified PRACH in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Msg1 transmission (0 for NUL carrier, and 1 for SUL carrier).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for response to beam failure recovery request identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_B*I.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if in this Random Access procedure, the Random Access Preamble was selected by MAC among the contention-based Random Access Preambles:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> delay the subsequent Random Access Preamble transmission by the backoff time.

3> perform the Random Access Resource selection procedure (see subclause 5.1.2).

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

[TS 38.321, clause 6.1.5]

A MAC PDU consists of one or more MAC subPDUs and optionally padding. Each MAC subPDU consists one of the following:

- a MAC subheader with Backoff Indicator only;

- a MAC subheader with RAPID only (i.e. acknowledgment for SI request);

- a MAC subheader with RAPID and MAC RAR.

A MAC subheader with Backoff Indicator consists of five header fields E/T/R/R/BI as described in Figure 6.1.5-1. A MAC subPDU with Backoff Indicator only is placed at the beginning of the MAC PDU, if included. 'MAC subPDU(s) with RAPID only' and 'MAC subPDU(s) with RAPID and MAC RAR' can be placed anywhere between MAC subPDU with Backoff Indicator only (if any) and padding (if any).

A MAC subheader with RAPID consists of three header fields E/T/RAPID as described in Figure 6.1.5-2.

Padding is placed at the end of the MAC PDU if present. Presence and length of padding is implicit based on TB size, size of MAC subPDU(s).



Figure 6.1.5-1: E/T/R/R/BI MAC subheader



Figure 6.1.5-2: E/T/RAPID MAC subheader



Figure 6.1.5-3: Example of MAC PDU consisting of MAC RARs

[38.331, clause 5.2.2.2.2]

UEs in RRC\_IDLE or in RRC\_INACTIVE shall monitor for SI change indication in its own paging occasion every DRX cycle. UEs in RRC\_CONNECTED shall monitor for SI change indication in any paging occasion at least once per modification period if the UE is provided with common search space on the active BWP to monitor paging, as specified in TS 38.213 [13], clause 13.

ETWS or CMAS capable UEs in RRC\_IDLE or in RRC\_INACTIVE shall monitor for indications about PWS notification in its own paging occasion every DRX cycle. ETWS or CMAS capable UEs in RRC\_CONNECTED shall monitor for indication about PWS notification in any paging occasion at least once every *defaultPagingCycle* if the UE is provided with common search space on the active BWP to monitor paging.

For Short Message reception in a paging occasion, the UE monitors the PDCCH monitoring occasion(s) for paging as specified in TS 38.304 [20] and TS 38.213 [13].

If the UE receives a Short Message, the UE shall:

1> if the UE is ETWS capable or CMAS capable, the *etwsAndCmasIndication* bit of Short Message is set, and the UE is provided with *searchSpaceOtherSystemInformation* on the active BWP:

2> immediately re-acquire the *SIB1*;

2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB6*:

3> acquire *SIB6*, as specified in clause 5.2.2.3.2,immediately;

2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB7*:

3> acquire *SIB7*, as specified in clause 5.2.2.3.2,immediately;

2> if the UE is CMAS capable and *si-SchedulingInfo* includes scheduling information for *SIB8*:

3> acquire *SIB8*, as specified in sub-clause 5.2.2.3.2,immediately;

1> if the *systemInfoModification* bit of Short Message is set:

2> apply the SI acquisition procedure as defined in sub-clause 5.2.2.3 from the start of the next modification period.

7.1.1.1.3.3 Test description

7.1.1.1.3.3.1 Pre-test conditions

System Simulator:

- NR Cell 1 and NR Cell 11.

- System information combination NR-3 as defined in TS 38.508-1 [4] clause 4.4.3.1.3 is used in NR Cell 1.

UE:

- None.

Preamble:

- The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.

7.1.1.1.3.3.2 Test procedure sequence

Table 7.1.1.1.3.3.2-1/2 illustrate the downlink power levels and other changing parameters to be applied for the cell at various time instants of the test execution. The exact instants on which these values shall be applied are described in the texts in this clause. Configurations marked "T0" is applied for Preamble. Configurations marked "T1" and "T2" are applied at the points indicated in the Main behaviour description in Table 7.1.1.1.3.3.2-3.

Table 7.1.1.1.3.3.2-1: Time instances of cell power level and parameter changes for FR1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 11 | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/SCS | -90 | Off | The power level is such that SrxlevNRCell1 > 0 |
| Qrxlevmin | dBm | -106 | - |  |
| Qrxlevminoffset | dB | 0 | - |  |
| Pcompensation | dB | 0 | - |  |
|  | Qoffset | dB | 16 | - |  |
| T1 | SS/PBCH  SSS EPRE | dBm/SCS | -90 | -84 | The power level values are assigned to satisfy RNRCell 1 > RNRCell 11 |
|  | Qrxlevmin | dBm | -106 | -106 |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | 16 | - |  |
| T2 | SS/PBCH  SSS EPRE | dBm/SCS | -90 | -84 | The power level values are assigned to satisfy RNRCell 1 < RNRCell 11 |
|  | Qrxlevmin | dBm | -106 | -106 |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | -10 | - |  |
| Note: The downlink signal level uncertainty is specified in TS 38.508-1 [4] clause 6.2.2.1. | | | | | |

Table 7.1.1.1.3.3.2-2: Time instances of cell power level and parameter changes for FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 11 | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/SCS | -91 | Off | The power level is such that SrxlevNRCell1 > 0 |
| Qrxlevmin | dBm | 2\* ROUND((-110+Delta(NRfs))/2) | - |  |
| Qrxlevminoffset | dB | 0 | - |  |
| Pcompensation | dB | 0 | - |  |
|  | Qoffset | dB | 16 | - |  |
| T1 | SS/PBCH  SSS EPRE | dBm/SCS | -91 | -82 | The power level values are assigned to satisfy RNRCell 1 > RNRCell 11 |
|  | Qrxlevmin | dBm | 2\* ROUND((-110+Delta(NRfs))/2) | 2\* ROUND((-110+Delta(NRfs))/2) |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | 16 | - |  |
| T2 | SS/PBCH  SSS EPRE | dBm/SCS | -91 | -82 | The power level values are assigned to satisfy RNRCell 1 < RNRCell 11 |
|  | Qrxlevmin | dBm | 2\* ROUND((-110+Delta(NRfs))/2) | 2\* ROUND((-110+Delta(NRfs))/2) |  |
|  | Qrxlevminoffset | dB | 0 | 0 |  |
|  | Pcompensation | dB | 0 | 0 |  |
|  | Qoffset | dB | -10 | - |  |
| Note: The downlink signal level uncertainty is specified in TS 38.508-1 [4] section 6.2.2.2. | | | | | |

Table 7.1.1.1.3.3.2-3: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS changes SS/PBCH  EPRE level of NR Cell 11 according to the row "T1" in Table 7.1.1.1.3.3.2-1/2. | - | - | - | - |
| 2 | Wait 60s to ensure UE detects NR Cell 11. | - | *-* | - | - |
| 3 | SS transmits Short Message on PDCCH addressed to P-RNTI using Short Message field in DCI format 1\_0. Bit 1 of Short Message field is set to 1 to indicate the SI modification. | <-- | (Short Message) | - | - |
| 4 | The *valueTag* for SIB3 in the SIB1 message is increased and *si*-*BroadcastStatus* for SIB3 is set to ‘*notBroadcasted’* and SS stops broadcasting SIB3. | <-- |  | - | - |
| 5 | Check: Does the UE transmit a preamble on PRACH using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 6 | Check: Does the UE re-transmit a preamble on PRACH after *ra-ResponseWindow* using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 7 | Check: Does the UE re-transmit a preamble on PRACH after *ra-ResponseWindow* using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 8 | Check: Does the UE re-transmit a preamble on PRACH after *ra-ResponseWindow* using the preamble indicated by *ra-PreambleStartIndex* defined in SI-*RequestConfig* in *SIB1* in Table 7.1.1.1.3.3.3-1? | --> | PRACH Preamble | 1 | P |
| 9 | The SS transmits a RAR message addressed to UE RA-RNTI including a MAC subPDU with a matching RAPID only. (Note 1) | <-- | Random Access Response | - | - |
| 9A | The SS changes the parameter ‘*Qoffset’* in SIB3 of NR Cell 1 according to the row "T2"inTable 7.1.1.1.3.3.2-1/2 and starts broadcasting SIB3. |  |  |  |  |
| 10 | Check: Does UE send Msg3 containing an *RRCSetupRequest* message in the grant associated to the Random Access Response received in step 9? | --> | *RRCSetupRequest* | 2 | F |
| 11 | Check: Does the test result of generic test procedure in TS 38.508-1 [4] Table 4.9.5.2.2-1 indicate that the UE is camped on NR Cell 11 belonging to a new TA? | - | - | 2 | P |
| Note 1: The UE will indicate the reception of an acknowledgement for SI request to upper layers after UE receives the RAR message including a MAC subPDU with a matching RAPID only, according to TS 38.321 [18] clause 5.1.4. | | | | | |

7.1.1.1.3.3.3 Specific message contents

Table 7.1.1.1.3.3.3-1: *SIB1* on NR Cell 1 (Step 4, Table 7.1.1.1.3.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { | |  |  |  |
| si-SchedulingInfo SEQUENCE { | |  |  |  |
| schedulingInfoList SEQUENCE { | | 2 entries |  |  |
| si-BroadcastStatus[1] | | Broadcasting |  |  |
| si-Periodicity[1] | | rf32 |  |  |
| sib-MappingInfo[1] SEQUENCE { | |  |  |  |
| type | | SibType2 |  |  |
| valueTag | | 0 |  |  |
| areaScope | | Not present |  |  |
| } | |  |  |  |
| si-BroadcastStatus[2] | | notBroadcasting |  |  |
| si-Periodicity[2] | | rf64 |  |  |
| sib-MappingInfo[2] SEQUENCE { | |  |  |  |
| type | | SibType3 |  |  |
| valueTag | | 1 |  |  |
| areaScope | | Not present |  |  |
| } | |  |  |  |
| } | |  |  |  |
| si-RequestConfig SEQUENCE { | |  |  |  |
| rach-OccasionsSI SEQUENCE { | |  |  |  |
| rach-ConfigSI | | RACH-ConfigGeneric | TS 38.508-1 [4], Table 4.6.3-130 |  |
| ssb-perRACH-Occasion | | one |  |  |
| } | |  |  |  |
| si-RequestPeriod | | two |  |  |
| si-RequestResources SEQUENCE { | | 1 entry |  |  |
| ra-PreambleStartIndex[1] | | 52 |  |  |
| ra-AssociationPeriodIndex[1] | | 0 |  |  |
| ra-ssb-OccasionMaskIndex[1] | | 0 |  |  |
| } | |  |  |  |
| } | |  |  |  |
| si-RequestConfigSUL | | Not present |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.3.3.3-2: *SIB3* on NR Cell 1 (Preamble and Step 9A, Table 7.1.1.1.3.3.2-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.2-2 | | | |
| Information Element | | Value/remark | Comment | Condition |
| SIB3 ::= SEQUENCE { | |  |  |  |
| intraFreqNeighCellList SEQUENCE { | |  |  |  |
| physCellId | | The cell identity of NR Cell 11 defined in 38.508-1 [4] clause 4.4.2 |  |  |
| q-OffsetCell | | 16 | Preamble |  |
| -10 | Step 9A |  |
| } | |  |  |  |
| } | |  |  |  |

##### 7.1.1.1.4 Random access procedure / Successful / Beam Failure / Preamble selected by MAC itself / Non Contention Free RACH procedure

7.1.1.1.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with no failureDetectionResources configured and RACH procedure due to beam failure is triggered }

**ensure that** {

**when** { contention free random access resources for beam failure recovery request associated with SS blocks are not provided by RRC }

**then** { UE selects initiates the non-contention free Random Access Procedure }

}

(2)

**with** { UE in RRC\_CONNECTED state and RACH procedure due to beam failure is triggered }

**ensure** **that** {

**when** { contention free random access resources for beam failure recovery request associated with SS blocks are explicitly provided by RRC }

**then** { UE selects the PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected SS block and initiates the contention free Random Access Procedure }

}

(3)

**with** { UE in RRC\_CONNECTED state and RACH procedure due to beam failure is triggered }

**ensure** **that** {

**when** { contention free random access resources for beam failure recovery request associated with CSI-RS are explicitly provided by RRC }

**then** { UE selects the PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected CSI-RS and initiates the contention free Random Access Procedure }

}

(4)

**with** { UE in RRC\_CONNECTED state with Preamble transmitted for contention free RACH procedure for beam failure }

**ensure** **that** {

**when** { ra-ResponseWindowBFR expires and the PDCCH addressed to the C-RNTI has not been received }

**then** { UE retransmits the PRACH Preamble }

}

(5)

**with** { UE in RRC\_CONNECTED state with Preamble transmitted for contention free RACH procedure for beam failure }

**ensure** **that** {

**when** { before expiry of ra-ResponseWindowBFR the PDCCH addressed to the C-RNTI is received }

**then** { UE considers the RACH procedure to be successfully completed and stops retransmitting PRACH preambles }

}

7.1.1.1.4.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clause 5.1.2, 5.1.3, 5.1.4 and 5.17. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided by RRC and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided by RRC and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

2> if the association between Random Access Preambles and SSBs is configured:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

2> else:

3> select a Random Access Preamble randomly with equal probability from the Random Access Preambles within the selected Random Access Preambles group.

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

1> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

NOTE: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for response to beam failure recovery request identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

1> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received; or

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if the PDCCH addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response transmission.

7.1.1.1.4.3 Test description

7.1.1.1.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.1.4.3.2 Test procedure sequence

Table 7.1.1.1.4.3.2-1/1A illustrates the downlink power levels and other changing parameters to be applied for the cells at various time instants of the test execution. Row marked "T0" denotes the initial conditions after preamble, while columns marked "T1"and "T2"are to be applied subsequently. The exact instants on which these values shall be applied are described in the texts in this clause.

Table 7.1.1.1.4.3.2-1: Time instances of cell power level and parameter changes for FR1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | E-UTRA Cell 1 | NR Cell 1 | NR Cell 1 Beam index #1 | NR Cell 1  Beam index #0 | Remark |
| T0 | Cell-specific RS EPRE | dBm/15kHz | -85 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -88 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | 0 | -57 |
| T1 | Cell-specific RS EPRE | dBm/15kHz | -85 | - | - | - | Beam#1 Switch OFF and Beam#0 Switch ON |
| Reference Power | dBm/SCS | - | -88 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | -57 | 0 |
| T2 | Cell-specific RS EPRE | dBm/15kHz | -85 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -88 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | 0 | -57 |
| NOTE: "Beam index #1" refers to transmission of the SS/PBCH block with SSB index #1 (according to the ssb-PositionsInBurst) and CSI-RS with index #1 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17); "Beam index #0" refers to transmission of the SS/PBCH block with SSB index #0 (according to the ssb-PositionsInBurst) and CSI-RS with index #0 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17). | | | | | | | |

Table 7.1.1.1.4.3.2-1A: Time instances of cell power level and parameter changes for FR2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | E-UTRA Cell 1 | NR Cell 1 | NR Cell 1 Beam index #1 | NR Cell 1  Beam index #0 | Remark |
| T0 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dB | - | - | 0 | -63 |
| T1 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch OFF and Beam#0 Switch ON |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dBm/SCS | - | - | -63 | 0 |
| T2 | Cell-specific RS EPRE | dBm/15kHz | -96 | - | - | - | Beam#1 Switch ON and Beam#0 Switch OFF |
| Reference Power | dBm/SCS | - | -82 | - | - |
| CSI-RS EPRE  SS/PBCH  SSS EPRE, | dBm/SCS | - | - | 0 | -63 |
| NOTE: "Beam index #1" refers to transmission of the SS/PBCH block with SSB index #1 (according to the ssb-PositionsInBurst) and CSI-RS with index #1 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17); "Beam index #0" refers to transmission of the SS/PBCH block with SSB index #0 (according to the ssb-PositionsInBurst) and CSI-RS with index #0 (according to the CSI-MeasConfig being signalled to the UE at step 1/8/17). | | | | | | | |

Table 7.1.1.1.4.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an NR *RRCReconfiguration* message to configure parameters for BFR. Note 1. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | The SS changes NR Cell 1 power level according to the row "T1" in table 7.1.1.1.4.3.2-1/1A. | - | - | - | - |
| 4 | Check: Does the UE transmit a preamble on PRACH for the non-contention free Random Access Procedure on NR Cell 1 Beam index #1? | --> | PRACH Preamble | 1 | P |
| 5 | The SS transmits a MAC PDU addressed to UE RA-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 6 | UE sends a msg3 using the grant associated to the Random Access Response received in Step 5 on NR Cell 1. | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 7 | SS schedules PDCCH transmission for UE C-RNTI. | <-- | Contention Resolution | - | - |
| 8 | The SS transmits an NR *RRCReconfiguration* to establish random access resources for BFR associated with SS blocks explicitly. Note 1. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 9 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 10 | The SS changes NR Cell 1 power level according to the row "T2" in table 7.1.1.1.4.3.2-1/1A. | - | - | - | - |
| 11 | Check: Does the UE transmit preamble on PRACH using a preamble with PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected SS block provided by RRC on NR Cell 1 Beam index #0? | --> | PRACH Preamble | 2 | P |
| 12 | The SS waits for ra-ResponseWindowBFR expire.  NOTE: The SS does not transmit Random Access Response to the UE. | - | - | - | - |
| 13 | Check: Does the UE retransmit a preamble on PRACH with ra-PreambleIndex same as the Step 11? | --> | PRACH Preamble | 4 | P |
| 14 | The SS transmits a MAC PDU addressed to UE C-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 15 | The SS waits for ra-ResponseWindowBFR expire. | - | - | - | - |
| 16 | Check: Does the UE retransmit a preamble on PRACH? | - | - | 5 | F |
| - | EXCEPTION: Steps 17 to 25 describe behaviour that depends on the UE capability. | - | - | - | - |
| 17 | IF pc\_csi\_RS\_CFRA\_ForHO THEN the SS transmits an NR *RRCReconfiguration* message to establish random access resources for BFR associated with CSI-RS explicitly. Note 1. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 18 | UE responses NR *RRCReconfigurationComplete* message. Note 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 19 | The SS changes NR Cell 1 power level according to the row "T1" in table 7.1.1.1.4.3.2-1/1A. | - | - | - | - |
| 20 | Check: Does the UE transmit preamble on PRACH using a preamble with PREAMBLE\_INDEX to a ra-PreambleIndex corresponding to the selected CSI-RS provided by RRC on NR Cell 1 Beam index #1? | --> | PRACH Preamble | 3 | P |
| 21 | The SS waits for ra-ResponseWindowBFR expire.  NOTE: The SS does not transmit Random Access Response to the UE. | - | - | - | - |
| 22 | Check: Does the UE retransmit a preamble on PRACH with ra-PreambleIndex same as the Step 20? | --> | PRACH Preamble | 4 | P |
| 23 | The SS transmits a MAC PDU addressed to UE C-RNTI, containing multiple RAR’s and one of the MAC sub headers contains a matching RAPID on NR Cell 1. | <-- | Random Access Response | - | - |
| 24 | The SS waits for ra-ResponseWindowBFR expire. | - | - | - | - |
| 25 | Check: Does the UE retransmit a preamble on PRACH? | - | - | 5 | F |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration* 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: for EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete*. | | | | | |

7.1.1.1.4.3.3 Specific message contents

Table 7.1.1.1.4.3.3-1: Void

Table 7.1.1.1.4.3.3-2: Void

Table 7.1.1.1.4.3.3-3: *RRCReconfiguration* (Step 1, Step8, Step17 Table 7.1.1.1.4.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration::=SEQUENCE{ | |  |  |  |
| criticalExtensions CHOICE{ | |  |  |  |
| rrcReconfiguration SEQUENCE{ | |  |  |  |
| secondaryCellGroup | | CellGroupConfig | OCTET STRING | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.4.3.3-4: *CellGroupConfig* (Table 7.1.1.1.4.3.3-3: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-5: *ServingCellConfig* (Table 7.1.1.1.4.3.3-4: *CellGroupConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| initialDownlinkBWP | BWP-DownlinkDedicated |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| csi-MeasConfig CHOICE { |  |  | Step 1 |
| setup | CSI-MeasConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated* (Table 7.1.1.1.4.3.3-5: *ServingCellConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-DownlinkDedicated ::= SEQUENCE { |  |  |  |
| pdcch-Config | Not present |  | Step 17 |
| pdcch-Config CHOICE { |  |  | Step 1, Step 8 |
| setup | PDCCH-Config |  |  |
| } |  |  |  |
| pdsch-Config CHOICE { |  |  |  |
| setup | PDSCH-Config |  |  |
| } |  |  |  |
| radioLinkMonitoringConfig CHOICE { |  |  |  |
| setup | RadioLinkMonitoringConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-7: RadioLinkMonitoringConfig(Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-133 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioLinkMonitoringConfig ::= SEQUENCE { |  |  |  |
| failureDetectionResourcesToAddModList SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS { | 2 entries |  |  |
| RadioLinkMonitoringRS[1] SEQUENCE { |  | entry 1 |  |
| radioLinkMonitoringRS-Id | 0 |  |  |
| purpose | rlf |  | Step 1, Step 17 |
|  | both |  | Step 8 |
| detectionResource CHOICE { |  |  |  |
| csi-rs | 0 | NR Cell 1 Beam index #0 |  |
| } |  |  |  |
| } |  |  |  |
| RadioLinkMonitoringRS[2] SEQUENCE { |  | entry 2 |  |
| radioLinkMonitoringRS-Id | 1 |  |  |
| purpose | rlf |  | Step 1, Step 8 |
|  | both |  | Step 17 |
| detectionResource CHOICE { |  |  |  |
| csi-rs | 1 | NR Cell 1 Beam index #1 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| beamFailureInstanceMaxCount | n1 |  |  |
| beamFailureDetectionTimer | pbfd1 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-8: *PDSCH-Config* (Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| tci-StatesToAddModList SEQUENCE(SIZE (1.. maxNrofTCI-States)) OF TCI-State { | 3 entries |  |  |
| TCI-State[1] SEQUENCE { |  | entry 1 |  |
| tci-StateId | 0 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 1 | SSB index #1 |  |
| } |  |  |  |
| qcl-Type | type C |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 1 | SSB index #1 |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| TCI-State[2] SEQUENCE { |  | entry 2 |  |
| tci-StateId | 1 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 0 | SSB index #0 |  |
| } |  |  |  |
| qcl-Type | type C |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 0 | SSB index #0 |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| TCI-State[3] SEQUENCE { |  | entry 3 |  |
| tci-StateId | 2 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| csi-rs | 1 | Csi-Rs index #1 |  |
| } |  |  |  |
| qcl-Type | type A |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex of NR SpCell | Cell ID |  |
| bwp-id | 0 | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| Csi-rs | 1 | Csi-Rs index #1 |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-9: *PDCCH-Config* (Table 7.1.1.1.4.3.3-6: *BWP-DownlinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 2 entries |  |  |
| ControlResourceSet[1] | ControlResourceSetid1 | entry 1 |  |
| ControlResourceSet[2] | ControlResourceSetid2 | entry 2 |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace { | 2 entries |  |  |
| SearchSpace[1] | SearchSpace with condition USS | entry 1 |  |
| SearchSpace[2] | SearchSpaceBFR | entry 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-10: *ControlResourceSetId1* (Table 7.1.1.1.4.3.3-9: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| tci-StatesPDCCH-ToAddList SEQUENCE (SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId { | 1 entry |  | Step 1 |
| TCI-StateId[1] | 2 | entry 1  TCI-State Id 2 |  |
| } |  |  |  |
| tci-StatesPDCCH-ToReleaseList SEQUENCE (SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId { | 1 entry |  | Step 8 |
| TCI-StateId[1] | 2 | entry 1  TCI-State Id 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-11: *ControlResourceSetId2* (Table 7.1.1.1.4.3.3-9: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 2 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-12: *SearchSpaceBFR* (Table 7.1.1.1.4.3.3-9: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-162 | | | |
| Information Element | Value/remark | Comment | Condition |
| SearchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceId | 4 |  |  |
| controlResourceSetId | 2 |  |  |
| searchSpaceType CHOICE { |  |  |  |
| ue-Specific SEQUENCE { |  |  |  |
| dci-Formats | formats0-0-And-1-0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig* (Table 7.1.1.1.4.3.3-5: *ServingCellConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-38 | | | |
| Information Element | Value/remark | Comment | Condition |
| CSI-MeasConfig::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceToAddModList SEQUENCE { | 2 entries |  |  |
| NZP-CSI-RS-Resource[1] | NZP-CSI-RS-ResourceId0 |  |  |
| NZP-CSI-RS-Resource[2] | NZP-CSI-RS-ResourceId1 |  |  |
| } |  |  |  |
| nzp-CSI-RS-ResourceSetToAddModList SEQUENCE { | 1 entry |  |  |
| NZP-CSI-RS-ResourceSet[1] | NZP-CSI-RS-ResourceSetid0 |  |  |
| } |  |  |  |
| csi-IM-ResourceToAddModList | Not present |  |  |
| csi-IM-ResourceSetToAddModList | Not present |  |  |
| csi-SSB-ResourceSetToAddModList | Not present |  |  |
| csi-ReportConfigToAddModList | Not present |  |  |
| reportTriggerSize | Not present |  |  |
| aperiodicTriggerStateList | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-14: *NZP-CSI-RS-ResourceId0* (Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-85 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-Resource ::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceId | 0 |  |  |
| resourceMapping | CSI-RS-ResourceMapping with condition TRS | TS 38.508-1 [4], Table 4.6.3-45 |  |
| qcl-InfoPeriodicCSI-RS | 0 | QCL to SSB #0 |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-15: *NZP-CSI-RS-ResourceId1* (Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-85 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-Resource ::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceId | 1 |  |  |
| resourceMapping | CSI-RS-ResourceMapping with condition TRS | TS 38.508-1 [4], Table 4.6.3-45 |  |
| periodicityAndOffset | CSI-ResourcePeriodicityAndOffset\_Id1 |  |  |
| qcl-InfoPeriodicCSI-RS | 1 | QCL to SSB #1 |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-16: *CSI-ResourcePeriodicityAndOffset\_Id1* (Table 7.1.1.1.4.3.3-15: *NZP-CSI-RS-ResourceId1*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-43 | | | |
| Information Element | Value/remark | Comment | Condition |
| CSI-ResourcePeriodicityAndOffset ::= CHOICE { |  |  |  |
| slots80 | 11 |  | FR1 |
| slots320 | 41 |  | FR2 |
| } |  |  |  |

Table 7.1.1.1.4.3.3-17: *NZP-CSI-RS-ResourceSetid0* (Table 7.1.1.1.4.3.3-13: *CSI-MeasConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-87 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-ResourceSet ::= SEQUENCE { |  |  |  |
| nzp-CSI-ResourceSetId | 0 |  |  |
| nzp-CSI-RS-Resources SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId { | 2 entries |  |  |
| NZP-CSI-RS-ResourceId[1] | 0 | entry 1 |  |
| NZP-CSI-RS-ResourceId[2] | 1 | entry 2 |  |
| } |  |  |  |
| trs-Info | true |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated* (Table 7.1.1.1.4.3.3-5: *ServingCellConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup | PUSCH-Config |  |  |
| } |  |  |  |
| beamFailureRecoveryConfig | BeamFailureRecoveryConfig\_SSB |  | Step8 |
|  | BeamFailureRecoveryConfig\_CSIRS |  | Step17 |
|  | Not Present |  | Step1 |
| } |  |  |  |

Table 7.1.1.1.4.3.3-19: *BeamFailureRecoveryConfig\_SSB* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-6 | | | |
| Information Element | Value/remark | Comment | Condition |
| BeamFailureRecoveryConfig ::= SEQUENCE { |  |  |  |
| rootSequenceIndex-BFR | 0 | See TS 38.508-1 [4] clause 4.4.2, Table 4.4.2-2 |  |
| rach-ConfigBFR | RACH-ConfigGeneric | 38.508-1 [4] Table 4.6.3-130 |  |
| rsrp-ThresholdSSB | 57(-99dBm) |  |  |
| candidateBeamRSList SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR CHOICE{ |  |  |  |
| ssb SEQUENCE { |  |  |  |
| ssb | 1 | NR Cell Beam#1 |  |
| ra-PreambleIndex | 56 | (0..63) |  |
| } |  |  |  |
| } |  |  |  |
| ssb-perRACH-Occasion | one |  |  |
| ra-ssb-OccasionMaskIndex | 0 |  |  |
| recoverySearchSpaceID | 4 |  |  |
| ra-Prioritization | Not Present |  |  |
| beamFailureRecoveryTimer | ms200 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-20: *BeamFailureRecoveryConfig\_CSIRS* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-6 | | | |
| Information Element | Value/remark | Comment | Condition |
| BeamFailureRecoveryConfig ::= SEQUENCE { |  |  |  |
| rootSequenceIndex-BFR | 0 | See TS 38.508-1 [4] clause 4.4.2, Table 4.4.2-2 |  |
| rach-ConfigBFR | RACH-ConfigGeneric | 38.508-1 [4] Table 4.6.3-130 |  |
| rsrp-ThresholdSSB | 57(-99dBm) |  |  |
| candidateBeamRSList SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR CHOICE{ |  |  |  |
| csi-RS SEQUENCE { |  |  |  |
| csi-RS | 0 |  |  |
| ra-OccasionList SEQUENCE (SIZE(1..maxRA-OccasionsPerCSIRS)) OF INTEGER (0..maxRA-Occasions-1) { | 1 entry |  |  |
| INTEGER[1] | 0 | entry 1  NR Cell Beam#0 |  |
| } |  |  |  |
| ra-PreambleIndex | 59 |  |  |
| } |  |  |  |
| } |  |  |  |
| ssb-perRACH-Occasion | Not Present |  |  |
| ra-ssb-OccasionMaskIndex | Not Present |  |  |
| recoverySearchSpaceID | 4 |  |  |
| ra-Prioritization | Not Present |  |  |
| beamFailureRecoveryTimer | ms200 |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-21: *PUCCH-Config* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| pucch-Config::= SEQUENCE { |  |  |  |
| pucch-PowerControl SEQUENCE { |  |  |  |
| pathlossReferenceRSs SEQUENCE (SIZE (1..maxNrofPUCCH-PathlossReferenceRSs)) OF PUCCH-PathlossReferenceRS { | 1 entry |  |  |
| PUCCH-PathlossReferenceRS[1] SEQUENCE { |  | entry 1 |  |
| referenceSignal CHOICE { |  |  |  |
| ssb-Index | 1 |  | Step1, Step17 |
|  | 0 |  | Step8 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.4.3.3-22: *PUSCH-Config* (Table 7.1.1.1.4.3.3-18: *BWP-UplinkDedicated*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| pusch-Config::= SEQUENCE { |  |  |  |
| pusch-PowerControl SEQUENCE { |  |  |  |
| pathlossReferenceRSToAddModList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS { | 1 entry |  |  |
| PUSCH-PathlossReferenceRS[1] SEQUENCE { |  | entry 1 |  |
| referenceSignal CHOICE{ |  |  |  |
| ssb-Index | 1 |  | Step1, Step17 |
|  | 0 |  | Step8 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.5 Random access procedure / Successful / Supplementary Uplink

7.1.1.1.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with supplementary uplink configured and RACH procedure is triggered }

**ensure** **that** {

**when** { RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL* }

**then** { UE performs the Random Access Procedure on the Supplementary Uplink carrier }

}

7.1.1.1.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in TS 38.321: clause 5.1.1 and clause 5.16. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.1]

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

NOTE 1: If a new Random Access procedure is triggered while another is already ongoing in the MAC entity, it is up to UE implementation whether to continue with the ongoing procedure or start with the new procedure (e.g. for SI request).

RRC configures the following parameters for the Random Access procedure:

- *prach-ConfigurationIndex*: the available set of PRACH occasions for the transmission of the Random Access Preamble;

- *preambleReceivedTargetPower*: initial Random Access Preamble power;

- *rsrp-ThresholdSSB*: an RSRP threshold for the selection of the SSB. If the Random Access procedure is initiated for beam failure recovery, *rsrp-ThresholdSSB* used for the selection of the SSB within *candidateBeamRSList* refers to *rsrp-ThresholdSSB* in *BeamFailureRecoveryConfig* IE;

- *rsrp-ThresholdCSI-RS*: an RSRP threshold for the selection of CSI-RS. If the Random Access procedure is initiated for beam failure recovery, *rsrp-ThresholdCSI-RS* is equal to *rsrp-ThresholdSSB* in *BeamFailureRecoveryConfig* IE;

- *rsrp-ThresholdSSB-SUL*: an RSRP threshold for the selection between the NUL carrier and the SUL carrier;

- *candidateBeamRSList*: a list of reference signals (CSI*-RS* and/or SSB) identifying the candidate beams for recovery and the associated Random Access parameters;

- *recoverySearchSpaceId*: the search space identity for monitoring the response of the beam failure recovery request;

- *powerRampingStep*: the power-ramping factor;

- *powerRampingStepHighPriority*: the power-ramping factor in case of prioritized Random Access procedure;

- *scalingFactorBI*: a scaling factor for prioritized Random Access procedure;

- *ra-PreambleIndex*: Random Access Preamble;

- *ra-ssb-OccasionMaskIndex*: defines PRACH occasion(s) associated with an SSB in which the MAC entity may transmit a Random Access Preamble (see clause 7.4);

- *ra-OccasionList*: defines PRACH occasion(s) associated with a CSI-RS in which the MAC entity may transmit a Random Access Preamble;

- *ra-PreambleStartIndex*: the starting index of Random Access Preamble(s) for on-demand SI request;

- *preambleTransMax*: the maximum number of Random Access Preamble transmission;

- *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*: defines the number of SSBs mapped to each PRACH occasion and the number of contention-based Random Access Preambles mapped to each SSB;

- if *groupBconfigured* is configured, then Random Access Preambles group B is configured.

- Amongst the contention-based Random Access Preambles associated with an SSB (as defined in TS 38.213 [6]), the first *numberOfRA-PreamblesGroupA* Random Access Preambles belong to Random Access Preambles group A. The remaining Random Access Preambles associated with the SSB belong to Random Access Preambles group B (if configured).

NOTE 2: If Random Access Preambles group B is supported by the cell Random Access Preambles group B is included for each SSB.

- if Random Access Preambles group B is configured:

- *ra-Msg3SizeGroupA*: the threshold to determine the groups of Random Access Preambles;

- *msg3-DeltaPreamble*: ∆*PREAMBLE\_Msg3* in TS 38.213 [6];

- *messagePowerOffsetGroupB*: the power offset for preamble selection;

- *numberOfRA-PreamblesGroupA*: defines the number of Random Access Preambles in Random Access Preamble group A for each SSB.

- the set of Random Access Preambles and/or PRACH occasions for SI request, if any;

- the set of Random Access Preambles and/or PRACH occasions for beam failure recovery request, if any;

- the set of Random Access Preambles and/or PRACH occasions for reconfiguration with sync, if any;

- *ra-ResponseWindow*: the time window to monitor RA response(s) (SpCell only);

- *ra-ContentionResolutionTimer*: the Contention Resolution Timer (SpCell only).

In addition, the following information for related Serving Cell is assumed to be available for UEs:

- if Random Access Preambles group B is configured:

- if the Serving Cell for the Random Access procedure is configured with supplementary uplink as specified in TS 38.331 [5], and SUL carrier is selected for performing Random Access Procedure:

- PCMAX,f,c of the SUL carrier as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16].

- else:

- PCMAX,f,c of the NUL carrier as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16].

The following UE variables are used for the Random Access procedure:

- *PREAMBLE\_INDEX*;

- *PREAMBLE\_TRANSMISSION\_COUNTER*;

- *PREAMBLE\_POWER\_RAMPING\_COUNTER*;

- *PREAMBLE\_POWER\_RAMPING\_STEP*;

- *PREAMBLE\_RECEIVED\_TARGET\_POWER*;

- *PREAMBLE\_BACKOFF*;

- *PCMAX*;

- *SCALING\_FACTOR\_BI*;

- *TEMPORARY\_C-RNTI*.

When the Random Access procedure is initiated on a Serving Cell, the MAC entity shall:

1> flush the Msg3 buffer;

1> set the *PREAMBLE\_TRANSMISSION\_COUNTER* to 1;

1> set the *PREAMBLE\_POWER\_RAMPING\_COUNTER* to 1;

1> set the *PREAMBLE\_BACKOFF* to 0 ms;

1> if the carrier to use for the Random Access procedure is explicitly signalled:

2> select the signalled carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the signalled carrier.

1> else if the carrier to use for the Random Access procedure is not explicitly signalled; and

1> if the Serving Cell for the Random Access procedure is configured with supplementary uplink as specified in TS 38.331 [5]; and

1> if the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdSSB-SUL*:

2> select the SUL carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the SUL carrier.

1> else:

2> select the NUL carrier for performing Random Access procedure;

2> set the *PCMAX* to PCMAX,f,c of the NUL carrier.

1> perform the BWP operation as specified in clause 5.15;

1> set *PREAMBLE\_POWER\_RAMPING\_STEP* to

*powerRampingStep*;1> set *SCALING\_FACTOR\_BI* to 1;

1> if the Random Access procedure was initiated for beam failure recovery (as specified in clause 5.17); and

1> if *beamFailureRecoveryConfig* is configured for the active UL BWP of the selected carrier:

2> start the *beamFailureRecoveryTimer*, if configured;

2> apply the parameters *powerRampingStep*, *preambleReceivedTargetPower*, and *preambleTransMax* configured in the *beamFailureRecoveryConfig*;

2> if *powerRampingStepHighPriority* is configured in the *beamFailureRecoveryConfig*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

2> else:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to *powerRampingStep*.

2> if *scalingFactorBI* is configured in the *beamFailureRecoveryConfig*:

3> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

1> else if the Random Access procedure was initiated for handover; and

1> if *rach-ConfigDedicated* is configured for the selected carrier:

2> if *powerRampingStepHighPriority* is configured in the *rach-ConfigDedicated*:

3> set *PREAMBLE\_POWER\_RAMPING\_STEP* to the *powerRampingStepHighPriority*.

2> if *scalingFactorBI* is configured in the *rach-ConfigDedicated*:

3> set *SCALING\_FACTOR\_BI* to the *scalingFactorBI*.

1> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.16]

The Supplementary UL (SUL) carrier can be configured as a complement to the normal UL (NUL) carrier. Switching between the NUL carrier and the SUL carrier means that the UL transmissions move from one carrier to the other carrier, which is done by:

- an indication in DCI;

- the Random Access procedure as specified in clause 5.1.1.

If the MAC entity receives a UL grant indicating an SUL switch while a Random Access procedure is ongoing, the MAC entity shall ignore the UL grant.

The Serving Cell configured with *supplementaryUplink* belongs to a single TAG.

7.1.1.1.5.3 Test description

7.1.1.1.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that supplementary uplink (SUL) carrier is configured on NR Cell 33.

7.1.1.1.5.3.2 Test procedure sequence

Table 7.1.1.1.5.3.2-1 illustrates the downlink power levels to be applied for the NR cells at various time instants of the test execution. Row marked "T0" denotes the initial conditions, while row marked "T1" are to be applied subsequently. The exact instants on which these values shall be applied are described in the texts in this clause.

Table 7.1.1.1.5.3.2-1: Time instances of cell power level changes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1  (NUL) | NR Cell 33 (SUL) | Remark |
| T0 | SS/PBCH  SSS EPRE | dBm/SCS | -75 | N/A | NR Cell1 Power level is higher than *rsrp-ThresholdSSB-SUL.* |
| T1 | SS/PBCH  SSS EPRE | dBm/SCS | -85 | N/A | NR Cell1 Power level is lower than *rsrp-ThresholdSSB-SUL.* |

Table 7.1.1.1.5.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant |  | - | - | - |
| 2 | The SS transmits a MAC PDU containing a PDCP SDU on NR Cell 1. | <-- | MAC PDU | - | - |
| 3 | The SS changes NR Cell 1’s power level according to the row "T1" in table 7.1.1.1.5.3.2-1. (Note 1) | - | - | - | - |
| 4 | Void. | - | - | - | - |
| 5 | Check: Does the UE initiate the random access procedure on SUL carrier on NR Cell 33? | --> | PRACH Preamble | 1 | P |
| 6 | The SS transmits Random Access Response with an UL Grant of 56-bits on NR Cell 1 and RAPID corresponding to the transmitted preamble in step 5. (Note 2) | <-- | Random Access Response | - | - |
| 7 | Check: Does the UE send a msg3 using the grant associated to the Random Access Response received in Step 6 on SUL carrier on NR Cell 33? | --> | Msg3 (C-RNTI MAC CE) | 1 | P |
| 8 | The SS schedules PDCCH transmission on NR Cell 1 for UE C-RNTI with uplink grant’s UL/SUL indicator set to 1. | <-- | Contention Resolution | - | - |
| 9 | Check: Does the UE transmit a MAC PDU with C-RNTI containing looped back PDCP SDU on SUL carrier on NR Cell 33? | --> | MAC PDU | 1 | P |
| Note 1: Reduce the NR Cell 1 SS/PBCH EPRE level to ensure that RSRP of the downlink pathloss reference is lower than rsrp-ThresholdSSB-SUL, while UE is still able to receive msg2 and msg4 correctly.  Note 2: UL grant of 56 bits is to make UE not send any loopback data in uplink with msg3, according to TS 38.321 [18] clause 5.4.3.1. | | | | | |

7.1.1.1.5.3.3 Specific message contents

Table 7.1.1.1.5.3.3-1: SIB1 of NR Cell 1 (preamble and all steps, Table 7.1.1.1.5.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommonSIB |  |  |
| } |  |  |  |

Table 7.1.1.1.5.3.3-2: ServingCellConfigCommonSIB (Table 7.1.1.1.5.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-169 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommonSIB ::= SEQUENCE { |  |  |  |
| supplementaryUplink SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.5.3.3-3: BWP-UplinkCommon (Table 7.1.1.1.5.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.5.3.3-4: RACH-ConfigCommon(Table 7.1.1.1.5.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rsrp-ThresholdSSB-SUL | 76 | IE value 76 means -80dBm | SUL |
| } |  |  |  |

Table 7.1.1.1.5.3.3-5: DCI Format 0-1(Step 8 of Table 7.1.1.1.5.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.3.6.1.1.2-1 | | | |
| Information Element | Value/remark | Comment | Condition |
| UL/SUL indicator | 1 |  | UE configured with SUL in the cell |

##### 7.1.1.1.6 Random access procedure / Successful/ Temporary C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC Idle state has UL CCCH PDU to send and Random Access Preambles group B is configured }

**ensure that** {

**when** { the UL CCCH MAC PDU Size is less than messageSizeGroupA }

**then** { UE transmits a random access preamble using a preamble in group A of random access preambles }

}

(2)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSG3 }

**ensure that** {

**when** { The SS schedules any PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry with MAC PDU does not contain a matching UE Contention Resolution Identity MAC CE }

**then** {UE re transmits a random access preamble using a preamble in the same group of random access preambles as used for the first transmission of Msg3 }

}

(3)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSG3 }

**ensure that** {

**when** { The SS does not schedule any PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry }

**then** {UE re transmits a random access preamble using a preamble in the same group of random access preambles as used for the first transmission of Msg3 }

}

(4)

**with** { UE in RRC Idle state initiated Random Access procedure to transmit UL CCCH PDU and transmitted MSG3 }

**ensure that** {

**when** { The SS schedules a PDCCH transmission addressed to UE Temporary C-RNTI before Contention resolution timer expiry }

**then** {UE assumes RACH procedure as complete }

}

7.1.1.1.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clauses 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.2, 6.1.3.2, 6.1.5 and 6.2.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.1.2]

The MAC entity shall:

1> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17); and

1> if the *beamFailureRecoveryTimer* (in subclause 5.17) is either running or not configured; and

1> if the contention-free Random Access Resources for beam failure recovery request associated with any of the SSBs and/or CSI-RSs have been explicitly provided by RRC; and

1> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or the CSI-RSs with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList* is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the SSBs in *candidateBeamRSList* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the CSI-RSs in *candidateBeamRSList*;

2> if CSI-RS is selected, and there is no *ra-PreambleIndex* associated with the selected CSI-RS:

3> set the *PREAMBLE\_INDEX* to a ra-PreambleIndex corresponding to the SSB in *candidateBeamRSList* which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7].

2> else:

3> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB or CSI-RS from the set of Random Access Preambles for beam failure recovery request.

1> else if the *ra-PreambleIndex* has been explicitly provided by PDCCH; and

1> if the *ra-PreambleIndex* is not 0b000000:

2> set the *PREAMBLE\_INDEX* to the signalled *ra-PreambleIndex*;

2> select the SSB signalled by PDCCH.

1> else if the contention-free Random Access Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *rsrp-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else if the contention-free Random Access Resources associated with CSI-RSs have been explicitly provided in *rach-ConfigDedicated* and at least one CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs is available:

2> select a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS* amongst the associated CSI-RSs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected CSI-RS.

1> else if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if the Random Access Resources for SI request have been explicitly provided by RRC:

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> select a Random Access Preamble corresponding to the selected SSB, from the Random Access Preamble(s) determined according to *ra-PreambleStartIndex* as specified in TS 38.331 [5];

2> set the *PREAMBLE\_INDEX* to selected Random Access Preamble.

1> else (i.e. for the contention-based Random Access preamble selection):

2> if at least one of the SSBs with SS-RSRP above *rsrp-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *rsrp-ThresholdSSB*.

2> else:

3> select any SSB.

2> if Msg3 has not yet been transmitted:

3> if Random Access Preambles group B is configured:

4> if the potential Msg3 size (UL data available for transmission plus MAC header and, where required, MAC CEs) is greater than *ra-Msg3SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *preambleReceivedTargetPower* – *msg3-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-Msg3SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Msg3 is being retransmitted):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the first transmission of Msg3.

> select a Random Access Preamble3 randomly with equal probability from the Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group.

> else:

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

11> ifthe Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]); and

1> if *ra-AssociationPeriodIndex* and *si-RequestPeriod* are configured:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB in the association period given by *ra-AssociationPeriodIndex* in the *si-RequestPeriod*permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6] corresponding to the selected SSB).

> else if an SSB is selected above:

2> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured or indicated by PDCCH (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB).

1> else if a CSI-RS is selected above:

2> if there is no contention-free Random Access Resource associated with the selected CSI-RS:

3> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the ra-ssb-OccasionMaskIndex if configured, corresponding to the SSB in candidateBeamRSList which is quasi-colocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the consecutive PRACH occasions according to subclause 8.1 of TS 38.213 [6], corresponding to the SSB which is quasi-colocated with the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-colocated with the selected CSI-RS).

2> else:

3> determine the next available PRACH occasion from the PRACH occasions in *ra-OccasionList* corresponding to the selected CSI-RS (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers, corresponding to the selected CSI-RS; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected CSI-RS).

1> else if Random Access procedure was initiated for beam failure recovery; and

1> if a CSI-RS is selected above and there is no contention-free Random Access Resource associated with the selected CSI-RS:

2> determine the next available PRACH occasion from the PRACH occasions, permitted by the restrictions given by the *ra-ssb-OccasionMaskIndex* if configured, corresponding to the SSB in *candidateBeamRSList* which is quasi-collocated with the selected CSI-RS as specified in TS 38.214 [7] (the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the SSB which is quasi-collected with the selected CSI-RS).

1> else:

2> determine the next available PRACH occasion (the MAC entity shall select a PRACH occasion randomly with equal probability amongst the PRACH occasions occurring simultaneously but on different subcarriers; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion).

1> perform the Random Access Preamble transmission procedure (see subclause 5.1.3).

NOTE: When the UE determines if there is an SSB with SS-RSRP above *rsrp-ThresholdSSB* or a CSI-RS with CSI-RSRP above *rsrp-ThresholdCSI-RS*, the UE uses the latest unfiltered L1-RSRP measurement.

[TS 38.321, clause 5.1.3]

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to subclause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *preambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE\_INDEX* and *PREAMBLE\_RECEIVED\_TARGET\_POWER*.

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

RA-RNTI= 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id

where s\_id is the index of the first OFDM symbol of the PRACH occasion (0 ≤ s\_id < 14), t\_id is the index of the first slot of the PRACH occasion in a system frame (0 ≤ t\_id < 80), f\_id is the index of the PRACH occasion in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

[TS 38.321, clause 5.1.4]

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* is received from lower layers on the Serving Cell where the preamble was transmitted; and

1> if PDCCH transmission is addressed to the C-RNTI; and

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> consider the Random Access procedure successfully completed.

1> else if a downlink assignment has been received on the PDCCH for the RA-RNTI and the received TB is successfully decoded:

2> if the Random Access Response contains a MAC subPDU with Backoff Indicator:

3> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_B*I.

2> else:

3> set the *PREAMBLE\_BACKOFF* to 0 ms.

2> if the Random Access Response contains a MAC subPDU with Random Access Preamble identifier corresponding to the transmitted *PREAMBLE\_INDEX* (see subclause 5.1.3):

3> consider this Random Access Response reception successful.

2> if the Random Access Response reception is considered successful:

3> if the Random Access Response includes a MAC subPDU with RAPID only:

4> consider this Random Access procedure successfully completed;

4> indicate the reception of an acknowledgement for SI request to upper layers.

3> else:

4> apply the following actions for the Serving Cell where the Random Access Preamble was transmitted:

5> process the received Timing Advance Command (see subclause 5.2);

5> indicate the *preambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Serving Cell for the Random Access procedure is SRS-only SCell:

6> ignore the received UL grant.

5> else:

6> process the received UL grant value and indicate it to the lower layers.

4> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

5> consider the Random Access procedure successfully completed.

4> else:

5> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

5> if this is the first successfully received Random Access Response within this Random Access procedure:

6> if the transmission is not being made for the CCCH logical channel:

7> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

6> obtain the MAC PDU to transmit from the Multiplexing and assembly entity and store it in the Msg3 buffer.

NOTE: If within a Random Access procedure, an uplink grant provided in the Random Access Response for the same group of contention-based Random Access Preambles has a different size than the first uplink grant allocated during that Random Access procedure, the UE behavior is not defined.

1> if *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* expires and if a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* addressed to the C-RNTI has not been received on the Serving Cell where the preamble was transmitted; or

> if *ra-ResponseWindow* configured in *RACH-ConfigCommon* expires, and if the Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX* has not been received1:

2> consider the Random Access Response reception not successful;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> if the Random Access Preamble is transmitted on the SpCell:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider the Random Access procedure unsuccessfully completed.

3> else if the Random Access Preamble is transmitted on a SCell:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2);

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

The MAC entity may stop *ra-ResponseWindow* (and hence monitoring for Random Access Response(s)) after successful reception of a Random Access Response containing Random Access Preamble identifiers that matches the transmitted *PREAMBLE\_INDEX*.

HARQ operation is not applicable to the Random Access Response reception.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted, the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNT:I

> if the Random Access procedure was initiated for beam failure recovery (as specified in subclause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

5> else:

6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Random Access procedure successfully completed.

4> else:

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

1> if *ra-ContentionResolutionTimer* expires:

2> discard the *TEMPORARY\_C-RNTI*;

2> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

3> if the criteria (as defined in subclause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

3> perform the Random Access Resource selection procedure (see subclause 5.1.2).

3> else:

4> perform the Random Access Resource selection procedure (see subclause 5.1.2) after the backoff time.

[TS 38.321, clause 5.2]

RRC configures the following parameters for the maintenance of UL time alignment:

- *timeAlignmentTimer* (per TAG) which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned.

The MAC entity shall:

1> when a Timing Advance Command MAC CE is received, and if an NTA (as defined in TS 38.211 [8]) has been maintained with the indicated TAG:

2> apply the Timing Advance Command for the indicated TAG;

2> start or restart the *timeAlignmentTimer* associated with the indicated TAG.

1> when a Timing Advance Command is received in a Random Access Response message for a Serving Cell belonging to a TAG:

2> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble:

3> apply the Timing Advance Command for this TAG;

3> start or restart the *timeAlignmentTimer* associated with this TAG.

2> else if the *timeAlignmentTimer* associated with this TAG is not running:

3> apply the Timing Advance Command for this TAG;

3> start the *timeAlignmentTimer* associated with this TAG;

3> when the Contention Resolution is considered not successful as described in subclause 5.1.5; or

3> when the Contention Resolution is considered successful for SI request as described in subclause 5.1.5, after transmitting HARQ feedback for MAC PDU including UE Contention Resolution Identity MAC CE:

4> stop *timeAlignmentTimer* associated with this TAG.

2> else:

3> ignore the received Timing Advance Command.

1> when a *timeAlignmentTimer* expires:

2> if the *timeAlignmentTimer* is associated with the PTAG:

3> flush all HARQ buffers for all Serving Cells;

3> notify RRC to release PUCCH for all Serving Cells, if configured;

3> notify RRC to release SRS for all Serving Cells, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> consider all running *timeAlignmentTimer*s as expired;

3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.

2> else if the *timeAlignmentTimer* is associated with an STAG, then for all Serving Cells belonging to this TAG:

3> flush all HARQ buffers;

3> notify RRC to release PUCCH, if configured;

3> notify RRC to release SRS, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> maintain NTA (defined in TS 38.211 [8]) of this TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell except the Random Access Preamble transmission when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the PTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble transmission on the SpCell.

[TS 38.321, clause 6.1.3.2]

The C-RNTI MAC CE is identified by MAC PDU subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.



Figure 6.1.3.2-1: C-RNTI MAC CE

[TS 38.321, clause 6.1.5]

A MAC PDU consists of one or more MAC subPDUs and optionally padding. Each MAC subPDU consists one of the following:

- a MAC subheader with Backoff Indicator only;

- a MAC subheader with RAPID only (i.e. acknowledgment for SI request);

- a MAC subheader with RAPID and MAC RAR.

A MAC subheader with Backoff Indicator consists of five header fields E/T/R/R/BI as described in Figure 6.1.5-1. A MAC subPDU with Backoff Indicator only is placed at the beginning of the MAC PDU, if included. 'MAC subPDU(s) with RAPID only' and 'MAC subPDU(s) with RAPID and MAC RAR' can be placed anywhere between MAC subPDU with Backoff Indicator only (if any) and padding (if any).

A MAC subheader with RAPID consists of three header fields E/T/RAPID as described in Figure 6.1.5-2.

Padding is placed at the end of the MAC PDU if present. Presence and length of padding is implicit based on TB size, size of MAC subPDU(s).



Figure 6.1.5-1: E/T/R/R/BI MAC subheader



Figure 6.1.5-2: E/T/RAPID MAC subheader



Figure 6.1.5-3: Example of MAC PDU consisting of MAC RARs

[TS 38.321, clause 6.2.3]

The MAC RAR is of fixed size as depicted in Figure 6.2.3-1, and consists of the following fields:

- R: Reserved bit, set to "0";

- Timing Advance Command: The Timing Advance Command field indicates the index value *TA* used to control the amount of timing adjustment that the MAC entity has to apply in TS 38.213 [6]. The size of the Timing Advance Command field is 12 bits;

- UL Grant: The Uplink Grant field indicates the resources to be used on the uplink in TS 38.213 [6]. The size of the UL Grant field is 27 bits;

- Temporary C-RNTI: The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access. The size of the Temporary C-RNTI field is 16 bits.

The MAC RAR is octet aligned.



Figure 6.2.3-1: MAC RAR

7.1.1.1.6.3 Test description

7.1.1.1.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*).7.1.1.1.6.3.2 Test procedure sequence

Table 7.1.1.1.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits a Paging message including a matched UE identity. | <-- | *Paging* | - | - |
| 2 | Check: Does the UE transmit preamble on PRACH using a preamble in group A defined in *servingCellConfigCommon* in *SIB1* (totalNumberOfRA-Preambles, ssb-perRACH-OccasionAndCB-PreamblesPerSSB and numberOfRA-PreamblesGroupA)? | --> | PRACH Preamble | 1 | P |
| 3 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 2, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - | - |
| 4 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. (Note 1) | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 5 | Before the contention resolution timer expires, the SS does not schedule any PDCCH. |  |  |  |  |
| 6 | Check: Does the UE re-transmit a preamble on PRACH using a preamble in the same group A? | --> | PRACH Preamble | 3 | P |
| 7 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 6, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - | - |
| 8 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. (Note 1) | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 9 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* message, but not including a matching ‘UE Contention Resolution Identity’ MAC control element. | <-- | MAC PDU  (*RRCSetup*) | - | - |
| - | EXCEPTION: In parallel with step 10, the parallel behaviour in table 7.1.1.1.6.3.2-2 is running. | - | - | - | - |
| 10 | Check: Does the UE re-transmit a preamble on PRACH using a preamble in the same group A? | --> | PRACH Preamble | 2 | P |
| 11 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 10, including TC-RNTI and not including Back off Indicator subheader. | <-- | Random Access Response | - |  |
| 12 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. (Note 1) | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 13 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 14 | Check: Does UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message? | --> | MAC PDU (*RRCSetupComplete)* | 4 | P |
| Note 1: Size of *RRCSetupRequest* message is 45 bits, octet aligned = 48 bits. With 16 bits of MAC Header the minimum size of MAC PDU carrying *RRCSetupRequest* is 64 bits. | | | | | |

Table 7.1.1.1.6.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: UE transmits a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message? | --> | MAC PDU (*RRCSetupComplete)* | 2 | F |

7.1.1.1.6.3.3 Specific message contents

Table 7.1.1.1.6.3.3-1: *SIB1 (*Preamble, Table 7.1.1.1.6.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.6.3.3-2: *BWP-UplinkCommon (*Table 7.1.1.1.6.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.6.3.3-3: *RACH-ConfigCommon (*Table 7.1.1.1.6.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| totalNumberOfRA-Preambles | 42 |  |  |
| ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| One | n32 |  |  |
| } |  |  |  |
| groupBconfigured SEQUENCE { |  |  |  |
| ra-Msg3SizeGroupA | b208 |  |  |
| messagePowerOffsetGroupB | minusinfinity |  |  |
| numberOfRA-PreamblesGroupA | 28 |  |  |
| } |  |  |  |
| ra-ContentionResolutionTimer | sf48 |  |  |
| } |  |  |  |

##### 7.1.1.1.7 Random access procedure / Successful/ Temporary C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected and NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above msgA-RSRP-Threshold }

**then** { UE SET RA\_TYPE to 2-step AND sends a MSGA on the NR SpCell }

}

(2)

**with** { UE in RRC\_Connected NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources }

**then** { UE SET RA\_TYPE to 2-step AND sends a MSGA on the NR SpCell }

}

7.1.1.1.7.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.1, 5.1.2a and 5.1.3a. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.1]

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

7.1.1.1.7.3 Test description

7.1.1.1.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.1.7.3.2 Test procedure sequence

Table 7.1.1.1.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 0A | SS transmits an RRCReconfiguration message toconfigure both 2-Step and 4-Step RA type Random Access Resources. Note 1 | <-- | RRCReconfiguration | - | - |
| 0B | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 1 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 2 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU | <-- | MAC PDU | - | - |
| 3 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 4 | Check: Does the UE MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA | --> | MAC PDU (including C-RNTI MAC CE) | 1 | P |
| 5 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance  Command MAC Control Element) | - | - |
| 6 | SS transmits an RRCReconfiguration message toconfigure only 2-Step RA type Random Access Resources. Note 1 | <-- | RRCReconfiguration | - | - |
| 7 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 8 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 9 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU | <-- | MAC PDU | - | - |
| 10 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 11 | Check: Does the UE MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA | --> | MAC PDU (including C-RNTI MAC CE) | 2 | P |
| 12 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance  Command MAC Control Element) | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.1.7.3.3 Specific message contents

Table 7.1.1.1.7.3.3-1: *RRCReconfiguration* for EN-DC (steps 0A and 6, Table 7.1.1.1.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-1A: *RRCReconfiguration* for NR/5GC (steps 0A and 6, Table 7.1.1.1.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| radioBearerConfig | RadioBearerConfig as per TS 38.508-1[4] Table 4.6.3-132 with conditions DRBn and Recover\_PDCP | n set to the default DRB of the first PDU session | NR |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-2: *CellGroupConfig* for EN-DC (Table 7.1.1.1.7.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | Not present |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-2A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.7.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | Not present |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-3: *ServingCellConfigCommon* (Table 7.1.1.1.7.3.3-2 and Table 7.1.1.1.7.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-4: *BWP-UplinkCommon (*Table 7.1.1.1.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  | Step 0A |
| Not present |  | Step 6 |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-5: *RACH-ConfigCommon (*Table 7.1.1.1.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-6: *MsgA-ConfigCommon* (Table 7.1.1.1.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommonL-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-7: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 SCS 30 |
| ms5 |  | FR1 SCS 15 |
| ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 SCS 30 |
|  | 10 |  | FR1 SCS 15 |
| 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 SCS 30 or FR1 SCS 15 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 SCS 30 or FR1 SCS 15 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.7.3.3-8: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.7.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 57 | -100 dBm |  |

Table 7.1.1.1.7.3.3-9: *MsgA-PUSCH-Config* (Table 7.1.1.1.7.3.3-4)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B |

##### 7.1.1.1.8 Correct selection of RACH parameters / 2-step RACH/MSGA and PRACH resource explicitly signalled to the UE by RRC / contention free random access procedure

7.1.1.1.8.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected }

**ensure that** {

**when** { SS sends an RRCReconfiguration message including RACH-ConfigDedicated information element and the contention-free Random Access Resources for 2-step RA type have been explicitly provided in rach-ConfigDedicated }

**then** { UE SET RA\_TYPE to 2-step AND sends a MSGA on the NR PSCell }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell received in RACH-ConfigDedicated on the target cell }

**ensure that** {

**when** { UE does not receive a matching MSGB in msgB-ResponseWindow and PREAMBLE\_TRANSMISSION\_COUNTER is less than msgA-TransMax + 1 }

**then** { UE retransmits a MSGA in RACH-ConfigDedicated on the target cell }

}

7.1.1.1.8.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321, clause 5.1.1, 5.1.2a, 5.1.3a and 5.1.4a. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.1]

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

1> if C-RNTI MAC CE was included in the MSGA:

2> monitor the PDCCH of the SpCell for Random Access Response identified by the C-RNTI while the *msgB-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in MSGA:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Random Access Response reception successful;

4> stop the *msgB-ResponseWindow*;

4> consider this Random Access procedure successfully completed.

3> else if the *timeAlignmentTimer* associated with the PTAG is running:

4> if the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

5> consider this Random Access Response reception successful;

5> stop the *msgB-ResponseWindow*;

5> consider this Random Access procedure successfully completed.

3> else:

4> if a downlink assignment has been received on the PDCCH for the C-RNTI and the received TB is successfully decoded:

5> if the MAC PDU contains the Absolute Timing Advance Command MAC CE:

6> process the received Timing Advance Command (see clause 5.2);

6> consider this Random Access Response reception successful;

6> stop the *msgB-ResponseWindow*;

6> consider this Random Access procedure successfully completed and finish the disassembly and demultiplexing of the MAC PDU.

2> if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the MSGB-RNTI and the received TB is successfully decoded:

3> if the MSGB contains a MAC subPDU with Backoff Indicator:

4> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

3> else:

4> set the *PREAMBLE\_BACKOFF* to 0 ms.

3> if the MSGB contains a fallbackRAR MAC subPDU; and

3> if the Random Access Preamble identifier in the MAC subPDU matches the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3a):

4> consider this Random Access Response reception successful;

4> apply the following actions for the SpCell:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

6> consider the Random Access procedure successfully completed;

6> process the received UL grant value and indicate it to the lower layers.

5> else:

6> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

6> if the Msg3 buffer is empty:

7> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

6> process the received UL grant value and indicate it to the lower layers and proceed with Msg3 transmission.

NOTE: If within a 2-step RA type procedure, an uplink grant provided in the fallback RAR has a different size than the MSGA payload, the UE behaviour is not defined.

3> else if the MSGB contains a successRAR MAC subPDU; and

3> if the CCCH SDU was included in the MSGA and the UE Contention Resolution Identity in the MAC subPDU matches the CCCH SDU:

4> stop *msgB-ResponseWindow*;

4> if this Random Access procedure was initiated for SI request:

5> indicate the reception of an acknowledgement for SI request to upper layers.

4> else:

5> set the C-RNTI to the value received in the *successRAR*;

5> apply the following actions for the SpCell:

6> process the received Timing Advance Command (see clause 5.2);

6> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*).

4> deliver the *TPC*, *PUCCH resource Indicator*, *ChannelAccess-CPext* (if indicated), and *HARQ feedback Timing Indicator* received in successRAR to lower layers.

4> consider this Random Access Response reception successful;

4> consider this Random Access procedure successfully completed;

4> finish the disassembly and demultiplexing of the MAC PDU.

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers;

3> if this Random Access procedure was triggered for SI request:

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

4> set the *RA\_TYPE* to *4-stepRA*;

4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

3> else:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time.

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

7.1.1.1.8.3 Test description

7.1.1.1.8.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*).

7.1.1.1.8.3.2 Test procedure sequence

Table 7.1.1.1.8.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | SS transmits an RRCReconfiguration message with reconfiguration with sync and contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated*. Note 1 | <-- | RRCReconfiguration | - | - |
| - | Exception: Steps 2 to 3 are run *msgA-TransMax* times | - | - | - | - |
| 2 | The UE transmits MSGA including RRCReconfigurationComplete message using the Random Access Resources for 2-step RA type explicitly provided. Note 2 | --> | MAC PDU (including C-RNTI MAC CE,RRCReconfigurationComplete) | 1,2 | P |
| 3 | SS does not schedulePDCCH transmission for UE C\_RNTI until *msgB-ResponseWindow* expires | - | - | - | - |
| 4 | The UE transmits MSGA including RRCReconfigurationComplete message using the Random Access Resources for 2-step RA type explicitly provided. Note 2 | --> | MAC PDU (including C-RNTI MAC CE,RRCReconfigurationComplete) | 2 | P |
| 6 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance  Command MAC Control Element) | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete and sent in E-UTRA cell. In NR Cell a MAC PDU containing C-RNTI MAC CE is sent. | | | | | |

7.1.1.1.8.3.3 Specific message contents

Table 7.1.1.1.8.3.3-1: *RRCReconfiguration* for EN-DC (steps 1, Table 7.1.1.1.8.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-1A: *RRCReconfiguration* for NR/5GC (steps 0A and 6, Table 7.1.1.1.8.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| radioBearerConfig | RadioBearerConfig as per TS 38.508-1[4] Table 4.6.3-132 with conditions DRBn and Recover\_PDCP | n set to the default DRB of the first PDU session | NR |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-2: *CellGroupConfig* for EN-DC (Table 7.1.1.1.8.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-2A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.8.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-3: *RACH-ConfigDedicated* (Table 7.1.1.1.8.3.3-2 and Table 7.1.1.1.8.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| cfra-TwoStep-r16 SEQUENCE { |  |  |  |
| occasionsTwoStepRA-r16 SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA |  |  |
| ssb-PerRACH-OccasionTwoStepRA-r16 |  |  |  |
| } |  |  |  |
| msgA-CFRA-PUSCH-r16 | MsgA-PUSCH-Resource |  |  |
| msgA-TransMax-r16 | N10 |  |  |
| resourcesTwoStep-r16 SEQUENCE { |  |  |  |
| ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource { |  |  |  |
| ssb | 0 |  |  |
| ra-PreambleIndex | 52 | Randomly selected |  |
| msgA-PUSCH-Resource-Index-r16 | Not present |  |  |
| } |  |  |  |
| ra-ssb-OccasionMaskIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-4: *RACH-ConfigGeneric* (Table 7.1.1.1.8.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 14 |  | FR1 |
|  | 149 |  | FR2 |
| zeroCorrelationZoneConfig | 12 |  | FR1 |
|  | 15 |  | FR2 |
| } |  |  |  |

Table 7.1.1.1.8.3.3-5: *RACH-ConfigGenericTwoStepRA* (Table 7.1.1.1.8.3.3-3 and Table 7.1.1.1.8.3.3-3A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| msgA-PRACH-ConfigurationIndex-r16 | Not present |  |  |
| msgA-RO-FDM-r16 | Not present |  |  |
| msgA-RO-FrequencyStart-r16 | Not present |  |  |
| msgA-ZeroCorrelationZoneConfig-r16 | Not present |  |  |
| msgA-PreamblePowerRampingStep-r16 | Not present |  |  |
| msgA-PreambleReceivedTargetPower-r16 | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-6: *ServingCellConfigCommon* (Table 7.1.1.1.8.3.3-2 and Table 7.1.1.1.8.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.1.8.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.1.8.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-9: *MsgA-ConfigCommon* (Table 7.1.1.1.8.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommonL-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-10: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.8.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 SCS 30 |
| ms5 |  | FR1 SCS 15 |
| ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 SCS 30 |
|  | 10 |  | FR1 SCS 15 |
| 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 SCS 30 or FR1 SCS 15 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 SCS 30 or FR1 SCS 15 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.8.3.3-11: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.8.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 87 | -70 dBm |  |

Table 7.1.1.1.8.3.3-12: *MsgA-PUSCH-Config* (Table 7.1.1.1.8.3.3-7)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B |

##### 7.1.1.1.9 Random access procedure / Successful / 2-step RACH/C-RNTI Based / Preamble selected by MAC itself

7.1.1.1.9.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state after NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the UL MAC PDU Size is less than ra-MsgA-SizeGroupA }

**then** { UE transmits a MSGA using a preamble in group A of random access preambles }

}

(2)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell }

**ensure that** {

**when** { SS does not answer with a matching MSGB within msgB-ResponseWindow }

**then** { UE retransmits a MSGA using a preamble from same group }

}

(3)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell }

**ensure that** {

**when** { SS sends a MSGB including a Backoff Indicator and the Random Access Preamble identifier is different from the value received from UE }

**then** { UE performs the Random Access Resource selection procedure for 2-step RA type Random Access after a random time between 0 and the indicated Backoff parameter from same group }

}

(4)

**with** { UE in RRC\_Connected state after NR SpCell TimeAlignmentTimer expired, and has UL Data to send }

**ensure that** {

**when** { the UL MAC PDU Size is greater than messageSizeGroupA }

**then** { UE transmits a MSGA using a preamble in group B of random access preambles }

}

(5)

**with** { UE in RRC\_Connected state and having initiated a 2-step RA type Random Access procedure in NR SpCell }

**ensure that** {

**when** { SS transmits a Timing Advance Command in a MSGB message }

**then** { UE applies the received Timing Advance value in the next transmitted MAC PDU }

}

7.1.1.1.9.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38,321, clause 5.1.2a, 5.1.3a, 5.1.4a, 5.1.5 and 5.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.1.2a]

If the selected *RA\_TYPE* is set to *2-stepRA*, the MAC entity shall:

1> if the contention-free 2-step RA type Resources associated with SSBs have been explicitly provided in *rach-ConfigDedicated* and at least one SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs is available:

2> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB* amongst the associated SSBs;

2> set the *PREAMBLE\_INDEX* to a *ra-PreambleIndex* corresponding to the selected SSB.

1> else (i.e. for the contention-based Random Access Preamble selection):

2> if at least one of the SSBs with SS-RSRP above *msgA-RSRP-ThresholdSSB* is available:

3> select an SSB with SS-RSRP above *msgA-RSRP-ThresholdSSB*.

2> else:

3> select any SSB.

2> if contention-free Random Access Resources for 2-step RA type have not been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured:

4> if the potential MSGA payload size (UL data available for transmission plus MAC subheader and, where required, MAC CEs) is greater than the *ra-MsgA-SizeGroupA* and the pathloss is less than *PCMAX* (of the Serving Cell performing the Random Access Procedure) – *msgA-PreambleReceivedTargetPower* – *msgA-DeltaPreamble* – *messagePowerOffsetGroupB*; or

4> if the Random Access procedure was initiated for the CCCH logical channel and the CCCH SDU size plus MAC subheader is greater than *ra-MsgA-SizeGroupA*:

5> select the Random Access Preambles group B.

4> else:

5> select the Random Access Preambles group A.

3> else:

4> select the Random Access Preambles group A.

2> else if contention-free Random Access Resources for 2-step RA type have been configured and if Random Access Preambles group has not yet been selected during the current Random Access procedure:

3> if Random Access Preambles group B for 2-step RA type is configured; and

3> if the transport block size of the MSGA payload configured in the *rach-ConfigDedicated* corresponds to the transport block size of the MSGA payload associated with Random Access Preambles group B:

4> select the Random Access Preambles group B.

3> else:

4> select the Random Access Preambles group A.

2> else (i.e. Random Access preambles group has been selected during the current Random Access procedure):

3> select the same group of Random Access Preambles as was used for the Random Access Preamble transmission attempt corresponding to the earlier transmission of MSGA.

2> select a Random Access Preamble randomly with equal probability from the 2-step RA type Random Access Preambles associated with the selected SSB and the selected Random Access Preambles group;

2> set the *PREAMBLE\_INDEX* to the selected Random Access Preamble.

1> determine the next available PRACH occasion from the PRACH occasions corresponding to the selected SSB permitted by the restrictions given by the *msgA-SSB-SharedRO-MaskIndex* if configured and *ra-ssb-OccasionMaskIndex* if configured (the MAC entity shall select a PRACH occasion randomly with equal probability among the consecutive PRACH occasions allocated for 2-step RA type according to clause 8.1 of TS 38.213 [6], corresponding to the selected SSB; the MAC entity may take into account the possible occurrence of measurement gaps when determining the next available PRACH occasion corresponding to the selected SSB);

1> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

2> select a PUSCH occasion from the PUSCH occasions configured in *msgA-CFRA-PUSCH* corresponding to the PRACH slot of the selected PRACH occasion, according to *msgA-PUSCH-resource-Index* corresponding to the selected SSB;

2> determine the UL grant and the associated HARQ information for the MSGA payload in the selected PUSCH occasion;

2> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> else:

2> select a PUSCH occasion corresponding to the selected preamble and PRACH occasion according to clause 8.1A of TS 38.213 [6];

2> determine the UL grant for the MSGA payload according to the PUSCH configuration associated with the selected Random Access Preambles group and determine the associated HARQ information;

2> if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion as specified in clause 8.1A of TS 38.213 [6]:

3> deliver the UL grant and the associated HARQ information to the HARQ entity.

1> perform the MSGA transmission procedure (see clause 5.1.3a).

NOTE: To determine if there is an SSB with *SS-RSRP* above *msgA-RSRP-ThresholdSSB*, the UE uses the latest unfiltered *L1-RSRP* measurement.

[TS 38.321, clause 5.1.3a]

The MAC entity shall, for each MSGA:

1> if *PREAMBLE\_TRANSMISSION\_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last MSGA Random Access Preamble transmission; and

1> if SSB selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE\_POWER\_RAMPING\_COUNTER* by 1.

1> select the value of *DELTA\_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE\_RECEIVED\_TARGET\_POWER* to *msgA-PreambleReceivedTargetPower* + *DELTA\_PREAMBLE* + (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*;

1> if this is the first MSGA transmission within this Random Access procedure:

2> if the transmission is not being made for the CCCH logical channel:

3> indicate to the Multiplexing and assembly entity to include a C-RNTI MAC CE in the subsequent uplink transmission.

2> if the Random Access procedure was initiated for SpCell beam failure recovery and *spCell-BFR-CBRA* with value *true* is configured:

3> indicate to the Multiplexing and assembly entity to include a BFR MAC CE or a Truncated BFR MAC CE in the subsequent uplink transmission.

2> obtain the MAC PDU to transmit from the Multiplexing and assembly entity according to the HARQ information determined for the MSGA payload (see clause 5.1.2a) and store it in the MSGA buffer.

1> compute the MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA (if the selected preamble and PRACH occasion is mapped to a valid PUSCH occasion), using the corresponding RA-RNTI, MSGB-RNTI, *PREAMBLE\_INDEX*, *PREAMBLE\_RECEIVED\_TARGET\_POWER*, *msgA-PreambleReceivedTargetPower*, and the amount of power ramping applied to the latest MSGA preamble transmission (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

1> if LBT failure indication is received from lower layers for the transmission of this MSGA Random Access Preamble:

2> instruct the physical layer to cancel the transmission of the MSGA payload on the associated PUSCH resource;

2> if *lbt-FailureRecoveryConfig* is configured:

3> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

2> else:

3> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

3> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

4> indicate a Random Access problem to upper layers;

4> if this Random Access procedure was triggered for SI request:

5> consider this Random Access procedure unsuccessfully completed.

3> if the Random Access procedure is not completed:

4> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

5> set the *RA\_TYPE* to *4-stepRA*;

5> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

5> if the Msg3 buffer is empty:

6> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

5> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

5> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

5> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

NOTE: The MSGA transmission includes the transmission of the PRACH Preamble as well as the contents of the MSGA buffer in the PUSCH resource corresponding to the selected PRACH occasion and *PREAMBLE\_INDEX* (see TS 38.213 [6])

The MSGB-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

MSGB-RNTI = 1 + s\_id + 14 × t\_id + 14 × 80 × f\_id + 14 × 80 × 8 × ul\_carrier\_id + 14 × 80 × 8 × 2

where s\_id is the index of the first OFDM symbol of the PRACH occasion (0 ≤ s\_id < 14), t\_id is the index of the first slot of the PRACH occasion in a system frame (0 ≤ t\_id < 80), where the subcarrier spacing to determine t\_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f\_id is the index of the PRACH occasion in the frequency domain (0 ≤ f\_id < 8), and ul\_carrier\_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier). The RA-RNTI is calculated as specified in clause 5.1.3.

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> start the *msgB-ResponseWindow* at the PDCCH occasion as specified in TS 38.213 [6], clause 8.2A;

1> monitor the PDCCH of the SpCell for a Random Access Response identified by MSGB-RNTI while the *msgB-ResponseWindow* is running;

1> if C-RNTI MAC CE was included in the MSGA:

2> monitor the PDCCH of the SpCell for Random Access Response identified by the C-RNTI while the *msgB-ResponseWindow* is running.

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in MSGA:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI:

4> consider this Random Access Response reception successful;

4> stop the *msgB-ResponseWindow*;

4> consider this Random Access procedure successfully completed.

3> else if the *timeAlignmentTimer* associated with the PTAG is running:

4> if the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

5> consider this Random Access Response reception successful;

5> stop the *msgB-ResponseWindow*;

5> consider this Random Access procedure successfully completed.

3> else:

4> if a downlink assignment has been received on the PDCCH for the C-RNTI and the received TB is successfully decoded:

5> if the MAC PDU contains the Absolute Timing Advance Command MAC CE:

6> process the received Timing Advance Command (see clause 5.2);

6> consider this Random Access Response reception successful;

6> stop the *msgB-ResponseWindow*;

6> consider this Random Access procedure successfully completed and finish the disassembly and demultiplexing of the MAC PDU.

2> if a valid (as specified in TS 38.213 [6]) downlink assignment has been received on the PDCCH for the MSGB-RNTI and the received TB is successfully decoded:

3> if the MSGB contains a MAC subPDU with Backoff Indicator:

4> set the *PREAMBLE\_BACKOFF* to value of the BI field of the MAC subPDU using Table 7.2-1, multiplied with *SCALING\_FACTOR\_BI*.

3> else:

4> set the *PREAMBLE\_BACKOFF* to 0 ms.

3> if the MSGB contains a fallbackRAR MAC subPDU; and

3> if the Random Access Preamble identifier in the MAC subPDU matches the transmitted *PREAMBLE\_INDEX* (see clause 5.1.3a):

4> consider this Random Access Response reception successful;

4> apply the following actions for the SpCell:

5> process the received Timing Advance Command (see clause 5.2);

5> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*);

5> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble(s):

6> consider the Random Access procedure successfully completed;

6> process the received UL grant value and indicate it to the lower layers.

5> else:

6> set the *TEMPORARY\_C-RNTI* to the value received in the Random Access Response;

6> if the Msg3 buffer is empty:

7> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

6> process the received UL grant value and indicate it to the lower layers and proceed with Msg3 transmission.

NOTE: If within a 2-step RA type procedure, an uplink grant provided in the fallback RAR has a different size than the MSGA payload, the UE behaviour is not defined.

3> else if the MSGB contains a successRAR MAC subPDU; and

3> if the CCCH SDU was included in the MSGA and the UE Contention Resolution Identity in the MAC subPDU matches the CCCH SDU:

4> stop *msgB-ResponseWindow*;

4> if this Random Access procedure was initiated for SI request:

5> indicate the reception of an acknowledgement for SI request to upper layers.

4> else:

5> set the C-RNTI to the value received in the *successRAR*;

5> apply the following actions for the SpCell:

6> process the received Timing Advance Command (see clause 5.2);

6> indicate the *msgA-PreambleReceivedTargetPower* and the amount of power ramping applied to the latest Random Access Preamble transmission to lower layers (i.e. (*PREAMBLE\_POWER\_RAMPING\_COUNTER* – 1) × *PREAMBLE\_POWER\_RAMPING\_STEP*).

4> deliver the *TPC*, *PUCCH resource Indicator*, *ChannelAccess-CPext* (if indicated), and *HARQ feedback Timing Indicator* received in successRAR to lower layers.

4> consider this Random Access Response reception successful;

4> consider this Random Access procedure successfully completed;

4> finish the disassembly and demultiplexing of the MAC PDU.

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers;

3> if this Random Access procedure was triggered for SI request:

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

4> set the *RA\_TYPE* to *4-stepRA*;

4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

3> else:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time.

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

[TS 38.321, clause 5.1.5]

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI; or

3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission:

4> consider this Contention Resolution successful;

4> stop *ra-ContentionResolutionTimer*;

4> discard the *TEMPORARY\_C-RNTI*;

4> consider this Random Access procedure successfully completed.

2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY\_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

5> else:

6> set the C-RNTI to the value of the *TEMPORARY\_C-RNTI*;

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Random Access procedure successfully completed.

4> else:

5> discard the *TEMPORARY\_C-RNTI*;

5> consider this Contention Resolution not successful and discard the successfully decoded MAC PDU.

1> if *ra-ContentionResolutionTimer* expires:

2> discard the *TEMPORARY\_C-RNTI*;

2> consider the Contention Resolution not successful.

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if the *RA\_TYPE* is set to *4-stepRA*:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure (see clause 5.1.2);

4> else:

5> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

3> else (i.e. the *RA\_TYPE* is set to *2-stepRA*):

4> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

5> set the *RA\_TYPE* to *4-stepRA*;

5> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

5> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

5> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

5> perform the Random Access Resource selection as specified in clause 5.1.2.

4> else:

5> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

5> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

6> perform the Random Access Resource selection procedure for 2-step RA type as specified in clause 5.1.2a.

5> else:

6> perform the Random Access Resource selection for 2-step RA type procedure (see clause 5.1.2a) after the backoff time.

[TS 38.321, clause 5.2]

RRC configures the following parameters for the maintenance of UL time alignment:

- *timeAlignmentTimer* (per TAG) which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned.

The MAC entity shall:

1> when a Timing Advance Command MAC CE is received, and if an NTA (as defined in TS 38.211 [8]) has been maintained with the indicated TAG:

2> apply the Timing Advance Command for the indicated TAG;

2> start or restart the *timeAlignmentTimer* associated with the indicated TAG.

1> when a Timing Advance Command is received in a Random Access Response message for a Serving Cell belonging to a TAG or in a MSGB for an SpCell:

2> if the Random Access Preamble was not selected by the MAC entity among the contention-based Random Access Preamble:

3> apply the Timing Advance Command for this TAG;

3> start or restart the *timeAlignmentTimer* associated with this TAG.

2> else if the *timeAlignmentTimer* associated with this TAG is not running:

3> apply the Timing Advance Command for this TAG;

3> start the *timeAlignmentTimer* associated with this TAG;

3> when the Contention Resolution is considered not successful as described in clause 5.1.5; or

3> when the Contention Resolution is considered successful for SI request as described in clause 5.1.5, after transmitting HARQ feedback for MAC PDU including UE Contention Resolution Identity MAC CE:

4> stop *timeAlignmentTimer* associated with this TAG.

2> else:

3> ignore the received Timing Advance Command.

1> when an Absolute Timing Advance Command is received in response to a MSGA transmission including C-RNTI MAC CE as specified in clause 5.1.4a:

2> apply the Timing Advance Command for PTAG;

2> start or restart the *timeAlignmentTimer* associated with PTAG.

1> when a *timeAlignmentTimer* expires:

2> if the *timeAlignmentTimer* is associated with the PTAG:

3> flush all HARQ buffers for all Serving Cells;

3> notify RRC to release PUCCH for all Serving Cells, if configured;

3> notify RRC to release SRS for all Serving Cells, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> consider all running *timeAlignmentTimer*s as expired;

3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.

2> else if the *timeAlignmentTimer* is associated with an STAG, then for all Serving Cells belonging to this TAG:

3> flush all HARQ buffers;

3> notify RRC to release PUCCH, if configured;

3> notify RRC to release SRS, if configured;

3> clear any configured downlink assignments and configured uplink grants;

3> clear any PUSCH resource for semi-persistent CSI reporting;

3> maintain NTA (defined in TS 38.211 [8]) of this TAG.

When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired.

The MAC entity shall not perform any uplink transmission on a Serving Cell except the Random Access Preamble and MSGA transmission when the *timeAlignmentTimer* associated with the TAG to which this Serving Cell belongs is not running. Furthermore, when the *timeAlignmentTimer* associated with the PTAG is not running, the MAC entity shall not perform any uplink transmission on any Serving Cell except the Random Access Preamble and MSGA transmission on the SpCell.

7.1.1.1.9.3 Test description

7.1.1.1.9.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.1.9.3.2 Test procedure sequence

Table 7.1.1.1.9.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Step 1 is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 1 | The SS transmits an updated system information as specified in Table 7.1.1.1.9.3.3-2. | - | - | - | - |
| 2 | SS transmits an RRCReconfiguration message toconfigure 2-Step and RA type Random Access Resources. (Note 1) | <-- | RRCReconfiguration | - | - |
| 3 | The UE transmits RRCReconfigurationComplete message. (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 4 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC CE) | - | - |
| 5 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU of size 56 bits, less than *ra-MsgA-SizeGroupA* (208 bits) on SpCell. (Note 3) | <-- | MAC PDU | - | - |
| 6 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 7 | Check: Does the UE transmit MSGA using preamble on PRACH in group A? | --> | MAC PDU (including C-RNTI MAC CE) | 1 | P |
| 8 | Check: Does the UE re-transmit MSGA using a preamble on PRACH in the same group A after expiry of *msgB-ResponseWindow*? | --> | MAC PDU (including C-RNTI MAC CE) | 2 | P |
| 9 | The SS transmits a MSGB with the Backoff parameter set to value Index field '12' and with the RAPID different from the value received from the UE.  The SS sets Timer\_T2 to the Backoff value ‘960’ associated with the Index value ‘12’ and starts Timer\_T2. | <-- | MAC PDU(BI, RAPID) | - | - |
| 10 | Check: Does UE transmit MSGA using preamble on PRACH in group A while Timer\_T2 is running? | --> | MAC PDU (including C-RNTI MAC CE) | 3 | P |
| 11 | The SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Absolute Timing Advance Command MAC CE. | <-- | MAC PDU(Absolute Timing Advance Command MAC CE) | - | - |
| - | EXCEPTION: Step 12 is performed IF pc\_NG\_RAN\_NR only. | - | - | - | - |
| 12 | The SS transmits an updated system information as specified in Table 7.1.1.1.9.3.3-2. | - | - | - | - |
| 13 | SS transmits an RRCReconfiguration message toconfigure 2-Step RA type Random Access Resources. (Note 1) | <-- | RRCReconfiguration | - | - |
| 14 | The UE transmits RRCReconfigurationComplete message. (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 15 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T3 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC CE) | - | - |
| 16 | 40 to 50 TTI before Timer\_T3 expires the SS transmits a MAC PDU containing a PDCP SDU of size 256 bits, more than *ra-MsgA-SizeGroupA* (208 bits) on SpCell. (Note 4) | <-- | MAC PDU | - | - |
| 17 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 18 | Check: Does the UE transmit MSGA using preamble on PRACH in group B? | --> | MAC PDU (including C-RNTI MAC CE) | 4 | P |
| 19 | SS schedules PDCCH transmission for UE C\_RNTI and DL MAC PDU containing Timing Advance Command MAC CE. | <-- | MAC PDU(Timing Advance  Command MAC CE) | - | - |
| 20 | Check: Does the UE transmits a MAC PDU with C-RNTI containing looped back PDCP SDU using the new Timing Advance value? | --> | MAC PDU | 5 | P |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: MAC PDU size of 56bits is selected to allow UE send status PDU and stays below the limit of ra-MsgA-SizeGroupA.  Note 4: MAC PDU size of 256bits is selected to allow UE send status PDU and stays above the limit of ra-MsgA-SizeGroupA. | | | | | |

7.1.1.1.9.3.3 Specific message contents

Table 7.1.1.1.9.3.3-1: *MAC-CellGroupConfig* (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| tag-Config SEQUENCE { |  |  |  |
| tag-ToAddModList SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG { | 1 entry |  |  |
| TAG[1] SEQUENCE { |  | entry 1 |  |
| timeAlignmentTimer | ms750 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-2: *SIB1S* (steps 1 and 12, Table 7.1.1.1.9.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: TS 38.508-1 [4] Table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-3: *ServingCellConfigCommon* (Table 7.1.1.1.9.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-4: *BWP-UplinkCommon* (Table 7.1.1.1.9.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon-r16 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-5: *MsgA-ConfigCommon-r16* (Table 7.1.1.1.9.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommon-r16 :: = SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA-r16 |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config-r16 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-6: *RACH-ConfigCommonTwoStepRA-r16* (Table 7.1.1.1.9.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA-r16 |  |  |
| msgA-TotalNumberOfRA-Preambles-r16 | 8 |  |  |
| msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB-r16 CHOICE { |  |  |  |
| two | n4 |  |  |
| } |  |  |  |
| groupB-ConfiguredTwoStepRA-r16 | GroupB-ConfiguredTwoStepRA-r16 |  |  |
| msgA-PRACH-RootSequenceIndex-r16 CHOICE { |  |  |  |
| l839 | 100 |  |  |
| } |  |  |  |
| msgA-TransMax-r16 | n4 |  |  |
| msgA-RSRP-ThresholdSSB-r16 | 56 |  |  |
| msgA-RestrictedSetConfig-r16 | unrestrictedSet |  |  |
| ra-PrioritizationForAccessIdentityTwoStep-r16 SEQUENCE { |  |  |  |
| ra-Prioritization-r16 | RA-Prioritization | TS 38.508-1 [4], Table 4.6.3-131 |  |
| ra-PrioritizationForAI-r16 | ‘00’B |  |  |
| } |  |  |  |
| ra-ContentionResolutionTimer-r16 | sf32 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-7: *RACH-ConfigGenericTwoStepRA-r16* (Table 7.1.1.1.9.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGenericTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-PRACH-ConfigurationIndex-r16 | 0 |  |  |
| msgA-RO-FDM-r16 | one |  |  |
| msgA-RO-FrequencyStart-r16 | 0 |  |  |
| msgA-ZeroCorrelationZoneConfig-r16 | 0 |  |  |
| msgA-PreamblePowerRampingStep-r16 | dB2 |  |  |
| msgA-PreambleReceivedTargetPower-r16 | -200 |  |  |
| msgB-ResponseWindow-r16 | sl80 |  |  |
| preambleTransMax-r16 | n4 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-8: *GroupB-ConfiguredTwoStepRA-r16* (Table 7.1.1.1.9.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| GroupB-ConfiguredTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| ra-MsgA-SizeGroupA | b208 |  |  |
| messagePowerOffsetGroupB | minusinfinity |  |  |
| numberOfRA-PreamblesGroupA | 8 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-9: *MsgA-PUSCH-Config-r16* (Table 7.1.1.1.9.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-PUSCH-Config-r16 ::= SEQUENCE { |  |  |  |
| msgA-PUSCH-ResourceGroupA-r16 | MsgA-PUSCH-Resource-r16 |  |  |
| msgA-PUSCH-ResourceGroupB-r16 | MsgA-PUSCH-Resource-r16 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-10: *MsgA-PUSCH-Resource-r16* (Table 7.1.1.1.9.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6] ,clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-PUSCH-Resource-r16 ::= SEQUENCE { |  |  |  |
| msgA-MCS-r16 | 0 |  |  |
| nrofSlotsMsgA-PUSCH-r16 | 1 |  |  |
| nrofMsgA-PO-PerSlot-r16 | one |  |  |
| msgA-PUSCH-TimeDomainOffset-r16 | 1 |  |  |
| guardBandMsgA-PUSCH-r16 | 0 |  |  |
| frequencyStartMsgA-PUSCH-r16 | 0 |  |  |
| nrofPRBs-PerMsgA-PO-r16 | 24 |  |  |
| nrofMsgA-PO-FDM-r16 | one |  |  |
| msgA-DMRS-Config-r16 | MsgA-DMRS-Config-r16 |  |  |
| nrofDMRS-Sequences-r16 | 1 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-11: *MsgA-DMRS-Config-r16* (Table 7.1.1.1.9.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-DMRS-Config-r16 ::= SEQUENCE { |  |  |  |
| msgA-DMRS-AdditionalPosition-r16 | pos0 |  |  |
| msgA-MaxLength-r16 | len2 |  |  |
| } |  |  |  |

Table 7.1.1.1.9.3.3-12: *RRCReconfiguration* (steps 2 and 13, Table 7.1.1.1.9.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.9.3.3-13: *CellGroupConfig* (Table 7.1.1.1.9.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.1.9.3.3-3 |  |
| newUE-Identity | RNTI-Value |  |  |
| t304 | ms2000 |  |  |
| rach-ConfigDedicated | Not present |  |  |
| } |  |  |  |

##### 7.1.1.1.10 Random access procedure / 2-step RACH/not complete/ RA\_TYPE to 4-stepRA

7.1.1.1.10.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state after transmission of a MSGA on NR SpCell }

**ensure that** {

**when** { UE does not receive a matching MSGB in msgB-ResponseWindow and PREAMBLE\_TRANSMISSION\_COUNTER is equal to msgA-TransMax+1 }

**then** { UE triggers 4-step RACH procedure on NR SpCell }

}

7.1.1.1.10.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.1.1, and 5.1.4a.

[TS 38.321, clause5.1.1]

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

…

1> if the Random Access procedure is initiated by PDCCH order and if the *ra-PreambleIndex* explicitly provided by PDCCH is not 0b000000; or

1> if the Random Access procedure was initiated for SI request (as specified in TS 38.331 [5]) and the Random Access Resources for SI request have been explicitly provided by RRC; or

1> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and if the contention-free Random Access Resources for beam failure recovery request for 4-step RA type have been explicitly provided by RRC for the BWP selected for Random Access procedure; or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 4-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *4-stepRA*.

1> else if the BWP selected for Random Access procedure is configured with both 2-step and 4-step RA type Random Access Resources and the RSRP of the downlink pathloss reference is above *msgA-RSRP-Threshold*; or

1> if the BWP selected for Random Access procedure is only configured with 2-step RA type Random Access resources (i.e. no 4-step RACH RA type resources configured); or

1> if the Random Access procedure was initiated for reconfiguration with sync and if the contention-free Random Access Resources for 2-step RA type have been explicitly provided in *rach-ConfigDedicated* for the BWP selected for Random Access procedure:

2> set the *RA\_TYPE* to *2-stepRA*.

1> else:

2> set the *RA\_TYPE* to *4-stepRA*.

1> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

1> if *RA\_TYPE* is set to *2-stepRA*:

2> perform the Random Access Resource selection procedure for 2-step RA type (see clause 5.1.2a).

1> else:

2> perform the Random Access Resource selection procedure (see clause 5.1.2).

[TS 38.321, clause 5.1.4a]

Once the MSGA preamble is transmitted, regardless of the possible occurrence of a measurement gap, the MAC entity shall:

…

1> if *msgB-ResponseWindow* expires, and the Random Access Response Reception has not been considered as successful based on descriptions above:

2> increment *PREAMBLE\_TRANSMISSION\_COUNTER* by 1;

2> if *PREAMBLE\_TRANSMISSION\_COUNTE*R = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers;

3> if this Random Access procedure was triggered for SI request:

4> consider this Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if *msgA-TransMax* is applied (see clause 5.1.1a) and *PREAMBLE\_TRANSMISSION\_COUNTER* = *msgA-TransMax* + 1:

4> set the *RA\_TYPE* to *4-stepRA*;

4> perform initialization of variables specific to Random Access type as specified in clause 5.1.1a;

4> if the Msg3 buffer is empty:

5> obtain the MAC PDU to transmit from the MSGA buffer and store it in the Msg3 buffer;

4> flush HARQ buffer used for the transmission of MAC PDU in the MSGA buffer;

4> discard explicitly signalled contention-free 2-step RA type Random Access Resources, if any;

4> perform the Random Access Resource selection procedure as specified in clause 5.1.2.

3> else:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE\_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2a) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a).

4> else:

5> perform the Random Access Resource selection procedure for 2-step RA type Random Access (see clause 5.1.2a) after the backoff time.

Upon receiving a fallbackRAR, the MAC entity may stop *msgB-ResponseWindow* once the Random Access Response reception is considered as successful.

7.1.1.1.10.3 Test description

7.1.1.1.10.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.1.10.3.2 Test procedure sequence

Table 7.1.1.1.10.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | SS transmits an RRCReconfiguration message toconfigure both 2-Step and 4-Step RA type Random Access Resources. Note 1 | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 3 | SS transmits Timing Advance command to SpCell. SS does not send any subsequent timing alignments. Start Timer\_T1 = Time Alignment timer value on SS. | <-- | MAC PDU (Timing Advance  Command MAC Control Element) | - | - |
| 4 | 40 to 50 TTI before Timer\_T1 expires the SS transmits a MAC PDU containing a PDCP SDU | <-- | MAC PDU | - | - |
| 5 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| - | Exception: Step 6 will be repeated preambleTransMax times and SS does not response the MSGA in STEP 6, to make PREAMBLE\_TRANSMISSION\_COUNTER = msgA-TransMax+1. | - | - | - | - |
| 6 | The UE transmits MSGA using the selected PRACH occasion and the associated PUSCH resource of MSGA | --> | MAC PDU (including C-RNTI MAC CE) | - | - |
| 7 | Check: Does the UE transmit preamble on PRACH? | --> | PRACH Preamble | 1 | P |
| 8 | The SS transmits Random Access Response and RAPID corresponding to the transmitted Preamble in step 7. | <-- | Random Access Response | - | - |
| 9 | UE sends a msg3 using the grant associated to the Random Access Response received in step 8 | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 10 | SS schedules PDCCH transmission for UE C\_RNTI and allocate uplink grant. | <-- | Contention Resolution | - | - |
| 11 | The UE transmits a MAC PDU with C-RNTI containing looped back PDCP SDU | --> | MAC PDU | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.1.10.3.3 Specific message contents

Table 7.1.1.1.10.3.3-1: *RRCReconfiguration* for EN-DC (step 1, Table 7.1.1.1.10.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-1A: *RRCReconfiguration* for NR/5GC (step 1, Table 7.1.1.1.10.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| radioBearerConfig | RadioBearerConfig as per TS 38.508-1[4] Table 4.6.3-132 with conditions DRBn and Recover\_PDCP | n set to the default DRB of the first PDU session | NR |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-2: *CellGroupConfig* for EN-DC (Table 7.1.1.1.10.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-2A: *CellGroupConfig* for NR/5GC (Table 7.1.1.1.10.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated |  |  |
| } |  |  |  |
| newUE-Identity | UE identity different from NR cell 1 UE identity |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-3: *RACH-ConfigDedicated* (Table 7.1.1.1.10.3.3-2 and Table 7.1.1.1.10.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| cfra-TwoStep-r16 SEQUENCE { |  |  |  |
| occasionsTwoStepRA-r16 SEQUENCE { |  |  |  |
| rach-ConfigGenericTwoStepRA-r16 | RACH-ConfigGenericTwoStepRA |  |  |
| ssb-PerRACH-OccasionTwoStepRA-r16 |  |  |  |
| } |  |  |  |
| msgA-CFRA-PUSCH-r16 | MsgA-PUSCH-Resource |  |  |
| msgA-TransMax-r16 | N10 |  |  |
| resourcesTwoStep-r16 SEQUENCE { |  |  |  |
| ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource { |  |  |  |
| ssb | 0 |  |  |
| ra-PreambleIndex | 52 | Randomly selected |  |
| msgA-PUSCH-Resource-Index-r16 | Not present |  |  |
| } |  |  |  |
| ra-ssb-OccasionMaskIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-4: *Void*

Table 7.1.1.1.10.3.3-5: *RACH-ConfigGenericTwoStepRA* (Table 7.1.1.1.10.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated::= SEQUENCE { |  |  |  |
| msgA-PRACH-ConfigurationIndex-r16 | Not present |  |  |
| msgA-RO-FDM-r16 | Not present |  |  |
| msgA-RO-FrequencyStart-r16 | Not present |  |  |
| msgA-ZeroCorrelationZoneConfig-r16 | Not present |  |  |
| msgA-PreamblePowerRampingStep-r16 | Not present |  |  |
| msgA-PreambleReceivedTargetPower-r16 | Not present |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-6: *ServingCellConfigCommon* (Table 7.1.1.1.10.3.3-2 and Table 7.1.1.1.10.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.1.10.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| msgA-ConfigCommon-r16 CHOICE { |  |  |  |
| setup | MsgA-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.1.10.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| ssb\_perRACH\_OccasionAndCB\_PreamblesPerSSB CHOICE { |  |  |  |
| one | n36 |  |  |
| } |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. |  |  |
| l839 | Set according to table 4.4.2-2 in TS 38.508-1 [4] for the NR Cell. | PRACH Preamble format 0 used | FR1, |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-9: *MsgA-ConfigCommon* (Table 7.1.1.1.10.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81A | | | |
| Information Element | Value/remark | Comment | Condition |
| MsgA-ConfigCommonL-r16 ::= SEQUENCE { |  |  |  |
| rach-ConfigCommonTwoStepRA-r16 | RACH-ConfigCommonTwoStepRA |  |  |
| msgA-PUSCH-Config-r16 | MsgA-PUSCH-Config |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-10: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.1.10.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 SCS 30 |
| ms5 |  | FR1 SCS 15 |
| ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 3 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 SCS 30 |
|  | 10 |  | FR1 SCS 15 |
| 10 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 SCS 30 |
| 1 |  | FR1 SCS 15 |
| 1 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 SCS 30 or FR1 SCS 15 |
| } |  |  |  |
| pattern2 | Not present |  |  |
| pattern2 SEQUENCE { |  |  | FR1 SCS 30 or FR1 SCS 15 |
| dl-UL-TransmissionPeriodicity | ms2 |  |  |
| nrofDownlinkSlots | 4 |  | FR1 SCS 30 |
| 2 |  | FR1 SCS 15 |
| nrofDownlinkSymbols | 0 |  |  |
| nrofUplinkSlots | 0 |  |  |
| nrofUplinkSymbols | 0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.10.3.3-11: *RACH-ConfigCommonTwoStepRA* (Table 7.1.1.1.10.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128A | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE { |  |  |  |
| msgA-RSRP-Threshold-r16 | 57 | -100 dBm |  |

Table 7.1.1.1.10.3.3-12: *MsgA-PUSCH-Config* (Table 7.1.1.1.10.3.3-7)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-81B |

##### 7.1.1.1.11 to 7.1.1.1.15

##### 7.1.1.1.16 Random access procedure / RedCap UE identification / Msg3-based / CCCH1

7.1.1.1.16.1 Test Purpose (TP)

(1)

**with** { UE supporting RedCap and in NR RRC\_Inactive state }

**ensure that** {

**when** { UE starts Random Access procedure }

**then** { the UE uses the RedCap specific LCID in Msg3}

}

7.1.1.1.16.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clause 6.2.1 and TS38.331,clause 5.3.13.3. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 6.2.1]

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |  |
| --- | --- | --- |
| Codepoint/Index | | LCID values |
| 0 | | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]), except for a RedCap UE |
| 1–32 | | Identity of the logical channel of DCCH and DTCH |
| 33 | | Extended logical channel ID field (two-octet eLCID field) |
| 34 | | Extended logical channel ID field (one-octet eLCID field) |
| 35 | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]) for a RedCap UE | |
| 36 | CCCH of size 64 bits (referred to as "CCCH1" in TS 38.331 [5]) for a RedCap UE | |
| 37–42 | | Reserved |
| 43 | | Truncated Enhanced BFR (one octet Ci) |
| 44 | | Timing Advance Report |
| 45 | | Truncated Sidelink BSR |
| 46 | | Sidelink BSR |
| 47 | | Reserved |
| 48 | | LBT failure (four octets) |
| 49 | | LBT failure (one octet) |
| 50 | | BFR (one octet Ci) |
| 51 | | Truncated BFR (one octet Ci) |
| 52 | | CCCH of size 48 bits (referred to as "CCCH" in TS 38.331 [5]), except for a RedCap UE |
| 53 | | Recommended bit rate query |
| 54 | | Multiple Entry PHR (four octets Ci) |
| 55 | | Configured Grant Confirmation |
| 56 | | Multiple Entry PHR (one octet Ci) |
| 57 | | Single Entry PHR |
| 58 | | C-RNTI |
| 59 | | Short Truncated BSR |
| 60 | | Long Truncated BSR |
| 61 | | Short BSR |
| 62 | | Long BSR |
| 63 | | Padding |

[TS 38.331, clause 5.3.13.3]

The UE shall set the contents of *RRCResumeRequest* or *RRCResumeRequest1* message as follows:

1> if field *useFullResumeID* is signalled in *SIB1*:

2> select *RRCResumeRequest1* as the message to use;

2> set the *resumeIdentity* to the stored *fullI-RNTI* value;

7.1.1.1.16.3 Test description

7.1.1.1.16.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None

Preamble:

- The UE is in 2N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) and Test loop function(*Off*) according to TS 38.508-1 [4].

7.1.1.1.16.3.2 Test procedure sequence

Table 7.1.1.1.16.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS changes the SIB1 of NR Cell 1 to set the *useFullResumeID* to True. | - | - | - | - |
| 2 | The SS transmits a Short message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 3 | Wait for 2.1\* modification period second for the UE to receive new system information.  (Note 1) | - | - | - | - |
| 4 | The SS transmits a *Paging* message including a matched identity (correct *fullI-RNTI*). | <-- | NR RRC: *Paging* | - | - |
| 5 | Check: Does the UE transmit an *RRCResumeRequest1* message by setting LCID to 36? | --> | NR RRC: *RRCResumeRequest1* | 1 | P |
| 6 | The SS transmits an *RRCResume* message. | <-- | NR RRC: *RRCResume* | - | - |
| 7 | The UE transmits an *RRCResumeComplete* message. | --> | NR RRC: *RRCResumeComplete* | - | - |
| Note 1: The modification period, expressed in number of radio frames = modificationPeriodCoeff \* defaultPagingCycle. | | | | | |

7.1.1.1.16.3.3 Specific message contents

Table 7.1.1.1.16.3.3-1: SIB1 (step 1, Table 7.1.1.1.16.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| useFullResumeID | true |  |  |
| } |  |  |  |

Table 7.1.1.1.16.3.3-2: Paging (step 4, Table 7.1.1.1.16.3.2-1)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-9 with condition NR\_RRC\_RESUME |

##### 7.1.1.1.17 Random access procedure / RedCap UE identification / Msg1-based

7.1.1.1.17.1 Test Purpose (TP)

(1)

**with** { UE supporting RedCap and in NR RRC\_IDLE state }

**ensure that** {

**when** { UE starts Random Access procedure }

**then** { the UE uses the RedCap specific random access resource in Msg1}

}

7.1.1.1.17.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clauses 5.1.1, 5.1.1b, 5.1.1c and 5.1.1d. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.1.1]

…

When a Random Access procedure is initiated, UE selects a set of Random Access resources as specified in clause 5.1.1b and initialises the following parameters for the Random Access procedure according to the values configured by RRC for the selected set of Random Access resources:

…

*- featurePriorities*: priorities for features, such as REDCAP, Slice group(s), etc. (see clause 5.1.1d);

…

- *startPreambleForThisPartition*: the first preamble associated with the set of Random Access Resources applicable to the Random Access procedure;

…

- *numberOfPreamblesForThisPartition*: the number of consequtive preambles associated with the set of Random Access Resources applicable to the Random Access procedure;

…

When the Random Access procedure is initiated on a Serving Cell, the MAC entity shall:

…

1> perform the BWP operation as specified in clause 5.15;

1> select the set of Random Access resources applicable to the current Random Access procedure according to clause 5.1.1b;

…

[TS 38.321, clause 5.1.1b]

The MAC entity shall:

…

1> if contention-free Random Access Resources have not been provided for this Random Access procedure and one or more of the features including REDCAP and/or a specific slice group(s) and/or SDT and/or MSG3 repetition is applicable for this Random Access procedure:

Editor's Note: FFS if some clarification is needed on how feature applicability is known (e.g. from RRC etc)

2> if none of the sets of Random Access resources are available for the current Random Access procedure (as specified in clause 5.1.1c):

3> select the set of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if there are one or more set(s) of Random Access resources available (as specified in clause 5.1.1c) and one of these set(s) of Random Access resources can be used for indicating all features triggering this Random Access procedure:

3> select the available set of Random Access resources for this Random Access procedure.

…

[TS 38.321, clause 5.1.1c]

The MAC entity shall for each set of configured Random Access resources for 4-step RA type and for each set of configured Random Access resources for 2-step RA type:

1> if REDCAP indication is configured for a set of Random Access resources:

2> consider the set of Random Access resources as not available for a RACH procedure for which REDCAP indication is not applicable.

…

[TS 38.321, clause 5.1.1d]

The MAC entity shall:

1> among the available sets of Random Access resources, identify those configured with a feature which has the highest priority assigned in *featurePriorities* among all the features applicable to this Random Access procedure as specified in TS 38.331 [5].

1> if a single set of Random Access resources is identified:

2> select this set of Random Access resources.

…

7.1.1.1.17.3 Test description

7.1.1.1.17.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None

Preamble:

- The UE is in 1N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) and Test loop function(*Off*) according to TS 38.508-1 [4].

7.1.1.1.17.3.2 Test procedure sequence

Table 7.1.1.1.17.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS changes the SIB1 of NR Cell 1 to configure the specific PRACH resource for RedCap. | - | - | - | - |
| 2 | The SS transmits a Short message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 3 | Wait for 2.1\* modification period second for the UE to receive new system information.  (Note 1) | - | - | - | - |
| 4 | The SS transmits a Paging message including a matched identity. | <-- | - | - | - |
| 5 | Check: Does the UE transmits Preamble on PRACH with *ra-PreambleIndex* range from 8 to 11 on NR Cell 1? | --> | PRACH Preamble | 1 | P |
| 6 | The SS transmits Random Access Response with RAPID corresponding to the transmitted Preamble in step 5. | <-- | Random Access Response | - |  |
| 7 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU (*RRCSetupRequest*) | - | - |
| 8 | The SS schedules PDCCH transmission addressed to TC-RNTI to transmit a valid MAC PDU containing an *RRCSetup* messageand ‘UE Contention Resolution Identity’ MAC control element with matched ‘Contention Resolution Identity’. | <-- | MAC PDU  (*RRCSetup* andUE Contention Resolution Identity MAC CE) | - | - |
| 9 | UE transmit a MAC PDU containing an *RRCSetupComplete* message indicating acceptance of *RRCSetup* message | --> | MAC PDU (*RRCSetupComplete)* | - | - |
| Note 1: The modification period, expressed in number of radio frames = modificationPeriodCoeff \* defaultPagingCycle. | | | | | |

7.1.1.1.17.3.3 Specific message contents

Table 7.1.1.1.17.3.3-1: *SIB1* (step 1, Table 7.1.1.1.17.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { | |  |  |  |
| servingCellConfigCommon | | ServingCellConfigCommonSIB | Table 7.1.1.1.17.3.3-2 |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| featurePriorities-r17 SEQUENCE { | |  |  |  |
| redCapPriority-r17 | | 0 |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.1.17.3.3-2: *ServingCellConfigCommonSIB* (Table 7.1.1.1.17.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-169 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommonSIB ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon | UplinkConfigCommonSIB | Table 7.1.1.1.17.3.3-3 |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-3: *UplinkConfigCommonSIB* (Table 7.1.1.1.17.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-202 | | | |
| Information Element | Value/remark | Comment | Condition |
| UplinkConfigCommonSIB ::= SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon | Table 7.1.1.1.17.3.3-4 |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-4: *BWP-UplinkCommon* (Table 7.1.1.1.17.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| additionalRACH-ConfigList-r17 CHOICE { |  |  |  |
| setup SEQUENCE (SIZE(1..maxAdditionalRACH-r17)) OF AdditionalRACH-ConfigCommon-r17 { | 1 entry |  |  |
| AdditionalRACH-Config-r17[1] SEQUENCE { |  | entry 1 |  |
| rach-ConfigCommon-r17 | RACH-ConfigCommon | Table 7.1.1.1.17.3.3-5 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.1.17.3.3-5: *RACH-ConfigCommon* (Table 7.1.1.1.17.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon ::= SEQUENCE { |  |  |  |
| ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| one | n16 |  |  |
| } |  |  |  |
| featureCombinationPreamblesList-r17 SEQUENCE (SIZE(1..maxFeatureCombPreamblesPerRACHResource-r17)) OF FeatureCombinationPreambles-r17 { | 1 entry |  |  |
| FeatureCombinationPreambles-r17[1] SEQUENCE { |  | entry 1 |  |
| featureCombination-r17 SEQUENCE { |  |  |  |
| redCap-r17 | True |  |  |
| } |  |  |  |
| startPreambleForThisPartition-r17 | 8 |  |  |
| numberOfPreamblesPerSSB-ForThisPartition-r17 | 4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.1.18 Random access procedure / Msg3 repetition indication / Random access resources selection

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test description part is FFS

7.1.1.1.18.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_IDLE state and supporting MSG3 repetition }

**ensure that** {

**when** { UE is configured both set(s) of Random Access resources with and without MSG3 repetition indication AND the the RSRP of the downlink pathloss reference is less than the configured threshold }

**then** { UE requests MSG3 repetition via separate RACH resources }

}

(2)

**with** { UE in RRC\_IDLE state and supporting MSG3 repetition }

**ensure that** {

**when** { UE is only configured Random Access resources with MSG3 repetition indication }

**then** { UE requests MSG3 repetition via separate RACH resources }

}

7.1.1.1.18.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.300, clause 19, and TS 38.321 clause 5.1.1b.

[TS 38.300, clause 19]

To improve NR uplink coverage for both FR1 and FR2, the following enhancements on PUSCH, PUCCH and MSG3 PUSCH are supported:

- …

- Aggregation of multiple slots with TB repetition for MSG3 transmission is supported on both NUL and SUL, applicable to CBRA with 4-step RA type. If configured, the UE requests MSG3 repetition via separate RACH resources when the RSRP of DL path-loss reference is lower than a configured threshold. BWP configured with RACH resources solely for MSG3 repetition is also supported without the need to consider the RSRP of DL path-loss reference by the UE.

[TS 38.321, clause 5.1.1b]

The MAC entity shall:

1> if the BWP selected for Random Access procedure is configured with both set(s) of Random Access resources with MSG3 repetition indication and set(s) of Random Access resources without MSG3 repetition indication and the RSRP of the downlink pathloss reference is less than *rsrp-ThresholdMsg3*; or

1> if the BWP selected for Random Access procedure is only configured with the set(s) of Random Access resources with MSG3 repetition indication;

2> assume MSG3 repetition is applicable for the current Random Access procedure.

1> else:

2> assume MSG3 repetition is not applicable for the current Random Access procedure.

NOTE 1: Void.

1> if contention-free Random Access Resources have not been provided for this Random Access procedure and one or more of the features including RedCap and/or a specific NSAG(s) and/or SDT and/or MSG3 repetition is applicable for this Random Access procedure:

NOTE 2: The applicability of SDT is determined by MAC entity according to clause 5.27. The applicability of specific slice group(s) is determined by upper layers when the Random Access procedure is initiated by the upper layers. The applicability of RedCap is also determined by upper layers when Random Access procedure is initiated and it is applicable to the Random Access procedures initiated by PDCCH orders and any Random Access procedure initiated by the MAC entity.

2> if none of the sets of Random Access resources are available for any feature applicable to the current Random Access procedure (as specified in clause 5.1.1c):

3> select the set(s) of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for this Random Access procedure.

2> else if there is one set of Random Access resources available which can be used for indicating all features triggering this Random Access procedure:

3> select this set of Random Access resources for this Random Access procedure.

2> else (i.e. there are one or more sets of Random Access resources available that are configured with indication(s) for a subset of all features triggering this Random Access procedure):

3> select a set of Random Access resources from the available set(s) of Random Access resources based on the priority order indicated by upper layers as specified in clause 5.1.1d for this Random Access Procedure.

1> else if contention-free Random Access Resources have been provided for this Random Access procedure and RedCap is applicable for the current Random Access procedure and there is one set of Random Access resources available that is only configured with RedCap indication:

2> select this set of Random Access resources for this Random Access procedure.

1> else:

2> select the set of Random Access resources that are not associated with any feature indication (as specified in clause 5.1.1c) for the current Random Access procedure.

7.1.1.1.18.3 Test description

FFS

#### 7.1.1.2 Downlink Data Transfer

##### 7.1.1.2.1 Correct Handling of DL MAC PDU / Assignment / HARQ process

7.1.1.2.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives downlink assignment on the PDCCH for the UE’s C-RNTI and receives data in the associated Slot and UE performs HARQ operation }

**then** { UE sends a HARQ feedback on the HARQ process }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS transmits downlink assignment on the PDCCH with a C-RNTI unknown by the UE and data is available in the associated Slot }

**then** { UE does not send any HARQ feedback on the HARQ process }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { the UE receives a MAC PDU addressed to its C-RNTI and decode fails in the associated Slot }

**then** { the UE transmits a NACK for the corresponding HARQ process }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { the UE receives a MAC PDU retransmission addressed to its C-RNTI, and results in successful decode in the associated Slot}

**then** { the UE transmits an ACK for the corresponding HARQ process and forward to higher layer }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU containing multiple MAC sub PDUs each containing a MAC SDU that is larger than 256 bytes (16 bits L field used) with padding MAC sub PDU at the end }

**then** { UE successfully decodes the MAC PDU and forward to higher layer }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU containing multiple MAC sub PDUs each containing a MAC SDU that is smaller than 256 bytes (8 bits L field used) with padding MAC sub PDU at the end }

**then** { UE successfully decodes the MAC PDU and forward to higher layer }

}

(7)

**with** { UE in RRC\_CONNECTED state }

ensure that {

**when** { UE receives a MAC PDU containing MAC sub PDU containing a MAC SDU and no padding MAC sub PDU}

**then** { UE successfully decodes the MAC PDU and forward to higher layer }

}

(8)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU containing MAC sub PDU containing a MAC SDU that is smaller than 256 bytes (8 bits L field used) plus MAC sub PDU containing a MAC SDU that is greater than 256 bytes (16 bits L field used)and no padding }

**then** { UE successfully decodes the MAC PDU and forwards the AMD PDUs to higher layer }

}

(9)

**with** { UE in RRC\_CONNECTED state and configured with a specific *TDD-UL-DL-ConfigCommon* including configuration of *pattern2*}

**ensure that** {

**when** { UE receives downlink assignment on the PDCCH associated with *pattern2* for the UE’s C-RNTI and receives data in the associated Slot and UE performs HARQ operation }

**then** { UE sends a HARQ feedback on the HARQ process }

}

7.1.1.2.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.3.1, 5.3.2.1, 5.3.2.2 and 6.1.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity’s C-RNTI, or Temporary C‑RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity’s C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity’s CS-RNTI or a configured downlink assignment:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity’s CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the timeAlignmentTimer associated with the PTAG is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in subclause 5.8.1;

4> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> indicate the presence of a configured downlink assignment for this Serving Cell and deliver the stored HARQ information to the HARQ entity.

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (numberOfSlotsPerFrame × semiPersistSchedIntervalDL))] modulo nrofHARQ-Processes

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or more (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode;

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

[TS 38.321, clause 6.1.2]

A MAC PDU consists of one or more MAC subPDUs. Each MAC subPDU consists of one of the following:

- A MAC subheader only (including padding);

- A MAC subheader and a MAC SDU;

- A MAC subheader and a MAC CE;

- A MAC subheader and padding.

The MAC SDUs are of variable sizes.

Each MAC subheader corresponds to either a MAC SDU, a MAC CE, or padding.

A MAC subheader except for fixed sized MAC CE and padding consists of the four header fields R/F/LCID/L. A MAC subheader for fixed sized MAC CE and padding consists of the two header fields R/LCID.



Figure 6.1.2-1: R/F/LCID/L MAC subheader with 8-bit L field



Figure 6.1.2-2: R/F/LCID/L MAC subheader with 16-bit L field



Figure 6.1.2-3: R/LCID MAC subheader

MAC CEs are placed together. DL MAC subPDU(s) with MAC CE(s) is placed before any MAC subPDU with MAC SDU and MAC subPDU with padding as depicted in Figure 6.1.2-4. UL MAC subPDU(s) with MAC CE(s) is placed after all the MAC subPDU(s) with MAC SDU and before the MAC subPDU with padding in the MAC PDU as depicted in Figure 6.1.2-5. The size of padding can be zero.



Figure 6.1.2-4: Example of a DL MAC PDU



Figure 6.1.2-5: Example of a UL MAC PDU

A maximum of one MAC PDU can be transmitted per TB per MAC entity.

7.1.1.2.1.3 Test description

7.1.1.2.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and parameters as in Table 7.1.1.2.1.3.1-1.

Table 7.1.1.2.1.3.1-1: MAC Parameters

|  |  |
| --- | --- |
| nrofHARQ-ProcessesForPDSCH | n16 |

7.1.1.2.1.3.2 Test procedure sequence

Table 7.1.1.2.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE | <-- | (PDCCH (C-RNTI)) | - | - |
| 2 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 1 | P |
| 4 | SS transmits a downlink assignment to including a C-RNTI different from the assigned to the UE | <-- | (PDCCH (unknown C-RNTI)) | - | - |
| 5 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE send any HARQ ACK/NACK on PUCCH? | --> | HARQ ACK/NACK | 2 | F |
| - | EXCEPTION: Steps 7 to 10 are run repeated using test parameter values as given for each iteration in table 7.1.1.2.1.3.2.-2. | - | - | - | - |
| 7 | The SS indicates a new transmission on PDCCH and transmits a MAC PDU including a RLC PDU with poll bit not set, with content set so that UE could not successfully decode the data from its soft buffer. (Note 1) | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | 3 | P |
| - | EXCEPTION: Step 9 shall be repeated till HARQ ACK is received at step 10 or until HARQ retransmission count = 4 is reached for MAC PDU at step 9 (Note 2). | - | - | - | - |
| 9 | The SS indicates a retransmission on PDCCH and transmits the same MAC PDU like step 7 (Note 1). | <-- | MAC PDU | - | - |
| - | EXCEPTION: Up to [3] HARQ NACK from the UE should be allowed at step 10 (Note 2). | - | - | - | - |
| 10 | Check: Does the UE send a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 11 | The SS transmits a MAC PDU containing three MAC sub PDUs each containing a MAC SDU(RLC PDU) that is of 260 bytes (16 bits L field used) and a padding MAC sub PDU at the end. The third RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of all the AMD PDUs in step 11? | --> | MAC PDU (RLC STATUS PDU ) | 5 | P |
| 13 | The SS transmits a MAC PDU containing three MAC sub PDUs each containing a MAC SDU(RLC PDU) that is of 128 bytes (8 bits L field used) and a padding MAC sub PDU at the end. The third RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 14 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of all the AMD PDUs in step 13? | --> | MAC PDU (RLC STATUS PDU ) | 6 | P |
| 15 | The SS transmits a MAC PDU containing one MAC sub PDU containing a MAC SDU(RLC PDU) that is of [128] bytes (8 bits L field used) and no padding MAC sub PDU at the end. The RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 16 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 15? | --> | MAC PDU (RLC STATUS PDU ) | 7 | P |
| 17 | The SS transmits a MAC PDU containing one MAC sub PDU containing a MAC SDU(RLC PDU) that is of [128] bytes (8 bits L field used), one MAC sub PDU containing a MAC SDU(RLC PDU) that is of [260] bytes (16 bits L field used) and no padding MAC sub PDU at the end. The second RLC PDU contained will have poll bit set. | <-- | MAC PDU | - | - |
| 18 | Check: Does the UE transmit a MAC PDU containing an RLC STATUS PDU acknowledging the reception of all the AMD PDUs in step 17? | --> | MAC PDU (RLC STATUS PDU ) | 8 | P |
| - | EXCEPTION : Steps 19a0 to 19a5 are executed for operation on NR TDD band only | - | *-* | - | - |
| 19a0 | The SS transmits an updated system information as specified in Table 7.1.1.3.1.3.3-14. (Note 5) | - | *-* | - | - |
| 19a1 | The SS transmits NR RRCReconfiguration message including *TDD-UL-DL-ConfigCommon* with *pattern1 and pattern2* specified in Table 7.1.1.2.1.3.3-5 (Note 3) | <-- | *RRCReconfiguration* | - | - |
| 19a2 | The UE transmits a NR *RRCReconfigurationComplete* message.  (Note 4) | --> | *RRCReconfigurationComplete* | - | - |
| 19a3 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE indicating downlink reception in a symbol in a slot part of pattern2. | <-- | (PDCCH (C-RNTI)) | - | - |
| 19a4 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 19a5 | Check: Does the UE transmit an HARQ ACK on PUCCH? | --> | HARQ ACK | 9 | P |
| Note 1: SS should transmit this PDU so as to ensure at least one NACK.  Note 2: The value 4 for the maximum number of HARQ retransmissions has been chosen based on an assumption that, given the radio conditions used in this test case, a UE soft combiner implementation should have sufficient retransmissions to be able to successfully decode the data in its soft buffer.  Note 3: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 4: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 5: if pc\_NG\_RAN\_NR only | | | | | |

Table 7.1.1.2.1.3.2-2: Test Parameters

|  |  |
| --- | --- |
| Iteration | DL HARQ process (X) |
| K=1 to 16 | X=K-1 |

7.1.1.2.1.3.3 Specific message contents

Table 7.1.1.2.1.3.3-1: *Void*

Table 7.1.1.2.1.3.3-2: *RRCReconfiguration* (step19a1, Table 7.1.1.2.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-131 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-3: *CellGroupConfig* (Table 7.1.1.2.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-4, 7.1.1.2.1.3.3-13: *ServingCellConfigCommon (*Table 7.1.1.2.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-5: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.2.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 |
|  | 2 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 |
|  | 2 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms2 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 4 |  | FR1 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 0 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 0 |  | FR1 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 0 |  | FR1 |
|  | 2 |  | FR2 |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-6: *BWP-UplinkCommon (*Table 7.1.1.2.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-7: *RACH-ConfigCommon (*Table 7.1.1.2.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-8: *RACH-ConfigGeneric (*Table 7.1.1.2.1.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-configurationIndex | 156 |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-9: ServingCellConfig (Table 7.1.1.2.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-10: *BWP-UplinkDedicated* (Table 7.1.1.2.1.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-11: *PUCCH-Config* (Table 7.1.1.2.1.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig[1] | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-12: *SchedulingRequestResourceConfig* (Table 7.1.1.2.1.3.3-11)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 5 | With SCS = kHz15 results in repetition every 10 ms | SCS\_15kHz |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS\_30kHz |
| sl80 | 5 | With SCS = kHz120 results in repetition every 10 ms | SCS\_120kHz |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.1.3.3-13: *SystemInformationBlockType1* (step 19a0, Table 7.1.1.2.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.2.1.3.3-5 |  |
| } |  |  |  |

##### 7.1.1.2.2 Correct Handling of DL HARQ process PDSCH Aggregation

7.1.1.2.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and pdsch-AggregationFactor > 1 }

**ensure that** {

**when** { UE receives downlink assignment on the PDCCH for the UE’s C-RNTI and receives data in the associated slot and successive pdsch-AggregationFactor – 1 HARQ retransmissions within a bundle and UE performs HARQ operation }

**then** { UE sends a HARQ feedback on the HARQ process }

}

7.1.1.2.2.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.3.1, 5.3.2.1 and 5.3.2.2, TS 38.214, clause 5.1.2.1.

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, or Temporary C‑RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity's C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's CS-RNTI or a configured downlink assignment:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the timeAlignmentTimer associated with the PTAG is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in subclause 5.8.1;

4> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> indicate the presence of a configured downlink assignment for this Serving Cell and deliver the stored HARQ information to the HARQ entity.

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (*numberOfSlotsPerFrame* × *periodicity*))] modulo *nrofHARQ-Processes*

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Position* = 3 | | | | | | |

When the UE is configured with *aggregationF*actorDL > 1, the same symbol allocation is applied across the *aggregationFactorDL* consecutive slots. The UE may expect that the TB is repeated within each symbol allocation among each of the *aggregationFactorDL* consecutive slots and the PDSCH is limited to a single transmission layer. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 5.1.2.1-2.

Table 5.1.2.1-2: Applied redundancy version when *aggregationFactorDL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PDSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration as defined in Subclause 11.1 of [6, TS 38.213] determines symbol of a slot allocated for PDSCH as uplink symbols, the transmission on that slot is omitted for multi-slot PDSCH transmission.

The UE is not expected to receive a PDSCH with mapping type A in a slot, if the PDCCH scheduling the PDSCH was received in the same slot and was not contained within the first three symbols of the slot.

The UE is not expected to receive a PDSCH with mapping type B in a slot, if the first symbol of the PDCCH scheduling the PDSCH was received in a later symbol than the first symbol indicated in the PDSCH time domain resource allocation.

7.1.1.2.2.3 Test description

7.1.1.2.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and parameters as in Table 7.1.1.2.2.3.1-1.

Table 7.1.1.2.2.3.1-1: Void

7.1.1.2.2.3.2 Test procedure sequence

Table 7.1.1.2.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits in the indicated downlink assignment an NR RRCReconfiguration. (Note 1) | <-- | - | - | - |
| 2 | UE transmits NR RRCReconfigurationComplete message to the SS. (Note 2) | --> | - | - | - |
| 3 | The SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, the rv\_idx is 0. | <-- | - | - | - |
| 4 | The SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU, The CRC is calculated in such a way, it will result in CRC error on UE side. | <-- | MAC PDU | - | - |
| 5 | In the following 3 consecutive slots, the SS transmits on the same downlink assignment a MAC PDU including a RLC PDU, The CRC is calculated in such a way, it will result in CRC error on UE side. (Note3) | <-- | MAC PDU | - | - |
| 5A | Void | - | - | - | - |
| 6 | Check: Does the UE transmit a HARQ NACK on slot n3+k1? (Note 4) | --> | HARQ NACK | 1 | P |
| 7 | The SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE, the rv\_idx is 0. | <-- | - | - | - |
| 8 | The SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU, The CRC is calculated in such a way, it will result in CRC pass on UE side. | <-- | MAC PDU | - | - |
| 9 | In the following 3 consecutive slots, the SS transmits on the same downlink assignment a MAC PDU including a RLC PDU, The CRC is calculated in such a way, it will result in CRC pass on UE side. (Note3) | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK on slot n3+k1? (Note 4) | --> | HARQ ACK | 1 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For *aggregationF*actorDL=4, the PDSCH will repeat in following 4-1=3 slots with same resource allocation but different redundancy version, if the slot can be used for downlink transmission.  Note 4: n0 is the index of slot when 1st transmission of MAC PDU in step 4/8 happens, n1, n2, n3 are indices of slots when 2nd, 3rd, 4th transmission of MAC PDU in step 5/9 may happen, k1 is obtained from "PDSCH-to-HARQ\_feedback timing indicator" of downlink assignment in step 3/7. | | | | | |

7.1.1.2.2.3.3 Specific message contents

Table 7.1.1.2.2.3.3-1: RRCReconfiguration(step 1, Table 7.1.1.2.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs ::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.2.3.3-2: cellGroupConfig (Table 7.1.1.2.2.3.3-1: RRCReconfiguration)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  |  |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig SEQUENCE { |  |  |  |
| initialDownlinkBWP SEQUENCE { |  |  |  |
| pdsch-Config SEQUENCE { |  |  |  |
| pdsch-AggregationFactor | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.2.2.3.3-3: Physical layer parameters for DCI format 1\_1 (Steps 3, 7, Table 7.1.1.2.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.3.6.1.2.2-1 | | | |
| Parameter | Value | Value in binary | Condition |
| PDSCH-to-HARQ\_feedback timing indicator | Corresponding to K1=5 slots as per dl-DataToUL-ACK in Table 4.6.3-112 TS 38.508-1 [4]. | “011”B |  |

##### 7.1.1.2.3 Correct HARQ process handling / CCCH

7.1.1.2.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to RA-RNTI }

**then** { UE does not transmit the HARQ feedback for the corresponding HARQ process }

}

(2)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to T-CRNTI without UE Contention Resolution Identity corresponding the transmitted RRCSetupRequest message }

**then** { UE does not transmit the HARQ feedback for the corresponding HARQ process }

}

(3)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to T-CRNTI and cannot decode properly }

**then** { UE does not transmit the HARQ feedback for the corresponding HARQ process }

}

(4)

**with** { UE in RRC\_IDLE state with RRC connection establishment procedure initiated }

**ensure that** {

**when** { UE receives a MAC PDU addressed to T-CRNTI with UE Contention Resolution Identity corresponding the transmitted RRCSetupRequest message }

**then** { UE transmits the HARQ ACK for the corresponding HARQ process }

}

7.1.1.2.3.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.3.2.1 and 5.3.2.2.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

NOTE: If the MAC entity receives a retransmission with a TB size different from the last TB size signalled for this TB, the UE behavior is left up to UE implementation.

7.1.1.2.3.3 Test description

7.1.1.2.3.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None

Preamble:

- The UE is in 1N-A state on NR Cell 1 using generic procedure parameter Connectivity (*NR*) according to TS 38.508-1 [4].

7.1.1.2.3.3.2 Test procedure sequence

Table 7.1.1.2.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a Paging message including a matched identity. | <-- | - | - | - |
| 2 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 3 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. The CRC is calculated in such a way, it will result in CRC error on UE side. | <-- | Random Access Response | - | - |
| 4 | Check: does the UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 1 | F |
| 5 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 6 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. The CRC is calculated in such a way, it will result in CRC pass on UE side. | <-- | Random Access Response | - | - |
| 7 | Check: does the UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 1 | F |
| 8 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU | - | - |
| 9 | The SS transmits a valid MAC PDU containing *RRCSetup*, and including ‘UE Contention Resolution Identity’ MAC control element with not matching ‘Contention Resolution Identity’. | <-- | MAC PDU | - | - |
| 10 | Check: does the UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 2 | F |
| 11 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 12 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. | <-- | Random Access Response | - | - |
| 13 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU | - | - |
| 14 | The SS transmits a valid MAC PDU containing *RRCSetup*, and including ‘UE Contention Resolution Identity’ MAC control element with matching ‘Contention Resolution Identity’. The CRC is calculated in such a way that it will result in CRC error on UE side. | <-- | MAC PDU | - | - |
| 15 | Check: Does UE transmit a HARQ ACK/NACK? | --> | HARQ ACK/NACK | 3 | F |
| 16 | The UE transmits Preamble on PRACH. | --> | PRACH Preamble | - | - |
| 17 | The SS transmits Random Access Response with matching RA-RNTI and including Temporary C-RNTI. | <-- | Random Access Response | - | - |
| 18 | The UE transmits a MAC PDU containing an *RRCSetupRequest* message. | --> | MAC PDU | - | - |
| 19 | The SS transmits a valid MAC PDU containing *RRCSetup*, and including ‘UE Contention Resolution Identity’ MAC control element with matching ‘Contention Resolution Identity’. The CRC is calculated in such a way that it will result in CRC pass on UE side. | <-- | MAC PDU | - | - |
| 20 | Check: does the UE transmit a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 21 | The UE transmits a MAC PDU containing an *RRCSetupComplete* message including SERVICE REQUEST message indicating acceptance of *RRCSetup* message | --> | MAC PDU | - | - |
| 22-25 | Steps 5 to 8 of the generic radio bearer establishment procedure (TS 38.508 table 4.5.4.2-3) are executed to successfully complete the service request procedure. | - | - | - | - |

7.1.1.2.3.3.3 Specific message contents

None.

##### 7.1.1.2.4 Correct HARQ process handling / BCCH

7.1.1.2.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a MAC PDU addressed to SI-RNTI on the broadcast HARQ process }

**then** { UE does not transmit the HARQ feedback for the broadcast HARQ process }

}

7.1.1.2.4.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321, clauses 5.3.2.1 and 5.3.2.2.

[TS 38.321, clause 5.3.2.1]

The MAC entity includes a HARQ entity for each Serving Cell, which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of parallel DL HARQ processes per HARQ entity is specified in TS 38.214 [7]. The dedicated broadcast HARQ process is used for BCCH.

The HARQ process supports one TB when the physical layer is not configured for downlink spatial multiplexing. The HARQ process supports one or two TBs when the physical layer is configured for downlink spatial multiplexing.

When the MAC entity is configured with *pdsch-AggregationFactor* > 1, the parameter *pdsch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic downlink assignment. Bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. After the initial transmission, *pdsch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle.

The MAC entity shall:

1> if a downlink assignment has been indicated:

2> allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.

1> if a downlink assignment has been indicated for the broadcast HARQ process:

2> allocate the received TB to the broadcast HARQ process.

[TS 38.321, clause 5.3.2.2]

When a transmission takes place for the HARQ process, one or two (in case of downlink spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

1> if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or

1> if the HARQ process is equal to the broadcast process, and this is the first received transmission for the TB according to the system information schedule indicated by RRC; or

1> if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):

2> consider this transmission to be a new transmission.

1> else:

2> consider this transmission to be a retransmission.

The MAC entity then shall:

1> if this is a new transmission:

2> attempt to decode the received data.

1> else if this is a retransmission:

2> if the data for this TB has not yet been successfully decoded:

3> instruct the physical layer to combine the received data with the data currently in the soft buffer for this TB and attempt to decode the combined data.

1> if the data which the MAC entity attempted to decode was successfully decoded for this TB; or

1> if the data for this TB was successfully decoded before:

2> if the HARQ process is equal to the broadcast process:

3> deliver the decoded MAC PDU to upper layers.

2> else if this is the first successful decoding of the data for this TB:

3> deliver the decoded MAC PDU to the disassembly and demultiplexing entity.

1> else:

2> instruct the physical layer to replace the data in the soft buffer for this TB with the data which the MAC entity attempted to decode.

1> if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or

1> if the HARQ process is equal to the broadcast process; or

1> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is stopped or expired:

2> not instruct the physical layer to generate acknowledgement(s) of the data in this TB.

1> else:

2> instruct the physical layer to generate acknowledgement(s) of the data in this TB.

The MAC entity shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

NOTE: If the MAC entity receives a retransmission with a TB size different from the last TB size signalled for this TB, the UE behaviour is left up to UE implementation.

7.1.1.2.4.3 Test description

7.1.1.2.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Short\_DCI condition is applied in NR Serving cell configuration.

7.1.1.2.4.3.2 Test procedure sequence

Table 7.1.1.2.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a Short message on PDCCH using P-RNTI indicating a systemInfoModification. (Note 1) | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 2 | At the start of the modification period, the SS transmits an updated system information with SI-RNTI addressed in L1/L2 header. CRC is calculated in such a way, it will result in CRC fail on UE side. Dedicated HARQ process for broadcast is used. (Note 5) | <-- | - | - | - |
| 3 | Check: Does the UE transmit a HARQ ACK/NACK? (Note 2 and 3) | --> | HARQ ACK/NACK | 1 | F |
| 4 | After 400ms of step 2, the SS transmits an updated system information contents same as in step 2 with SI-RNTI addressed in L1/L2 header. CRC is calculated in such a way, it will result in CRC pass on UE side. Dedicated HARQ process for broadcast is used. | <-- | - | - | - |
| 5 | Check: Does the UE transmit a HARQ ACK/NACK? (Note 2 and 4) | -> | HARQ ACK/NACK | 1 | F |
| 6 | After 100 ms of Step 4, SS is configured to not allocate UL Grants on Scheduling Request. | - | - | - | - |
| 7 | The SS transmits MAC PDU containing an RLC PDU. | <-- | MAC PDU | - | - |
| 8 | The UE transmits a HARQ ACK. | --> | HARQ ACK | - | - |
| 9 | Check: Does the UE transmit PRACH Preamble, using PRACH resources as in new SI? | --> | PRACH Preamble | 1 | P |
| 10 | The SS transmits Random Access Response | <-- | Random Access Response | - | - |
| 11 | The UE transmits a MAC PDU with C-RNTI containing loop backed RLC PDU. | --> | MAC PDU | - | - |
| 12 | SS sends PDCCH transmission for UE C-RNTI to complete contention resolution. | <-- | - | - | - |
| Note 1: The Short Message was transmitted in controlResourceSetZero as Configured in SIB1, need to guarantee that the UE will receive at least one Paging in the Modification Period preceding the SysInfo change, SS should send the Paging message in every eligible PO in this Modification Period.  Note 2: When requested to check HARQ feedback for the dedicated broadcast HARQ process, the SS shall assume the same PUCCH reception requirement as specified in TS 38.213 section 9 for a normal HARQ process.  Note 3: For duration of 400ms, the SS shall check HARQ ACK/NACK for all broadcast SIBs. This duration is sufficient to ensure that SS transmits few times SIBs with CRC corruption.  Note 4: For duration of 100 ms, The SS shall check for HARQ ACK/NACK for all broadcast SIBs. This duration is sufficient to ensure that SS transmits few times SIBs after CRC corruption is removed.  Note 5: The modification period boundaries are defined by SFN values for which SFN mod m = 0, where m is the number of radio frames comprising the modification period. Value of m is caluclated based on the parameters specified in TS 38.508-1 [4] i.e m = (*modificationPeriodCoeff=4)* \* (*defaultPagingCycle=128* | | | | | |

7.1.1.2.4.3.3 Specific message contents

Table 7.1.1.2.4.3.3-1: *SystemInformationBlockType1* (steps 2 and 4 of table 7.1.1.2.4.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| rach-ConfigCommon SEQUENCE { |  |  |  |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | 20 |  | FDD |
| l139 | 2 |  | TDD |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.2.5 Correct HARQ process handling / DL grant prioritization

Editor’s Note: Does the test coverage need to be provided for simultaneous 2 HARQ transmission or can be tested with 2 transmissions in two different time slots? The first option requires additional mechanism to make sure HARQ feedback is with right priority by enforcing different HARQ feedbacks for 2 PDSCH simultaneous transmissions. The test sequence currently is for second option.

7.1.1.2.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with two PUCCH-config each corresponds to a PHY priority}

**ensure that** {

**when** { UE receives DL MAC PDU’s with DL grant indicating different priorities }

**then** { UE transmit the HARQ feedback using correct PUCCH resource as per priority}

}

7.1.1.2.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.213 clause 9, 9.2.4. Unless otherwise stated these are Rel-16 requirements.

[TS 38.213, clause 9]

A PUSCH or a PUCCH transmission, including repetitions if any, can be of priority index 0 or of priority index 1. For a configured grant PUSCH transmission, a UE determines a priority index from *phy-PriorityIndex*, if provided. For a PUCCH transmission with HARQ-ACK information corresponding to a SPS PDSCH reception or a SPS PDSCH release, a UE determines a priority index from *harq-CodebookID*, if provided. For a PUCCH transmission with SR, a UE determines the corresponding priority as described in Clause 9.2.4. For a PUSCH transmission with semi-persistent CSI report, a UE determines a priority index from a priority indicator field, if provided, in a DCI format that activates the semi-persistent CSI report. If a priority index is not provided to a UE for a PUSCH or a PUCCH transmission, the priority index is 0.

[TS 38.213, clause 9.1]

If a UE is provided *pdsch-HARQ-ACK-CodebookList*, the UE can be indicated by *pdsch-HARQ-ACK-CodebookList* to generate one or two HARQ-ACK codebooks. If the UE is indicated to generate one HARQ-ACK codebook, the HARQ-ACK codebook is associated with a PUCCH of priority index 0. If a UE is provided *pdsch-HARQ-ACK-CodebookList*, the UE multiplexes in a same HARQ-ACK codebook only HARQ-ACK information associated with a same priority index. If the UE is indicated to generate two HARQ-ACK codebooks

- a first HARQ-ACK codebook is associated with a PUCCH of priority index 0 and a second HARQ-ACK codebook is associated with a PUCCH of priority index 1

[TS 38.213, clause 9.2.4]

A UE can be configured by *SchedulingRequestResourceConfig* a set of configurations for SR in a PUCCH transmission using either PUCCH format 0 or PUCCH format 1. A UE can be configured by *schedulingRequestID-BFR-SCell* a configuration for LRR in a PUCCH transmission using either PUCCH format 0 or PUCCH format 1. The UE can be provided, by *phy-PriorityIndex* in *SchedulingRequestResourceConfig*, a priority index 0 or a priority index 1 for the SR. If the UE is not provided a priority index for SR, the priority index is 0.

7.1.1.2.5.3 Test description

7.1.1.2.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and parameters as in Table 7.1.1.2.5.3.1-1.

Table 7.1.1.2.5.3.1-1: MAC Parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Comment** |
| pdsch-HARQ-ACK-Codebook | Not Present | It is assumed this will force the UE to use pdsch-HARQ-ACK-CodebookList-r16 |
| pdsch-HARQ-ACK-CodebookList-r16 | dynamic, semiStatic | 2 entries |

7.1.1.2.5.3.2 Test procedure sequence

Table 7.1.1.2.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE with priority indicator =0 | <-- | (PDCCH (C-RNTI) priority Ind =0)  (PDCCH (C-RNTI)) | - | - |
| 2 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit an HARQ ACK on PUCCH associated with priority indicator 0? | --> | HARQ ACK | 1 | P |
| 4 | SS transmits a downlink assignment addressed to the C-RNTI assigned to the UE with priority indicator =1 | <-- | (PDCCH (C-RNTI) priority Ind =1)  (PDCCH (C-RNTI)) | - | - |
| 5 | SS transmits in the indicated downlink assignment a MAC PDU including a RLC PDU with poll bit not set. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit an HARQ ACK on PUCCH associated with priority indicator 1? | --> | HARQ ACK | 1 | P |

7.1.1.2.5.3.3 Specific message contents

None

#### 7.1.1.3 Uplink Data Transfer

##### 7.1.1.3.1 Correct Handling of UL MAC PDU / Assignment / HARQ process

7.1.1.3.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives for a Slot an uplink grant with valid C-RNTI }

**then** { UE transmits data and associated HARQ information to the HARQ entity for this Slot }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS transmits for a Slot an uplink grant with not allocated C-RNTI }

**then** { UE does not transmits data and associated HARQ information to the HARQ entity for this Slot }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives an UL Grant with toggled NDI and has data available for transmission }

**then** { UE transmits a new MAC PDU }

}

(4)

**with** { UE in RRC\_CONNECTED state and having transmitted a MAC PDU on a HARQ process }

**ensure that** {

**when** { UE receives an uplink grant on PDCCH for the next Slot corresponding to the HARQ process with old NDI not toggled}

**then** { UE performs an adaptive retransmission of the MAC PDU with redundancy version as received on PDCCH }

}

(5)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives an uplink grant on PDCCH for the next Slot corresponding to the HARQ process with toggled NDI, and data is not available for transmission }

**then** { UE transmits any MAC Padding PDU }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has a MAC SDU to be transmitted that is smaller or equal to 256 bytes }

**then** { UE sets F field to 0 and includes 8 bit L field in the MAC sub PDU}

}

(7)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has a MAC SDU to be transmitted that is larger than 256 bytes }

**then** { UE sets F field to 1 and includes 16 bit L field in the MAC sub PDU }

}

(8)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE has to insert padding in a MAC PDU }

**then** { UE inserts the last MAC sub PDU as a padding sub PDU }

}

(9)

**with** { UE in  RRC\_CONNECTED state and configured with a specific *TDD-UL-DL-ConfigCommon* including configuration of *pattern2*}

**ensure that** {

**when** { UE receives for a Slot an uplink grant associated with *pattern2* with valid C-RNTI }

**then** { UE transmits data and associated HARQ information to the HARQ entity for this Slot }

}

7.1.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.1, 5.4.2.1, 5.4.2.2 and 6.1.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity’s C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity’s C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity’s CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this serving cell on the PDCCH for the MAC entity’s CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> stop the *ConfiguredGrantTimer* for the corresponding HARQ process, if running;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured grant confirmation;

4> store the uplink grant for this serving cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this serving cell to start in the associated PUSCH duration and to recur according to rules in subclause 5.8.2;

4> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> stop the *ConfiguredGrantTimer* for the corresponding HARQ process, if running;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

1> if the *ConfiguredGrantTimer* for the corresponding HARQ process is not running:

2> consider the NDI bit for the corresponding HARQ process to have been toggled;

2> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

NOTE 1: For the same serving cell, an uplink grant addressed to C-RNTI shall override a configured uplink grant in case of overlap in time domain.

For configured uplink grants, the HARQ Process ID associated with this symbol is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *numberOfConfGrant-Processes*

where CURRENT\_symbol=(SFN \* *numberOfSlotsPerFrame* \* *numberOfSymbolsPerSlot* + slot number in the frame \* *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 2: CURRENT\_symbol refers to the symbol index of the first transmission of a repetition bundle that takes place.[TS 36.322, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*),which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response, HARQ process identifier 0 is used.

When repetition is configured with *repK* >1, the parameter *repK* provides the number of repetitions of a TB within a bundle. Repetition operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and triggered without waiting for feedback from previous transmissions according to *repK*.

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process(es) associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else:

4> obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a new transmission.

4> if the uplink grant is addressed to CS-RNTI or the uplink grant is a configured uplink grant:

5> start or restart the *ConfiguredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

2> else:

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI or the uplink grant is a configured uplink grant:

5> start or restart the *ConfiguredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on either PDCCH, Random Access Response, or RRC. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH.

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

1> if the MAC PDU was obtained from the Msg3 buffer; or

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer:

2> instruct the physical layer to generate a transmission according to the stored uplink grant.

[TS 38.321, clause 6.1.2]

A MAC PDU consists of one or more MAC subPDUs. Each MAC subPDU consists of one of the following:

- A MAC subheader only (including padding);

- A MAC subheader and a MAC SDU;

- A MAC subheader and a MAC CE;

- A MAC subheader and padding.

The MAC SDUs are of variable sizes.

Each MAC subheader corresponds to either a MAC SDU, a MAC CE, or padding.

A MAC subheader except for fixed sized MAC CE and padding consists of the four header fields R/F/LCID/L. A MAC subheader for fixed sized MAC CE and padding consists of the two header fields R/LCID.



Figure 6.1.2-1: R/F/LCID/L MAC subheader with 8-bit L field



Figure 6.1.2-2: R/F/LCID/L MAC subheader with 16-bit L field



Figure 6.1.2-3: R/LCID MAC subheader

MAC CEs are placed together. DL MAC subPDU(s) with MAC CE(s) is placed before any MAC subPDU with MAC SDU and MAC subPDU with padding as depicted in Figure 6.1.2-4. UL MAC subPDU(s) with MAC CE(s) is placed after all the MAC subPDU(s) with MAC SDU and before the MAC subPDU with padding in the MAC PDU as depicted in Figure 6.1.2-5. The size of padding can be zero.



Figure 6.1.2-4: Example of a DL MAC PDU



Figure 6.1.2-5: Example of a UL MAC PDU

A maximum of one MAC PDU can be transmitted per TB per MAC entity.

7.1.1.3.1.3 Test description

7.1.1.3.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.3.1.3.2 Test procedure sequence

Table 7.1.1.3.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | SS transmits a MAC PDU including a RLC SDU | <-- | MAC PDU | - | - |
| - | EXCEPTION: Step 3 runs in parallel with behaviour in table 7.1.1.3.1.3.2-2 | - | - | - | - |
| 3 | For 100 ms SS transmits an UL Grant every 10 ms , allowing the UE to return the RLC SDU as received in step 2, on PDCCH, but with the C-RNTI different from the C-RNTI assigned to the UE. | <-- | (UL Grant (unknown C-RNTI)) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 3? | --> | MAC PDU | 2 | F |
| 5 | SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 2, on PDCCH with the C-RNTI assigned to the UE. | <-- | (UL Grant (C-RNTI)) | - | - |
| 6 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 6? | --> | MAC PDU | 1 | P |
| 6A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 6. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| 7 | The SS Transmits a valid MAC PDU containing RLC PDU | <-- | MAC PDU | - | - |
| 8 | The SS allocates an UL Grant for one HARQ process X, sufficient for one RLC SDU to be looped back in a Slot, and NDI indicates new transmission redundancy version to be used as 0 | <-- | Uplink Grant | - | - |
| 9 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process X? | --> | MAC PDU | 3 | P |
| 10 | The SS transmits an UL grant corresponding to slot for HARQ process X, with NDI not toggled and redundancy version to be used as 1 | <-- | Uplink Grant | - | - |
| 11 | Check: Does the UE retransmit the MAC PDU in for HARQ process X, using redundancy version1? | --> | MAC PDU | 4 | P |
| 11A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 11. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| 12 | The SS transmits an UL grant corresponding to SLOT for HARQ process X, with NDI toggled and redundancy version to be used as 0 | <-- | Uplink Grant | - | - |
| 13 | Check: Does the UE retransmit the MAC PDU containing padding for HARQ process X, using redundancy version 0? | --> | MAC PDU | 5 | P |
| 14 | SS transmits a MAC PDU including a RLC PDU of size 128 bytes | <-- | MAC PDU | - | - |
| 15 | The SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 14 and padding. | <-- | (UL Grant (C-RNTI)) | - | - |
| 16 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 14 with F field set to 0 and includes 8 bit L field in the MAC sub PDU and includes a padding sub PDU at end? | --> | MAC PDU | 6,8 | P |
| 16A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 16. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| 17 | SS transmits a MAC PDU including a RLC PDU of size 512 bytes | <-- | MAC PDU | - | - |
| 18 | The SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 17 and padding. | <-- | (UL Grant (C-RNTI)) | - | - |
| 19 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 17 with F field set to 1 and includes 16 bit L field in the MAC sub PDU and includes a padding sub PDU at end? | --> | MAC PDU | 7,8 | P |
| 19A | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 19. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| - | EXCEPTION : Steps 20a0 to 20a6 are executed for operation on NR TDD band only | - | *-* | - | - |
| 20a0 | The SS transmits an updated system information as specified in Table 7.1.1.3.1.3.3-14. |  |  |  |  |
| 20a1 | The SS transmits a NR RRCReconfiguration message including *TDD-UL-DL-ConfigCommon* with *pattern1 and pattern 2* specified in Table 7.1.1.3.1.3.3-5 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 20a2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 20a3 | SS transmits a MAC PDU including a RLC SDU | <-- | MAC PDU | - | - |
| 20a4 | SS transmits an UL Grant, allowing the UE to return the RLC SDU as received in step 20a3, on PDCCH with the C-RNTI assigned to the UE. | <-- | (UL Grant (C-RNTI)) | - | - |
| 20a5 | Check: Does the UE transmit a MAC PDU corresponding to grant in step 20a4? | --> | MAC PDU | 9 | P |
| 20a6 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDUs in step 20a5. | <-- | MAC PDU (RLC STATUS PDU) | - | - |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

Table 7.1.1.3.1.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | UE transmits a Scheduling Request. | --> | (SR) | - | - |

7.1.1.3.1.3.3 Specific message contents

Table 7.1.1.3.1.3.3-1: *Void*

Table 7.1.1.3.1.3.3-2: *Void*

Table 7.1.1.3.1.3.3-3: *RRCReconfiguration* (step20a1, Table 7.1.1.3.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-4: *CellGroupConfig* (Table 7.1.1.3.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-5: *ServingCellConfigCommon (*Table 7.1.1.3.1.3.3-4, Table 7.1.1.3.1.3.3-14)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| uplinkConfigCommon SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |
| tdd-UL-DL-ConfigurationCommon | TDD-UL-DL-ConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-6: *TDD-UL-DL-ConfigCommon (*Table 7.1.1.3.1.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 3 |  | FR1 |
|  | 2 |  | FR2 |
| nrofDownlinkSymbols | 6 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 2 |  | FR1 |
|  | 2 |  | FR2 |
| nrofUplinkSymbols | 4 |  | FR1 |
|  | 2 |  | FR2 |
| dl-UL-TransmissionPeriodicity-v1530 | ms3 |  | FR1 |
| } |  |  |  |
| pattern2 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms2 |  | FR1 |
|  | ms0p625 |  | FR2 |
| nrofDownlinkSlots | 4 |  | FR1 |
|  | 3 |  | FR2 |
| nrofDownlinkSymbols | 0 |  | FR1 |
|  | 6 |  | FR2 |
| nrofUplinkSlots | 0 |  | FR1 |
|  | 1 |  | FR2 |
| nrofUplinkSymbols | 0 |  | FR1 |
|  | 2 |  | FR2 |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-7: *BWP-UplinkCommon (*Table 7.1.1.3.1.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 |  |  |  |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  |  |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-8: *RACH-ConfigCommon (*Table 7.1.1.3.1.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-9: *RACH-ConfigGeneric (*Table 7.1.1.3.1.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-configurationIndex | 156 |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-10: *ServingCellConfig* (Table 7.1.1.3.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-11: *BWP-UplinkDedicated* (Table 7.1.1.3.1.3.3-10)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-12: *PUCCH-Config* (Table 7.1.1.3.1.3.3-11)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig { | 1 entry |  |  |
| SchedulingRequestResourceConfig[1] | SchedulingRequestResourceConfig | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-13: *SchedulingRequestResourceConfig* (Table 7.1.1.3.1.3.3-12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl10 | 5 | With SCS = kHz15 results in repetition every 10 ms | SCS\_15kHz |
| sl20 | 5 | With SCS = kHz30 results in repetition every 10 ms | SCS\_30kHz |
| sl80 | 4 | With SCS = kHz120 results in repetition every 10 ms | SCS\_120kHz |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.1.3.3-14: *SystemInformationBlockType1* (step 20a0, Table 7.1.1.3.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4] table 4.6.1-28 | | | |
| Information Element | Value/Remark | Comment | Condition |
| SIB1 ::= SEQUENCE { |  |  |  |
| servingCellConfigCommon | ServingCellConfigCommon | Same contents as in Table 7.1.1.3.1.3.3-5 |  |
| } |  |  |  |

##### 7.1.1.3.2 Logical channel prioritization handling

7.1.1.3.2.1 Test Purpose (TP)

(1)

**with** {UE in RRC\_CONNECTED state}

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR }

}

7.1.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.4.3.1.1, 5.4.3.1.2, 5.4.3.1.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.3.1.1]

The Logical Channel Prioritization procedure is applied whenever a new transmission is performed.

RRC controls the scheduling of uplink data by signalling for each logical channel per MAC entity:

- *priority* where an increasing priority value indicates a lower priority level;

- *prioritisedBitRate* which sets the Prioritized Bit Rate (PBR);

- *bucketSizeDuration* which sets the Bucket Size Duration (BSD).

RRC additionally controls the LCP procedure by configuring mapping restrictions for each logical channel:

- *allowedSCS-List* which sets the allowed Subcarrier Spacing(s) for transmission;

- *maxPUSCH-Duration* which sets the maximum PUSCH duration allowed for transmission;

- *configuredGrantType1Allowed* which sets whether a Configured Grant Type 1 can be used for transmission;

- *allowedServingCells* which sets the allowed cell(s) for transmission.

The following UE variable is used for the Logical channel prioritization procedure:

- *Bj* which is maintained for each logical channel j.

The MAC entity shall initialize Bj of the logical channel to zero when the logical channel is established.

For each logical channel j, the MAC entity shall:

1> increment *Bj* by the product PBR × T before every instance of the LCP procedure, where T is the time elapsed since *Bj* was last updated;

1> if the value of *Bj* is greater than the bucket size (i.e. PBR × BSD):

2> set *Bj* to the bucket size.

NOTE: The exact moment(s) when the UE updates *Bj* between LCP procedures is up to UE implementation, as long as *Bj* is up to date at the time when a grant is processed by LCP.

[TS 38.321, clause 5.4.3.1.2]

The MAC entity shall, when a new transmission is performed:

1> select the logical channels for each UL grant that satisfy all the following conditions:

2> the set of allowed Subcarrier Spacing index values in *allowedSCS-List*, if configured, includes the Subcarrier Spacing index associated to the UL grant; and

2> *maxPUSCH-Duration*, if configured, is larger than or equal to the PUSCH transmission duration associated to the UL grant; and

2> *configuredGrantType1Allowed*, if configured, is set to TRUE in case the UL grant is a Configured Grant Type 1; and

2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant.

NOTE: The Subcarrier Spacing index, PUSCH transmission duration and Cell information are included in Uplink transmission information received from lower layers for the corresponding scheduled uplink transmission.

[TS 38.321, clause 5.4.3.1.3]

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in subclause 5.4.3.1.2 for the UL grant with Bj > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to "infinity", the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement Bj by the total size of MAC SDUs served to logical channel j above;

NOTE: The value of Bj can be negative.

2> if any resources remain, all the logical channels selected in subclause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of Bj) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given an UL grant size that is equal to or larger than 8 bytes while having data available for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:

- the MAC entity is configured with *skipUplinkTxDynamic* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

- the MAC PDU includes zero MAC SDUs; and

- the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- MAC CE for C-RNTI or data from UL-CCCH;

- MAC CE for SPS confirmation;

- MAC CE for BSR, with exception of BSR included for padding;

- MAC CE for single entry PHR or multiple entry PHR;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for BSR included for padding.

7.1.1.3.2.3 Test description

7.1.1.3.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 UM SN terminated SCG bearers configured according to Table 7.1.1.3.2.3.1-1.

Table 7.1.1.3.2.3.1-1: Priority, PBR and Bucket Delay settings

|  |  |  |  |
| --- | --- | --- | --- |
| DRB | priority | prioritizedBitRate (kbytes/s) | bucketSizeDuration (ms) |
| DRB1 | 6 | 8 | 100 |
| DRB2 | 7 | 16 | 100 |
| DRB3 | 8 | 32 | 100 |

Table 7.1.1.3.2.3.1-2: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| Discard\_Timer | ms1500 |

7.1.1.3.2.3.2 Test procedure sequence

Table 7.1.1.3.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 3 are run 4 times using the parameters specified for each run in table 7.1.1.3.2.3.2-3. | - | - | - | - |
| 1 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| 1A | Start WatchDog\_Timer set to 5 seconds | - | - | - | - |
| - | EXCEPTION: In parallel to the event described in step 2 the events specified in Table 7.1.1.3.2.3.2-2 shall take place. | - | - | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 150 ms after Step 1 (Note1), for a duration of T2, the SS transmits an UL grant of D octets every T1. | <-- | (UL grants) | - | - |
| 3 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 is D1 octets +/- 10%  - total number of octets received for DRB2 is D2 octets +/- 10%  - total number of octets received for DRB3 is D3 octets +/- 10% ? | - | - | 1 | P |
| 4 | Wait for WatchDog\_Timer expiry(Note2) | - | - | - | - |
| Note 1: This wait time will ensure that a) all octets have been completely received by the UE on all 3 DRBs before the first UL grant is received and b) the Bjs for each logical channel have reached their maximum value i.e. the bucket size of the corresponding logical channel before the first UL grant is received.  Note 2: Several PDUs on DRB3 after second run and on DRB2 after third run and on DRB1 after fourth run would be awaiting on PDCP Tx Buffer. Timer 5 seconds ensures the PDCP Data PDUs are discarded after expiry of Discard\_timer(1500ms). | | | | | |

Table 7.1.1.3.2.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit the RLC SDUs back to the SS? | --> | - | 1 | P |

Table 7.1.1.3.2.3.2-3: Test parameter values

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | First run | Second run | Third run | Fourth run |
| N1 (SDUs) | 13 | 13 | 7 | 104 |
| N2 (SDUs) | 25 | 25 | 50 | 25 |
| N3 (SDUs) | 50 | 50 | 50 | 50 |
| D (octets) | 1153 | 576 | 1153 | 1153 |
| T1 (ms) | 20 | 20 | 20 | 10 |
| T2 (ms) | 500 | 700 | 500 | 500 |
| D1 (octets) | 4160 | 4160 | 2240 | 33350 (Note 1) |
| D2 (octets) | 8000 | 8000 | 10435 (Note 1) | 8000 |
| D3 (octets) | 16000 | 7790 (Note 1) | 16000 | 16000 |
| Note 1: Calculated using the following equation for the case of the least header size: (D1 + D2 + D3) = (D - 6) \* T2 / T1 | | | | |

NOTE: The Test parameter values above and the test procedure assume that the UE has a loopback buffer of at least 57280 octets.

7.1.1.3.2.3.3 Specific message contents

Table 7.1.1.3.2.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

##### 7.1.1.3.2b Logical channel prioritization handling with Mapping restrictions

7.1.1.3.2b.1 Test Purpose (TP)

(1)

**with** {UE in RRC\_CONNECTED state with allowedSCS-List configured }

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR and respecting allowedSCS-List }

}

(2)

**with** {UE in RRC\_CONNECTED state with maxPUSCH-Duration configured }

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR and respecting maxPUSCH-Duration }

}

(3)

**with** { UE in RRC\_CONNECTED state with configuredGrantType1Allowed configured and supporting Type 1 PUSCH transmissions with configured grant }

**ensure that** {

**when** { UE is sending data on the uplink }

**then** { UE serves the logical channels according to their priority and configured PBR and respecting configuredGrantType1Allowed }

}

7.1.1.3.2b.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.4.3.1.1, 5.4.3.1.2, 5.4.3.1.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.3.1.1]

The Logical Channel Prioritization (LCP) procedure is applied whenever a new transmission is performed.

RRC controls the scheduling of uplink data by signalling for each logical channel per MAC entity:

- *priority* where an increasing priority value indicates a lower priority level;

- *prioritisedBitRate* which sets the Prioritized Bit Rate (PBR);

- *bucketSizeDuration* which sets the Bucket Size Duration (BSD).

RRC additionally controls the LCP procedure by configuring mapping restrictions for each logical channel:

- *allowedSCS-List* which sets the allowed Subcarrier Spacing(s) for transmission;

- *maxPUSCH-Duration* which sets the maximum PUSCH duration allowed for transmission;

- *configuredGrantType1Allowed* which sets whether a configured grant Type 1 can be used for transmission;

- *allowedServingCells* which sets the allowed cell(s) for transmission.

The following UE variable is used for the Logical channel prioritization procedure:

- *Bj* which is maintained for each logical channel *j*.

The MAC entity shall initialize *Bj* of the logical channel to zero when the logical channel is established.

For each logical channel *j*, the MAC entity shall:

1> increment *Bj* by the product PBR × T before every instance of the LCP procedure, where T is the time elapsed since *Bj* was last incremented;

1> if the value of *Bj* is greater than the bucket size (i.e. PBR × BSD):

2> set *Bj* to the bucket size.

NOTE: The exact moment(s) when the UE updates *Bj* between LCP procedures is up to UE implementation, as long as *Bj* is up to date at the time when a grant is processed by LCP.

[TS 38.321, clause 5.4.3.1.2]

The MAC entity shall, when a new transmission is performed:

1> select the logical channels for each UL grant that satisfy all the following conditions:

2> the set of allowed Subcarrier Spacing index values in *allowedSCS-List*, if configured, includes the Subcarrier Spacing index associated to the UL grant; and

2> *maxPUSCH-Duration*, if configured, is larger than or equal to the PUSCH transmission duration associated to the UL grant; and

2> *configuredGrantType1Allowed*, if configured, is set to *true* in case the UL grant is a Configured Grant Type 1; and

2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant. Does not apply to logical channels associated with a DRB configured with PDCP duplication within the same MAC entity (i.e. CA duplication) for which PDCP duplication is deactivated.

NOTE: The Subcarrier Spacing index, PUSCH transmission duration and Cell information are included in Uplink transmission information received from lower layers for the corresponding scheduled uplink transmission.

[TS 38.321, clause 5.4.3.1.3]

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in subclause 5.4.3.1.2 for the UL grant with *Bj* > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to *infinity*, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement *Bj* by the total size of MAC SDUs served to logical channel *j* above;

2> if any resources remain, all the logical channels selected in subclause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of *Bj*) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

NOTE: The value of *Bj* can be negative.

If the MAC entity is requested to simultaneously transmit multiple MAC PDUs, or if the MAC entity receives the multiple UL grants within one or more coinciding PDCCH occasions (i.e. on different Serving Cells), it is up to UE implementation in which order the grants are processed.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given a UL grant size that is equal to or larger than 8 bytes while having data available and allowed (according to subclause 5.4.3.1) for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall not generate a MAC PDU for the HARQ entity if the following conditions are satisfied:

- the MAC entity is configured with *skipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

- there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

- the MAC PDU includes zero MAC SDUs; and

- the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding.

7.1.1.3.2b.3 Test description

7.1.1.3.2b.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 UM NR DRBs configured according to Table 7.1.1.3.2b.3.1-1.

Table 7.1.1.3.2b.3.1-1: Priority, PBR, Bucket Delay allowed-SCSList settings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DRB | priority | prioritizedBitRate (kbytes/s) | bucketSizeDuration (ms) | allowed-SCSList | |
| FR1 | FR2 |
| DRB1 | 6 | 8 | 100 | {15KHz, 30KHz} | {60KHz, 120KHz} |
| DRB2 | 7 | 16 | 100 | {60KHz} | {60KHz} |
| DRB3 | 8 | 32 | 100 | {15KHz, 30KHz,60KHz} | {120KHz} |

Table 7.1.1.3.2b.3.1-2: allowed-SCSList and maxPUSCH-Duration settings

|  |  |  |
| --- | --- | --- |
| DRB | allowed-SCSList | maxPUSCH-Duration |
| DRB1 | Not Present | ms0p02 |
| DRB2 | Not Present | ms0p5 |
| DRB3 | Not Present | ms0p5 |

Table 7.1.1.3.2b.3.1-2a: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation { | 2 entry |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 |  |
| k2 | 2 |  | FR1 |
|  | 4 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 52 | Start symbol(S)=10, Length(L)=4 | FR1 |
| startSymbolAndLength | 42 | Start symbol(S)=0, Length(L)=4 | FR2 |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 |  |
| k2 | 2 |  | FR1 |
|  | 4 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.2b.3.1-3: maxPUSCH-Duration and configuredGrantType1Allowed settings

|  |  |  |
| --- | --- | --- |
| DRB | maxPUSCH-Duration | configuredGrantType1Allowed |
| DRB1 | Not Present | true |
| DRB2 | Not Present | false |
| DRB3 | Not Present | true |

Table 7.1.1.3.2b.3.1-4: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| Discard\_Timer | ms1500 |

7.1.1.3.2b.3.2 Test procedure sequence

Table 7.1.1.3.2b.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 3 are run using the parameters specified for first run in table 7.1.1.3.2b.3.2-3. | - | - | - | - |
| 1 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| - | EXCEPTION: In parallel to the event described in step 2 the events specified in Table 7.1.1.3.2b.3.2-2 shall take place. | - | - | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 150 ms after Step 1 (Note1), for a duration of T2, the SS transmits an UL grant of D octets every T1. | <-- | (UL grants) | - | - |
| 3 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 is D1 octets +/- 10%  - total number of octets received for DRB2 is 0  - total number of octets received for DRB3 is  D3 octets +/- 10% otherwise? | - | - | 1 | P |
| 4 | SS transmits NR *RRCReconfiguration* message to configure allowed-SCSList and maxPUSCH-Duration as per Table 7.1.1.3.2b.3.1-2. (Note 2) | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| - | EXCEPTION: In parallel to the event described in step 5 the events specified in Table 7.1.1.3.2b.3.2-2a shall take place on DRB2 | - | - | - | - |
| 5 | The UE transmits NR *RRCReconfigurationComplete* message. (Note 3) | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| - | EXCEPTION: Steps 6 to 8 are run using the parameters specified for second run in table 7.1.1.3.2b.3.1-2. | - | - | - | - |
| 6 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| - | EXCEPTION: In parallel to the event described in step 7 the events specified in Table 7.1.1.3.2b.3.2-2 shall take place. | - | - | - | - |
| 7 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 150 ms after Step 1 (Note1), for a duration of T2, the SS transmits an UL grant of D octets every T1. | <-- | (UL grants) | - | - |
| 8 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 are 0  - total number of octets received for DRB2 are D2 octets +/- 10%  - total number of octets received for DRB3 are D3 octets +/- 10%? | - | - | 2 | P |
| - | EXCEPTION: Steps 9 to 14 describe behaviour that depends on the UE capability. | - | - | - | - |
| 9 | IF pc\_configuredUL\_GrantType1 the SS transmits NR *RRCReconfiguration* message to configure UL configured grant type 1 with UL grant configured 150 ms after Step 11 (Note1), for a duration of T2 and an UL grant of D octets every T1. It also configures maxPUSCH-Duration and configuredGrantType1Allowed as per Table 7.1.1.3.2b.3.1-3 (Note 2) | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| - | EXCEPTION: In parallel to the event described in step 10 the events specified in Table 7.1.1.3.2b.3.2-2a shall take place on DRB1 | - | - | - | - |
| 10 | The UE transmits NR *RRCReconfigurationComplete* message. (Note 3) | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| - | EXCEPTION: Steps 11 to 13 are run using the parameters specified for third run in table 7.1.1.3.2b.3.1-1. | - | - | - | - |
| 11 | The SS transmits N1 320-octet RLC SDUs on DRB1, N2 320-octet RLC SDUs on DRB2, and N3 320-octet RLC SDUs on DRB3. | <-- | (RLC SDUs) | - | - |
| - | EXCEPTION: In parallel to the event described in step 9 the events specified in Table 7.1.1.3.2b.3.2-2 shall take place. | - | - | - | - |
| 12 | Check: Are the total number of octets of the UL RLC SDUs received at the SS for each DRB as follows:  - total number of octets received for DRB1 are D1 octets +/- 10%  - total number of octets received for DRB2 are 0  - total number of octets received for DRB3 are D3 octets +/- 10%? | - | - | 3 | P |
| 13 | The SS sends one Uplink Grant to send loop back PDU on DRB 2. | <-- | (UL grants) | - | - |
| 14 | The UE transmits the RLC SDU back to the SS. | --> | - | - | - |
| Note 1: This wait time will ensure that a) all octets have been completely received by the UE on all 3 DRBs before the first UL grant is received and b) the Bjs for each logical channel have reached their maximum value i.e. the bucket size of the corresponding logical channel before the first UL grant is received.  Note 2: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 3: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete* | | | | | |

Table 7.1.1.3.2b.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U – S | Message |  |  |
| 1 | Check: Does the UE transmit the RLC SDUs back to the SS? | --> | - | 1,2,3 | P |

Table 7.1.1.3.2b.3.2-2a: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U – S | Message |  |  |
| 1 | The UE may transmit the RLC SDU back to the SS within one second. | --> | - | - | - |

Table 7.1.1.3.2b.3.2-3: Test parameter values

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | First run | Second run | Third run |
| N1 (SDUs) | 13 | 1 | 13 |
| N2 (SDUs) | 1 | 25 | 1 |
| N3 (SDUs) | 50 | 50 | 50 |
| D (octets) | 1153 | 576 | 1153 |
| T1 (ms) | 20 | 20 | 20 |
| T2 (ms) | 360 | 860 | 360 |
| D1 (octets) | 4160 | 0 | 4160 |
| D2 (octets) | 0 | 8000 | 0 |
| D3 (octets) | 16000 | 16000 | 16000 |
| Note 1: Calculated using the following equation for the case of the least header size:(D1 + D2 + D3) = (D - 6) \* T2 / T1. | | | |

7.1.1.3.2b.3.3 Specific message contents

Table 7.1.1.3.2b.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.3-20 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

Table 7.1.1.3.2b.3.3-2: *RRCReconfiguration* (step 9, Table 7.1.1.3.2b.3.2-1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | | | | |
| Information Element | | Value/remark | | Comment | Condition | |
| RRCReconfiguration ::= SEQUENCE { | |  | |  |  | |
| criticalExtensions CHOICE { | |  | |  |  | |
| rrcReconfiguration SEQUENCE { | |  | |  |  | |
| radioBearerConfig | | Not present | |  |  | |
| secondaryCellGroup | | CellGroupConfig | | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC | |
| nonCriticalExtension := SEQUENCE {} | | Not present | |  | | EN-DC |
| nonCriticalExtension := SEQUENCE{ | |  | |  | NR | |
| masterCellGroup | | CellGroupConfig | | OCTET STRING (CONTAINING CellGroupConfig) |  | |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | | Not present | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |

Table 7.1.1.3.2b.3.3-3: *CellGroupConfig* (Table 7.1.1.3.2b.3.3-2: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList | Not present |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig SEQUENCE { |  |  |  |
| cs-RNTI CHOICE { |  |  |  |
| setup SEQUENCE{ |  |  |  |
| RNTI-Value | ‘FFE0’H |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| reconfigurationWithSync | Not present |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 10 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1[4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym20x14 |  | 15kHz |
| periodicity | Sym40x14 |  | 30kHz |
| periodicity | Sym80x14 |  | 60kHz |
| periodicity | Sym160x14 |  | 120kHz |
| rrc-ConfiguredUplinkGrant SEQUENCE{ |  |  |  |
| timeDomainOffset | 0 |  |  |
| timeDomainAllocation | 0 | Reference TS 38.508-1 [4], Table 4.6.3-122 |  |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB = 23 PRB,  RBstart = 0,  NBWPsize is the size [PRBs] of the active carrier bandwidth part and ontained in TS.38.508-1 [4] clause 4.3.1.1. |  |
| antennaPort | 0 |  |  |
| precodingAndNumberOfLayers | 0 |  |  |
| srs-ResourceIndicator | Not present |  |  |
| mcsAndTBS | 16 |  |  |
| pathlossReferenceIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.3 Correct handling of MAC control information / Scheduling requests

7.1.1.3.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE has UL data available for transmission and UE has no UL-SCH resources available and SR\_COUNTER is less than sr-TransMax }

**then** { the UE transmits a SR on every available PUCCH until resources are granted }

}

(2)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE receives an UL grant for a new transmission }

**then** { UE cancels all pending SR(s) }

}

(3)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE has UL data available for transmission and UE has no UL-SCH resources available and SR\_COUNTER becomes equal to sr-TransMax }

**then** { the UE transmits a PRACH Preamble to initiate a Random Access procedure }

}

(4)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured and logicalChannelSR-DelayTimer is configured }

**ensure that** {

**when** { UE has UL data available for transmission on LCH for which logicalChannelSR-DelayTimer is configured and UE has no UL-SCH resources available and SR\_COUNTER is less than sr-TransMax }

**then** { the UE delays transmission of SR until logicalChannelSR-DelayTimer expires }

}

(5)

**with** { UE in RRC\_CONNECTED state with SR resource on PUCCH is configured }

**ensure that** {

**when** { UE has UL data available for transmission on LCH for which logicalChannelSR-DelayTimer is not configured and UE has no UL-SCH resources available and SR\_COUNTER is less than sr-TransMax }

**then** { the UE transmits a SR on every available PUCCH until resources are granted }

}

7.1.1.3.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.4 and 5.4.5. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.4]

The Scheduling Request (SR) is used for requesting UL-SCH resources for new transmission.

The MAC entity may be configured with zero, one, or more SR configurations. An SR configuration consists of a set of PUCCH resources for SR across different BWPs and cells. For a logical channel, at most one PUCCH resource for SR is configured per BWP.

Each SR configuration corresponds to one or more logical channels. Each logical channel may be mapped to zero or one SR configuration, which is configured by RRC. The SR configuration of the LCH that triggered the BSR (subclause 5.4.5) (if such a configuration exists) is considered as corresponding SR configuration for the triggered SR. For BSR triggered by *retxBSR-Timer* expiry, the corresponding SR configuration for the triggered SR is that of the highest priority LCH (if such a configuration exists) that has data available for transmission at the time the BSR is triggered.

RRC configures the following parameters for the scheduling request procedure:

- *sr-ProhibitTimer* (per SR configuration);

- *sr-TransMax* (per SR configuration);

- *sr-ConfigIndex*.

The following UE variables are used for the scheduling request procedure:

- *SR\_COUNTER* (per SR configuration).

If an SR is triggered and there are no other SRs pending corresponding to the same SR configuration, the MAC entity shall set the *SR\_COUNTER* of the corresponding SR configuration to 0.

When an SR is triggered, it shall be considered as pending until it is cancelled. All pending SR(s) shall be cancelled and each respective *sr-ProhibitTimer* shall be stopped when a MAC PDU is assembled and this PDU includes a BSR which contains buffer status up to (and including) the last event that triggered a BSR (see subclause 5.4.5), or when the UL grant(s) can accommodate all pending data available for transmission.

Only PUCCH resources on a BWP which is active at the time of SR transmission occasion are considered valid.

As long as at least one SR is pending, the MAC entity shall for each pending SR:

1> if the MAC entity has no valid PUCCH resource configured for the pending SR:

2> initiate a Random Access procedure (see subclause 5.1) on the SpCell and cancel the pending SR.

1> else, for the SR configuration corresponding to the pending SR:

2> when the MAC entity has an SR transmission occasion on the valid PUCCH resource for SR configured; and

2> if *sr-ProhibitTimer* is not running at the time of the SR transmission occasion; and

2> if the PUCCH resource for the SR transmission occasion does not overlap with a measurement gap; and

2> if the PUCCH resource for the SR transmission occasion does not overlap with a UL-SCH resource:

3> if *SR\_COUNTER* < *sr-TransMax*:

4> increment *SR\_COUNTER* by 1;

4> instruct the physical layer to signal the SR on one valid PUCCH resource for SR;

4> start the *sr-ProhibitTimer*.

3> else:

4> notify RRC to release PUCCH for all serving cells;

4> notify RRC to release SRS for all serving cells;

4> clear any configured downlink assignments and uplink grants;

4> initiate a Random Access procedure (see subclause 5.1) on the SpCell and cancel all pending SRs.

NOTE: The selection of which valid PUCCH resource for SR to signal SR on when the MAC entity has more than one overlapping valid PUCCH resource for the SR transmission occasion is left to UE implementation.

[TS 38.321, clause 5.4.5]

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

…

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

7.1.1.3.3.3 Test description

7.1.1.3.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 2 AM DRBs configured according to Table 7.1.1.3.3.3.1-1 and Table 7.1.1.3.3.3.1-2 and with MAC-CellGroupConfig configured according to Table 7.1.1.3.3.3.1-3 and Short\_DCI condition is applied in NR Serving cell configuration.

Table 7.1.1.3.3.3.1-1: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |
| logicalChannelSR-DelayTimerApplied | False | True |
| logicalChannelSR-DelayTimer | Not Present | sf512 |

Table 7.1.1.3.3.3.1-2: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

Table 7.1.1.3.3.3.1-3: MAC-CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.308 [6], clause Table 4.6.3-49 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | infinity |  |  |
| retxBSR-Timer | sf2560 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

7.1.1.3.3.3.2 Test procedure sequence

Table 7.1.1.3.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a MAC PDU containing A MAC Sub PDU containing a RLC SDU on LCH 5 | <-- | MAC PDU (containing 1 MAC sub PDU) | - | - |
| 2 | Check: Does the UE transmit Scheduling Requests for logicalChannelSR-DelayTimer (sf512) from step 1? | --> | (SR) | 4 | F |
| 3 | Check: Does the UE transmit [x] Scheduling Requests separately on [x] consecutively available PUCCHs after logicalChannelSR-DelayTimer expiry? (Note 1) | --> | (SR) | 1,4 | P |
| 4 | The SS transmits an UL grant to allocate UL-SCH resources that are enough to transmit looped back PDU | <-- | (UL Grant) | - | - |
| 5 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on LCH5? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 6 | The SS transmits a MAC PDU containing A MAC Sub PDU containing a RLC SDU on LCH 4 | <-- | MAC PDU (containing 1 MAC sub PDU) | - | - |
| 7 | Check: Does the UE transmit Scheduling Requests separately on [x] consecutively available PUCCHs? (Note 1) | --> | (SR) | 1,5 | P |
| 8 | The SS transmits an UL grant to allocate UL-SCH resources that are enough to transmit looped back PDU | <-- | (UL Grant ) | - | - |
| 9 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on LCH4? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 10 | Check: For 1 second, does the UE transmit a Scheduling Request? | --> | (SR) | 1,2 | F |
| 11 | The SS transmits a MAC PDU containing a Timing Advance Command MAC Control Element, but does not send any subsequent alignments. | <-- | MAC PDU (Timing Advance Command) | - | - |
| 12 | The SS transmits a MAC PDU containing a MAC SDU on LCH 4 | <-- | MAC PDU (MAC SDU) | - | - |
| - | EXCEPTION: Step 13 is repeated less than sr-TransMax times | - | - | - | - |
| 13 | The UE may transmit Scheduling Requests before time alignment timer expires. The SS shall not respond to the Scheduling Requests in this step. (Note 2) | --> | (SR) | - | - |
| 14 | Check: does the UE transmit a preamble on PRACH? | --> | (PRACH Preamble) | 3 | P |
| 15 | The SS transmits a Random Access Response including an UL grant to enable UE to transmit C-RNTI MAC Control Element and the MAC SDU as received in step 14. | <-- | Random Access Response | - | - |
| 16 | The UE transmit a MAC PDU including a C-RNTI MAC Control Element and a MAC SDU. (Note 3) | --> | MAC PDU (MAC Sub PDU containing C-RNTI control element, MAC sub PDU containing MAC SDU) | - | - |
| 17 | The SS sends PDCCH transmission for UE C-RNTI | <-- | - | - | - |
| Note 1: The UE repeats the scheduling requests on every available PUCCH as long as SR\_COUNTER < dsr-TransMax and there is UL data available for transmission and there are no resources available to transmit it. At the reception of first Scheduling Request from the UE, SS will be scheduled to transmit a grant after 100ms. Hence SS will receive 10 Scheduling Requests.  Note 2: In step 8, SR repetition of [63] times (*sr-TransMax* (64)) will take at least [63\*10 = 630] ms which is smaller than TA timer [infinity].  Note 3: The UE transmission of the MAC PDU ensures that the random access procedure was successful. | | | | | |

7.1.1.3.3.3.3 Specific message contents

Table 7.1.1.3.3.3.3-1: SchedulingRequestConfig (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestConfig ::= SEQUENCE { schedulingRequestToAddModList (SIZE(1..maxNrofSR-ConfigPerCellGroup)) OF SSchedulingRequestToAddMod { | 1 entry |  |  |
| SchedulingRequestToAddMod[1] SEQUENCE { |  | entry 1 |  |
| sr-TransMax | n64 | MAX Value |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.4 Correct handling of MAC control information / Buffer status / UL data arrive in the UE Tx buffer / Regular BSR

7.1.1.3.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UL data arrives in the UE transmission buffer and the data belongs to a logical channel with higher priority than those for which data is already available for transmission and the new logical channel and the existing logical channels belongs to the different LCG }

**then** { UE Reports a Long Buffer Status Reporting (BSR) }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UL data arrives in the UE transmission buffer and there is no data available for transmission for any of the logical channels which belong to a LCG }

**then** { UE Reports a Short Buffer Status Reporting (BSR) }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UL data arrives in the UE transmission buffer and the data belongs to a logical channel with higher priority than those for which data is already available for transmission and the new logical channel and existing logical channels belong to the same LCG }

**then** { UE Reports a Short Buffer Status Reporting (BSR) }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { retxBSR-Timer expires and only one LCG has data available for transmission }

**then** { UE triggers a regular BSR and Reports a Short Buffer Status Reporting (BSR) }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { a Regular BSR has been triggered and UE has pending data for transmission and UE has only resources to send either BSR report or data }

**then** { UE transmits the BSR report }

}

(6)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE determines that a BSR has been triggered since the last transmission of a BSR and UE has no UL resources allocated for new transmission for this TTI }

**then** { UE transmits a scheduling request }

}

(7)

Void.

(8)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { a Regular BSR has been triggered and UE has pending data on several logical channels for transmission and UE has UL resources to send all pending data including BSR }

**then** { UE transmits the UL data and reports buffer status reporting (BSR) that indicates there is no more data in the buffer }

}

7.1.1.3.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.5, 6.1.3.1, 6.2.1 and TS 38.323 clause 5.6. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.3.1.3]

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding.

[TS 38.321, clause 5.4.5]

The Buffer Status reporting (BSR) procedure is used to provide the serving gNB with information about UL data volume in the MAC entity.

RRC configures the following parameters to control the BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *logicalChannelSR-Delay*;

- *logicalChannelSR-DelayTimer*;

- *logicalChannelGroup*.

Each logical channel may be allocated to an LCG using the *logicalChannelGroup*. The maximum number of LCGs is eight.

The MAC entity determines the amount of UL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4].

A BSR shall be triggered if any of the following events occur:

- the MAC entity has new UL data available for a logical channel which belongs to an LCG; and either

- the new UL data belongs to a logical channel with higher priority than the priority of any logical channel containing available UL data which belong to any LCG; or

- none of the logical channels which belong to an LCG contains any available UL data.

in which case the BSR is referred below to as 'Regular BSR';

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC CE plus its subheader, in which case the BSR is referred below to as 'Padding BSR';

- *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains UL data, in which case the BSR is referred below to as 'Regular BSR';

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as 'Periodic BSR'.

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic BSR, the MAC entity shall:

1> if more than one LCG has data available for transmission when the BSR is to be transmitted:

2> report Long BSR for all LCGs which have data available for transmission.

1> else:

2> report Short BSR.

For Padding BSR:

1> if the number of padding bits is equal to or larger than the size of the Short BSR plus its subheader but smaller than the size of the Long BSR plus its subheader:

2> if more than one LCG has data available for transmission when the BSR is to be transmitted:

3> if the number of padding bits is equal to the size of the Short BSR plus its subheader:

4> report Short Truncated BSR of the LCG with the highest priority logical channel with data available for transmission.

3> else:

4> report Long Truncated BSR of the LCG(s) with the logical channels having data available for transmission following a decreasing order of priority, and in case of equal priority, in increasing order of LCGID.

2> else:

3> report Short BSR;

1> else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader:

2> report Long BSR for all LCGs which have data available for transmission.

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

A MAC PDU shall contain at most one BSR MAC CE, even when multiple events have triggered a BSR by the time. The Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of a grant for transmission of new data on any UL-SCH.

All triggered BSRs may be cancelled when the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the BSR MAC control element plus its subheader. All triggered BSRs shall be cancelled when a BSR is included in a MAC PDU for transmission.

The MAC entity shall transmit at most one BSR in one MAC PDU. Padding BSR shall not be included when the MAC PDU contains a Regular or Periodic BSR.

[TS 38.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC CEs consist of either:

- Short BSR format (fixed size); or

- Long BSR format (variable size); or

- Short Truncated BSR format (fixed size); or

- Long Truncated BSR format (variable size).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in Table 6.2.1-2.

The fields in the BSR MAC CE are defined as follows:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose buffer status is being reported. The length of the field is 3 bits;

- LCGi: For the Long BSR format, this field indicates the presence of the Buffer Size field for the logical channel group i. The LCGi field set to "1" indicates that the Buffer Size field for the logical channel group i is reported. The LCGi field set to "0" indicates that the Buffer Size field for the logical channel group i is not reported. For the Long Truncated BSR format, this field indicates whether logical channel group i has data available. The LCGi field set to "1" indicates that logical channel group i has data available. The LCGi field set to "0" indicates that logical channel group i does not have data available;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4] across all logical channels of a logical channel group after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field for the Short BSR format and the Short Truncated BSR format is 5 bits. The length of this field for the Long BSR format and the Long Truncated BSR format is 8 bits. The values for the 5-bit and 8-bit Buffer Size fields are shown in Tables 6.1.3.1-1 and 6.1.3.1-2, respectively. For the Long BSR format and the Long Truncated BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Long Truncated BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the Long Truncated BSR format can be zero.



Figure 6.1.3.1-1: Short BSR and Short Truncated BSR MAC CE



Figure 6.1.3.1-2: Long BSR and Long Truncated BSR MAC CE

Table 6.1.3.1-1: Buffer size levels (in bytes) for 5-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 8 | ≤ 102 | 16 | ≤ 1446 | 24 | ≤ 20516 |
| 1 | ≤ 10 | 9 | ≤ 142 | 17 | ≤ 2014 | 25 | ≤ 28581 |
| 2 | ≤ 14 | 10 | ≤ 198 | 18 | ≤ 2806 | 26 | ≤ 39818 |
| 3 | ≤ 20 | 11 | ≤ 276 | 19 | ≤ 3909 | 27 | ≤ 55474 |
| 4 | ≤ 28 | 12 | ≤ 384 | 20 | ≤ 5446 | 28 | ≤ 77284 |
| 5 | ≤ 38 | 13 | ≤ 535 | 21 | ≤ 7587 | 29 | ≤ 107669 |
| 6 | ≤ 53 | 14 | ≤ 745 | 22 | ≤ 10570 | 30 | ≤ 150000 |
| 7 | ≤ 74 | 15 | ≤ 1038 | 23 | ≤ 14726 | 31 | > 150000 |

Table 6.1.3.1-2: Buffer size levels (in bytes) for 8-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 64 | ≤ 560 | 128 | ≤ 31342 | 192 | ≤ 1754595 |
| 1 | ≤ 10 | 65 | ≤ 597 | 129 | ≤ 33376 | 193 | ≤ 1868488 |
| 2 | ≤ 11 | 66 | ≤ 635 | 130 | ≤ 35543 | 194 | ≤ 1989774 |
| 3 | ≤ 12 | 67 | ≤ 677 | 131 | ≤ 37850 | 195 | ≤ 2118933 |
| 4 | ≤ 13 | 68 | ≤ 720 | 132 | ≤ 40307 | 196 | ≤ 2256475 |
| 5 | ≤ 14 | 69 | ≤ 767 | 133 | ≤ 42923 | 197 | ≤ 2402946 |
| 6 | ≤ 15 | 70 | ≤ 817 | 134 | ≤ 45709 | 198 | ≤ 2558924 |
| 7 | ≤ 16 | 71 | ≤ 870 | 135 | ≤ 48676 | 199 | ≤ 2725027 |
| 8 | ≤ 17 | 72 | ≤ 926 | 136 | ≤ 51836 | 200 | ≤ 2901912 |
| 9 | ≤ 18 | 73 | ≤ 987 | 137 | ≤ 55200 | 201 | ≤ 3090279 |
| 10 | ≤ 19 | 74 | ≤ 1051 | 138 | ≤ 58784 | 202 | ≤ 3290873 |
| 11 | ≤ 20 | 75 | ≤ 1119 | 139 | ≤ 62599 | 203 | ≤ 3504487 |
| 12 | ≤ 22 | 76 | ≤ 1191 | 140 | ≤ 66663 | 204 | ≤ 3731968 |
| 13 | ≤ 23 | 77 | ≤ 1269 | 141 | ≤ 70990 | 205 | ≤ 3974215 |
| 14 | ≤ 25 | 78 | ≤ 1351 | 142 | ≤ 75598 | 206 | ≤ 4232186 |
| 15 | ≤ 26 | 79 | ≤ 1439 | 143 | ≤ 80505 | 207 | ≤ 4506902 |
| 16 | ≤ 28 | 80 | ≤ 1532 | 144 | ≤ 85730 | 208 | ≤ 4799451 |
| 17 | ≤ 30 | 81 | ≤ 1631 | 145 | ≤ 91295 | 209 | ≤ 5110989 |
| 18 | ≤ 32 | 82 | ≤ 1737 | 146 | ≤ 97221 | 210 | ≤ 5442750 |
| 19 | ≤ 34 | 83 | ≤ 1850 | 147 | ≤ 103532 | 211 | ≤ 5796046 |
| 20 | ≤ 36 | 84 | ≤ 1970 | 148 | ≤ 110252 | 212 | ≤ 6172275 |
| 21 | ≤ 38 | 85 | ≤ 2098 | 149 | ≤ 117409 | 213 | ≤ 6572925 |
| 22 | ≤ 40 | 86 | ≤ 2234 | 150 | ≤ 125030 | 214 | ≤ 6999582 |
| 23 | ≤ 43 | 87 | ≤ 2379 | 151 | ≤ 133146 | 215 | ≤ 7453933 |
| 24 | ≤ 46 | 88 | ≤ 2533 | 152 | ≤ 141789 | 216 | ≤ 7937777 |
| 25 | ≤ 49 | 89 | ≤ 2698 | 153 | ≤ 150992 | 217 | ≤ 8453028 |
| 26 | ≤ 52 | 90 | ≤ 2873 | 154 | ≤ 160793 | 218 | ≤ 9001725 |
| 27 | ≤ 55 | 91 | ≤ 3059 | 155 | ≤ 171231 | 219 | ≤ 9586039 |
| 28 | ≤ 59 | 92 | ≤ 3258 | 156 | ≤ 182345 | 220 | ≤ 10208280 |
| 29 | ≤ 62 | 93 | ≤ 3469 | 157 | ≤ 194182 | 221 | ≤ 10870913 |
| 30 | ≤ 66 | 94 | ≤ 3694 | 158 | ≤ 206786 | 222 | ≤ 11576557 |
| 31 | ≤ 71 | 95 | ≤ 3934 | 159 | ≤ 220209 | 223 | ≤ 12328006 |
| 32 | ≤ 75 | 96 | ≤ 4189 | 160 | ≤ 234503 | 224 | ≤ 13128233 |
| 33 | ≤ 80 | 97 | ≤ 4461 | 161 | ≤ 249725 | 225 | ≤ 13980403 |
| 34 | ≤ 85 | 98 | ≤ 4751 | 162 | ≤ 265935 | 226 | ≤ 14887889 |
| 35 | ≤ 91 | 99 | ≤ 5059 | 163 | ≤ 283197 | 227 | ≤ 15854280 |
| 36 | ≤ 97 | 100 | ≤ 5387 | 164 | ≤ 301579 | 228 | ≤ 16883401 |
| 37 | ≤ 103 | 101 | ≤ 5737 | 165 | ≤ 321155 | 229 | ≤ 17979324 |
| 38 | ≤ 110 | 102 | ≤ 6109 | 166 | ≤ 342002 | 230 | ≤ 19146385 |
| 39 | ≤ 117 | 103 | ≤ 6506 | 167 | ≤ 364202 | 231 | ≤ 20389201 |
| 40 | ≤ 124 | 104 | ≤ 6928 | 168 | ≤ 387842 | 232 | ≤ 21712690 |
| 41 | ≤ 132 | 105 | ≤ 7378 | 169 | ≤ 413018 | 233 | ≤ 23122088 |
| 42 | ≤ 141 | 106 | ≤ 7857 | 170 | ≤ 439827 | 234 | ≤ 24622972 |
| 43 | ≤ 150 | 107 | ≤ 8367 | 171 | ≤ 468377 | 235 | ≤ 26221280 |
| 44 | ≤ 160 | 108 | ≤ 8910 | 172 | ≤ 498780 | 236 | ≤ 27923336 |
| 45 | ≤ 170 | 109 | ≤ 9488 | 173 | ≤ 531156 | 237 | ≤ 29735875 |
| 46 | ≤ 181 | 110 | ≤ 10104 | 174 | ≤ 565634 | 238 | ≤ 31666069 |
| 47 | ≤ 193 | 111 | ≤ 10760 | 175 | ≤ 602350 | 239 | ≤ 33721553 |
| 48 | ≤ 205 | 112 | ≤ 11458 | 176 | ≤ 641449 | 240 | ≤ 35910462 |
| 49 | ≤ 218 | 113 | ≤ 12202 | 177 | ≤ 683087 | 241 | ≤ 38241455 |
| 50 | ≤ 233 | 114 | ≤ 12994 | 178 | ≤ 727427 | 242 | ≤ 40723756 |
| 51 | ≤ 248 | 115 | ≤ 13838 | 179 | ≤ 774645 | 243 | ≤ 43367187 |
| 52 | ≤ 264 | 116 | ≤ 14736 | 180 | ≤ 824928 | 244 | ≤ 46182206 |
| 53 | ≤ 281 | 117 | ≤ 15692 | 181 | ≤ 878475 | 245 | ≤ 49179951 |
| 54 | ≤ 299 | 118 | ≤ 16711 | 182 | ≤ 935498 | 246 | ≤ 52372284 |
| 55 | ≤ 318 | 119 | ≤ 17795 | 183 | ≤ 996222 | 247 | ≤ 55771835 |
| 56 | ≤ 339 | 120 | ≤ 18951 | 184 | ≤ 1060888 | 248 | ≤ 59392055 |
| 57 | ≤ 361 | 121 | ≤ 20181 | 185 | ≤ 1129752 | 249 | ≤ 63247269 |
| 58 | ≤ 384 | 122 | ≤ 21491 | 186 | ≤ 1203085 | 250 | ≤ 67352729 |
| 59 | ≤ 409 | 123 | ≤ 22885 | 187 | ≤ 1281179 | 251 | ≤ 71724679 |
| 60 | ≤ 436 | 124 | ≤ 24371 | 188 | ≤ 1364342 | 252 | ≤ 76380419 |
| 61 | ≤ 464 | 125 | ≤ 25953 | 189 | ≤ 1452903 | 253 | ≤ 81338368 |
| 62 | ≤ 494 | 126 | ≤ 27638 | 190 | ≤ 1547213 | 254 | > 81338368 |
| 63 | ≤ 526 | 127 | ≤ 29431 | 191 | ≤ 1647644 | 255 | Reserved |

[TS 38.321, clause 6.2.1]

Table 6.2.1-2 Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 000000 | CCCH |
| 000001–100000 | Identity of the logical channel |
| 100001–110110 | Reserved |
| 110111 | Configured Grant Confirmation |
| 111000 | Multiple Entry PHR |
| 111001 | Single Entry PHR |
| 111010 | C-RNTI |
| 111011 | Short Truncated BSR |
| 111100 | Long Truncated BSR |
| 111101 | Short BSR |
| 111110 | Long BSR |
| 111111 | Padding |

[TS 38.323, clause 5.6]

For the purpose of MAC buffer status reporting, the transmitting PDCP entity shall consider the following as PDCP data volume:

- the PDCP SDUs for which no PDCP Data PDUs have been constructed;

- the PDCP Data PDUs that have not been submitted to lower layers;

- the PDCP Control PDUs;

- for AM DRBs, the PDCP SDUs to be retransmitted according to subclause 5.1.2;

- for AM DRBs, the PDCP Data PDUs to be retransmitted according to subclause 5.5.

[TS 38.322, clause 5.5]For the purpose of MAC buffer status reporting, the UE shall consider the following as RLC data volume:

- RLC SDUs and RLC SDU segments that have not yet been included in an RLC data PDU;

- RLC data PDUs that are pending for initial transmission;

- RLC data PDUs that are pending for retransmission (RLC AM).

In addition, if a STATUS PDU has been triggered and *t-StatusProhibit* is not running or has expired, the UE shall estimate the size of the STATUS PDU that will be transmitted in the next transmission opportunity, and consider this as part of RLC data volume.

7.1.1.3.4.3 Test description

7.1.1.3.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 AM DRBs on NR cell configured according to Table 7.1.1.3.4.3.1-1.

Table 7.1.1.3.4.3.1-1: Logical Channel Configuration Settings

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value DRB1 | Value DRB2 | Value DRB3 |
| LogicalChannelIdentity | LCH4((DRB-Identity +3) | LCH5(DRB-Identity +3) | LCH6(DRB-Identity +3) |
| Priority | 8 | 7 | 6 |
| prioritizedBitRate | 0 kB/s | 0 kB/s | 0 kB/s |
| logicalChannelGroup | 2 (LCG ID#2) | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.4.3.2 Test procedure sequence

Table 7.1.1.3.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | The SS transmits a MAC PDU containing two RLC SDUs of size 12 bytes on LCH4 | <-- | MAC PDU (2 RLC SDUs on LCH4) | - | - |
| 3 | SS allocates an UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 4 | Check: Does the UE transmit a Short BSR with ‘LCG ID’ field set to ‘2’ and ‘Buffer size’ field set to value ‘4’ or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID=‘2’, Buffer Size=’4’ or bigger)) | 2,5 | P |
| 5 | Wait for retxBSR-Timer expiry on UE side. | - | - | - | - |
| 6 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 7 | The SS responds to the scheduling request in step 6 by an UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 8 | Check: Does the UE transmit a Short BSR with ‘LCG ID’ field set to ‘2’ and ‘Buffer size’ field set to value ‘4’ or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID=‘2’, Buffer Size=’4’ or bigger)) | 4,5 | P |
| 9 | The SS transmits a MAC PDU containing one RLC SDU of size 12 bytes on LCH5 | <-- | MAC PDU (1 RLC SDU on LCH5) | - | - |
| 10 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 11 | The SS respond to the scheduling request in step 10 by an UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 12 | Check: Does the UE transmit a Short BSR with ‘LCG ID’ field set to ‘2’ and ‘Buffer size#1’ field set to value ‘5’ or bigger? (Note 2) | --> | MAC PDU (MAC Short BSR (LCG ID=‘2’, Buffer Size=’5’ or bigger)) | 3,5 | P |
| 13 | The SS transmits a MAC PDU containing two RLC SDUs of size 5 bytes on LCH6 | <-- | MAC PDU (2 RLC SDUs on LCH6) | - | - |
| 14 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 15 | The SS responds to the scheduling request in step 14 by one UL Grant of 40 bits. (Note 1) | <-- | (UL Grant, 40 bits) | - | - |
| 16 | Check: Does the UE transmit a Long BSR with ‘Buffer size#1’ field set to value ‘1’, ‘Buffer size#2’ field set to value ‘20’ or bigger? (Note 3) | --> | MAC PDU (MAC Long BSR (Buffer size#1=’1’ or bigger, Buffer size#2=’20’ or bigger) | 1,5 | P |
| 17 | Wait for retxBSR-Timer expiry on the UE side. | - |  | - | - |
| 18 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 6 | P |
| 19 | SS allocates an UL Grant of 608 bits. (Note 4) | <-- | (UL Grant, 608 bits) | - | - |
| 20 | Check: Does the UE transmit a MAC PDU including five RLC SDUs and BSR? (Note 5) | --> | MAC PDU (17-Byte 2 MAC sub PDUs from LCH4, 17-Byte 1 MAC sub PDU from LCH5 and 10-Byte 2 MAC Sub PDUs from LCH6) | - | - |
| 21 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=’000100’) | <-- | RLC STATUS PDU (ACK\_SN=2) | - | - |
| 22 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=’000101’) | <-- | RLC STATUS PDU (ACK\_SN=1) | - | - |
| 23 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=’000110’) | <-- | RLC STATUS PDU (ACK\_SN=2) | - | - |
| 24 | The SS transmits a MAC PDU containing two MAC SDUs, the first containing a 8 byte RLC SDU with LCID set to LCH4 and the second containing a 7 byte RLC SDU with LCID set to LCH6. | <-- | MAC PDU | - | - |
| 25 | The UE sends Scheduling Request | --> | (SR) | - | - |
| 26 | The SS transmits an uplink grant of size 256 bits. (Note 6) | <-- | (UL grant, 256 bits) | - | - |
| 27 | Check: Does the UE return a MAC PDU of length 256 bits including RLC SDUs, Padding and Short BSR or LongBSR with Buffer size(s) set to ‘0’? (Note 5) | --> | MAC PDU (13-Byte MAC Sub PDU from LC 4 and 12-Byte MAC Sub PDU from LCH6 and 5-Byte MAC Sub PDU containing Long BSR and 2-Byte MAC Sub PDU containing Padding)  Or  MAC PDU (13-Byte MAC Sub PDU from LCH4 and 12-Byte MAC Sub PDU from LCH6 and 2-Byte MAC Sub PDU containing short BSR and 5-Byte MAC Sub PDU containing Padding) | 8 | P |
| 28 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=LCH4) | <-- | RLC STATUS PDU (ACK\_SN=3) | - | - |
| 29 | SS transmits an RLC STATUS PDU to acknowledge correctly received data(LCID=LCH6) | <-- | RLC STATUS PDU (ACK\_SN=3) | - | - |
| Note 1: 40 bits enables UE to transmit a MAC PDU with a 1 byte MAC BSR header and a Short BSR (1 byte) or a 2 bytes MAC BSR header and a Long BSR (3 bytes with 2 LCG configured).  Note 2: UE triggers a Short BSR of type "Regular BSR" to report buffer status for one LCG for that TTI. The UE should not send any of the received RLC SDUs (segmented) due to Regular BSR has higher priority than U-plane logical channels.  Note 3: UE triggers and transmit a Long BSR of type "Regular BSR". The UL grant would be enough for UE to transmit one RLC SDU as received in step 8, but Regular BSR has higher priority than U-plane logical channels.  Note 4: The UE has 46 bytes of RLC SDU data (received in steps 2, 9 and 13) in the transmission buffer.608 bits enables UE to transmit user data in MAC PDU 2 RLC SDUs of 12 bytes on LCH4, each 3 Bytes RLC Header and 2 Bytes MAC Header resulting in 2 MAC Sub PDUs of 17 Bytes Each. Similarly one 17 Bytes MAC Sub PDU for 12 Bytes RLC SDU on LCH5. Two 5 Bytes RLC SDUs on LCH6 with 3 Bytes RLC header each and 2 Bytes MAC header each, will result in 2 MAC sub PDUs of 10 bytes each. Total comes to 17+17+17+10+10 +3 B LongBSR(2 Bytes LongBSR header + 1 Byte LongBSR) + 2 B padding =76 Bytes.  Note 5: The MAC SDUs for the different logical channels may be in any order in the MAC PDU.  Note 6: UL grant of 256 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to enable UE to transmit two MAC SDUs of size 11 and 10 bytes in a MAC PDU (8 bytes RLC SDU + 3 bytes AMD PDU header +2 Bytes MAC sub Header + 7 bytes RLC SDU+ 3 bytes AMD PDU header+2 Bytes MAC sub Header + 2 Bytes Long BSR MAC Sub Header + 3 Bytes Long BSR + 2 Bytes MAC Padding Sub PDU) or (8 bytes RLC SDU + 3 bytes AMD PDU header +2 Bytes MAC sub Header + 7 bytes RLC SDU+ 3 bytes AMD PDU header+2 Bytes MAC sub Header + 1 Byte Short BSR MAC Sub Header + 1 Byte Short BSR + 7 Bytes MAC Padding Sub PDU) = 32 Bytes | | | | | |

7.1.1.3.4.3.3 Specific message contents

Table 7.1.1.3.4.3.3: MAC-CellGroupConfig (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], clause Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | infinity |  |  |
| retxBSR-Timer | sf320 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.5 Correct handling of MAC control information / Buffer Status / UL resources are allocated / Padding BSR

7.1.1.3.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is equal to the size of a Short BSR plus its subheader and the UE has available data for transmission from more than one LCG in the TTI where the BSR is transmitted }

**then** { UE reports a Truncated short BSR of the LCG with the highest priority logical channel with data available for transmission }

}

(2)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is larger than the size of a Short BSR plus its subheader but smaller than the size of a Long BSR plus its subheader and the UE has available data for transmission from more than one LCG in the TTI where the BSR is transmitted }

**then** { UE reports a Truncated long BSR }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is equal to or larger than the size of a Short BSR plus its subheader but smaller than the size of a Long BSR plus its subheader and the UE has available data for transmission from only one LCG in the TTI where the BSR is transmitted }

**then** { UE reports a Short BSR }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE transmits a MAC PDU and the number of padding bits is equal to or larger than the size of a Long BSR plus its subheader }

**then** { UE reports a long BSR }

}

7.1.1.3.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.5, 6.1.3.1 and 6.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.5]

The Buffer Status reporting (BSR) procedure is used to provide the serving gNB with information about UL data volume in the MAC entity.

RRC configures the following parameters to control the BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *logicalChannelSR-Delay*;

- *logicalChannelSR-DelayTimer*;

- *logicalChannelGroup*.

Each logical channel may be allocated to an LCG using the *logicalChannelGroup*. The maximum number of LCGs is eight.

The MAC entity determines the amount of UL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4].

A BSR shall be triggered if any of the following events occur:

- the MAC entity has new UL data available for a logical channel which belongs to an LCG; and either

- the new UL data belongs to a logical channel with higher priority than the priority of any logical channel containing available UL data which belong to any LCG; or

- none of the logical channels which belong to an LCG contains any available UL data.

in which case the BSR is referred below to as 'Regular BSR';

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC CE plus its subheader, in which case the BSR is referred below to as 'Padding BSR';

- *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains UL data, in which case the BSR is referred below to as 'Regular BSR';

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as 'Periodic BSR'.

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic BSR, the MAC entity shall:

1> if more than one LCG has data available for transmission when the BSR is to be transmitted:

2> report Long BSR for all LCGs which have data available for transmission.

1> else:

2> report Short BSR.

For Padding BSR:

1> if the number of padding bits is equal to or larger than the size of the Short BSR plus its subheader but smaller than the size of the Long BSR plus its subheader:

2> if more than one LCG has data available for transmission when the BSR is to be transmitted:

3> if the number of padding bits is equal to the size of the Short BSR plus its subheader:

4> report Short Truncated BSR of the LCG with the highest priority logical channel with data available for transmission.

3> else:

4> report Long Truncated BSR of the LCG(s) with the logical channels having data available for transmission following a decreasing order of priority, and in case of equal priority, in increasing order of LCGID.

2> else:

3> report Short BSR;

1> else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader:

2> report Long BSR for all LCGs which have data available for transmission.

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

A MAC PDU shall contain at most one BSR MAC CE, even when multiple events have triggered a BSR by the time. The Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of a grant for transmission of new data on any UL-SCH.

All triggered BSRs may be cancelled when the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the BSR MAC control element plus its subheader. All triggered BSRs shall be cancelled when a BSR is included in a MAC PDU for transmission.

The MAC entity shall transmit at most one BSR in one MAC PDU. Padding BSR shall not be included when the MAC PDU contains a Regular or Periodic BSR.

[TS 38.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC CEs consist of either:

- Short BSR format (fixed size); or

- Long BSR format (variable size); or

- Short Truncated BSR format (fixed size); or

- Long Truncated BSR format (variable size).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in Table 6.2.1-2.

The fields in the BSR MAC CE are defined as follows:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose buffer status is being reported. The length of the field is 3 bits;

- LCGi: For the Long BSR format, this field indicates the presence of the Buffer Size field for the logical channel group i. The LCGi field set to "1" indicates that the Buffer Size field for the logical channel group i is reported. The LCGi field set to "0" indicates that the Buffer Size field for the logical channel group i is not reported. For the Long Truncated BSR format, this field indicates whether logical channel group i has data available. The LCGi field set to "1" indicates that logical channel group i has data available. The LCGi field set to "0" indicates that logical channel group i does not have data available;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4] across all logical channels of a logical channel group after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field for the Short BSR format and the Short Truncated BSR format is 5 bits. The length of this field for the Long BSR format and the Long Truncated BSR format is 8 bits. The values for the 5-bit and 8-bit Buffer Size fields are shown in Tables 6.1.3.1-1 and 6.1.3.1-2, respectively. For the Long BSR format and the Long Truncated BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Long Truncated BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the Long Truncated BSR format can be zero.



Figure 6.1.3.1-1: Short BSR and Short Truncated BSR MAC CE



Figure 6.1.3.1-2: Long BSR and Long Truncated BSR MAC CE

Table 6.1.3.1-1: Buffer size levels (in bytes) for 5-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 8 | ≤ 102 | 16 | ≤ 1446 | 24 | ≤ 20516 |
| 1 | ≤ 10 | 9 | ≤ 142 | 17 | ≤ 2014 | 25 | ≤ 28581 |
| 2 | ≤ 14 | 10 | ≤ 198 | 18 | ≤ 2806 | 26 | ≤ 39818 |
| 3 | ≤ 20 | 11 | ≤ 276 | 19 | ≤ 3909 | 27 | ≤ 55474 |
| 4 | ≤ 28 | 12 | ≤ 384 | 20 | ≤ 5446 | 28 | ≤ 77284 |
| 5 | ≤ 38 | 13 | ≤ 535 | 21 | ≤ 7587 | 29 | ≤ 107669 |
| 6 | ≤ 53 | 14 | ≤ 745 | 22 | ≤ 10570 | 30 | ≤ 150000 |
| 7 | ≤ 74 | 15 | ≤ 1038 | 23 | ≤ 14726 | 31 | > 150000 |

Table 6.1.3.1-2: Buffer size levels (in bytes) for 8-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 64 | ≤ 560 | 128 | ≤ 31342 | 192 | ≤ 1754595 |
| 1 | ≤ 10 | 65 | ≤ 597 | 129 | ≤ 33376 | 193 | ≤ 1868488 |
| 2 | ≤ 11 | 66 | ≤ 635 | 130 | ≤ 35543 | 194 | ≤ 1989774 |
| 3 | ≤ 12 | 67 | ≤ 677 | 131 | ≤ 37850 | 195 | ≤ 2118933 |
| 4 | ≤ 13 | 68 | ≤ 720 | 132 | ≤ 40307 | 196 | ≤ 2256475 |
| 5 | ≤ 14 | 69 | ≤ 767 | 133 | ≤ 42923 | 197 | ≤ 2402946 |
| 6 | ≤ 15 | 70 | ≤ 817 | 134 | ≤ 45709 | 198 | ≤ 2558924 |
| 7 | ≤ 16 | 71 | ≤ 870 | 135 | ≤ 48676 | 199 | ≤ 2725027 |
| 8 | ≤ 17 | 72 | ≤ 926 | 136 | ≤ 51836 | 200 | ≤ 2901912 |
| 9 | ≤ 18 | 73 | ≤ 987 | 137 | ≤ 55200 | 201 | ≤ 3090279 |
| 10 | ≤ 19 | 74 | ≤ 1051 | 138 | ≤ 58784 | 202 | ≤ 3290873 |
| 11 | ≤ 20 | 75 | ≤ 1119 | 139 | ≤ 62599 | 203 | ≤ 3504487 |
| 12 | ≤ 22 | 76 | ≤ 1191 | 140 | ≤ 66663 | 204 | ≤ 3731968 |
| 13 | ≤ 23 | 77 | ≤ 1269 | 141 | ≤ 70990 | 205 | ≤ 3974215 |
| 14 | ≤ 25 | 78 | ≤ 1351 | 142 | ≤ 75598 | 206 | ≤ 4232186 |
| 15 | ≤ 26 | 79 | ≤ 1439 | 143 | ≤ 80505 | 207 | ≤ 4506902 |
| 16 | ≤ 28 | 80 | ≤ 1532 | 144 | ≤ 85730 | 208 | ≤ 4799451 |
| 17 | ≤ 30 | 81 | ≤ 1631 | 145 | ≤ 91295 | 209 | ≤ 5110989 |
| 18 | ≤ 32 | 82 | ≤ 1737 | 146 | ≤ 97221 | 210 | ≤ 5442750 |
| 19 | ≤ 34 | 83 | ≤ 1850 | 147 | ≤ 103532 | 211 | ≤ 5796046 |
| 20 | ≤ 36 | 84 | ≤ 1970 | 148 | ≤ 110252 | 212 | ≤ 6172275 |
| 21 | ≤ 38 | 85 | ≤ 2098 | 149 | ≤ 117409 | 213 | ≤ 6572925 |
| 22 | ≤ 40 | 86 | ≤ 2234 | 150 | ≤ 125030 | 214 | ≤ 6999582 |
| 23 | ≤ 43 | 87 | ≤ 2379 | 151 | ≤ 133146 | 215 | ≤ 7453933 |
| 24 | ≤ 46 | 88 | ≤ 2533 | 152 | ≤ 141789 | 216 | ≤ 7937777 |
| 25 | ≤ 49 | 89 | ≤ 2698 | 153 | ≤ 150992 | 217 | ≤ 8453028 |
| 26 | ≤ 52 | 90 | ≤ 2873 | 154 | ≤ 160793 | 218 | ≤ 9001725 |
| 27 | ≤ 55 | 91 | ≤ 3059 | 155 | ≤ 171231 | 219 | ≤ 9586039 |
| 28 | ≤ 59 | 92 | ≤ 3258 | 156 | ≤ 182345 | 220 | ≤ 10208280 |
| 29 | ≤ 62 | 93 | ≤ 3469 | 157 | ≤ 194182 | 221 | ≤ 10870913 |
| 30 | ≤ 66 | 94 | ≤ 3694 | 158 | ≤ 206786 | 222 | ≤ 11576557 |
| 31 | ≤ 71 | 95 | ≤ 3934 | 159 | ≤ 220209 | 223 | ≤ 12328006 |
| 32 | ≤ 75 | 96 | ≤ 4189 | 160 | ≤ 234503 | 224 | ≤ 13128233 |
| 33 | ≤ 80 | 97 | ≤ 4461 | 161 | ≤ 249725 | 225 | ≤ 13980403 |
| 34 | ≤ 85 | 98 | ≤ 4751 | 162 | ≤ 265935 | 226 | ≤ 14887889 |
| 35 | ≤ 91 | 99 | ≤ 5059 | 163 | ≤ 283197 | 227 | ≤ 15854280 |
| 36 | ≤ 97 | 100 | ≤ 5387 | 164 | ≤ 301579 | 228 | ≤ 16883401 |
| 37 | ≤ 103 | 101 | ≤ 5737 | 165 | ≤ 321155 | 229 | ≤ 17979324 |
| 38 | ≤ 110 | 102 | ≤ 6109 | 166 | ≤ 342002 | 230 | ≤ 19146385 |
| 39 | ≤ 117 | 103 | ≤ 6506 | 167 | ≤ 364202 | 231 | ≤ 20389201 |
| 40 | ≤ 124 | 104 | ≤ 6928 | 168 | ≤ 387842 | 232 | ≤ 21712690 |
| 41 | ≤ 132 | 105 | ≤ 7378 | 169 | ≤ 413018 | 233 | ≤ 23122088 |
| 42 | ≤ 141 | 106 | ≤ 7857 | 170 | ≤ 439827 | 234 | ≤ 24622972 |
| 43 | ≤ 150 | 107 | ≤ 8367 | 171 | ≤ 468377 | 235 | ≤ 26221280 |
| 44 | ≤ 160 | 108 | ≤ 8910 | 172 | ≤ 498780 | 236 | ≤ 27923336 |
| 45 | ≤ 170 | 109 | ≤ 9488 | 173 | ≤ 531156 | 237 | ≤ 29735875 |
| 46 | ≤ 181 | 110 | ≤ 10104 | 174 | ≤ 565634 | 238 | ≤ 31666069 |
| 47 | ≤ 193 | 111 | ≤ 10760 | 175 | ≤ 602350 | 239 | ≤ 33721553 |
| 48 | ≤ 205 | 112 | ≤ 11458 | 176 | ≤ 641449 | 240 | ≤ 35910462 |
| 49 | ≤ 218 | 113 | ≤ 12202 | 177 | ≤ 683087 | 241 | ≤ 38241455 |
| 50 | ≤ 233 | 114 | ≤ 12994 | 178 | ≤ 727427 | 242 | ≤ 40723756 |
| 51 | ≤ 248 | 115 | ≤ 13838 | 179 | ≤ 774645 | 243 | ≤ 43367187 |
| 52 | ≤ 264 | 116 | ≤ 14736 | 180 | ≤ 824928 | 244 | ≤ 46182206 |
| 53 | ≤ 281 | 117 | ≤ 15692 | 181 | ≤ 878475 | 245 | ≤ 49179951 |
| 54 | ≤ 299 | 118 | ≤ 16711 | 182 | ≤ 935498 | 246 | ≤ 52372284 |
| 55 | ≤ 318 | 119 | ≤ 17795 | 183 | ≤ 996222 | 247 | ≤ 55771835 |
| 56 | ≤ 339 | 120 | ≤ 18951 | 184 | ≤ 1060888 | 248 | ≤ 59392055 |
| 57 | ≤ 361 | 121 | ≤ 20181 | 185 | ≤ 1129752 | 249 | ≤ 63247269 |
| 58 | ≤ 384 | 122 | ≤ 21491 | 186 | ≤ 1203085 | 250 | ≤ 67352729 |
| 59 | ≤ 409 | 123 | ≤ 22885 | 187 | ≤ 1281179 | 251 | ≤ 71724679 |
| 60 | ≤ 436 | 124 | ≤ 24371 | 188 | ≤ 1364342 | 252 | ≤ 76380419 |
| 61 | ≤ 464 | 125 | ≤ 25953 | 189 | ≤ 1452903 | 253 | ≤ 81338368 |
| 62 | ≤ 494 | 126 | ≤ 27638 | 190 | ≤ 1547213 | 254 | > 81338368 |
| 63 | ≤ 526 | 127 | ≤ 29431 | 191 | ≤ 1647644 | 255 | Reserved |

[TS 38.321, clause 6.2.1]

Table 6.2.1-2: Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 000000 | CCCH |
| 000001–100000 | Identity of the logical channel |
| 100001–110110 | Reserved |
| 110111 | Configured Grant Confirmation |
| 111000 | Multiple Entry PHR |
| 111001 | Single Entry PHR |
| 111010 | C-RNTI |
| 111011 | Short Truncated BSR |
| 111100 | Long Truncated BSR |
| 111101 | Short BSR |
| 111110 | Long BSR |
| 111111 | Padding |

7.1.1.3.5.3 Test description

7.1.1.3.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 2 AM DRBs on NR cell configured according to Table 7.1.1.3.5.3.1-1.

Table 7.1.1.3.5.3.1-1: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.5.3.2 Test procedure sequence

Table 7.1.1.3.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| - | EXCEPTION: Step 2 shall be repeated for 3 times | - | - | - | - |
| 2 | The SS transmits a MAC PDU including an RLC PDU of size 13 bytes on LCH5. | <-- | MAC PDU (RLC SDU on LCH5) | - | - |
| 3 | The SS transmits a MAC PDU including an RLC PDU of size 12 bytes on LCH4. | <-- | MAC PDU (RLC SDU on LCH4) | - | - |
| 4 | UE transmits a Scheduling Request on PUCCH. | --> | (SR) | - | - |
| 5 | The SS sends an uplink grant of size 40 bits. (Note 1) | <-- | (UL grant) | - | - |
| 6 | The UE transmit a Long BSR report. | --> | MAC PDU (Long BSR header (LCID=’ 111110’), Long BSR) | - | - |
| 7 | The SS sends an uplink grant of size 136 bits. (Note 2) | <-- | (UL grant) | - | - |
| 8 | Check: Does UE transmit a MAC PDU containing an RLC SDU and a short truncated BSR indicating pending data (‘Buffer size’ field > ‘0’) for logicalChannelGroup 1 (‘LCG ID’ field set to ‘01’)? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, short truncated BSR header (LCID=’ 111011’), short truncatedBSR(LCG ID =’01’, Buffer size>’0’)) | 1 | P |
| 9 | The SS sends an uplink grant of size 152 bits. (Note 3) | <-- | (UL grant) | - | - |
| 10 | Check: Does UE transmit a MAC PDU containing an RLC SDU and a long truncated BSR indicating pending data available for LCG1 and LCG2 and ‘Buffer size’ field > ‘0’ for logicalChannelGroup 1? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, long truncated BSR header (LCID=’ 111100’), long truncatedBSR( LCG1=1, LCG2=1, Buffer size1>’0’)) | 2 | P |
| 11 | The SS sends an uplink grant of size 136 bits.  (Note 4) | <-- | (UL grant) | - | - |
| 12 | Check: Does UE transmit a MAC PDU containing an RLC SDU and with a Short BSR indicating pending data (‘Buffer size’ field > ‘0’) for logicalChannelGroup 2 (‘LCG ID’ field =’10’)? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, Short BSR header(LCID=’11101’), Short BSR(LCG ID =’10’,Buffer size>’0’)) | 3 | P |
| 12A | SS transmits an RLC STATUS PDU to acknowledge correctly received data (LCID=LCH5) | <-- | RLC STATUS PDU (ACK\_SN=3) | - | - |
| 13 | The SS sends an uplink grant of size 160 bits. (Note 5) | <-- | (UL grant) | - | - |
| 14 | Check: Does UE transmit a MAC PDU containing a RLC SDU and a Long BSR? | --> | MAC PDU (MAC sub PDU header for RLC PDU, RLC PDU, Long BSR header (LCID=’11110’), Long BSR)) | 4 | P |
| 15 | SS transmits an RLC STATUS PDU to acknowledge correctly received data (LCID=LCH4) | <-- | RLC STATUS PDU (ACK\_SN=1) | - | - |
| Note 1: 40 bits (LRBs & IMCS as per 38.523-3[3] annex B) enables UE to transmit a MAC PDU with a MAC BSR header (1 byte) and a Short BSR (1 byte) or a MAC BSR header (2 bytes) a Long BSR (3 bytes when 2 LCG configured).  Note 2: UE triggers a truncated Short BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 13 Bytes MAC SDU + 1 Byte Short truncated BSR sub header + 1 Byte Short truncated BSR = 17 bytes)  Note 3: UE triggers a truncated Long BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 13 Bytes MAC SDU + 2 Bytes Long truncated BSR sub header + 2 Bytes Long truncated BSR = 19 bytes)  Note 4: UE triggers a Short BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 13 Bytes MAC SDU + 1 Byte Short BSR sub header + 1 Byte short BSR = 17 bytes)  Note 5: UE triggers a long BSR of type "Padding BSR" to report buffer status for one LCG for that TTI. (2 Bytes MAC Data sub PDU header + 12 Bytes MAC SDU + 2 Bytes long BSR sub header + 1 Byte long BSR + 1 byte Padding sub header + 2 bytes Padding = 20 bytes) | | | | | |

7.1.1.3.5.3.3 Specific message contents

None

##### 7.1.1.3.6 Correct handling of MAC control information / Buffer status / Periodic BSR timer expires

7.1.1.3.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { periodicBSR-Timer expires and more than one LCG has buffered data }

**then** { UE triggers a Periodic BSR and reports Long BSR and restarts the periodicBSR-Timer }

}

(2)

**with** { UE in E-UTRA RRC\_CONNECTED state }

**ensure that** {

**when** { periodicBSR-Timer expires and one LCG has buffered data }

**then** { UE triggers a Periodic BSR and reports Short BSR and restarts the periodicBSR-Timer }

}

7.1.1.3.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.5, 6.1.3.1 and 6.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.5]

The Buffer Status reporting (BSR) procedure is used to provide the serving gNB with information about UL data volume in the MAC entity.

RRC configures the following parameters to control the BSR:

- *periodicBSR-Timer*;

- *retxBSR-Timer*;

- *logicalChannelSR-Delay*;

- *logicalChannelSR-DelayTimer*;

- *logicalChannelGroup*.

Each logical channel may be allocated to an LCG using the *logicalChannelGroup*. The maximum number of LCGs is eight.

The MAC entity determines the amount of UL data available for a logical channel according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4].

A BSR shall be triggered if any of the following events occur:

- the MAC entity has new UL data available for a logical channel which belongs to an LCG; and either

- the new UL data belongs to a logical channel with higher priority than the priority of any logical channel containing available UL data which belong to any LCG; or

- none of the logical channels which belong to an LCG contains any available UL data.

in which case the BSR is referred below to as 'Regular BSR';

- UL resources are allocated and number of padding bits is equal to or larger than the size of the Buffer Status Report MAC CE plus its subheader, in which case the BSR is referred below to as 'Padding BSR';

- *retxBSR-Timer* expires, and at least one of the logical channels which belong to an LCG contains UL data, in which case the BSR is referred below to as 'Regular BSR';

- *periodicBSR-Timer* expires, in which case the BSR is referred below to as 'Periodic BSR'.

For Regular BSR, the MAC entity shall:

1> if the BSR is triggered for a logical channel for which *logicalChannelSR-Delay* is configured by upper layers:

2> start or restart the *logicalChannelSR-DelayTimer*.

1> else:

2> if running, stop the *logicalChannelSR-DelayTimer*.

For Regular and Periodic BSR, the MAC entity shall:

1> if more than one LCG has data available for transmission when the BSR is to be transmitted:

2> report Long BSR for all LCGs which have data available for transmission.

1> else:

2> report Short BSR.

For Padding BSR:

1> if the number of padding bits is equal to or larger than the size of the Short BSR plus its subheader but smaller than the size of the Long BSR plus its subheader:

2> if more than one LCG has data available for transmission when the BSR is to be transmitted:

3> if the number of padding bits is equal to the size of the Short BSR plus its subheader:

4> report Short Truncated BSR of the LCG with the highest priority logical channel with data available for transmission.

3> else:

4> report Long Truncated BSR of the LCG(s) with the logical channels having data available for transmission following a decreasing order of priority, and in case of equal priority, in increasing order of LCGID.

2> else:

3> report Short BSR;

1> else if the number of padding bits is equal to or larger than the size of the Long BSR plus its subheader:

2> report Long BSR for all LCGs which have data available for transmission.

The MAC entity shall:

1> if the Buffer Status reporting procedure determines that at least one BSR has been triggered and not cancelled:

2> if UL-SCH resources are available for a new immediate transmission:

3> instruct the Multiplexing and Assembly procedure to generate the BSR MAC CE(s);

3> start or restart *periodicBSR-Timer* except when all the generated BSRs are long or short Truncated BSRs;

3> start or restart *retxBSR-Timer*.

2> else if a Regular BSR has been triggered and *logicalChannelSR-DelayTimer* is not running:

3> if an uplink grant is not a configured grant; or

3> if the Regular BSR was not triggered for a logical channel for which logical channel SR masking (*logicalChannelSR-Mask*) is setup by upper layers:

4> trigger a Scheduling Request.

A MAC PDU shall contain at most one BSR MAC CE, even when multiple events have triggered a BSR by the time. The Regular BSR and the Periodic BSR shall have precedence over the padding BSR.

The MAC entity shall restart *retxBSR-Timer* upon reception of a grant for transmission of new data on any UL-SCH.

All triggered BSRs may be cancelled when the UL grant(s) can accommodate all pending data available for transmission but is not sufficient to additionally accommodate the BSR MAC control element plus its subheader. All triggered BSRs shall be cancelled when a BSR is included in a MAC PDU for transmission.

The MAC entity shall transmit at most one BSR in one MAC PDU. Padding BSR shall not be included when the MAC PDU contains a Regular or Periodic BSR.

[TS 38.321, clause 6.1.3.1]

Buffer Status Report (BSR) MAC CEs consist of either:

- Short BSR format (fixed size); or

- Long BSR format (variable size); or

- Short Truncated BSR format (fixed size); or

- Long Truncated BSR format (variable size).

The BSR formats are identified by MAC PDU subheaders with LCIDs as specified in Table 6.2.1-2.

The fields in the BSR MAC CE are defined as follows:

- LCG ID: The Logical Channel Group ID field identifies the group of logical channel(s) whose buffer status is being reported. The length of the field is 3 bits;

- LCGi: For the Long BSR format, this field indicates the presence of the Buffer Size field for the logical channel group i. The LCGi field set to "1" indicates that the Buffer Size field for the logical channel group i is reported. The LCGi field set to "0" indicates that the Buffer Size field for the logical channel group i is not reported. For the Long Truncated BSR format, this field indicates whether logical channel group i has data available. The LCGi field set to "1" indicates that logical channel group i has data available. The LCGi field set to "0" indicates that logical channel group i does not have data available;

- Buffer Size: The Buffer Size field identifies the total amount of data available according to the data volume calculation procedure in TSs 38.322 and 38.323 [3] [4] across all logical channels of a logical channel group after the MAC PDU has been built (i.e. after the logical channel prioritization procedure, which may result the value of the Buffer Size field to zero). The amount of data is indicated in number of bytes. The size of the RLC and MAC headers are not considered in the buffer size computation. The length of this field for the Short BSR format and the Short Truncated BSR format is 5 bits. The length of this field for the Long BSR format and the Long Truncated BSR format is 8 bits. The values for the 5-bit and 8-bit Buffer Size fields are shown in Tables 6.1.3.1-1 and 6.1.3.1-2, respectively. For the Long BSR format and the Long Truncated BSR format, the Buffer Size fields are included in ascending order based on the LCGi. For the Long Truncated BSR format the number of Buffer Size fields included is maximised, while not exceeding the number of padding bits.

NOTE: The number of the Buffer Size fields in the Long Truncated BSR format can be zero.



Figure 6.1.3.1-1: Short BSR and Short Truncated BSR MAC CE



Figure 6.1.3.1-2: Long BSR and Long Truncated BSR MAC CE

Table 6.1.3.1-1: Buffer size levels (in bytes) for 5-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 8 | ≤ 102 | 16 | ≤ 1446 | 24 | ≤ 20516 |
| 1 | ≤ 10 | 9 | ≤ 142 | 17 | ≤ 2014 | 25 | ≤ 28581 |
| 2 | ≤ 14 | 10 | ≤ 198 | 18 | ≤ 2806 | 26 | ≤ 39818 |
| 3 | ≤ 20 | 11 | ≤ 276 | 19 | ≤ 3909 | 27 | ≤ 55474 |
| 4 | ≤ 28 | 12 | ≤ 384 | 20 | ≤ 5446 | 28 | ≤ 77284 |
| 5 | ≤ 38 | 13 | ≤ 535 | 21 | ≤ 7587 | 29 | ≤ 107669 |
| 6 | ≤ 53 | 14 | ≤ 745 | 22 | ≤ 10570 | 30 | ≤ 150000 |
| 7 | ≤ 74 | 15 | ≤ 1038 | 23 | ≤ 14726 | 31 | > 150000 |

Table 6.1.3.1-2: Buffer size levels (in bytes) for 8-bit Buffer Size field

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | BS value | Index | BS value | Index | BS value | Index | BS value |
| 0 | 0 | 64 | ≤ 526 | 128 | ≤ 29431 | 192 | ≤ 1647644 |
| 1 | ≤ 10 | 65 | ≤ 560 | 129 | ≤ 31342 | 193 | ≤ 1754595 |
| 2 | ≤ 11 | 66 | ≤ 597 | 130 | ≤ 33376 | 194 | ≤ 1868488 |
| 3 | ≤ 12 | 67 | ≤ 635 | 131 | ≤ 35543 | 195 | ≤ 1989774 |
| 4 | ≤ 13 | 68 | ≤ 677 | 132 | ≤ 37850 | 196 | ≤ 2118933 |
| 5 | ≤ 13 | 69 | ≤ 720 | 133 | ≤ 40307 | 197 | ≤ 2256475 |
| 6 | ≤ 14 | 70 | ≤ 767 | 134 | ≤ 42923 | 198 | ≤ 2402946 |
| 7 | ≤ 15 | 71 | ≤ 817 | 135 | ≤ 45709 | 199 | ≤ 2558924 |
| 8 | ≤ 16 | 72 | ≤ 870 | 136 | ≤ 48676 | 200 | ≤ 2725027 |
| 9 | ≤ 17 | 73 | ≤ 926 | 137 | ≤ 51836 | 201 | ≤ 2901912 |
| 10 | ≤ 18 | 74 | ≤ 987 | 138 | ≤ 55200 | 202 | ≤ 3090279 |
| 11 | ≤ 19 | 75 | ≤ 1051 | 139 | ≤ 58784 | 203 | ≤ 3290873 |
| 12 | ≤ 20 | 76 | ≤ 1119 | 140 | ≤ 62599 | 204 | ≤ 3504487 |
| 13 | ≤ 22 | 77 | ≤ 1191 | 141 | ≤ 66663 | 205 | ≤ 3731968 |
| 14 | ≤ 23 | 78 | ≤ 1269 | 142 | ≤ 70990 | 206 | ≤ 3974215 |
| 15 | ≤ 25 | 79 | ≤ 1351 | 143 | ≤ 75598 | 207 | ≤ 4232186 |
| 16 | ≤ 26 | 80 | ≤ 1439 | 144 | ≤ 80505 | 208 | ≤ 4506902 |
| 17 | ≤ 28 | 81 | ≤ 1532 | 145 | ≤ 85730 | 209 | ≤ 4799451 |
| 18 | ≤ 30 | 82 | ≤ 1631 | 146 | ≤ 91295 | 210 | ≤ 5110989 |
| 19 | ≤ 32 | 83 | ≤ 1737 | 147 | ≤ 97221 | 211 | ≤ 5442750 |
| 20 | ≤ 34 | 84 | ≤ 1850 | 148 | ≤ 103532 | 212 | ≤ 5796046 |
| 21 | ≤ 36 | 85 | ≤ 1970 | 149 | ≤ 110252 | 213 | ≤ 6172275 |
| 22 | ≤ 38 | 86 | ≤ 2098 | 150 | ≤ 117409 | 214 | ≤ 6572925 |
| 23 | ≤ 40 | 87 | ≤ 2234 | 151 | ≤ 125030 | 215 | ≤ 6999582 |
| 24 | ≤ 43 | 88 | ≤ 2379 | 152 | ≤ 133146 | 216 | ≤ 7453933 |
| 25 | ≤ 46 | 89 | ≤ 2533 | 153 | ≤ 141789 | 217 | ≤ 7937777 |
| 26 | ≤ 49 | 90 | ≤ 2698 | 154 | ≤ 150992 | 218 | ≤ 8453028 |
| 27 | ≤ 52 | 91 | ≤ 2873 | 155 | ≤ 160793 | 219 | ≤ 9001725 |
| 28 | ≤ 55 | 92 | ≤ 3059 | 156 | ≤ 171231 | 220 | ≤ 9586039 |
| 29 | ≤ 59 | 93 | ≤ 3258 | 157 | ≤ 182345 | 221 | ≤ 10208280 |
| 30 | ≤ 62 | 94 | ≤ 3469 | 158 | ≤ 194182 | 222 | ≤ 10870913 |
| 31 | ≤ 66 | 95 | ≤ 3694 | 159 | ≤ 206786 | 223 | ≤ 11576557 |
| 32 | ≤ 71 | 96 | ≤ 3934 | 160 | ≤ 220209 | 224 | ≤ 12328006 |
| 33 | ≤ 75 | 97 | ≤ 4189 | 161 | ≤ 234503 | 225 | ≤ 13128233 |
| 34 | ≤ 80 | 98 | ≤ 4461 | 162 | ≤ 249725 | 226 | ≤ 13980403 |
| 35 | ≤ 85 | 99 | ≤ 4751 | 163 | ≤ 265935 | 227 | ≤ 14887889 |
| 36 | ≤ 91 | 100 | ≤ 5059 | 164 | ≤ 283197 | 228 | ≤ 15854280 |
| 37 | ≤ 97 | 101 | ≤ 5387 | 165 | ≤ 301579 | 229 | ≤ 16883401 |
| 38 | ≤ 103 | 102 | ≤ 5737 | 166 | ≤ 321155 | 230 | ≤ 17979324 |
| 39 | ≤ 110 | 103 | ≤ 6109 | 167 | ≤ 342002 | 231 | ≤ 19146385 |
| 40 | ≤ 117 | 104 | ≤ 6506 | 168 | ≤ 364202 | 232 | ≤ 20389201 |
| 41 | ≤ 124 | 105 | ≤ 6928 | 169 | ≤ 387842 | 233 | ≤ 21712690 |
| 42 | ≤ 132 | 106 | ≤ 7378 | 170 | ≤ 413018 | 234 | ≤ 23122088 |
| 43 | ≤ 141 | 107 | ≤ 7857 | 171 | ≤ 439827 | 235 | ≤ 24622972 |
| 44 | ≤ 150 | 108 | ≤ 8367 | 172 | ≤ 468377 | 236 | ≤ 26221280 |
| 45 | ≤ 160 | 109 | ≤ 8910 | 173 | ≤ 498780 | 237 | ≤ 27923336 |
| 46 | ≤ 170 | 110 | ≤ 9488 | 174 | ≤ 531156 | 238 | ≤ 29735875 |
| 47 | ≤ 181 | 111 | ≤ 10104 | 175 | ≤ 565634 | 239 | ≤ 31666069 |
| 48 | ≤ 193 | 112 | ≤ 10760 | 176 | ≤ 602350 | 240 | ≤ 33721553 |
| 49 | ≤ 205 | 113 | ≤ 11458 | 177 | ≤ 641449 | 241 | ≤ 35910462 |
| 50 | ≤ 218 | 114 | ≤ 12202 | 178 | ≤ 683087 | 242 | ≤ 38241455 |
| 51 | ≤ 233 | 115 | ≤ 12994 | 179 | ≤ 727427 | 243 | ≤ 40723756 |
| 52 | ≤ 248 | 116 | ≤ 13838 | 180 | ≤ 774645 | 244 | ≤ 43367187 |
| 53 | ≤ 264 | 117 | ≤ 14736 | 181 | ≤ 824928 | 245 | ≤ 46182206 |
| 54 | ≤ 281 | 118 | ≤ 15692 | 182 | ≤ 878475 | 246 | ≤ 49179951 |
| 55 | ≤ 299 | 119 | ≤ 16711 | 183 | ≤ 935498 | 247 | ≤ 52372284 |
| 56 | ≤ 318 | 120 | ≤ 17795 | 184 | ≤ 996222 | 248 | ≤ 55771835 |
| 57 | ≤ 339 | 121 | ≤ 18951 | 185 | ≤ 1060888 | 249 | ≤ 59392055 |
| 58 | ≤ 361 | 122 | ≤ 20181 | 186 | ≤ 1129752 | 250 | ≤ 63247269 |
| 59 | ≤ 384 | 123 | ≤ 21491 | 187 | ≤ 1203085 | 251 | ≤ 67352729 |
| 60 | ≤ 409 | 124 | ≤ 22885 | 188 | ≤ 1281179 | 252 | ≤ 71724679 |
| 61 | ≤ 436 | 125 | ≤ 24371 | 189 | ≤ 1364342 | 253 | ≤ 76380419 |
| 62 | ≤ 464 | 126 | ≤ 25953 | 190 | ≤ 1452903 | 254 | ≤ 81338368 |
| 63 | ≤ 494 | 127 | ≤ 27638 | 191 | ≤ 1547213 | 255 | > 81338368 |

[TS 38.321, clause 6.2.1]

Table 6.2.1-2: Values of LCID for UL-SCH

|  |  |
| --- | --- |
| Index | LCID values |
| 000000 | CCCH |
| 000001–100000 | Identity of the logical channel |
| 100001–110110 | Reserved |
| 110111 | Configured Grant Confirmation |
| 111000 | Multiple Entry PHR |
| 111001 | Single Entry PHR |
| 111010 | C-RNTI |
| 111011 | Short Truncated BSR |
| 111100 | Long Truncated BSR |
| 111101 | Short BSR |
| 111110 | Long BSR |
| 111111 | Padding |

7.1.1.3.6.3 Test description

7.1.1.3.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 2 SN terminated SCG bearers configured according to Table 7.1.1.3.6.3.1-1.

Table 7.1.1.3.6.3.1-1: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 7 | 6 |
| prioritizedBitRate | 0kbs | 0kbs |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.6.3.2 Test procedure sequence

Table 7.1.1.3.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | The SS transmits a MAC PDU containing an RLC PDU on LCH4 (LCG ID 2), which contains 1 RLC SDU of size 14 bytes. | <-- | MAC PDU (RLC PDU) |  |  |
| 3 | The SS sends an uplink grant of size 32 bits. (Note 1) | <-- | (UL grant) | - | - |
| 4 | The UE transmits a short BSR report and restarts *periodicBSR-Timer* | --> | MAC PDU ((LCID=’ 111101’, LCG ID='10', Buffer size index > 0) | - | - |
| - | EXCEPTION: Steps 5 to 7 shall be repeated two times (Note 2) | - | - | - | - |
| 5 | Wait for periodicBSR-Timer expiry. | - | - | - | - |
| 6 | The SS sends an uplink grant of size 32 bits | - | - | - | - |
| 7 | Check: Does UE transmit a MAC PDU containing a Short BSR with ‘LCG ID’ field set to ‘10’ (logicalChannelGroup 2) and Buffer Size Index > 0? | --> | MAC PDU (LCID=’111101’, LCG ID=’10’, Buffer Size index > 0) | 2 | P |
| 8 | The SS transmits a MAC PDU containing an RLC PDU on LCH5 (LCG ID 1), which contains 1 RLC SDU of size 14 bytes. | <-- | MAC PDU (RLC PDU) | - | - |
| 9 | The SS sends an uplink grant of size 40 bits (Note 3) | <-- | (UL grant) | - | - |
| 10 | The UE transmits a long BSR report with ‘Buffer size#1’ (LCG ID=1) and ‘Buffer size#2’ (LCG ID=2) fields set to value > ‘0’ | --> | MAC PDU (( ‘Buffer size#1 index’ > 0, ‘Buffer size#2 index=’ >0’) | - | - |
| - | EXCEPTION: Step 11 to 13 shall be repeated twice. (Note 4) | - | - | - | - |
| 11 | Wait for periodicBSR-Timer expiry. | - | - | - | - |
| 12 | The SS sends an uplink grant of size 40 bits | - | - | - | - |
| 13 | Check: Does UE transmit a MAC PDU containing a Long BSR with ‘Buffer size#1’ (LCG ID=1) and ‘Buffer size#2’ (LCG ID=2) fields set to value > ‘0’? | --> | MAC PDU | 1 | P |
| 14 | The SS transmits 1 UL grant of size 320 bits to enable the UE to loopback RLC SDU on LCH4 and LCH5. |  |  | - | - |
| 15 | The UE transmits MAC PDU containing the remaining RLC SDUs as sent by the SS in steps 2 and 8. | --> | MAC PDU | - | - |
| Note 1: SS transmits an UL grant of 32 bits(LRBs & IMCS as per 38.523-3[3] annex B) to allow UE to transmit a Regular BSR triggered by the new data received logicalChannelGroup 1 in step 2.  Note 2: One short BSR due to first expiry of *periodicBSR-Timer* and one short BSR due to second expire of *periodicBSR-Timer*.  Note 3: SS transmits an UL grant of 40 bits(LRBs & IMCS as per 38.523-3[3] annex B) to allow UE to transmit a Regular BSR triggered by the new data received on higher priority logicalChannelGroup 1 in step 8.  Note 4: One long BSR due to expire of *periodicBSR-Timer* and one long BSR due to second expiry of *periodicBSR-Timer.* | | | | | |

7.1.1.3.6.3.3 Specific message contents

Table 7.1.1.3.6.3.3: MAC-CellGroupConfig (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.308 [6], clause Table 4.6.3-49 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | sf160 |  |  |
| retxBSR-Timer | sf10240 |  |  |
| } |  |  |  |
| phr-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.3.7 UE power headroom reporting / Periodic reporting / DL pathloss change reporting

7.1.1.3.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { *phr-PeriodicTimer* is configured in UE }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element }

}

(2)

**with** { UE in RRC\_CONNECTED state with periodic power headroom reporting configured }

**ensure that** {

**when** { *phr-PeriodicTimer* expires **and** UL resources allocated for new transmission }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element }

}

(3)

**with** { UE in RRC\_CONNECTED state with periodic power headroom reporting configured }

**ensure that** {

**when** { power headroom reporting is disabled }

**then** { UE stops transmitting Power Headroom MAC Control Element }

}

(4)

**with** { UE in RRC\_Connected state with Power headroom reporting for *phr-Tx-PowerFactorChange* configured }

**ensure that** {

**when** { the DL Pathloss has changed more than *phr-Tx-PowerFactorChange* dB **and** *phr-ProhibitTimer* is running }

**then** { UE does not transmit a MAC PDU containing Power Headroom MAC Control Element }

}

(5)

**with** { UE in RRC\_Connected state with Power headroom reporting for *phr-Tx-PowerFactorChange* configured }

**ensure that** {

**when** { *phr-ProhibitTimer* expires **and** power headroom report is triggered due to DL Pathloss change }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element }

}

7.1.1.3.7.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321 clause 5.4.6 and 6.1.3.8. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving gNB with the following information:

- Type 1 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell;

- Type 2 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH and PUCCH transmission on SpCell of the other MAC entity (i.e. E-UTRA MAC entity in EN-DC case only);

- Type 3 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for SRS transmission per activated Serving Cell.

RRC controls Power Headroom reporting by configuring the following parameters:

- *phr-PeriodicTimer*;

- *phr-ProhibitTimer*;

- *phr-Tx-PowerFactorChange*;

- *phr-Type2PCell*;

- *phr-Type2OtherCell*;

- *phr-ModeOtherCG*;

- *multiplePHR*.

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between.

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink;

- addition of the PSCell (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*;

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in subclause 5.4.3.1:

2> if *multiplePHR* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity:

4> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in subclause 7.7 of TS 38.213 [6];

4> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

4> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to real by upper layers:

5> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

3> if *phr-Type2OtherCell* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to real by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in subclause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell;

3> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in subclause 6.1.3.8 based on the values reported by the physical layer.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

[TS 38.321, clause 6.1.3.8]

The Single Entry PHR MAC CE is identified by a MAC PDU subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of two octet defined as follows (figure 6.1.3.8-1):

- R: Reserved bit, set to "0";

- Power Headroom (PH): This field indicates the power headroom level. The length of the field is 6 bits. The reported PH and the corresponding power headroom levels are shown in Table 6.1.3.8-1 below (the corresponding measured values in dB are specified in TS 38.133 [11]);

- PCMAX,f,c: This field indicates the PCMAX,f,c (as specified in TS 38.213 [6]) used for calculation of the preceding PH field. The reported PCMAX,f,c and the corresponding nominal UE transmit power levels are shown in Table 6.1.3.8-2 (the corresponding measured values in dBm are specified in TS 38.133 [11]).



Figure 6.1.3.8-1: Single Entry PHR MAC CE

Table 6.1.3.8-1: Power Headroom levels for PHR

|  |  |
| --- | --- |
| PH | Power Headroom Level |
| 0 | POWER\_HEADROOM\_0 |
| 1 | POWER\_HEADROOM\_1 |
| 2 | POWER\_HEADROOM\_2 |
| 3 | POWER\_HEADROOM\_3 |
| … | … |
| 60 | POWER\_HEADROOM\_60 |
| 61 | POWER\_HEADROOM\_61 |
| 62 | POWER\_HEADROOM\_62 |
| 63 | POWER\_HEADROOM\_63 |

Table 6.1.3.8-2: Nominal UE transmit power level for PHR

|  |  |
| --- | --- |
| PCMAXf,,c | Nominal UE transmit power level |
| 0 | PCMAX\_C\_00 |
| 1 | PCMAX\_C\_01 |
| 2 | PCMAX\_C\_02 |
| … | … |
| 61 | PCMAX\_C\_61 |
| 62 | PCMAX\_C\_62 |
| 63 | PCMAX\_C\_63 |

7.1.1.3.7.3 Test description

7.1.1.3.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.3.7.3.2 Test procedure sequence

Table 7.1.1.3.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits UL grant to the UE at every 10ms in PDCCH occasion. | <-- | - | - | - |
| 2 | SS transmits NR *RRCReconfiguration*message to configure specific Power Headroom parameters for NR Cell(Note 1). | <-- | *(RRCReconfiguration)* | - | - |
| 3 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element?  (Note 2, 5) | --> | MAC PDU | 1 | P |
| 4 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the setup of Power Headroom parameters.  (Note 2,3) | --> | *(RRCReconfigurationComplete)* | - | - |
| 5 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element 500ms after step 3? (Note 5) | --> | MAC PDU | 2 | P |
| 6 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 7 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters.(Note 3) | --> | *(RRCReconfigurationComplete)* | - | - |
| 8 | Check: for 2 seconds, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 3 | F |
| 9 | SS transmits NR *RRCReconfiguration*message to configure specific Power Headroom parameters for NR Cell.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 10 | Check: does the UE transmit a MAC PDU containing Power Headroom MAC Control Element?  (Note 4, 5) | --> | MAC PDU | 1 | P |
| 11 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the setup of Power Headroom parameters.  (Note 3,4) | --> | *(RRCReconfigurationComplete)* | - | - |
| 12 | Wait for T1= 20% of *prohibitPHR-Timer*. | - | - | - | - |
| 13 | Reduce SS power level for NR Cell so as to cause a DL\_Pathloss change at UE by 5dB. | - | - | - | - |
| 14 | Check: for 80% of *prohibitPHR-Timer* since step 10, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 4 | F |
| 15 | Check: after *prohibitPHR-Timer* after step 10, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 5 | P |
| 16 | Increase SS power level for NR Cell so as to cause a DL\_Pathloss change at UE by 5dB. | - | - | - | - |
| 17 | Check: for 80% of *prohibitPHR-Timer* since step 15, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 4 | F |
| 18 | Check: after *prohibitPHR-Timer* after step 15, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element? (Note 5) | --> | MAC PDU | 5 | P |
| 19 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 20 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters.(Note 3) | --> | *(RRCReconfigurationComplete)* | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration* 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: Steps 3 and 4 can happen in any order.  Note 3: for EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 4: Steps 10 and 11 can happen in any order.  Note 5: For NR5GC the received MAC PDU will contain Single-entry PHR MAC CE. For EN-DC/NE-DC the received MAC PDU will contain Multiple-Entry PHR MAC CE. | | | | | |

7.1.1.3.7.3.3 Specific message contents

Table 7.1.1.3.7.3.3-1: RRCReconfiguration(step 2 Table 7.1.1.3.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR  NE-DC |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-2: CellGroupConfig (Table 7.1.1.3.7.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| phr-PeriodicTimer | sf500 |  |  |
| phr-ProhibitTimer | sf1000 |  |  |
| phr-Tx-PowerFactorChange | infinity |  |  |
| multiplePHR | false |  |  |
| multiplePHR | true |  | EN-DC  NE-DC |
| phr-Type2PCell | false |  |  |
| phr-Type2OtherCell | false |  |  |
| phr-ModeOtherCG | real |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-3: RRCReconfiguration(step 6,19 Table 7.1.1.3.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR  NE-DC |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-4: CellGroupConfig(Table 7.1.1.3.7.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { | |  |  |  |
| mac-CellGroupConfig SEQUENCE { | |  |  |  |
| phr-Config CHOICE { | |  |  |  |
| release | | NULL |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.3.7.3.3-5: RRCReconfiguration(step 9 Table 7.1.1.3.7.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR  NE-DC |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.7.3.3-6: CellGroupConfig(Table 7.1.1.3.7.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { | |  |  |  |
| mac-CellGroupConfig SEQUENCE { | |  |  |  |
| phr-Config CHOICE { | |  |  |  |
| setup SEQUENCE { | |  |  |  |
| phr-PeriodicTimer | | infinity |  |  |
| phr-ProhibitTimer | | sf1000 |  |  |
| phr-Tx-PowerFactorChange | | 3dB |  |  |
| multiplePHR | | false |  |  |
| multiplePHR | | true |  | EN-DC  NE-DC |
| phr-Type2PCell | | false |  |  |
| phr-Type2OtherCell | | false |  |  |
| phr-ModeOtherCG | | real |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

##### 7.1.1.3.8 UE power headroom reporting / SCell activation / DL pathloss change reporting

###### 7.1.1.3.8.1 UE power headroom reporting / SCell activation / DL pathloss change reporting/ Intra-band Contiguous CA

7.1.1.3.8.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state with multiple Power headroom reporting and an SCell with uplink is configured }

**ensure that** {

**when** { *UE receives an Activation MAC Control Element activating the SCell* }

**then** { UE transmits a MAC PDU containing Power Headroom Report MAC Control Element including PH type1 for SpCell and Scell }

}

(2)

**with** { UE in RRC\_Connected state with multiple Power headroom reporting for phr-dl-PathlossChange configured }

**ensure that** {

**when** { *the DL Pathloss changes and phr-ProhibitTimer is running*  }

**then** { UE does not transmit a MAC PDU containing Power Headroom Report MAC Control Element including PH type1 for SpCell and Scell }

}

(3)

**with** { UE in RRC\_Connected state with Power headroom reporting for phr-dl-PathlossChange configured }

**ensure that** {

**when** { phr-ProhibitTimer expires and power headroom report is triggered due to DL Pathloss change }

**then** { UE transmits a MAC PDU containing Power Headroom Report MAC Control Element including PH type1 for SpCell and Scell }

}

7.1.1.3.8.1.2 Conformance requirements

References: The conformance requirements covered in the current TC are specified in: TS 38.321 clause 5.4.6 and 6.1.3.8. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.6]

The Power Headroom reporting procedure is used to provide the serving gNB with the following information:

- Type 1 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH transmission per activated Serving Cell;

- Type 2 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for UL-SCH and PUCCH transmission on SpCell of the other MAC entity (i.e. E-UTRA MAC entity in EN-DC, NE-DC, and NGEN-DC cases);

- Type 3 power headroom: the difference between the nominal UE maximum transmit power and the estimated power for SRS transmission per activated Serving Cell.

RRC controls Power Headroom reporting by configuring the following parameters:

- *phr-PeriodicTimer*;

- *phr-ProhibitTimer*;

- *phr-Tx-PowerFactorChange*;

- *phr-Type2OtherCell*;

- *phr-ModeOtherCG*;

- *multiplePHR*.

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between.

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink;

- addition of the PSCell (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*;

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in clause 5.4.3.1:

2> if *multiplePHR* with value *true* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity:

4> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell and clause 5.1.1.2 of TS 36.213 [17] for E-UTRA Serving Cell;

4> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

4> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to *real* by upper layers:

5> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

3> if *phr-Type2OtherCell* with value *true* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to *real* by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in clause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell;

3> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in clause 6.1.3.8 based on the values reported by the physical layer.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

[TS 38.321, clause 6.1.3.9]

The Multiple Entry PHR MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-2.

It has a variable size, and includes the bitmap, a Type 2 PH field and an octet containing the associated PCMAX,f,c field (if reported) for SpCell of the other MAC entity, a Type 1 PH field and an octet containing the associated PCMAX,f,c field (if reported) for the PCell. It further includes, in ascending order based on the *ServCellIndex*, one or multiple of Type X PH fields and octets containing the associated PCMAX,f,c fields (if reported) for Serving Cells other than PCell indicated in the bitmap. X is either 1 or 3 according to TS 38.213 [6] and TS 36.213 [17].

The presence of Type 2 PH field for SpCell of the other MAC entity is configured by *phr-Type2OtherCell* with value *true*.

A single octet bitmap is used for indicating the presence of PH per Serving Cell when the highest *ServCellIndex* of Serving Cell with configured uplink is less than 8, otherwise four octets are used.

The MAC entity determines whether PH value for an activated Serving Cell is based on real transmission or a reference format by considering the configured grant(s) and downlink control information which has been received until and including the PDCCH occasion in which the first UL grant for a new transmission that can accommodate the MAC CE for PHR as a result of LCP as defined in clause 5.4.3.1 is received since a PHR has been triggered if the PHR MAC CE is reported on an uplink grant received on the PDCCH or until the first uplink symbol of PUSCH transmission minus PUSCH preparation time as defined in clause 7.7 of TS 38.213 [6] if the PHR MAC CE is reported on a configured grant.

For a band combination in which the UE does not support dynamic power sharing, the UE may omit the octets containing Power Headroom field and PCMAX,f,c field for Serving Cells in the other MAC entity except for the PCell in the other MAC entity and the reported values of Power Headroom and PCMAX,f,c for the PCell are up to UE implementation.

The PHR MAC CEs are defined as follows:

- Ci: This field indicates the presence of a PH field for the Serving Cell with *ServCellIndex* i as specified in TS 38.331 [5]. The Ci field set to 1 indicates that a PH field for the Serving Cell with *ServCellIndex* i is reported. The Ci field set to 0 indicates that a PH field for the Serving Cell with *ServCellIndex* i is not reported;

- R: Reserved bit, set to 0;

- V: This field indicates if the PH value is based on a real transmission or a reference format. For Type 1 PH, the V field set to 0 indicates real transmission on PUSCH and the V field set to 1 indicates that a PUSCH reference format is used. For Type 2 PH, the V field set to 0 indicates real transmission on PUCCH and the V field set to 1 indicates that a PUCCH reference format is used. For Type 3 PH, the V field set to 0 indicates real transmission on SRS and the V field set to 1 indicates that an SRS reference format is used. Furthermore, for Type 1, Type 2, and Type 3 PH, the V field set to 0 indicates the presence of the octet containing the associated PCMAX,f,c field, and the V field set to 1 indicates that the octet containing the associated PCMAX,f,c field is omitted;

- Power Headroom (PH): This field indicates the power headroom level. The length of the field is 6 bits. The reported PH and the corresponding power headroom levels are shown in Table 6.1.3.8-1 (the corresponding measured values in dB for the NR Serving Cell are specified in TS 38.133 [11] while the corresponding measured values in dB for the E-UTRA Serving Cell are specified in TS 36.133 [12]);

- P: This field indicates whether the MAC entity applies power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]). The MAC entity shall set the P field to 1 if the corresponding PCMAX,f,c field would have had a different value if no power backoff due to power management had been applied;

- PCMAX,f,c: If present, this field indicates the PCMAX,f,c (as specified in TS 38.213 [6]) for the NR Serving Cell and the PCMAX,c or P̃CMAX,c (as specified in TS 36.213 [17]) for the E-UTRA Serving Cell used for calculation of the preceding PH field. The reported PCMAX,f,c and the corresponding nominal UE transmit power levels are shown in Table 6.1.3.8-2 (the corresponding measured values in dBm for the NR Serving Cell are specified in TS 38.133 [11] while the corresponding measured values in dBm for the E-UTRA Serving Cell are specified in TS 36.133 [12]).



Figure 6.1.3.9-1: Multiple Entry PHR MAC CE with the highest *ServCellIndex* of Serving Cell with configured uplink is less than 8

7.1.1.3.8.1.3 Test description

7.1.1.3.8.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*) System information combination NR-4 and in addition NR Cell 3 is configured as NR Active Scell.

7.1.1.3.8.1.3.2 Test procedure sequence

Table 7.1.1.3.8.1.3.2-0: Cell configuration power level changes over time for conducted test environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 3 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 |  |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -99 | -88 |  |
| **T2** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 |  |
| **T3** | Cell-specific RS EPRE | dBm/SCS | -88 | -99 |  |
| **T4** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 |  |

Table 7.1.1.3.8.1.3.2-0A: Cell configuration power level changes over time for OTA test environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 3 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -91 | -82 |  |
| **T2** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T3** | Cell-specific RS EPRE | dBm/SCS | -82 | -91 |  |
| **T4** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |

Table 7.1.1.3.8.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits an RRCReconfiguration message toconfigure SCell (NR Cell 3). Note 1 | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 3 | The SS is configured for Uplink Grant Allocation Type 2. SS is configured to transmit UL grant for UE at every 10 ms. | - | - | - | - |
| 4 | SS transmits an RRCReconfiguration message to provide Power Headroom parameters. Note 1 | <-- | RRCReconfiguration | - | - |
|  | EXCEPTION: In parallel with step 5, UE executes parallel behaviour defined in Table 7.1.1.3.8.1.3.2-2 | - | *-* | - | - |
| 5 | The UE transmits RRCReconfigurationComplete message to confirm the setup of Power Headroom parameters. Note 2 | --> | RRCReconfigurationComplete | - | - |
| 6 | The SS transmits an Activation MAC control element to activate SCell. | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=1)) | - | - |
| 7 | Check: Does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 1 | P |
| 8 | Void | - | - | - | - |
| 9 | SS adjusts cell levels according to row T1 of Table 7.1.1.3.8.3.1.2-0/0A. | - | - | - | - |
| 10 | Check: For 80% of *prohibitPHR-Timer* since step 7, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE? | --> | MAC PDU | 2 | F |
| 11 | Check: After *prohibitPHR-Timer* after step 7, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 12 | SS adjusts cell levels according to row T2 of Table 7.1.1.3.8.1.3.2-0/0A. | - | - | - | - |
| 13 | Check: For 80% of *prohibitPHR-Timer* since step 11, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE ? | --> | MAC PDU | 2 | F |
| 14 | Check: After *prohibitPHR-Timer* after step 11, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 15 | SS adjusts cell levels according to row T3 of Table 7.1.1.3.8.1.3.2-0/0A. | - | - | - | - |
| 16 | Check: For 80% of *prohibitPHR-Timer* since step 14, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing? | --> | MAC PDU | 2 | F |
| 17 | Check: After *prohibitPHR-Timer* after step 14, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 18 | SS adjusts cell levels according to row T4 of Table 7.1.1.3.8.1.3.2-0/0A. | - | - | - | - |
| 19 | Check: For 80% of *prohibitPHR-Timer* since step 17, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE? | --> | MAC PDU | 2 | F |
| 20 | Check: After *prohibitPHR-Timer* after step 17, does the UE transmit a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell and Scell? Note 3 | --> | MAC PDU | 3 | P |
| 21 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting.(Note 1) | <-- | *(RRCReconfiguration)* | - | - |
| 22 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters.(Note 3) | --> | *(RRCReconfigurationComplete)* | - | - |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 3: For EN-DC the Type 1 PHR report for EUTRA Pcell is also included. | | | | | |

Table 7.1.1.3.8.1.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The UE transmits a MAC PDU containing Multiple Entry PHR MAC CE containing Type 1 PH of NR SpCell. | --> | MAC PDU | - | - |

7.1.1.3.8.1.3.3 Specific message contents

Table 7.1.1.3.8.1.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.3.8.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13. | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| c1 CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.3.8.1.3.3-2: CellGroupConfig (Table 7.1.1.3.8.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19. | | | |
| Information Element | | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { | |  |  |  |
| sCellToAddModList SEQUENCE (SIZE (1..maxMeasId)) OF SCellConfig { | | 1 entry |  |  |
| SCellConfig[1] SEQUENCE { | |  | entry 1 |  |
| sCellIndex | | SCellIndex as per TS 38.508-1 [4] table 4.6.3-154 |  |  |
| sCellConfigCommon | | ServingCellConfigCommon |  |  |
| sCellConfigDedicated | | ServingCellConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.3.8.1.3.3-3: ServingCellConfigCommon (Table 7.1.1.3.8.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 3 |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-3A: Void

Table 7.1.1.3.8.1.3.3-4: *RRCReconfiguration* ( Step 4, Table 7.1.1.3.8.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-5: CellGroupConfig (Table 7.1.1.3.8.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | CellGroupId as per TS 38.508-1 [4] table 4.6.3-20 |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| phr-PeriodicTimer | infinity |  |  |
| phr-ProhibitTimer | sf1000 |  |  |
| phr-Tx-PowerFactorChange | 3db |  |  |
| multiplePHR | true |  |  |
| dummy | true |  |  |
| phr-Type2OtherCell | false |  |  |
| phr-ModeOtherCG | real |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-6: ServingCellConfig (Table 7.1.1.3.8.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-7: *BWP-UplinkDedicated*(Table 7.1.1.3.8.1.3.3-6)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config | Not present |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-8: ServingCellConfigCommon (Table 7.1.1.3.8.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 3 |  |  |
| uplinkConfigCommon | UplinkConfigCommon |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-9: UplinkConfigCommon (Table 7.1.1.3.8.1.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| UplinkConfigCommon ::= SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkCommon |  |  |
| } |  |  |  |

Table 7.1.1.3.8.1.3.3-10: BWP-UplinkCommon (Table 7.1.1.3.8.1.3.3-9)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| pucch-ConfigCommon | Not present |  |  |
| } |  |  |  |

###### 7.1.1.3.8.2 UE power headroom reporting / SCell activation / DL pathloss change reporting / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.1.3.8.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA

- Cells configuration: NR Cell 10 replaces NR Cell 3

###### 7.1.1.3.8.3 UE power headroom reporting / SCell activation / DL pathloss change reporting / Intra-band non-Contiguous CA

The scope and description of the present TC is the same as test case 7.1.1.3.8.1 with the following differences:

- CA configuration: Intra-band non-Contiguous CA replaces Intra-band Contiguous CA.

##### 7.1.1.3.9 Correct Handling of UL HARQ process / PUSCH Repetition Type A / PUSCH Aggregation

7.1.1.3.9.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and PUSCH Aggregation > 1 }

**ensure that** {

**when** { UE receives an UL Grant with toggled NDI and has data available for transmission }

**then** { UE transmits a new MAC PDU and repeats the MAC PDU *pusch-AggregationFactor*-1 times after first transmission and selects the redundancy version correctly }

}

7.1.1.3.9.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clauses 5.4.1, 5.4.2.1 and 5.4.2.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as where is the *i*th codepoint of .



- The slot where the UE shall transmit the PUSCH is determined by *K2* as where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and and are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and



- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if then



else



where, and



- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **PUSCH mapping type** | **Normal cyclic prefix** | | | **Extended cyclic prefix** | | |
| ***S*** | ***L*** | ***S+L*** | ***S*** | ***L*** | ***S+L*** |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI to determine the modulation order and target code rate (*R*) based on the procedure defined in Subclause 6.1.4.1



- read redundancy version field (*rv*) in the DCI to determine the redundancy version, and

- [check the "CSI request" bit field]

and second

- the UE shall use the number of layers , the total number of allocated PRBs to determine the transport block size based on the procedure defined in Subclause 6.1.4.2.



[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the correponding HARQ process, if configured.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in subclause 5.8.2;

4> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

4> consider the NDI bit for the corresponding HARQ process to have been toggled;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if the *configuredGrantTimer* for the corresponding HARQ process is not running:

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

where CURRENT\_symbol=(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a repetition bundle that takes place.

NOTE 2: A HARQ process is configured for a configured uplink grant if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*.

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response, HARQ process identifier 0 is used.

When the MAC entity is configured with *pusch-AggregationFactor* > 1, the parameter *pusch-AggregationFactor* provides the number of transmissions of a TB within a bundle of the dynamic grant. After the initial transmission, *pusch-AggregationFactor* – 1 HARQ retransmissions follow within a bundle. When the MAC entity is configured with *repK* > 1, the parameter *repK* provides the number of transmissions of a TB within a bundle of the configured uplink grant. After the initial transmission, HARQ retransmissions follow within a bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *pusch-AggregationFactor* for a dynamic grant and *repK* for a configured uplink grant, respectively. Each transmission within a bundle is a separate uplink grant after the initial uplink grant within a bundle is delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant, the sequence of redundancy versions is determined according to subclause 6.1.4 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to subclause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to subclause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a new transmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is a configured uplink grant; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH of the uplink grant overlaps with a PUSCH of another uplink grant received on the PDCCH for this Serving Cell:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

[TS 38.321, clause 5.4.2.2]

Each HARQ process is associated with a HARQ buffer.

New transmissions are performed on the resource and with the MCS indicated on either PDCCH, Random Access Response, or RRC. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle.

If the HARQ entity requests a new transmission for a TB, the HARQ process shall:

1> store the MAC PDU in the associated HARQ buffer;

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

If the HARQ entity requests a retransmission for a TB, the HARQ process shall:

1> store the uplink grant received from the HARQ entity;

1> generate a transmission as described below.

To generate a transmission for a TB, the HARQ process shall:

1> if the MAC PDU was obtained from the Msg3 buffer; or

1> if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer:

2> instruct the physical layer to generate a transmission according to the stored uplink grant.

7.1.1.3.9.3 Test description

7.1.1.3.9.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1.3.9.3.1-1.

Table 7.1.1.3.9.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.3.9.3.2 Test procedure sequence

Table 7.1.1.3.9.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0A | SS transmits in the indicated downlink assignment an NR RRCReconfiguration. (Note 1) | <--- | - | - | - |
| 0B | UE transmits NR RRCReconfigurationComplete message to the SS. (Note 2) | --> | - | - | - |
| 1 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 2 | The UE transmits a Scheduling Request. | --> | (SR) | - | - |
| 3 | The SS allocates an UL Grant for HARQ process 1, sufficient for one RLC SDU to be looped back in a slot n, and NDI indicates new transmission and DCI scheduling the PUSCH indicates rvID = 0. | <-- | UL Grant | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n+4 and repeats in following pusch-AggregationFactor-1 slots with same resource allocation but different redundancy version (Note 3), if the slot can be used for uplink transmission (Note 4) | --> | MAC PDU | 1 | P |
| 5 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 4. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The redundancy version for the first transmission and all possible repetitions are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row.  Note 4: Usage of correct redundancy version is implicitely checked upon correct decoding by the SS of the UE UL repetitions. | | | | | |

7.1.1.3.9.3.3 Specific message contents

Table 7.1.1.3.9.3.3-0A: *RRCReconfiguration* (step 0A, Table 7.1.1.3.9.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs ::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-0B: *CellGroupConfig* (Table 7.1.1.3.9.3.3-0A: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  |  |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-1: *ServingCellConfig* (Table 7.1.1.3.9.3.3-0B: *CellGroupConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-2: *BWP-UplinkDedicated* (Table 7.1.1.3.9.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pusch-Config CHOICE { | Not present |  |  |
| Setup | PUSCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.9.3.3-3: *PUSCH-Config* (Table 7.1.1.3.9.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| pusch-AggregationFactor | n4 |  |  |
|  | n8 |  | (TDD AND SCS15) OR FR2 |
| } |  |  |  |

##### 7.1.1.3.10 Correct Handling of HARQ process / Multiple CORESETPoolIndex

7.1.1.3.10.1. Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with PDCCH-Config that contains two different values of CORESETPoolIndex in ControlResourceSet }

**ensure that** {

**when** { UE receives PDCCHs that schedule two non-overlapping in time domain PUSCHs are associated to different ControlResourceSets having different values of CORESETPoolIndex }

**then** { UE sends PUSCHs following the scheduling information of PDCCHs }

}

(2)

**with**(UE in RRC\_CONNECTED state and is configured with PDCCH-Config that contains two different values of CORESETPoolIndex in ControlResourceSet)

**ensure that** {

**when**{ UE receives PDCCHs that schedule two overlapping in time domain PDSCHs are associated to different ControlResourceSets having different values of CORESETPoolIndex }

**then** { UE Receives PDSCHs following the scheduling information of PDCCHs }

}

7.1.1.3.10.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214, clauses 5.18.10 and 6.1.20. Unless otherwise stated these are Rel-16 requirements.

[TS 38.214, clause 5.11]

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet*, the UE may expect to receive multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain. The UE may expect the reception of full/partially-overlapped PDSCHs in time only when PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *CORESETPoolIndex*. For a *ControlResourceSet* without *CORESETPoolIndex*, the UE may assume that the *ControlResourceSet* is assigned with *CORESETPoolIndex* as 0. When the UE is scheduled with full/partially/non-overlapped PDSCHs in time and frequency domain, the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH, the UE is expected to be scheduled with the same active BWP and the same SCS. When the UE is scheduled with full/partially-overlapped PDSCHs in time and frequency domain, the UE can be scheduled with at most two codewords simultaneously. When PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *CORESETPoolIndex,* the following operations are allowed:

- For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH associated with a value of *CORESETpoolIndex* ending in symbol *i*, the UE can be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH associated with a different value of *CORESETpoolIndex* that ends later than symbol *i*.

- In a given scheduled cell, the UE can receive a first PDSCH in slot *i*, with the corresponding HARQ-ACK assigned to be transmitted in slot *j*, and a second PDSCH associated with a value of *CORESETpoolindex* different from that of the first PDSCH starting later than the first PDSCH with its corresponding HARQ-ACK assigned to be transmitted in a slot before slot *j*.

If PDCCHs that schedule corresponding PDSCHs are associated to the same or different *ControlResourceSets* having the same value of *CORESETPoolIndex*, the UE procedure for receiving the PDSCH upon detection of a PDCCH follows Clause 5.1.

[TS 38.214, clause 6.1]

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet* for the active BWP of a serving cell and PDCCHs that schedule two non-overlapping in time domain PUSCHs are associated to different *ControlResourceSets* having different values of *CORESETPoolIndex,* for any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start a first PUSCH transmission starting in symbol *j* by a PDCCH associated with a value of *CORESETpoolIndex* ending in symbol *i*, the UE can be scheduled to transmit a PUSCH starting earlier than the end of the first PUSCH by a PDCCH associated with a different value of *CORESETpoolIndex* that ends later than symbol *i*.

7.1.1.3.10.3 Test description

7.1.1.3.10.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.3.10.3.2 Test procedure sequence

Table 7.1.1.3.10.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits NR *RRCReconfiguration* message to configure two different values of *CORESETPoolIndex* in *ControlResourceSet*, (Note1) | <-- | - | - | - |
| 2 | The UE transmitNR *RRCReconfigurationComplete* messages (Note 2) | --> | - | - | - |
| 3 | The SS transmits 2 MAC PDU’s on overlapping PDSCH’s scheduled by two different values of CORESETPoolIndex in ControlResourceSet | <-- | MAC PDU 1, MAC PDU 2 | - | - |
| 4 | 100 ms after step 4, the SS transmits a two UL grants scheduling two non-overlapping in time domain PUSCHs associated to different ControlResourceSets having different values of CORESETPoolIndex | <-- | (UL Grant 1, UL Grant 2) | - | - |
| 5 | Check: The UE transmits 2 MAC PDU’s loop backed PDU’s from step 4 | --> | MAC PDU 1, MAC PDU 2 | 1,2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.3.10.3.3 Specific message contents

Table 7.1.1.3.10.3.3-1: *PDCCH-Config* (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 2 entries |  |  |
| ControlResourceSet[1] | ControlResourceSetid1 | entry 1 |  |
| ControlResourceSet[2] | ControlResourceSetid2 | entry 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.10.3.3-2: *ControlResourceSetId1* (Table 7.1.1.3.10.3.3-1: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| coresetPoolIndex-r16 | 0 |  |  |
| } |  |  |  |

Table 7.1.1.3.10.3.3-3: *ControlResourceSetId2* (Table 7.1.1.3.10.3.3-1: *PDCCH-Config*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 2 |  |  |
| coresetPoolIndex-r16 | 1 |  |  |
| } |  |  |  |

##### 7.1.1.3.11 Correct handling of UL grant prioritization

7.1.1.3.11.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED and configured with *lch-basedPrioritization，*and a resource conflict happened when the UE is sending data based on a UL grant which is addressed to CS-RNTI with NDI = 1 or C-RNTI }

**ensure that** {

**when** { the data causes the resource conflict is based on a configured UL grant whose priority is lower than or equal to the UL grant’s }

**then** { UE determines the UL grant to be prioritized and sends the corresponding MAC PDU.}

}

(2)

**with** { UE in RRC\_CONNECTED and configured with *lch-basedPrioritization，*a resource conflict happened when the UE is sending data based on a UL grant which is addressed to CS-RNTI with NDI = 1 or C-RNTI, and UE determines the UL grant to be prioritized }

**ensure that** {

**when** { UE sends out the MAC PDU associated with the prioritized grant }

**then** { autonomously re-transmit the MAC PDU associated with the de-prioritized grant.}

}

7.1.1.3.11.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.4.1 and 5.4.2.1. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.4.1]

…

For the MAC entity configured with *lch-basedPrioritization*, priority of an uplink grant is determined by the highest priority among priorities of the logical channels with data available that are multiplexed or can be multiplexed in the MAC PDU, according to the mapping restrictions as described in clause 5.4.3.1.2. The priority of an uplink grant for which no data for logical channels is multiplexed or can be multiplexed in the MAC PDU is lower than either the priority of an uplink grant for which data for any logical channels is multiplexed or can be multiplexed in the MAC PDU or the priority of the logical channel triggering an SR.

If the corresponding PUSCH transmission of a configured uplink grant is cancelled by CI-RNTI as specified in clause 11.2A of TS 38.213 [6] or cancelled by a high PHY-priority PUCCH transmission as specified in clause 9 of TS 38.213 [6], this uplink grant is considered as a de-prioritized uplink grant.

When the MAC entity is configured with *lch-basedPrioritization*, for each uplink grant whose associated PUSCH can be transmitted by lower layers, the MAC entity shall:

1> if this uplink grant is addressed to CS-RNTI with NDI = 1 or C-RNTI:

2> if there is no overlapping PUSCH duration of a configured uplink grant which was not already de-prioritized, in the same BWP whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission which was not already de-prioritized and the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> consider this uplink grant as a prioritized uplink grant;

3> consider the other overlapping uplink grant(s), if any, as a de-prioritized uplink grant(s);

3> consider the other overlapping SR transmission(s), if any, as a de-prioritized SR transmission(s).

1> else if this uplink grant is a configured uplink grant:

2> if there is no overlapping PUSCH duration of another configured uplink grant which was not already de-prioritized, in the same BWP, whose priority is higher than the priority of the uplink grant; and

2> if there is no overlapping PUSCH duration of an uplink grant addressed to CS-RNTI with NDI = 1 or C-RNTI which was not already de-prioritized, in the same BWP, whose priority is higher than or equal to the priority of the uplink grant; and

2> if there is no overlapping PUCCH resource with an SR transmission which was not already de-prioritized and the priority of the logical channel that triggered the SR is higher than the priority of the uplink grant:

3> consider this uplink grant as a prioritized uplink grant;

3> consider the other overlapping uplink grant(s), if any, as a de-prioritized uplink grant(s);

3> consider the other overlapping SR transmission(s), if any, as a de-prioritized SR transmission(s).

NOTE 6: If the MAC entity is configured with *lch-basedPrioritization* and if there is overlapping PUSCH duration of at least two configured uplink grants whose priorities are equal, the prioritized uplink grant is determined by UE implementation.

NOTE 7: If the MAC entity is not configured with *lch-basedPrioritzation* and if there is overlapping PUSCH duration of at least two configured uplink grants, it is up to UE implementation to choose one of the configured uplink grants.

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

NOTE: When a single DCI is used to schedule multiple PUSCH, the UE is allowed to map generated TB(s) internally to different HARQ processes in case of LBT failure(s), i.e. UE may transmit a new TB on any HARQ process in the grants that have the same TBS, the same RV and the NDIs indicate new transmission.

The number of transmissions of a TB within a bundle of the dynamic grant or configured grant is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

- For a configured grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.3 of TS 38.214 [7].

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response (i.e. in a MAC RAR or a fallback RAR); or

2> if the uplink grant was determined as specified in clause 5.1.2a for the transmission of the MSGA payload; or

2> if the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the MSGA buffer and the uplink grant determined as specified in clause 5.1.2a for the transmission of the MSGA payload was selected; or

3> if there is a MAC PDU in the MSGA buffer and the uplink grant was received in a fallbackRAR and this fallbackRAR successfully completed the Random Access procedure:

4> obtain the MAC PDU to transmit from the MSGA buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a fallbackRAR:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a MAC RAR; or:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

4> if the uplink grant size does not match with size of the obtained MAC PDU; and

4> if the Random Access procedure was successfully completed upon receiving the uplink grant:

5> indicate to the Multiplexing and assembly entity to include MAC subPDU(s) carrying MAC SDU from the obtained MAC PDU in the subsequent uplink transmission;

5> obtain the MAC PDU to transmit from the Multiplexing and assembly entity.

3> else if this uplink grant is a configured grant configured with *autonomousTx*; and

3> if the previous configured uplink grant, in the BWP, for this HARQ process was not prioritized; and

3> if a MAC PDU had already been obtained for this HARQ process; and

3> if the uplink grant size matches with size of the obtained MAC PDU; and

3> if a transmission of the obtained MAC PDU has not been performed:

4> consider the MAC PDU has been obtained.

3> else if the MAC entity is not configured with *lch-basedPrioritization*; or

3> if this uplink grant is a prioritized uplink grant:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

5> if the uplink grant is a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

6> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if *cg-RetransmissionTimer* is configured for the identified HARQ process; and

5> if the transmission is performed and LBT failure indication is received from lower layers:

6> consider the identified HARQ process as pending.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with a PUSCH duration of another uplink grant received on the PDCCH or an uplink grant received in a Random Access Response (i.e. MAC RAR or fallbackRAR) or an uplink grant determined as specified in clause 5.1.2a for MSGA payload for this Serving Cell; or:

3> if the MAC entity is configured with *lch-basedPrioritization* and this uplink grant is not a prioritized uplink grant:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the uplink grant is a configured uplink grant:

5> if the identified HARQ process is pending:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

5> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the identified HARQ process is pending and the transmission is performed and LBT failure indication is not received from lower layers:

5> consider the identified HARQ process as not pending.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

When *configuredGrantTimer* or *cg-RetransmissionTimer* is started or restarted by a PUSCH transmission, it shall be started at the beginning of the first symbol of the PUSCH transmission.

7.1.1.3.11.3 Test description

7.1.1.3.11.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that the UM DRB is configured and the logical channels are configured according to 7.1.1.3.11.3.1-1.

Table 7.1.1.3.11.3.1-2: Logical Channel Configuration Settings

|  |  |  |
| --- | --- | --- |
| Parameter | DRB1 | DRB2 |
| LogicalChannelIdentity | LCH4(DRB-Identity +3) | LCH5(DRB-Identity +3) |
| Priority | 6 | 7 |
| logicalChannelGroup | 2 (LCG ID#2) | 1 (LCG ID#1) |

7.1.1.3.11.3.2 Test procedure sequence

Table 7.1.1.3.11.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR RRCReconfiguration message to configure type 2 configured uplink grant. | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits NR RRCReconfigurationComplete. | --> | RRCReconfigurationComplete | - | - |
| 3 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 4 | SS transmits a MAC PDU including a RLC SDU-1 on LCH 4. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 5 | The SS allocates an UL Grant (with size 384 bits that only sufficient for one RLC SDU to be looped back in a Slot) for one HARQ process X and NDI indicates new transmission redundancy version to be used as 0. | <-- | (UL Grant (C-RNTI)) | - | - |
| 6 | The UE transmit a MAC PDU including the RLC SDU-1, in HARQ process X. | --> | MAC PDU | - | - |
| 7 | SS transmits a MAC PDU including a RLC SDU-2 on LCH 5. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 8 | SS transmits a configured UL Grant (with size 384 bits that only sufficient for one RLC SDU to be looped back in a Slot), on PDCCH with the CS-RNTI assigned to the UE, allowing the UE to return the RLC SDU-2 (as received in step 5) in Slot P. | <-- | (UL Grant (CS-RNTI)) | - | - |
| 9 | The SS transmits an UL grant corresponding to slot for HARQ process X, with NDI not toggled and redundancy version to be used as 1. (Note 3) | <-- | (UL Grant (C-RNTI)) | - | - |
| 10 | Check: Does the UE retransmit the MAC PDU including RLC SDU-1 in slot P? | --> | MAC PDU | 1 | P |
| 11 | Check: Does the UE transmit the MAC PDU including RLC SDU-2 after slot P? | --> | MAC PDU | 2 | P |
| 12 | The SS transmits a PDCCH [for UL configured grant type 2 explicit release] using UE’s CS-RNTI in Symbol ‘S’ of slot ‘p’ with NDI=0. Where (z+5x< p <z+6x). | <-- | PDCCH [for UL configured grant type 2 explicit release] | - | - |
| Note 1: Void.  Note 2: Void*.*  Note 3: The UL grant slot is equal to the configured slot in step 8*.* | | | | | |

7.1.1.3.11.3.3 Specific message contents

Table 7.1.1.3.11.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.3.11.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.11.3.3-2: *CellGroupConfig* (Table 7.1.1.3.11.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig | MAC-CellGroupConfig | Table 7.1.1.3.11.3.3-3 |  |
| physicalCellGroupConfig | PhysicalCellGroupConfig | Table 7.1.1.3.11.3.3-4 |  |
| spCellConfig SEQUENCE{ |  |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 10 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1 [4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym80x14 |  | 15kHz |
| periodicity | Sym160x14 |  | 30kHz |
| periodicity | Sym320x14 |  | 60kHz |
| periodicity | Sym640x14 |  | 120kHz |
| autonomousTx-r16 | enabled |  |  |
| } |  |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| PUSCH-TimeDomainResourceAllocationList SEQUENCE { |  |  |  |
| k2 | n8 |  | FR1 and FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 0011011 |  | FR1 |
| startSymbolAndLength | 0001110 |  | FR2 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.11.3.3-3: MAC-CellGroupConfig(Table 7.1.1.3.11.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| lch-BasedPrioritization-r16 | enabled |  |  |
| } |  |  |  |

Table 7.1.1.3.11.3.3-4: PhysicalCellGroupConfig(Table 7.1.1.3.11.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-106 | | | |
| Information Element | Value/remark | Comment | Condition |
| PhysicalCellGroupConfig ::= SEQUENCE { |  |  |  |
| cs-RNTI | ‘FFE0’H |  |  |
| } |  |  |  |

##### 7.1.1.3.12 Correct Handling of UL HARQ process / PUSCH Repetition Type B

7.1.1.3.12.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and is configured with PUSCH repetition type B}

**ensure that** {

**when** { UE receives an UL Grant with toggled NDI and has data available for transmission }

**then** { UE transmits a new MAC PDU and repeats the MAC PDU in proper actual transmission times after first transmission and selects the redundancy version correctly }

}

7.1.1.3.12.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.214 clauses 6.1.2.1 and 6.1.4, TS 38.321 clause 5.4.2.1. Unless otherwise stated these are Rel-16 requirements.

[TS 38.214, clause 6.1.2.1]

- for PUSCH scheduled by DCI format 0\_1, if *pusch-RepTypeIndicatorDCI-0-1* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. For PUSCH scheduled by DCI format 0\_2, if *pusch-RepTypeIndicatorDCI-0-2* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. Otherwise, the UE applies PUSCH repetition Type A procedure when determining the time domain resource allocation for PUSCH scheduled by PDCCH.

- For PUSCH repetition Type A, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- For PUSCH repetition Type B, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are provided by *startSymbol* and *length* of the indexed row of the resource allocation table, respectively.

- For PUSCH repetition Type A, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

- For PUSCH repetition Type B, the PUSCH mapping type is set to Type B.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*;

- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*;

- otherwise *K=1*.

If a UE is configured with higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, the UE does not expect to be configured with *pusch-AggregationFactor*.

For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, … *K*-1, is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or *n*th actual repetition (repetition Type B) | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

When transmitting MsgA PUSCH on a non-initial UL BWP, if the UE is configured with *startSymbolAndLengthMsgA-PO*, the UE shall determine the *S* and *L* from *startSymbolAndLengthMsgA-PO*.

When transmitting MsgA PUSCH, if the UE is not configured with *startSymbolAndLengthMsgA-PO*, and if the TDRA list *PUSCH-TimeDomainResourceAllocationList* is provided in *PUSCH-ConfigCommon*, the UE shall use *msgA-PUSCH-TimeDomainAllocation* to indicate which values are used in the list. If *PUSCH-TimeDomainResourceAllocationList* is not provided in *PUSCH-ConfigCommon*, the UE shall use parameters *S* and *L* from table 6.1.2.1.1-2 or table 6.1.2.1.1-3 where *msgA-PUSCH-TimeDomainAllocation* indicates which values are used in the list. The time offset for PUSCH transmission is described in [6, TS38.213].

For PUSCH repetition Type A, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213].

For PUSCH repetition Type B, except for PUSCH transmitting CSI report(s) with no transport block, the number of nominal repetitions is given by *numberOfRepetitions*. For the *n*-th nominal repetition, *n* = *0*, …, *numberOfRepetitions* - 1,

- The slot where the nominal repetition starts is given by , and the starting symbol relative to the start of the slot is given by .

- The slot where the nominal repetition ends is given by , and the ending symbol relative to the start of the slot is given by .

Here is the slot where the PUSCH transmission starts, and is the number of symbols per slot as defined in Clause 4.3.2 of [4, TS38.211].

For PUSCH repetition Type B, the UE determines invalid symbol(s) for PUSCH repetition Type B transmission as follows:

- A symbol that is indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* is considered as an invalid symbol for PUSCH repetition Type B transmission.

- For operation in unpaired spectrum, symbols indicated by *ssb-PositionsInBurst* in SIB1 or *ssb-PositionsInBurst* in *ServingCellConfigCommon* for reception of SS/PBCH blocks are considered as invalid symbols for PUSCH repetition Type B transmission.

- For operation in unpaired spectrum, symbol(s) indicated by *pdcch-ConfigSIB1* in *MIB* for a CORESET for Type0-PDCCH CSS set are considered as invalid symbol(s) for PUSCH repetition Type B transmission.

- For operation in unpaired spectrum, if *numberOfInvalidSymbolsForDL-UL-Switching* is configured, *numberOfInvalidSymbolsForDL-UL-Switching* symbol(s) after the last symbol that is indicated as downlink in each consecutive set of all symbols that are indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* are considered as invalid symbol(s) for PUSCH repetition Type B transmission. The symbol(s) given by *numberOfInvalidSymbolsForDL-UL-Switching* are defined using the reference SCS configuration *referenceSubcarrierSpacing* provided in *tdd-UL-DL-ConfigurationCommon*.

- The UE may be configured with the higher layer parameter *invalidSymbolPattern*, which provides a symbol level bitmap spanning one or two slots (higher layer parameter *symbols* given by *invalidSymbolPattern*). A bit value equal to 1 in the symbol level bitmap *symbols* indicates that the corresponding symbol is an invalid symbol for PUSCH repetition Type B transmission. The UE may be additionally configured with a time-domain pattern (higher layer parameter *periodicityAndPattern* given by *invalidSymbolPattern*), where each bit of *periodicityAndPattern* corresponds to a unit equal to a duration of the symbol level bitmap *symbols*, and a bit value equal to 1 indicates that the symbol level bitmap *symbols* is present in the unit. The *periodicityAndPattern* can be {1, 2, 4, 5, 8, 10, 20 or 40} units long, but maximum of 40 msec. The first symbol of *periodicityAndPattern* every 40 msec/P periods is a first symbol in frame 𝑛𝑓 mod 4 = 0, where P is the duration of *periodicityAndPattern-r16* in units of msec. When *periodicityAndPattern* is not configured, for a symbol level bitmap spanning two slots, the bits of the first and second slots correspond respectively to even and odd slots of a radio frame, and for a symbol level bitmap spanning one slot, the bits of the slot correspond to every slot of a radio frame. If *invalidSymbolPattern* is configured, when the UE applies the invalid symbol pattern is determined as follows:

- if the PUSCH is scheduled by DCI format 0\_1, or corresponds to a Type 2 configured grant activated by DCI format 0\_1, and if *invalidSymbolPatternIndicatorDCI-0-1* is configured,

- if invalid symbol pattern indicator field is set 1, the UE applies the invalid symbol pattern;

- otherwise, the UE does not apply the invalid symbol pattern;

- if the PUSCH is scheduled by DCI format 0\_2, or corresponds to a Type 2 configured grant activated by DCI format 0\_2, and if *invalidSymbolPatternIndicatorDCI-0-2* is configured,

- if invalid symbol pattern indicator field is set 1, the UE applies the invalid symbol pattern;

- otherwise, the UE does not apply the invalid symbol pattern;

- otherwise, the UE applies the invalid symbol pattern.

- If the UE

- is configured with multiple serving cells and is provided *half-duplex-behavior* = 'enable', and

- is not capable of simultaneous transmission and reception on any of the multiple serving cells, and

- indicates support of capability for half-duplex operation in CA with unpaired spectrum, and

- is not configured to monitor PDCCH for detection of DCI format 2-0 on any of the multiple serving cells,

- a symbol is considered as an invalid symbol in any of the multiple serving cells for PUSCH repetition Type B transmission if the symbol is indicated to the UE for reception of SS/PBCH blocks in any of the multiple serving cells by *ssb-PositionsInBurst* in *SIB1* or *ssb-PositionsInBurst* in *ServingCellConfigCommon*, and

a symbol is considered as an invalid symbol in any of the multiple serving cells for PUSCH repetition Type B transmission with Type 1 or Type 2 configured grant except for the first Type 2 PUSCH transmission (including all repetitions) after activation if the symbol is indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* on the reference cell, or the UE is configured by higher layers to receive PDCCH, PDSCH, or CSI-RS on the reference cell in the symbol.

For PUSCH repetition Type B, after determining the invalid symbol(s) for PUSCH repetition type B transmission for each of the *K* nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of all potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of *L*=1. An actual repetition is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213]. The redundancy version to be applied on the *n*th actual repetition (with the counting including the actual repetitions that are omitted) is determined according to table 6.1.2.1-2.

For PUSCH repetition Type B, when a UE receives a DCI that schedules aperiodic CSI report(s) or activates semi-persistent CSI report(s) on PUSCH with no transport block by a '*CSI request'* field on a DCI, the number of nominal repetitions is always assumed to be 1, regardless of the value of *numberOfRepetitions*. When the UE is scheduled to transmit a PUSCH repetition Type B with no transport block and with aperiodic or semi-persistent CSI report(s) by a '*CSI request'* field on a DCI, the first nominal repetition is expected to be the same as the first actual repetition. For PUSCH repetition Type B carrying semi-persistent CSI report(s) without a corresponding PDCCH after being activated on PUSCH by a '*CSI request'* field on a DCI, if the first nominal repetition is not the same as the first actual repetition, the first nominal repetition is omitted; otherwise, the first nominal repetition is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213].

For PUSCH repetition Type B, when a UE is scheduled to transmit a transport block and aperiodic CSI report(s) on PUSCH by a '*CSI request'* field on a DCI, the CSI report(s) is multiplexed only on the first actual repetition. The UE does not expect that the first actual repetition has a single symbol duration.

[TS 38.214, clause 6.1.4]

To determine the modulation order, target code rate, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit modulation and coding scheme field in the DCI scheduling PUSCH or provided in a DCI activating a configured grant Type 2 PUSCH, or as provided by *mcsAndTBS* as described in Clause 6.1.2.3 for a configured grant Type 1 PUSCH to determine the modulation order  and target code rate (*R*) based on the procedure defined in Clause 6.1.4.1

- read redundancy version field (*rv*) in the DCI to determine the redundancy version for PUSCH scheduled by DCI, or determine the redundancy version according to Clause 6.1.2.3.1 for configured grant Type 1 and Type 2 PUSCH,

and second

- use the number of layers , the total number of allocated PRBs  to determine the transport block size based on the procedure defined in Clause 6.1.4.2.

When the UE is scheduled with multiple PUSCHs by a DCI, as described in clause 6.1.2.1, the bits of *rv* field and NDI field, respectively, in the DCI are one to one mapped to the scheduled PUSCH(s) with the corresponding transport block(s) in the scheduled order where the LSB bits of the *rv* field and NDI field, respectively, correspond to the last scheduled PUSCH.

Within a cell group, a UE is not required to handle PUSCH(s) transmissions in slot *sj* in serving cell-*j*, and for *j* = 0,1,2.. *J-1*, slot *sj* overlapping with any given point in time, if the following condition is not satisfied at that point in time:

,



where

*- J* is the number of configured serving cells belong to a frequency range

- for the *j-th* serving cell,

*- M* is the number of TB(s) transmitted in slot-*sj*. For PUSCH repetition Type B, each actual repetition is counted separately.

*- Tslotμ(j)* =10-3/2*μ(j*), where *μ(j)* is the numerology for PUSCH(s) in slot *sj* of the *j*-th serving cell.

- for the *m*-th TB,



*- A* is the number of bits in the transport block as defined in Clause 6.2.1 [5, TS 38.212]

*- C* is the total number of code blocks for the transport block defined in Clause 5.2.2 [5, TS 38.212].



- is the number of scheduled code blocks for the transport block as defined in Clause 5.4.2.1 [5,38.212]



- [Mbps] is computed as the maximum data rate summed over all the carriers in the frequency range for any signalled band combination and feature set consistent with the configured servings cells, where the data rate value is given by the formula in Clause 4.1.2 in [13, TS 38.306], including the scaling factor *f(i).*



For a *j*-th serving cell, if higher layer parameter *processingType2Enabled* of *PUSCH-ServingCellConfig* is configured for the serving cell and set to 'enable'*,* or if at least one *IMCS > W* for a PUSCH, where *W* = 28 for MCS tables 5.1.3.1-1 and 5.1.3.1-3, and *W* = 27 for MCS tables 5.1.3.1-2, 6.1.4.1-1, and 6.1.4.1-2, or if it is an actual repetition for PUSCH repetition Type B, the UE is not required to handle PUSCH transmissions, if the following condition is not satisfied:



where

- is the number of symbols assigned to the PUSCH



- *M* is the number of TB in the PUSCH

- where μ is the numerology of the PUSCH



- for the *m*-th TB,



- *A* is the number of bits in the transport block as defined in Clause 6.2.1 [5, TS 38.212]

- *C* is the total number of code blocks for the transport block defined in Clause 5.2.2 [5, TS 38.212]

- is the number of scheduled code blocks for the transport block as defined in Clause 5.4.2.1 [5, TS 38.212]



- [Mbps] is computed as the maximum data rate for a carrier in the frequency band of the serving cell for any signalled band combination and feature set consistent with the serving cell, where the data rate value is given by the formula in Clause 4.1.2 in [13, TS 38.306], including the scaling factor *f(i)*



- each actual repetition for PUSCH repetition type B is treated as one PUSCH*.*

[TS 38.321, clause 5.4.2.1]

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

NOTE: When a single DCI is used to schedule multiple PUSCH, the UE is allowed to map generated TB(s) internally to different HARQ processes in case of LBT failure(s), i.e. UE may transmit a new TB on any HARQ process in the grants that have the same TBS, the same RV and the NDIs indicate new transmission.

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant is given by *REPETITION\_NUMBER* as follows:

- For a dynamic grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];

- For a configured grant, *REPETITION\_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.3 of TS 38.214 [7].

If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION\_NUMBER* for a dynamic grant or configured uplink grant unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

For each transmission within a bundle of the dynamic grant, the sequence of redundancy versions is determined according to clause 6.1.2.1 of TS 38.214 [7]. For each transmission within a bundle of the configured uplink grant, the sequence of redundancy versions is determined according to clause 6.1.2.3 of TS 38.214 [7].

For each uplink grant, the HARQ entity shall:

1> identify the HARQ process associated with this grant, and for each identified HARQ process:

2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or

2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

2> if the uplink grant was received in a Random Access Response (i.e. in a MAC RAR or a fallback RAR); or

2> if the uplink grant was determined as specified in clause 5.1.2a for the transmission of the MSGA payload; or

2> if the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery; or

2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:

3> if there is a MAC PDU in the MSGA buffer and the uplink grant determined as specified in clause 5.1.2a for the transmission of the MSGA payload was selected; or

3> if there is a MAC PDU in the MSGA buffer and the uplink grant was received in a fallbackRAR and this fallbackRAR successfully completed the Random Access procedure:

4> obtain the MAC PDU to transmit from the MSGA buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a fallbackRAR:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

3> else if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a MAC RAR; or:

3> if there is a MAC PDU in the Msg3 buffer and the uplink grant was received on PDCCH for the C-RNTI in *ra-ResponseWindow* and this PDCCH successfully completed the Random Access procedure initiated for beam failure recovery:

4> obtain the MAC PDU to transmit from the Msg3 buffer.

4> if the uplink grant size does not match with size of the obtained MAC PDU; and

4> if the Random Access procedure was successfully completed upon receiving the uplink grant:

5> indicate to the Multiplexing and assembly entity to include MAC subPDU(s) carrying MAC SDU from the obtained MAC PDU in the subsequent uplink transmission;

5> obtain the MAC PDU to transmit from the Multiplexing and assembly entity.

3> else if this uplink grant is a configured grant configured with *autonomousTx*; and

3> if the previous configured uplink grant, in the BWP, for this HARQ process was not prioritized; and

3> if a MAC PDU had already been obtained for this HARQ process; and

3> if the uplink grant size matches with size of the obtained MAC PDU; and

3> if none of PUSCH transmission(s) of the obtained MAC PDU has been completely performed:

4> consider the MAC PDU has been obtained.

3> else if the MAC entity is not configured with *lch-basedPrioritization*; or

3> if this uplink grant is a prioritized uplink grant:

4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;

3> if a MAC PDU to transmit has been obtained:

4> if the uplink grant is not a configured grant configured with *autonomousTx*; or

4> if the uplink grant is a prioritized uplink grant:

5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;

5> instruct the identified HARQ process to trigger a new transmission;

5> if the uplink grant is a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

6> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

5> if *cg-RetransmissionTimer* is configured for the identified HARQ process; and

5> if the transmission is performed and LBT failure indication is received from lower layers:

6> consider the identified HARQ process as pending.

3> else:

4> flush the HARQ buffer of the identified HARQ process.

2> else (i.e. retransmission):

3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or

3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or

3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with a PUSCH duration of another uplink grant received on the PDCCH or an uplink grant received in a Random Access Response (i.e. MAC RAR or fallbackRAR) or an uplink grant determined as specified in clause 5.1.2a for MSGA payload for this Serving Cell; or:

3> if the MAC entity is configured with *lch-basedPrioritization* and this uplink grant is not a prioritized uplink grant:

4> ignore the uplink grant.

3> else:

4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;

4> instruct the identified HARQ process to trigger a retransmission;

4> if the uplink grant is addressed to CS-RNTI; or

4> if the uplink grant is addressed to C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

5> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the uplink grant is a configured uplink grant:

5> if the identified HARQ process is pending:

6> start or restart the *configuredGrantTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers;

5> start or restart the *cg-RetransmissionTimer*, if configured, for the corresponding HARQ process when the transmission is performed if LBT failure indication is not received from lower layers.

4> if the identified HARQ process is pending and the transmission is performed and LBT failure indication is not received from lower layers:

5> consider the identified HARQ process as not pending.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

When *configuredGrantTimer* or *cg-RetransmissionTimer* is started or restarted by a PUSCH transmission, it shall be started at the beginning of the first symbol of the PUSCH transmission.

7.1.1.3.12.3 Test description

7.1.1.3.12.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.3.12.3.2 Test procedure sequence

Table 7.1.1.3.12.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| 0A | SS transmits in the indicated downlink assignment an NR RRCReconfiguration. (Note 1) | <--- | - | - | - |
| 0B | UE transmits NR RRCReconfigurationComplete message to the SS. (Note 2) | --> | - | - | - |
| 1 | The SS transmits a valid MAC PDU containing one RLC PDU. | <--- | MAC PDU | - | - |
| 2 | The UE transmits a Scheduling Request. | --> | (SR) | - | - |
| 3 | The SS allocates an UL Grant for HARQ process 1, sufficient for one RLC SDU to be looped back in a slot n, NDI indicates new transmission, DCI scheduling the PUSCH indicates rvID = 0 and invalid symbol pattern indicator set to 1. The slot n is selected such that slot n+4 is the first UL slot in subframe m satisfying (m mod 20) = 9 for SCS=15kHz and SCS=120kHz and  (m mod 20) = 8 for SCS=30kHz. (Note 5) | <-- | UL Grant | - | - |
| 4 | Check: Does the UE transmit a MAC PDU including one RLC SDU, in HARQ process 1 and in slot n+4 and repeats in actual repetitions according to Table 7.1.1.3.12.3.2-2 with same resource allocation but different redundancy version (Note 3), if the slot can be used for uplink transmission (Note 4) | --> | MAC PDU | 1 | P |
| 5 | SS transmits a MAC PDU containing an RLC STATUS PDU acknowledging the reception of the AMD PDU in step 4. | <-- | MAC PDU (RLC STATUS PDU) | - |  |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The redundancy version for the first transmission and all possible actual repetitions (including skipped ones) are set in the following order {0, 2, 3, 1} according to TS 38.214 [15] Table 6.1.2.1-2, first row.  Note 4: Usage of correct redundancy version is implicitly checked upon correct decoding by the SS of the UE UL repetitions.  Note 5: The UL grant is set to 384 bits: LRBs = 24 & IMCS = 2 (with PUSCH-duration=4 and PUSCH mapping Type B). | | | | | |

Table 7.1.1.3.12.3.2-2: Transmitted actual repetition in each nominal repetition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Nominal repetition 0  (NOTE 1) | Nominal repetition 1  (NOTE 1) | Nominal repetition 2  (NOTE 2) | Nominal repetition 3  (NOTE 3) |
| FR1 TDD SCS=15kHz | Actual repetition 0 | Actual repetition 0 | N/A (NOTE 4, 5) | N/A (NOTE 6) |
| FR1 FDD SCS=15kHz | Actual repetition 0 | Actual repetition 0 | Actual repetition 1 (NOTE 4, 7) | Actual repetition 0 |
| FR1 TDD SCS=30kHz | Actual repetition 0 | Actual repetition 0 | Actual repetition 1 (NOTE 4) | Actual repetition 0 |
| FR2 SCS=120kHz | Actual repetition 0 | Actual repetition 0 | N/A (NOTE 4, 5) | N/A (NOTE 6) |
| NOTE 1: The nominal repetition is in slot n+4 and only one actual repetition expected.  NOTE 2: The nominal repetition is split into two actual repetitions in slot n+4 and n+5 respectively.  NOTE 3: The nominal repetition is in slot n+5 and only one actual repetition expected.  NOTE 4: The actual repetition 0 is skipped due to only 1 valid symbol left according to invalidSymbolPattern-r16.  NOTE 5: The actual repetition 1 is skipped due to being located in DL symbols  NOTE 6: The actual repetition 0 is skipped due to being located in DL symbols  NOTE 7: The SS may not be able to decode the MAC PDU and may only detect a CRC error as there are less symbols available for transmission of the TBS | | | | |

7.1.1.3.12.3.3 Specific message contents

Table 7.1.1.3.12.3.3-0A: *RRCReconfiguration* (step 0A, Table 7.1.1.3.12.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs ::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-0B: *CellGroupConfig* (Table 7.1.1.3.12.3.3-0A: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig::= SEQUENCE { |  |  |  |
| cellGroupId | 0 |  |  |
|  | 1 |  | EN-DC |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| servingCellConfig | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-1: *ServingCellConfig* (Table 7.1.1.3.12.3.3-0B: *CellGroupConfig*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-2: *BWP-UplinkDedicated* (Table 7.1.1.3.12.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-11 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup | PUSCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-3: *PUSCH-Config* (Table 7.1.1.3.12.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| pusch-TimeDomainAllocationListDCI-0-1-r16 CHOICE { |  |  |  |
| setup SEQUENCE (SIZE(1..maxNrofUL-Allocations-r16)) OF SEQUENCE { | 1 entry |  |  |
| k2-r16[1] | 4 |  |  |
| puschAllocationList-r16[1] SEQUENCE (SIZE(1..maxNrofMultiplePUSCHs-r16)) OF SEQUENCE { | 1 entry |  |  |
| mappingType-r16[1] | Not present |  |  |
| startSymbolAndLength-r16[1] | Not present |  |  |
| startSymbol-r16[1] | 4 |  |  |
| length-r16[1] | 4 |  |  |
| numberOfRepetitions-r16[1] | n4 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| invalidSymbolPatternIndicatorDCI-0-1-r16 | enabled |  |  |
| pusch-RepTypeIndicatorDCI-0-1-r16 | pusch-RepTypeB |  |  |
| invalidSymbolPattern-r16 SEQUENCE { |  |  |  |
| symbols-r16 CHOICE { |  |  |  |
| oneSlot | 00000000000001 |  |  |
| } |  |  |  |
| periodicityAndPattern-r16 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.3.12.3.3-4: *DMRS-UplinkConfig*

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-51 |

##### 7.1.1.3.13 Logical channel prioritization handling with Mapping restrictions / physical layer priority

7.1.1.3.13.1 Test Purpose (TP)

(1)

**with** {UE in RRC\_CONNECTED state with allowedPHY-PriorityIndex configured}

**ensure that** {

**when** { UE is scheduled by DCI including priority indicator}

**then** { UE serves the logical channels according to their priority and configured PHY priority}

}

7.1.1.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.331, clause 6.3.2, TS 38.321, clause 5.4.3.1.2, 5.4.3.1.3, TS 38.213 clause 9, TS 38.212 clause 7.3.1.1.3. Unless otherwise stated these are Rel-16 requirements.

[TS 38.331, clause 6.3.2]

|  |
| --- |
| ***allowedPHY-PriorityIndex***  This restriction applies only when the UL grant is a dynamic grant. If the field is present and the dynamic grant has a PHY-priority index, UL MAC SDUs from this logical channel can only be mapped to the dynamic grants indicating PHY-priority index equal to the values configured by this field. If the field is present and the dynamic grant does not have a PHY-priority index, UL MAC SDUs from this logical channel can only be mapped to this dynamic grant if the value of the field is *p0*, see TS 38.213 [13], clause 9. If the field is not present, UL MAC SDUs from this logical channel can be mapped to any dynamic grants. Corresponds to "allowedPHY-PriorityIndex" as specified in TS 38.321 [3]. |

[TS 38.321, clause 5.4.3.1.2]

The MAC entity shall, when a new transmission is performed:

1> select the logical channels for each UL grant that satisfy all the following conditions:

2> the set of allowed Subcarrier Spacing index values in *allowedSCS-List*, if configured, includes the Subcarrier Spacing index associated to the UL grant; and

2> *maxPUSCH-Duration*, if configured, is larger than or equal to the PUSCH transmission duration associated to the UL grant; and

2> *configuredGrantType1Allowed*, if configured, is set to *true* in case the UL grant is a Configured Grant Type 1; and

2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant. Does not apply to logical channels associated with a DRB configured with PDCP duplication within the same MAC entity (i.e. CA duplication) when CA duplication is deactivated for this DRB in this MAC entity; and

2> *allowedCG-List*, if configured, includes the configured grant index associated to the UL grant; and

2> *allowedPHY-PriorityIndex*, if configured, includes the priority index (as specified in clause 9 of TS 38.213 [6]) associated to the dynamic UL grant.

NOTE: The Subcarrier Spacing index, PUSCH transmission duration, Cell information, and priority index are included in Uplink transmission information received from lower layers for the corresponding scheduled uplink transmission.

[TS 38.321, clause 5.4.3.1.3]

Before the successful completion of the Random Access procedure initiated for DAPS handover, the target MAC entity shall not select the logical channel(s) corresponding to non-DAPS DRB(s) for the uplink grant received in a Random Access Response or the uplink grant for the transmission of the MSGA payload.

The MAC entity shall, when a new transmission is performed:

1> allocate resources to the logical channels as follows:

2> logical channels selected in clause 5.4.3.1.2 for the UL grant with *Bj* > 0 are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to *infinity*, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);

2> decrement *Bj* by the total size of MAC SDUs served to logical channel *j* above;

2> if any resources remain, all the logical channels selected in clause 5.4.3.1.2 are served in a strict decreasing priority order (regardless of the value of *Bj*) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.

NOTE 1: The value of *Bj* can be negative.

If the MAC entity is requested to simultaneously transmit multiple MAC PDUs, or if the MAC entity receives the multiple UL grants within one or more coinciding PDCCH occasions (i.e. on different Serving Cells), it is up to UE implementation in which order the grants are processed.

The UE shall also follow the rules below during the scheduling procedures above:

- the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;

- if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;

- the UE should maximise the transmission of data;

- if the MAC entity is given a UL grant size that is equal to or larger than 8 bytes while having data available and allowed (according to clause 5.4.3.1) for transmission, the MAC entity shall not transmit only padding BSR and/or padding.

The MAC entity shall:

1> if the MAC entity is configured with *enhancedSkipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or if the MAC entity is configured with *enhancedSkipUplinkTxConfigured* with value *true* and the grant indicated to the HARQ entity is a configured uplink grant; and

1> if the MAC entity is not configured with *lch-basedPrioritization*; and

1> if there is no UCI to be multiplexed on this PUSCH transmission as specified in TS 38.213 [6]; and

1> if there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

1> if the MAC PDU includes zero MAC SDUs; and

1> if the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR:

2> not generate a MAC PDU for the HARQ entity.

1> else if the MAC entity is configured with *skipUplinkTxDynamic* with value *true* and the grant indicated to the HARQ entity was addressed to a C-RNTI, or the grant indicated to the HARQ entity is a configured uplink grant; and

1> if there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.212 [9]; and

1> if the MAC PDU includes zero MAC SDUs; and

1> if the MAC PDU includes only the periodic BSR and there is no data available for any LCG, or the MAC PDU includes only the padding BSR:

2> not generate a MAC PDU for the HARQ entity.

Logical channels shall be prioritised in accordance with the following order (highest priority listed first):

- C-RNTI MAC CE or data from UL-CCCH;

- Configured Grant Confirmation MAC CE or BFR MAC CE or Multiple Entry Configured Grant Confirmation MAC CE;

- Sidelink Configured Grant Confirmation MAC CE;

- LBT failure MAC CE;

- MAC CE for SL-BSR prioritized according to clause 5.22.1.6;

- MAC CE for BSR, with exception of BSR included for padding;

- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;

- MAC CE for the number of Desired Guard Symbols;

- MAC CE for Pre-emptive BSR;

- MAC CE for SL-BSR, with exception of SL-BSR prioritized according to clause 5.22.1.6 and SL-BSR included for padding;

- data from any Logical Channel, except data from UL-CCCH;

- MAC CE for Recommended bit rate query;

- MAC CE for BSR included for padding;

- MAC CE for SL-BSR included for padding.

NOTE 2: Prioritization among Configured Grant Confirmation MAC CE, Multiple Entry Configured Grant Confirmation MAC CE, and BFR MAC CE is up to UE implementation.

The MAC entity shall prioritize any MAC CE listed in a higher order than 'data from any Logical Channel, except data from UL-CCCH' over transmission of NR sidelink communication.

[TS 38.213, clause 9]

A PUSCH or a PUCCH transmission, including repetitions if any, can be of priority index 0 or of priority index 1. For a configured grant PUSCH transmission, a UE determines a priority index from *phy-PriorityIndex*, if provided. For a PUCCH transmission with HARQ-ACK information corresponding to a SPS PDSCH reception or a SPS PDSCH release, a UE determines a priority index from *harq-CodebookID*, if provided. For a PUCCH transmission with SR, a UE determines the corresponding priority as described in Clause 9.2.4. For a PUSCH transmission with semi-persistent CSI report, a UE determines a priority index from a priority indicator field, if provided, in a DCI format that activates the semi-persistent CSI report. If a priority index is not provided to a UE for a PUSCH or a PUCCH transmission, the priority index is 0.

7.1.1.3.13.3 Test description

7.1.1.3.13.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 with the exception of 3 UM bearers configured according to Table 7.1.1.3.13.3.1-1.

Table 7.1.1.3.13.3.1-1: Priority, PBR and Bucket Delay settings

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DRB | priority | prioritisedBitRate (kbytes/s) | bucketSizeDuration (ms) | allowedPHY-PriorityIndex-r16 |
| DRB1 | 6 | infinity | 100 | p0 |
| DRB2 | 7 | infinity | 100 | p1 |
| DRB3 | 8 | infinity | 100 | p1 |

7.1.1.3.13.3.2 Test procedure sequence

Table 7.1.1.3.13.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
|  |  |  |  |  |  |
| 1 | The SS transmits 2 equal size RLC SDUs each on DRB1, DRB2, DRB3. | <-- | (RLC SDUs) | - | - |
| 2 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 100 ms after Step 1 (Note1), the SS transmits 4 UL grant of suitable size to receive one loop back RLC SDU on one logical channel every 20 ms with Priority indicator =1 | <-- | (UL grants) | - | - |
| 3 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB2? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 4 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB2? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 5 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 6 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 7 | The SS is configured for Uplink Grant Allocation Type 2 as defined in TS 38.523-3 [3]. 100 ms after Step 1 (Note1), the SS transmits 2 UL grant of suitable size to receive one loop back RLC SDU on one logical channel every 20 ms with Priority indicator=0 | <-- | (UL grants) | - | - |
| 8 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 9 | Check: Does the UE transmit a MAC PDU containing MAC Sub PDU containing a RLC SDU on DRB1? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| Note 1: This wait time will ensure that a) all octets have been completely received by the UE on all 3 DRBs before the first UL grant is received and b) the Bjs for each logical channel have reached their maximum value i.e. the bucket size of the corresponding logical channel before the first UL grant is received. | | | | | |

7.1.1.3.13.3.3 Specific message contents

Table 7.1.1.3.13.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

#### 7.1.1.4 Transport Size Selection

##### 7.1.1.4.1 DL-SCH Transport Block Size Selection

###### 7.1.1.4.1.0 Common parameters for DL-SCH Transport Block Size Selection

Table 7.1.1.4.1.0-1: PDSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-103 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-TimeDomainResourceAllocationList ::= SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation { | 2 entries |  |  |
| PDSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 |  |
| k0 | Not present |  |  |
| mappingType | typeA |  |  |
| startSymbolAndLength | 53 | S=2, L=12 |  |
| } |  |  |  |
| PDSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 |  |
| k0 | Not present |  |  |
| mappingType | typeA |  |  |
| startSymbolAndLength | 86 | S=2, L=7 |  |
| } |  |  |  |
| } |  |  |  |

###### 7.1.1.4.1.1 DL-SCH Transport Block Size selection / DCI format 1\_0

7.1.1.4.1.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_0 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.1, TS 38.214 clause 5.1.2.1, 5.1.2.2, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.2.1]

DCI format 1\_0 is used for the scheduling of PDSCH in one DL cell.

The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Frequency domain resource assignment – bits



- is the size of the active DL bandwidth part in case DCI format 1\_0 is monitored in the UE specific search space and satisfying



- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

otherwise,  is the size of the initial DL bandwidth part.

If the CRC of the DCI format 1\_0 is scrambled by C-RNTI and the "Frequency domain resource assignment" field are of all ones, the DCI format 1\_0 is for random access procedure initiated by a PDCCH order, with all remaining fields set as follows:

- Random Access Preamble index – 6 bits according to *ra-PreambleIndex* in Subclause 5.1.2 of [8, TS38.321]

- UL/SUL indicator – 1 bit. If the value of the “Random Access Preamble index” is not all zeros and if the UE is configured with SUL in the cell, this field indicates which UL carrier in the cell to transmit the PRACH according to Table 7.3.1.1.1-1; otherwise, this field is reserved

- SS/PBCH index – 6 bits. If the value of the “Random Access Preamble index” is not all zeros, this field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission; otherwise, this field is reserved.

- PRACH Mask index – 4 bits. If the value of the “Random Access Preamble index” is not all zeros, this field indicates the RACH occasion associated with the SS/PBCH indicated by “SS/PBCH index” for the PRACH transmission, according to Subclause 5.1.1 of [8, TS38.321]; otherwise, this field is reserved

- Reserved bits – 10 bits

Otherwise, all remaining fields are set as follows:

- Time domain resource assignment – 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]

- VRB-to-PRB mapping – 1 bit according to Table 7.3.1.1.2-33

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- Downlink assignment index – 2 bits as defined in Subclause 9.1.3 of [5, TS38.213], as counter DAI

- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and



- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if then



else



where, and



- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |

[38.214 clause 5.1.2.2]

Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, then downlink resource allocation type 1 is used.

[38.214 clause 5.1.2.2.2]

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks within the active bandwidth part of size PRBs except for the case when DCI format 1\_0 is decoded in any common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.



A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by



if then



else



where≥ 1 and shall not exceed .



[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, or P-RNTI,

if the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with a DCI format 1\_1 and the CRC is scrambled by C-RNTI or CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with new-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled with C-RNTI, and the PDSCH is assigned by a PDCCH in a UE-specific search space

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with new-RNTI, and the PDSCH is scheduled with new-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', the PDSCH is scheduled with CS-RNTI, and the PDSCH is assigned by a PDCCH with DCI format 1\_1

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-config* set to 'qam64LowSE', and the PDSCH is scheduled with CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

End

The UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then a transport block is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block, otherwise the transport block is enabled. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or as described for format 1\_0 in Subclause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 0, 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.1.3 Test description

7.1.1.4.1.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.1.1.3.2 Test procedure sequence

Table 7.1.1.4.1.1.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| **UE Category** | **Maximum number of bits of a UL-SCH transport block received within a TTI** |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.1.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤12128 note 2 | | 1 | | 8\*FLOOR((TBS– 128)/8) | |
| 12129 ≤ TBS≤24200 | | 2 | | 8\*FLOOR((TBS– 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS– 272)/24) | |
| 36273 ≤ TBS ≤48344 | | 4 | | 8\*FLOOR((TBS– 344)/32) | |
| 48345≤ TBS ≤60416 | | 5 | | 8\*FLOOR((TBS– 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS–488)/48) | |
| 72489 ≤ TBS ≤84560 | | 7 | | 8\*FLOOR((TBS– 560)/56) | |
| 84561 ≤ TBS≤96632 | | 8 | | 8\*FLOOR((TBS–632)/64) | |
| 96633< TBS ≤108704 | | 9 | | 8\*FLOOR((TBS–704)/72) | |
| 10705 ≤ TBS ≤120776 | | 10 | | 8\*FLOOR((TBS– 776)/80) | |
| 120777≤ TBS ≤132848 | | 11 | | 8\*FLOOR((TBS–848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS– 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS– 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS– 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS– 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS– 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS– 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS– 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS– 1424)/152) | |
| TBS> 229424 | | 20 | | 8\*FLOOR((TBS–1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;  MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.1.1.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 |  |
| mcs-Table | qam64 |  |
| *xoh-PDSCH* | Not Present | Results in value 0(xoh0) |

Table 7.1.1.4.1.1.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of 1 to in BWP, time domain resource as per table 7.1.1.4.1.0-1 and from 0 to 28.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.1.3.2-1 and larger than or equal to 132 bits as specified in Table 7.1.1.4.1.1.3.2-2 | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.1.1.3.2-2. | - | - | - | - |
| 3 | The SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_0 and values of S, L,and  *nPRB*. | <-- | MAC PDU (NxPDCP SDUs)  DCI: (DCI Format 1\_0, S, L,and  *nPRB.*) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |

7.1.1.4.1.1.3.3 Specific message contents

None.

###### 7.1.1.4.1.2 Void

###### 7.1.1.4.1.3 DL-SCH transport block size selection / DCI format 1\_1 / RA type 0/RA Type 1 / 2 Codewords enabled

7.1.1.4.1.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and maxNrofCodeWordsScheduledByDCI set to 'n2' }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

(2)

**with** { UE in RRC\_CONNECTED state and maxNrofCodeWordsScheduledByDCI set to 'n2' }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.2, TS 38.214 clause 5.1.2.1, 5.1.2.2.1, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.2.2]

DCI format 1\_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Carrier indicator – 0 or 3 bits as defined in Subclause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs  configured by higher layers, excluding the initial DL bandwidth part. The bit width for this field is determined as bits, where



- if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;



- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;



If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where is the size of the active DL bandwidth part:



- bits if only resource allocation type 0 is configured, where is defined in Subclause 5.1.2.2.1 of [6, TS38.214],



- bits if only resource allocation type 1 is configured, or



- bits if both resource allocation type 0 and 1 are configured.



- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Subclause 5.1.2.2.1 of [6, TS38.214].



- For resource allocation type 1, the LSBs provide the resource allocation as defined in Subclause 5.1.2.2.2 of [6, TS38.214]



If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the “Frequency domain resource assignment” field of the active bandwidth part is smaller than the bit width of the “Frequency domain resource assignment” field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-AllocationList*.



- VRB-to-PRB mapping – 0 or 1 bit

- 0 bit if only resource allocation type 0 is configured;

- 1 bit according to Table 7.3.1.1.2-33 otherwise, only applicable to resource allocation type 1, as defined in Subclause 7.3.1.6 of [4, TS38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingType* is not configured or is set to ‘static’, or 1 bit if the higher layer parameter *prb-BundlingType* is set to ‘dynamic’, according to Subclause 5.1.2.3 of [6, TS38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameter *rateMatchPattern*.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Subclause 5.1.4.2 of [6, TS38.214]. The bit width for this field is determined as bits, where is the number of ZP CSI-RS resource sets in the higher layer parameter*zp-CSI-RS-Resource*.



For transport block 1:

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

For transport block 2 (only present if *maxNrofCodeWordsScheduledByDCI* equals 2

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the value of *maxNrofCodeWordsScheduledByDCI* for the indicated bandwidth part equals 2 and the value of *maxNrofCodeWordsScheduledByDCI* for the active bandwidth part equals 1, the UE assumes zeros are padded when interpreting the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 according to Subclause 12 of [5, TS38.213], and the UE ignores the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 for the indicated bandwidth part.

- HARQ process number – 4 bits

- Downlink assignment index – number of bits as defined in the following

- 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 3 0, 1, 2, or bits as defined in Subclause 9.2.3 of [5, TS38.213]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK.*

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports  shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of  and .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* is not enabled; otherwise 3 bits as defined in Subclause 5.1.5 of [6, TS38.214].

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “Transmission configuration indication” field is not present in the DCI format 1\_1, the UE assumes *tci-PresentInDCI* is not enabled for the indicated bandwidth part.

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits as defined in Subclause 5.1.7 of [6, TS38.214], determined by the higher layer parameters *maxCodeBlockGroupsPerTransportBlock* and *Number-MCS-HARQ-DL-DCI* for the PDSCH.

- CBG flushing out information (CBGFI) – 0 or 1 bit as defined in Subclause 5.1.7 of [6, TS38.214], determined by higher layer parameter *codeBlockGroupFlushIndicator*.

- DMRS sequence initialization – 1 bit if both *scramblingID0* and *scramblingID1* are configured in *DMRS-DownlinkConfig* for selection defined in Subclause 7.4.1.1.1 of [4, TS38.211]; 0 bit otherwise.



[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and



- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if then



else



where, and



- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Posiition* = 3 | | | | | | |

[TS 38.214, clause 5.1.2.2.1]

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured for PDSCH and the size of the carrier bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a downlink carrier bandwidth part *i* of size PRBs is given by , where



- the size of the first RBG is ,



- the size of last RBG is if and *P* otherwise,



- the size of all other RBGs is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency and starting at the lowest frequency of the carrier bandwidth part. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.



[TS 38.214, clause 5.1.2.2.2]

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated localized or distributed virtual resource blocks within the active carrier bandwidth part of size PRBs except for the case when DCI format 1\_0 is decoded in the common search space in CORESET 0 in which case the initial bandwidth part of size shall be used.



A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by



if then



else



where≥ 1 and shall not exceed .



[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, or P-RNTI,

if the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with a DCI format 1\_1 and the CRC is scrambled by C-RNTI or CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with new-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled with C-RNTI, and the PDSCH is assigned by a PDCCH in a UE-specific search space

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with new-RNTI, and the PDSCH is scheduled with new-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', the PDSCH is scheduled with CS-RNTI, and the PDSCH is assigned by a PDCCH with DCI format 1\_1

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-config* set to 'qam64LowSE', and the PDSCH is scheduled with CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

End

The UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then a transport block is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block, otherwise the transport block is enabled. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or as described for format 1\_0 in Subclause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 0, 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.3.3 Test description

7.1.1.4.1.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value).

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.1.3.3.2 Test procedure sequence

Table 7.1.1.4.1.3.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| **UE Category** | **Maximum number of bits of a UL-SCH transport block received within a TTI** |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.3.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 192 ≤ TBS ≤12184 note 2 | 1 | 8\*FLOOR((TBS– 184)/8) |
| 12185≤ TBS≤24256 | 2 | 8\*FLOOR((TBS– 256)/16) |
| 24257≤ TBS ≤ 36328 | 3 | 8\*FLOOR((TBS– 328)/24) |
| 36329 ≤ TBS ≤48400 | 4 | 8\*FLOOR((TBS–400)/32) |
| 48401≤ TBS ≤60472 | 5 | 8\*FLOOR((TBS– 472)/40) |
| 60473 ≤ TBS ≤ 72544 | 6 | 8\*FLOOR((TBS– 544)/48) |
| 72545≤ TBS ≤84616 | 7 | 8\*FLOOR((TBS– 616)/56) |
| 84617 ≤ TBS≤96688 | 8 | 8\*FLOOR((TBS– 688)/64) |
| 96689< TBS ≤108760 | 9 | 8\*FLOOR((TBS– 760)/72) |
| 108761 ≤ TBS ≤120832 | 10 | 8\*FLOOR((TBS–832)/80) |
| 120833≤ TBS ≤132904 | 11 | 8\*FLOOR((TBS– 904)/88) |
| 132905 ≤ TBS ≤ 144976 | 12 | 8\*FLOOR((TBS– 976)/96) |
| TBS> 144976 | 13 | 8\*FLOOR((TBS– 1048)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU – 32 bit Additional RLC header with SO if one RLC SDU gets split in 2 TBS and 24 bit MAC header for this additional PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). IF RLC SDU does not get split the 32 bits additional padding gets added instead  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24– N\*24 -112 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 192 bits. | | |

Table 7.1.1.4.1.3.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| **=** | **Nominal RBG size *P (Configuration1)*** | **Size of last RBG** | **Allowed Values** |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160, 168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160, 169,176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158, 160,174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.1.3.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comments | Condition |
| number of layers (ʋ) | 1 |  |  |
| mcs-Table | qam64 |  |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PDSCH |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 1-5 |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 6-10 |
| maxNrofCodeWordsScheduledByDCI | n2 | both codewords enabled |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.1.3.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of as per table 7.1.1.4.1.3.3.2-2A in BWP, time domain resource as per table 7.1.1.4.1.0-1 and from 0 to 28.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.3.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 0 and values of S, L, , and  *nPRB.* | <-- | Transport block 1:  MAC PDU  Transport block 2:  MAC PDU  DCI: (DCI Format 1\_1, S, L,, and  *nPRB.*) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PDSCH-Config* with IE resourceAllocation set to resourceAllocationType1 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of 1 to in BWP, time domain resource as per table 7.1.1.4.1.0-1 and from 0 to 28. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.3.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.3.3.2-2. | - | - | - | - |
| 8 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 1 and values of S, L, , and  *nPRB.* | <-- | Transport block 1:  MAC PDU  Transport block 2:  MAC PDU  DCI: (DCI Format 1\_1, S, L,, and  *nPRB.*) | - | - |
| 9 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 10 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.4.1.3.3.3 Specific message contents

None.

###### 7.1.1.4.1.4 DL-SCH transport block size selection / DCI format 1\_1 / RA type 0/RA Type 1 / 2 Codewords enabled / 256QAM

7.1.1.4.1.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state, maxNrofCodeWordsScheduledByDCI set to 'n2' and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

(2)

**with** { UE in RRC\_CONNECTED state, maxNrofCodeWordsScheduledByDCI set to 'n2' and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.2, TS 38.214 clauses 5.1.2.1, 5.1.2.2.1, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.2.2]

DCI format 1\_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_1 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Carrier indicator – 0 or 3 bits as defined in Subclause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs  configured by higher layers, excluding the initial DL bandwidth part. The bit width for this field is determined as bits, where



- if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;



- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;



If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where is the size of the active DL bandwidth part:



- bits if only resource allocation type 0 is configured, where is defined in Subclause 5.1.2.2.1 of [6, TS38.214],



- bits if only resource allocation type 1 is configured, or



- bits if both resource allocation type 0 and 1 are configured.



- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Subclause 5.1.2.2.1 of [6, TS38.214].



- For resource allocation type 1, the LSBs provide the resource allocation as defined in Subclause 5.1.2.2.2 of [6, TS38.214]



If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the “Frequency domain resource assignment” field of the active bandwidth part is smaller than the bit width of the “Frequency domain resource assignment” field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 5.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-AllocationList*.



- VRB-to-PRB mapping – 0 or 1 bit

- 0 bit if only resource allocation type 0 is configured;

- 1 bit according to Table 7.3.1.1.2-33 otherwise, only applicable to resource allocation type 1, as defined in Subclause 7.3.1.6 of [4, TS38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingType* is not configured or is set to ‘static’, or 1 bit if the higher layer parameter *prb-BundlingType* is set to ‘dynamic’, according to Subclause 5.1.2.3 of [6, TS38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameter *rateMatchPattern*.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Subclause 5.1.4.2 of [6, TS38.214]. The bit width for this field is determined as bits, where is the number of ZP CSI-RS resource sets in the higher layer parameter*zp-CSI-RS-Resource*.



For transport block 1:

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

For transport block 2 (only present if *maxNrofCodeWordsScheduledByDCI* equals 2

- Modulation and coding scheme – 5 bits as defined in Subclause 5.1.3.1 of [6, TS38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the value of *maxNrofCodeWordsScheduledByDCI* for the indicated bandwidth part equals 2 and the value of *maxNrofCodeWordsScheduledByDCI* for the active bandwidth part equals 1, the UE assumes zeros are padded when interpreting the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 according to Subclause 12 of [5, TS38.213], and the UE ignores the “Modulation and coding scheme”, “New data indicator”, and “Redundancy version” fields of transport block 2 for the indicated bandwidth part.

- HARQ process number – 4 bits

- Downlink assignment index – number of bits as defined in the following

- 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;

- 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 bits are the counter DAI;

- 0 bits otherwise.

- TPC command for scheduled PUCCH – 2 bits as defined in Subclause 7.2.1 of [5, TS38.213]

- PUCCH resource indicator – 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Subclause 9.2.3 of [5, TS38.213]. The bit width for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *dl-DataToUL-ACK.*

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports  shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of  and .

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentInDCI* is not enabled; otherwise 3 bits as defined in Subclause 5.1.5 of [6, TS38.214].

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “Transmission configuration indication” field is not present in the DCI format 1\_1, the UE assumes *tci-PresentInDCI* is not enabled for the indicated bandwidth part.

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits as defined in Subclause 5.1.7 of [6, TS38.214], determined by the higher layer parameters *maxCodeBlockGroupsPerTransportBlock* and *Number-MCS-HARQ-DL-DCI* for the PDSCH.

- CBG flushing out information (CBGFI) – 0 or 1 bit as defined in Subclause 5.1.7 of [6, TS38.214], determined by higher layer parameter *codeBlockGroupFlushIndicator*.

- DMRS sequence initialization – 1 bit if both *scramblingID0* and *scramblingID1* are configured in *DMRS-DownlinkConfig* for selection defined in Subclause 7.4.1.1.1 of [4, TS38.211]; 0 bit otherwise.



[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in sub-clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is , where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and



- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if then



else



where, and



- The PDSCH mapping type is set to Type A or Type B as defined in sub-clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3  (Note 1)} | {3,…,14} | {3,…,14} | {0,1,2,3  (Note 1)} | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,4,7} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Posiition* = 3 | | | | | | |

[TS 38.214, clause 5.1.2.2.1]

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured for PDSCH and the size of the carrier bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a downlink carrier bandwidth part *i* of size PRBs is given by , where



- the size of the first RBG is ,



- the size of last RBG is if and *P* otherwise,



- the size of all other RBGs is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency and starting at the lowest frequency of the carrier bandwidth part. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.



[TS 38.214, clause 5.1.2.2.2]

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated localized or distributed virtual resource blocks within the active carrier bandwidth part of size PRBs except for the case when DCI format 1\_0 is decoded in the common search space in CORESET 0 in which case the initial bandwidth part of size shall be used.



A downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by



if then



else



where≥ 1 and shall not exceed .



[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, or P-RNTI,

if the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with a DCI format 1\_1 and the CRC is scrambled by C-RNTI or CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with new-RNTI, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled with C-RNTI, and the PDSCH is assigned by a PDCCH in a UE-specific search space

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with new-RNTI, and the PDSCH is scheduled with new-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with the higher layer parameter *mcs-Table* given by *SPS-config*, the higher layer parameter *mcs-Table* given by *PDSCH-Config* is set to 'qam256', the PDSCH is scheduled with CS-RNTI, and the PDSCH is assigned by a PDCCH with DCI format 1\_1

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is configured with the higher layer parameter *mcs-Table* given by *SPS-config* set to 'qam64LowSE', and the PDSCH is scheduled with CS-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

End

The UE is not expected to decode a PDSCH scheduled with P-RNTI, RA-RNTI, SI-RNTI and *Qm* > 2

…

Table 5.1.3.1-2: MCS index table 2 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 193 | 0.3770 |
| 2 | 2 | 308 | 0.6016 |
| 3 | 2 | 449 | 0.8770 |
| 4 | 2 | 602 | 1.1758 |
| 5 | 4 | 378 | 1.4766 |
| 6 | 4 | 434 | 1.6953 |
| 7 | 4 | 490 | 1.9141 |
| 8 | 4 | 553 | 2.1602 |
| 9 | 4 | 616 | 2.4063 |
| 10 | 4 | 658 | 2.5703 |
| 11 | 6 | 466 | 2.7305 |
| 12 | 6 | 517 | 3.0293 |
| 13 | 6 | 567 | 3.3223 |
| 14 | 6 | 616 | 3.6094 |
| 15 | 6 | 666 | 3.9023 |
| 16 | 6 | 719 | 4.2129 |
| 17 | 6 | 772 | 4.5234 |
| 18 | 6 | 822 | 4.8164 |
| 19 | 6 | 873 | 5.1152 |
| 20 | 8 | 682.5 | 5.3320 |
| 21 | 8 | 711 | 5.5547 |
| 22 | 8 | 754 | 5.8906 |
| 23 | 8 | 797 | 6.2266 |
| 24 | 8 | 841 | 6.5703 |
| 25 | 8 | 885 | 6.9141 |
| 26 | 8 | 916.5 | 7.1602 |
| 27 | 8 | 948 | 7.4063 |
| 28 | 2 | reserved | |
| 29 | 4 | reserved | |
| 30 | 6 | reserved | |
| 31 | 8 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then a transport block is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block, otherwise the transport block is enabled. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0 or format 1\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or as described for format 1\_0 in Subclause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 0, 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.4.3 Test description

7.1.1.4.1.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value).

Test frequency NRf1 is as specified in TS 38.508-1[4] clause 4.3.1 using the common highest UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1[4] clause 6.2.3.1.

7.1.1.4.1.4.3.2 Test procedure sequence

Table 7.1.1.4.1.4.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.4.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits] (Note 1) |
| 192 ≤ TBS ≤12184 note 2 | 1 | 8\*FLOOR((TBS– 184)/8) |
| 12185≤ TBS≤24256 | 2 | 8\*FLOOR((TBS– 256)/16) |
| 24257≤ TBS ≤ 36328 | 3 | 8\*FLOOR((TBS– 328)/24) |
| 36329 ≤ TBS ≤48400 | 4 | 8\*FLOOR((TBS–400)/32) |
| 48401≤ TBS ≤60472 | 5 | 8\*FLOOR((TBS– 472)/40) |
| 60473 ≤ TBS ≤ 72544 | 6 | 8\*FLOOR((TBS– 544)/48) |
| 72545≤ TBS ≤84616 | 7 | 8\*FLOOR((TBS– 616)/56) |
| 84617 ≤ TBS≤96688 | 8 | 8\*FLOOR((TBS– 688)/64) |
| 96689< TBS ≤108760 | 9 | 8\*FLOOR((TBS– 760)/72) |
| 108761 ≤ TBS ≤120832 | 10 | 8\*FLOOR((TBS–832)/80) |
| 120833≤ TBS ≤132904 | 11 | 8\*FLOOR((TBS– 904)/88) |
| 132905 ≤ TBS ≤ 144976 | 12 | 8\*FLOOR((TBS– 976)/96) |
| 144785 ≤ TBS ≤ 157048 | 13 | 8\*FLOOR((TBS– 1048)/104) |
| 157049 ≤ TBS≤ 169120 | 14 | 8\*FLOOR((TBS– 1120)/112) |
| 169121< TBS ≤ 181192 | 15 | 8\*FLOOR((TBS– 1192)/120) |
| 181193 ≤ TBS ≤193264 | 16 | 8\*FLOOR((TBS– 1264)/128) |
| 193337 ≤ TBS ≤ 205336 | 17 | 8\*FLOOR((TBS– 1336)/136) |
| 205409 ≤ TBS ≤ 217408 | 18 | 8\*FLOOR((TBS– 1408)/144) |
| TBS> 217408 | 19 | 8\*FLOOR((TBS– 1480)/152) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU – 32 bit Additional RLC header with SO if one RLC SDU gets split in 2 TBS and 24 bit MAC header for this additional PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead). IF RLC SDU does not get split the 32 bits additional padding gets added instead  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24– N\*24 -112 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 192 bits. | | |

Table 7.1.1.4.1.4.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| = | Nominal RBG size *P (Configuration1)* | Size of last RBG | Allowed Values |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160,168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160,169, 176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158,160, 174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.1.4.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comments | Condition |
| PDSCH mappingType | typeA |  |  |
| starting symbol *S* | 0 0r 3 to avoid clash with PDCCH symbols |  |  |
| number of consecutive symbols *L* | 3..14-S |  |  |
| k0 | 0 or 1 (if S=0) |  |  |
| number of layers (ʋ) | 1 |  |  |
| mcs-Table | qam256 |  |  |
| *xoh-PDSCH* | Not present | Results in value 0(xoh0) |  |
| dmrs-AdditionalPosition | pos0 | Results in 1 DMRS symbol per two carrier ()for Duration in symbols >=3 (TS 38.211 [24], table 7.4.1.1.2-3) |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PDSCH |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 1-5 |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH AND Steps 6-10 |
| maxNrofCodeWordsScheduledByDCI | n2 | both codewords enabled |  |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.1.4.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of as per Table 7.1.1.4.1.4.3.2-2A in BWP, time domain resource as per table 7.1.1.4.1.0-1 and from 0 to 27.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.4.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.4.3.2-2. | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.4.3.2-2. | - | - | - | - |
| 3 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 0 and values of S, L, , and  *nPRB.* | <-- | Transport block 1: MAC PDU  Transport block 2: MAC PDU  DCI: (DCI Format 1\_1, S, L,, and nPRB.) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PDSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PDSCH-Config* with IE resourceAllocation set to resourceAllocationType1 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of 1 to in BWP, time domain resource length L 3 to 14-S and from 0 to 27. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and  *nPRB.*  The SS uses the same and TBS for both transport blocks:  = =  TBS 1= TBS 2= TBS | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.4.3.2-1 and larger than or equal to 192 bits as specified in Table 7.1.1.4.1.4.3.2-2 | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs for transport block 1 and 2 depending on TBS1, and TBS2 in accordance with Table 7.1.1.4.1.4.3.2-2. | - | - | - | - |
| 8 | SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_1 resource allocation 1 and values of S, L, , and  *nPRB.* | <-- | Transport block 1: MAC PDU  Transport block 2: MAC PDU  DCI: (DCI Format 1\_1, S, L,, and nPRB.) | - | - |
| 9 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 10 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.4.1.4.3.3 Specific message contents

None.

###### 7.1.1.4.1.5 DL-SCH transport block size selection / DCI format 1\_2

7.1.1.4.1.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE on PDCCH receives DCI format 1\_2 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE decodes the received transport block of size correspondent as per Modulation Coding scheme, time domain resource allocation and PRB's and forwards it to higher layers }

}

7.1.1.4.1.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.2.3, TS 38.214 clause 5.1.2.1, 5.1.2.2, 5.1.2.2.1, 5.1.2.2.2, 5.1.3, 5.1.3.1 and 5.1.3.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.212, clause 7.3.1.2.3]

DCI format 1\_2 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format.

- Carrier indicator – 0, 1, 2 or 3 bits determined by higher layer parameter *carrierIndicatorSizeDCI-1-2*, as defined in Clause 10.1 of [5, TS38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs configured by higher layers, excluding the initial DL bandwidth part. The bitwidth for this field is determined as bits, where



- if , in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;



- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;



If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following:

- bits if only resource allocation type 0 is configured, where is defined in Clause 5.1.2.2.1 of [6, TS 38.214];



- bits if only resource allocation type 1 is configured, or bits if *resourceAllocationDCI-1-2-r16* is configured as '*dynamicSwitch'*, where , is the size of the active DL bandwidth part, is defined as in clause 4.4.4.4 of [4, TS 38.211] and is determined by higher layer parameter *resourceAllocationType1GranularityDCI-1-2*. If the higher layer parameter *resourceAllocationType1GranularityDCI-1-2* is not configured, is equal to 1.



- If *resourceAllocationDCI-1-2-r16* is configured as '*dynamicSwitch'*, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Clause 5.1.2.2.1 of [6, TS 38.214].



- For resource allocation type 1, the LSBs provide the resource allocation as defined in Clause 5.1.2.2.2 of [6, TS 38.214]



If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if *resourceAllocationDCI-1-2-r16* is configured as '*dynamicSwitch'* for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bitwidth of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bitwidth of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Clause 5.1.2.1 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationListDCI-1-2* if the higher layer parameter is configured, or *I* is the number of entries in the higher layer parameter *pdsch-TimeDomainAllocationList* if the higher layer parameter *pdsch-TimeDomainAllocationList* is configured when the higher layer parameter *pdsch-TimeDomainAllocationListDCI-1-2* is not configured; otherwise *I* is the number of entries in the default table.



- VRB-to-PRB mapping – 0 or 1 bit:

- 0 bit if the higher layer parameter *vrb-ToPRB-InterleaverDCI-1-2* is not configured;

- 1 bit according to Table 7.3.1.2.2-5 otherwise, only applicable to resource allocation type 1, as defined in Clause 7.3.1.6 of [4, TS 38.211].

- PRB bundling size indicator – 0 bit if the higher layer parameter *prb-BundlingTypeDCI-1-2* is not configured or is set to 'static', or 1 bit if the higher layer parameter *prb-BundlingTypeDCI-1-2* is set to 'dynamic' according to Clause 5.1.2.3 of [6, TS 38.214].

- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1DCI-1-2* and *rateMatchPatternGroup2DCI-1-2*, where the MSB is used to indicate *rateMatchPatternGroup1DCI-1-2* and the LSB is used to indicate *rateMatchPatternGroup2DCI-1-2* when there are two groups.

- ZP CSI-RS trigger – 0, 1, or 2 bits as defined in Clause 5.1.4.2 of [6, TS 38.214]. The bitwidth for this field is determined as bits, where is the number of aperiodic ZP CSI-RS resource sets configured by higher layer parameter *aperiodicZP-CSI-RS-ResourceSetsToAddModListDCI-1-2*.



- Modulation and coding scheme – 5 bits as defined in Clause 5.1.3.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-DCI-1-2*

- If 0 bit is configured, *rvid* to be applied is 0;

- 1 bit according to Table 7.3.1.2.3-1;

- 2 bits according to Table 7.3.1.1.1-2.

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-1-2*

- Downlink assignment index – 0, 1, 2 or 4 bits

- 0 bit if the higher layer parameter *downlinkAssignmentIndexDCI-1-2* is not configured;

- 1, 2 or 4 bits determined by higher layer parameter *downlinkAssignmentIndexDCI-1-2* otherwise,

- 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI

- 4 bits if one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, and the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode = joint*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI.

- 1 or 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, when the UE is not configured with *coresetPoolIndex* or the value of *coresetPoolIndex* is the same for all CORESETs if *coresetPoolIndex* is provided or the UE is not configured with *ackNackFeedbackMode = joint,* where the 1 bit or 2 bits are the counter DAI.

If higher layer parameter *priorityIndicatorDCI-1-2* is configured, if the bit width of the Downlink assignment index in DCI format 1\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 1\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 1\_2 for the two HARQ-ACK codebooks are the same.

- TPC command for scheduled PUCCH – 2 bits as defined in Clause 7.2.1 of [5, TS 38.213]

- PUCCH resource indicator – 0 or 1 or 2 or 3 bits determined by higher layer parameter *numberOfBitsForPUCCH-ResourceIndicatorDCI-1-2*

- PDSCH-to-HARQ\_feedback timing indicator – 0, 1, 2, or 3 bits as defined in Clause 9.2.3 of [5, TS 38.213]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *DL-DataToUL-ACK-DCI-1-2.*



If higher layer parameter *priorityIndicatorDCI-1-2* is configured, if the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for one HARQ-ACK codebook is not equal to that of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller PDSCH-to-HARQ\_feedback timing indicator until the bit width of the PDSCH-to-HARQ\_feedback timing indicator in DCI format 1\_2 for the two HARQ-ACK codebooks are the same.

- Antenna port(s) – 0, 4, 5, or 6 bits

- 0 bit if higher layer parameter *antennaPortsFieldPresenceDCI-1-2* is notconfigured;

- Otherwise 4, 5 or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4. If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* andis configured with higher layer parameter *antennaPortsFieldPresenceDCI-1-2*, the bitwidth of this field equals, where is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2*. A number of zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of and .



If a UE is not configured with higher layer parameter *antennaPortsFieldPresenceDCI-1-2*, antenna port(s) are defined assuming bit field index value 0 in Tables 7.3.1.2.2-1/2/3/4.

- Transmission configuration indication – 0 bit if higher layer parameter *tci-PresentDCI-1-2* is not configured; otherwise 1 or 2 or 3 bits determined by higher layer parameter *tci-PresentDCI-1-2* as defined in Clause 5.1.5 of [6, TS38.214].

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part,

- if the higher layer parameter *tci-PresentDCI-1-2* is not configured for the CORESET used for the PDCCH carrying the DCI format 1\_2,

- the UE assumes *tci-PresentDCI-1-2* is not configured for all CORESETs in the indicated bandwidth part;

- otherwise,

- the UE assumes *tci-PresentDCI-1-2* is configured for all CORESETs in the indicated bandwidth part with the same value configured for the CORESET used for the PDCCH carrying the DCI format 1\_2.

- SRS request – 0, 1, 2 or 3 bits

- 0 bit if the higher layer parameter *srs-RequestDCI-1-2* is not configured;

- 1 bit as defined by Table 7.3.1.1.3-1 if the higher layer parameter *srs-RequestDCI-1-2 = 1* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 2 bits if the higher layer parameter *srs-RequestDCI-1-2 = 1* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second bit is defined by Table 7.3.1.1.3-1;

- 2 bits as defined by Table 7.3.1.1.2-24 if the higher layer parameter *srs-RequestDCI-1-2 = 2* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 3 bits if the higher layer parameter *srs-RequestDCI-1-2 = 2* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24;

- DMRS sequence initialization – 0 or 1 bit

- 0 bit if the higher layer parameter *dmrs-SequenceInitializationDCI-1-2* is not configured;

- 1 bit otherwise.

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-1-2* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

If DCI formats 1\_2 are monitored in multiple search spaces associated with multiple CORESETs in a BWP for scheduling the same serving cell, zeros shall be appended until the payload size of the DCI formats 1\_2 monitored in the multiple search spaces equal to the maximum payload size of the DCI format 1\_2 monitored in the multiple search spaces.

Table 7.3.1.2.3-1: Redundancy version

|  |  |
| --- | --- |
| Value of the Redundancy version field | Value of  to be applied |
| 0 | 0 |
| 1 | 3 |

[TS 38.214, clause 5.1.2.1]

When the UE is scheduled to receive PDSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1 to an allocation table. The determination of the used resource allocation table is defined in Clause 5.1.2.1.1. The indexed row defines the slot offset *K0*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PDSCH mapping type to be assumed in the PDSCH reception.

Given the parameter values of the indexed row:

- The slot allocated for the PDSCH is *Ks*, where , if UE is configured with ca-SlotOffset for at least one of the scheduled and scheduling cell, and *Ks* = , otherwise, and where *n* is the slot with the scheduling DCI, and *K0* is based on the numerology of PDSCH, and  and are the subcarrier spacing configurations for PDSCH and PDCCH, respectively, and



- and are the and the, respectively, which are determined by higher-layer configured ca-SlotOffset, for the cell receiving the PDCCH respectively, and are the and the, respectively, which are determined by higher-layer configured ca-SlotOffset for the cell receiving the PDSCH, as defined in clause 4.5 of [4, TS 38.211].



- The reference point *S0* for starting symbol *S* is defined as:

- if configured with *referenceOfSLIVDCI-1-2*, and when receiving PDSCH scheduled by DCI format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI with *K0=0*, and PDSCH mapping Type B, the starting symbol *S* is relative to the starting symbol *S0* of the PDCCH monitoring occasion where DCI format 1\_2 is detected;

- otherwise, the starting symbol *S* is relative to the start of the slot using *S0=0.*

- The number of consecutive symbols *L* counting from the starting symbol *S* allocated for the PDSCH are determined from the start and length indicator *SLIV*:

if  then



else



where, and

- the PDSCH mapping type is set to Type A or Type B as defined in Clause 7.4.1.1.2 of [4, TS 38.211].

The UE shall consider the *S* and *L* combinations defined in table 5.1.2.1-1 satisfying  for normal cyclic prefix and  for extended cyclic prefix as valid PDSCH allocations:

Table 5.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PDSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | {0,1,2,3}  (Note 1) | {3,…,14} | {3,…,14} | {0,1,2,3}  (Note 1) | {3,…,12} | {3,…,12} |
| Type B | {0,…,12} | {2,…,13} | {2,…,14} | {0,…,10} | {2,4,6} | {2,…,12} |
| Note 1: S = 3 is applicable only if *dmrs-TypeA-Position* = 3 | | | | | | |

[38.214 clause 5.1.2.2]

Two downlink resource allocation schemes, type 0 and type 1, are supported. The UE shall assume that when the scheduling grant is received with DCI format 1\_0, then downlink resource allocation type 1 is used.

If the scheduling DCI is configured to indicate the downlink resource allocation type as part of the '*Frequency domain resource assignment'* field by setting a higher layer parameter *resourceAllocation* in *PDSCH-Config* to 'dynamicSwitch', for DCI format 1\_1 or setting a higher layer parameter *resourceAllocationDCI-1-2* in *PDSCH-Config* to 'dynamicSwitch' for DCI format 1\_2, the UE shall use downlink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the downlink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* for DCI format 1\_1 or by the higher layer parameter *resourceAllocationDCI-1-2* for DCI format 1\_2.

[38.214 clause 5.1.2.2.1]

In downlink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured by *PDSCH-Config* and the size of the bandwidth part as defined in Table 5.1.2.2.1-1.

Table 5.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | 2 | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

[38.214 clause 5.1.2.2.2]

When the scheduling grant is received with DCI format 1\_2, a downlink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block group *RBGstart*=0, 1, …, *NRBG*-1 and a length in terms of virtually contiguously allocated resource block groups *LRBGs*=1, …, *NRBG*, where the resource block groups are defined as in 5.1.2.2.1 with *P* defined by *resourceAllocationType1GranularityDCI-1-2* if the UE is configured with higher layer parameter *resourceAllocationType1GranularityDCI-1-2*, and *P*=1 otherwise*.* The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 5.1.3]

To determine the modulation order, target code rate, and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit *modulation and coding scheme* field (*IMCS*) in the DCI to determine the modulation order (*Qm*) and target code rate (*R*) based on the procedure defined in Subclause 5.1.3.1, and

- read *redundancy version* field (*rv*) in the DCI to determine the redundancy version.

and second

- the UE shall use the number of layers (ʋ), the total number of allocated PRBs before rate matching (*nPRB*) to determine to the transport block size based on the procedure defined in Subclause 5.1.3.2.

The UE may skip decoding a transport block in an initial transmission if the effective channel code rate is higher than 0.95, where the effective channel code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on PDSCH. If the UE skips decoding, the physical layer indicates to higher layer that the transport block is not successfully decoded.

[TS 38.214, clause 5.1.3.1]

For the PDSCH scheduled by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, SI-RNTI, RA-RNTI, MSGB-RNTI, or P-RNTI, or for the PDSCH scheduled without corresponding PDCCH transmissions using the higher-layer-provided PDSCH configuration *SPS-Config*,

if the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam256', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 with CRC scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

elseif the UE is not configured with MCS-C-RNTI, the higher layer parameter *mcs-TableDCI-1-2* given by *PDSCH-Config* is set to 'qam64LowSE', and the PDSCH is scheduled by a PDCCH with DCI format 1\_2 scrambled by C-RNTI

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical downlink shared channel.

…

Table 5.1.3.1-3: MCS index table 3 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| **0** | 2 | 30 | 0.0586 |
| **1** | 2 | 40 | 0.0781 |
| **2** | 2 | 50 | 0.0977 |
| **3** | 2 | 64 | 0.1250 |
| **4** | 2 | 78 | 0.1523 |
| **5** | 2 | 99 | 0.1934 |
| **6** | 2 | 120 | 0.2344 |
| **7** | 2 | 157 | 0.3066 |
| **8** | 2 | 193 | 0.3770 |
| **9** | 2 | 251 | 0.4902 |
| **10** | 2 | 308 | 0.6016 |
| **11** | 2 | 379 | 0.7402 |
| **12** | 2 | 449 | 0.8770 |
| **13** | 2 | 526 | 1.0273 |
| **14** | 2 | 602 | 1.1758 |
| **15** | 4 | 340 | 1.3281 |
| **16** | 4 | 378 | 1.4766 |
| **17** | 4 | 434 | 1.6953 |
| **18** | 4 | 490 | 1.9141 |
| **19** | 4 | 553 | 2.1602 |
| **20** | 4 | 616 | 2.4063 |
| **21** | 6 | 438 | 2.5664 |
| **22** | 6 | 466 | 2.7305 |
| **23** | 6 | 517 | 3.0293 |
| **24** | 6 | 567 | 3.3223 |
| **25** | 6 | 616 | 3.6094 |
| **26** | 6 | 666 | 3.9023 |
| **27** | 6 | 719 | 4.2129 |
| **28** | 6 | 772 | 4.5234 |
| **29** | 2 | reserved | |
| **30** | 4 | reserved | |
| **31** | 6 | reserved | |

[TS 38.214, clause 5.1.3.2]

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then one of the two transport blocks is disabled by DCI format 1\_1 if *IMCS* = 26 and if *rvid* = 1 for the corresponding transport block. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

For the PDSCH assigned by a PDCCH with DCI format 1\_0, format 1\_1 or format 1\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, or SI-RNTI, if Table 5.1.3.1-2 is used and *,* or a table other than Table 5.1.3.1-2 is usedand *,* the UE shall, except if the transport block is disabled in DCI format 1\_1, first determine the TBS as specified below:

1) The UE shall first determine the number of REs (*NRE*) within the slot.

- A UE first determines the number of REs allocated for PDSCH within a PRB () by , where is the number of subcarriers in a physical resource block,  is the number of symbols of the PDSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 1\_1 or format 1\_2 or as described for format 1\_0 in Clause 5.1.6.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PDSCH-ServingCellConfig*. If the *xOverhead* in *PDSCH-ServingCellconfig* is not configured (a value from 6, 12, or 18), the  is set to 0. If the PDSCH is scheduled by PDCCH with a CRC scrambled by SI-RNTI, RA-RNTI, MSGB-RNTI or P-RNTI,  is assumed to be 0.

- A UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs for the UE.

2) Unquantized intermediate variable (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-1 find the closest TBS that is not less than .

Table 5.1.3.2-1: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.1.5.3 Test description

7.1.1.4.1.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.1.5.3.2 Test procedure sequence

Table 7.1.1.4.1.5.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| **UE Category** | **Maximum number of bits of a UL-SCH transport block received within a TTI** |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.1.5.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 136 ≤ TBS ≤12128 note 2 | 1 | 8\*FLOOR((TBS– 128)/8) |
| 12129 ≤ TBS≤24200 | 2 | 8\*FLOOR((TBS– 200)/16) |
| 24201 ≤ TBS ≤ 36272 | 3 | 8\*FLOOR((TBS– 272)/24) |
| 36273 ≤ TBS ≤48344 | 4 | 8\*FLOOR((TBS– 344)/32) |
| 48345≤ TBS ≤60416 | 5 | 8\*FLOOR((TBS– 416)/40) |
| 60417 ≤ TBS ≤ 72488 | 6 | 8\*FLOOR((TBS–488)/48) |
| 72489 ≤ TBS ≤84560 | 7 | 8\*FLOOR((TBS– 560)/56) |
| 84561 ≤ TBS≤96632 | 8 | 8\*FLOOR((TBS–632)/64) |
| 96633< TBS ≤108704 | 9 | 8\*FLOOR((TBS–704)/72) |
| 10705 ≤ TBS ≤120776 | 10 | 8\*FLOOR((TBS– 776)/80) |
| 120777≤ TBS ≤132848 | 11 | 8\*FLOOR((TBS–848)/88) |
| 132849 ≤ TBS ≤ 144920 | 12 | 8\*FLOOR((TBS– 920)/96) |
| TBS> 144920 | 13 | 8\*FLOOR((TBS– 992)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;  MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | |

Table 7.1.1.4.1.5.3.2-2A: Void

Table 7.1.1.4.1.5.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| resourceAllocationType1GranularityDCI-1-2-r16 | Not Present | granularity ‘P’ is 1 PRB |
| mcs-TableDCI-1-2-r16 | Not present | qam64 per default |

Table 7.1.1.4.1.5.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: EXCEPTION: Steps 1 to 5 are repeated for allowed values of in BWP, time domain resource as per table 7.1.1.4.5.0-1 and from 0 to 28.  NOTE: Skip the execution of steps for which the TBS size results in coding rate exceeding 0.95. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of DL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.1.5.3.2-1 and larger than or equal to 132 bits as specified in Table 7.1.1.4.1.5.3.2-2 | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.1.5.3.2-2. | - | - | - | - |
| 3 | The SS transmits the PDCP SDUs concatenated into a MAC PDU and indicates on PDCCH DCI Format 1\_2 and values of S, L,and *nPRB*. | <-- | MAC PDU (NxPDCP SDUs)  DCI: (DCI Format 1\_2, S, L,and *nPRB.*) | - | - |
| 4 | At the reception of scheduling request the SS transmits UL Grant for transmitting loop back PDCP SDUs. | <-- | (UL Grant) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3? | --> | (NxPDCP SDUs) | 1 | P |

7.1.1.4.1.5.3.3 Specific message contents

Table 7.1.1.4.1.5.3.3-1: PDSCH-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2-r16 CHOICE { |  |  |  |
| setup | DMRS-DownlinkConfig |  |  |
| } |  |  |  |
| harq-ProcessNumberSizeDCI-1-2-r16 | 3 | nrofHARQ-ProcessesForPDSCH is 8 |  |
| numberOfBitsForRV-DCI-1-2-r16 | 2 |  |  |
| prb-BundlingTypeDCI-1-2-r16 |  |  |  |
| staticBundling SEQUENCE { |  |  |  |
| bundleSize | wideband |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocationDCI-1-2-r16 | resourceAllocationType1 |  |  |
| } |  |  |  |

Table 7.1.1.4.1.5.3.3-2: *PhysicalCellGroupConfig*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-106 | | | |
| Information Element | Value/remark | Comment | Condition |
| PhysicalCellGroupConfig ::= SEQUENCE { |  |  |  |
| downlinkAssignmentIndexDCI-1-2-r16 | 2 | pdsch-HARQ-ACK-Codebook=dynamic  ackNackFeedbackMode = Not present |  |
| } |  |  |  |

Table 7.1.1.4.1.5.3.3-3: *PUCCH-Config*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config ::= SEQUENCE { |  |  |  |
| numberOfBitsForPUCCH-ResourceIndicatorDCI-1-2-r16 | 3 |  |  |
| } |  |  |  |

##### 7.1.1.4.2 UL-SCH Transport Block Size Selection

###### 7.1.1.4.2.0 Common parameters for UL-SCH Transport Block Size Selection

Table 7.1.1.4.2.0-1: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation { | 2 entry |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 | FR1 |
| k2 | 2 |  | FR1 |
|  | 4 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 52 | Start symbol(S)=10, Length(L)=4 | FR1 |
| startSymbolAndLength | 42 | Start symbol(S)=0, Length(L)=4 | FR2 |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 | FR1 |
| k2 | 2 |  | FR1 |
|  | 4 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.4.2.0-2: *PUSCH-Config*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig | See Table 7.1.1.4.2.0-3 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.4.2.0-3: *DMRS-UplinkConfig*

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-51 |

Table 7.1.1.4.2.0-4: *SchedulingRequestResourceConfig*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508 [4], Table 4.6.3-157 | | | |
| Information Element | Value/remark | Comment | Condition |
| SchedulingRequestResourceConfig ::= SEQUENCE { |  |  |  |
| schedulingRequestResourceId | SchedulingRequestResourceId |  |  |
| schedulingRequestID | SchedulingRequestId |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl40 | 9 | With SCS = kHz15 results in repetition every 40 ms | SCS15 |
| sl80 | 9 | With SCS = kHz30 results in repetition every 40 ms | SCS30 |
| sl320 | 9 | With SCS = kHz120 results in repetition every 40 ms | SCS120 |
| } |  |  |  |
| resource | 6 | ID of the PUCCH resource as configured by PUCCH-Config (Table 4.6.3-84) |  |
| } |  |  |  |

Table 7.1.1.4.2.0-5: PDSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-103 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-TimeDomainResourceAllocationList ::= SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF SEQUENCE(SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation { | 2 entries |  |  |
| PDSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 |  |
| k0 | Not present |  |  |
| mappingType | typeA |  |  |
| startSymbolAndLength | 53 | S=2, L=12 |  |
| } |  |  |  |
| PDSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2 |  |
| k0 | 1 |  |  |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | S=0, L=14 |  |
| } |  |  |  |
| } |  |  |  |

###### 7.1.1.4.2.1 UL-SCH Transport Block Size selection / DCI format 0\_0 / Transform precoding disabled

7.1.1.4.2.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_0 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and modulation and coding }

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.1]

DCI format 0\_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –  bits where

-  is the size of the active UL bandwidth part in case DCI format 0\_0 is monitored in the UE specific search space and satisfying

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

- otherwise,  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1 and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is not configured on both UL and SUL the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured;

- If the UL/SUL indicator is not present in DCI format 0\_0, the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by TC-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –bits where

-  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if  and  otherwise

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214], using Table 5.1.3.1-1

- New data indicator – 1 bit, reserved

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits, reserved

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit if the cell has two ULs and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If 1 bit, reserved, and the corresponding PUSCH is always on the same UL carrier as the previous transmission of the same TB

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space and satisfies both of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in UE specific search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

- if *mcs-Table* in *PUSCH-Config* is set to 'qam256', and PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-Table* in *PUSCH-Config* is set to 'qam64LowSE', the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled and , the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-5 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2 Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.1.3 Test description

7.1.1.4.2.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.2.1.3.2 Test procedure sequence

Table 7.1.1.4.2.1.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.1.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤12128 note 2 | | 1 | | 8\*FLOOR((TBS– 128)/8) | |
| 12129 ≤ TBS≤24200 | | 2 | | 8\*FLOOR((TBS– 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS– 272)/24) | |
| 36273 ≤ TBS ≤48344 | | 4 | | 8\*FLOOR((TBS– 344)/32) | |
| 48345≤ TBS ≤60416 | | 5 | | 8\*FLOOR((TBS– 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS–488)/48) | |
| 72489 ≤ TBS ≤84560 | | 7 | | 8\*FLOOR((TBS– 560)/56) | |
| 84561 ≤ TBS≤96632 | | 8 | | 8\*FLOOR((TBS–632)/64) | |
| 96633< TBS ≤108704 | | 9 | | 8\*FLOOR((TBS–704)/72) | |
| 10705 ≤ TBS ≤120776 | | 10 | | 8\*FLOOR((TBS– 776)/80) | |
| 120777≤ TBS ≤132848 | | 11 | | 8\*FLOOR((TBS–848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS– 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS– 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS– 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS– 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS– 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS– 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS– 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS– 1424)/152) | |
| TBS> 229424 | | 20 | | 8\*FLOOR((TBS– 1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.2.1.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 |  |
| mcs-Table | qam64 |  |

Table 7.1.1.4.2.1.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of 1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and from 0 to 28. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.1.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.1.3.2-2.  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 2)  Skip the execution of steps for > 27 and < 5.  (Note 1) | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.1.3.2-2. | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request, , SS transmits UL Grant DCI 0\_0, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI Format 0\_0, S, L,and *nPRB.*) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N x PDCP SDU) | 1 | P |
| Note 1: For > 27 and < 5, the combination results in higher coding rate and therefore leading to CRC errors in decoding UL data.  Note 2: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15]. | | | | | |

7.1.1.4.2.1.3.3 Specific message contents

None.

###### 7.1.1.4.2.2 Void

###### 7.1.1.4.2.3 UL-SCH transport block size selection / DCI format 0\_1 / RA type 0/RA Type 1 / Transform precoding disabled

7.1.1.4.2.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.1, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.2]

DCI format 0\_1 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0 or 3 bits, as defined in Subclause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with SUL in the cell or UEs configured with SUL in the cell but only PUCCH carrier in the cell is configured for PUSCH transmission; 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs  configured by higher layers, excluding the initial UL bandwidth part. The bit width for this field is determined as bits, where

-  if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active UL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Subclause 6.1.2.2.1 of [6, TS 38.214],

- bits if only resource allocation type 1 is configured, or  bits if both resource allocation type 0 and 1 are configured.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the  LSBs provide the resource allocation as defined in Subclause 6.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the  LSBs provide the resource allocation as follows:

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bit width of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* the number of entries in the higher layer parameter *pusch-AllocationList.*

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if only resource allocation type 0 is configured or if the higher layer parameter *frequencyHopping* is not configured;

- 1 bit according to Table 7.3.1.1.2-34 otherwise, only applicable to resource allocation type 1, as defined in Subclause 6.3 of [6, TS 38.214].

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits:

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS38.213]

- SRS resource indicator – or  bits, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', and  is the maximum number of supported layers for the PUSCH.

-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*nonCodeBook*';

-  bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*'.

- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *maxRank* and *codebookSubset*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebookmaxRank* and *codebookSubset,* and according to the values of higher layer parameters.

- Antenna ports – number of bits determined by the following

- 2 bits as defined by Tables 7.3.1.1.2-6, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=1;

- 4 bits as defined by Tables 7.3.1.1.2-7, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=2;

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-UplinkForPUSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of  and .

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSize*.

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits determined by higher layer parameter *maxCodeBlockGroupsPerTransportBlock* for PUSCH.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured and *transformPrecoder*=*disabled*, or if *transformPrecoder*=*enabled*, or if *maxRank=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) for transmission of one PT-RS port and two PT-RS ports respectively, and the DMRS ports are indicated by the Antenna ports field.

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “PTRS-DMRS association” field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the “PTRS-DMRS association” field is not present for the indicated bandwidth part.*betaOffsets = semiStatic*

- beta\_offset indicator – 0 if the higher layer parameter ; otherwise 2 bits as defined by Table 9.3-3 in [5, TS 38.213].

- DMRS sequence initialization – 0 if the higher layer parameter *transformPrecoder=enabled*; 1 bit if the higher layer parameter *transformPrecoder=disabled* and both *scramblingID0* and *scramblingID1* are configured in *DMRS-UplinkConfig*, for  selection defined in Subclause 6.4.1.1.1.1 of [4, TS 38.211].

- UL-SCH indicator – 1 bit. A value of “1” indicates UL-SCH shall be transmitted on the PUSCH and a value of “0” indicates UL-SCH shall not be transmitted on the PUSCH.

For a UE configured with SUL in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in format 0\_1 for the SUL is not equal to the number of information bits in format 0\_1 for the non-SUL, zeros shall be appended to smaller format 0\_1 until the payload size equals that of the larger format 0\_1.

Table 7.3.1.1.2-1: Bandwidth part indicator

|  |  |
| --- | --- |
| Value of BWP indicator field | Bandwidth part |
| 2 bits |
| 00 | First bandwidth part configured by higher layers |
| 01 | Second bandwidth part configured by higher layers |
| 10 | Third bandwidth part configured by higher layers |
| 11 | Fourth bandwidth part configured by higher layers |

Table 7.3.1.1.2-2: Precoding information and number of layers, for 4 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2 or 3 or 4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 |
| … | … | … | … | … | … |
| 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 |
| 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 |
| 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 |
| 12 | 1 layer: TPMI=4 | 12 | 1 layer: TPMI=4 | 12-15 | reserved |
| … | … | … | … |  |  |
| 19 | 1 layer: TPMI=11 | 19 | 1 layer: TPMI=11 |  |  |
| 20 | 2 layers: TPMI=6 | 20 | 2 layers: TPMI=6 |  |  |
| … | … | … | … |  |  |
| 27 | 2 layers: TPMI=13 | 27 | 2 layers: TPMI=13 |  |  |
| 28 | 3 layers: TPMI=1 | 28 | 3 layers: TPMI=1 |  |  |
| 29 | 3 layers: TPMI=2 | 29 | 3 layers: TPMI=2 |  |  |
| 30 | 4 layers: TPMI=1 | 30 | 4 layers: TPMI=1 |  |  |
| 31 | 4 layers: TPMI=2 | 31 | 4 layers: TPMI=2 |  |  |
| 32 | 1 layers: TPMI=12 |  |  |  |  |
| … | … |  |  |  |  |
| 47 | 1 layers: TPMI=27 |  |  |  |  |
| 48 | 2 layers: TPMI=14 |  |  |  |  |
| … | … |  |  |  |  |
| 55 | 2 layers: TPMI=21 |  |  |  |  |
| 56 | 3 layers: TPMI=3 |  |  |  |  |
| … | … |  |  |  |  |
| 59 | 3 layers: TPMI=6 |  |  |  |  |
| 60 | 4 layers: TPMI=3 |  |  |  |  |
| 61 | 4 layers: TPMI=4 |  |  |  |  |
| 62-63 | reserved |  |  |  |  |

Table 7.3.1.1.2-3: Precoding information and number of layers for 4 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder=disabled* and *maxRank* = 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 1 layer: TPMI=4 | 4 | 1 layer: TPMI=4 |  |  |
| … | … | … | … |  |  |
| 11 | 1 layer: TPMI=11 | 11 | 1 layer: TPMI=11 |  |  |
| 12 | 1 layers: TPMI=12 | 12-15 | reserved |  |  |
| … | … |  |  |  |  |
| 27 | 1 layers: TPMI=27 |  |  |  |  |
| 28-31 | reserved |  |  |  |  |

Table 7.3.1.1.2-4: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 2 layers: TPMI=0 | 2 | 2 layers: TPMI=0 |
| 3 | 1 layer: TPMI=2 | 3 | reserved |
| 4 | 1 layer: TPMI=3 |  |  |
| 5 | 1 layer: TPMI=4 |  |  |
| 6 | 1 layer: TPMI=5 |  |  |
| 7 | 2 layers: TPMI=1 |  |  |
| 8 | 2 layers: TPMI=2 |  |  |
| 9-15 | reserved |  |  |

Table 7.3.1.1.2-5: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder= disabled* and *maxRank* = 1

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 1 layer: TPMI=2 |  |  |
| 3 | 1 layer: TPMI=3 |  |  |
| 4 | 1 layer: TPMI=4 |  |  |
| 5 | 1 layer: TPMI=5 |  |  |
| 6-7 | reserved |  |  |

...

Table 7.3.1.1.2-33: VRB-to-PRB mapping

|  |  |
| --- | --- |
| Bit field mapped to index | VRB-to-PRB mapping |
| 0 | Non-interleaved |
| 1 | Interleaved |

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.1]

In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size*configured for PUSCH and the size of the carrier bandwidth part as defined in Table 6.1.2.2.1-1.

Table 6.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Carrier Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | *2* | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a uplink carrier bandwidth part *i* of sizePRBs is given by  where

- the size of the first RBG is ,

- the size of the last RBG is if and *P* otherwise.

- the size of all other RBG is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency of the carrier bandwidth part and starting at the lowest frequency. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB of the bitmap. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

- if *mcs-Table* in *PUSCH-Config* is set to 'qam256', and PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-Table* in *PUSCH-Config* is set to 'qam64LowSE', the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-1: MCS index table 1 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 157 | 0.3066 |
| 2 | 2 | 193 | 0.3770 |
| 3 | 2 | 251 | 0.4902 |
| 4 | 2 | 308 | 0.6016 |
| 5 | 2 | 379 | 0.7402 |
| 6 | 2 | 449 | 0.8770 |
| 7 | 2 | 526 | 1.0273 |
| 8 | 2 | 602 | 1.1758 |
| 9 | 2 | 679 | 1.3262 |
| 10 | 4 | 340 | 1.3281 |
| 11 | 4 | 378 | 1.4766 |
| 12 | 4 | 434 | 1.6953 |
| 13 | 4 | 490 | 1.9141 |
| 14 | 4 | 553 | 2.1602 |
| 15 | 4 | 616 | 2.4063 |
| 16 | 4 | 658 | 2.5703 |
| 17 | 6 | 438 | 2.5664 |
| 18 | 6 | 466 | 2.7305 |
| 19 | 6 | 517 | 3.0293 |
| 20 | 6 | 567 | 3.3223 |
| 21 | 6 | 616 | 3.6094 |
| 22 | 6 | 666 | 3.9023 |
| 23 | 6 | 719 | 4.2129 |
| 24 | 6 | 772 | 4.5234 |
| 25 | 6 | 822 | 4.8164 |
| 26 | 6 | 873 | 5.1152 |
| 27 | 6 | 910 | 5.3320 |
| 28 | 6 | 948 | 5.5547 |
| 29 | 2 | reserved | |
| 30 | 4 | reserved | |
| 31 | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.3.3 Test description

7.1.1.4.2.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value).

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.2.3.3.2 Test procedure sequence

Table 7.1.1.4.2.3.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.3.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤12128 note 2 | | 1 | | 8\*FLOOR((TBS– 128)/8) | |
| 12129 ≤ TBS≤24200 | | 2 | | 8\*FLOOR((TBS– 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS– 272)/24) | |
| 36273 ≤ TBS ≤48344 | | 4 | | 8\*FLOOR((TBS– 344)/32) | |
| 48345≤ TBS ≤60416 | | 5 | | 8\*FLOOR((TBS– 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS–488)/48) | |
| 72489 ≤ TBS ≤84560 | | 7 | | 8\*FLOOR((TBS– 560)/56) | |
| 84561 ≤ TBS≤96632 | | 8 | | 8\*FLOOR((TBS–632)/64) | |
| 96633< TBS ≤108704 | | 9 | | 8\*FLOOR((TBS–704)/72) | |
| 10705 ≤ TBS ≤120776 | | 10 | | 8\*FLOOR((TBS– 776)/80) | |
| 120777≤ TBS ≤132848 | | 11 | | 8\*FLOOR((TBS–848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS– 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS– 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS– 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS– 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS– 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS– 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS– 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS– 1424)/152) | |
| TBS> 229424 | | 20 | | 8\*FLOOR((TBS– 1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.2.3.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| **=** | **Nominal RBG size *P (Configuration1)*** | **Size of last RBG** | **Allowed Values** |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160, 168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160, 169,176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158, 160,174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.2.3.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comment | Condition |
| mcs-Table | qam64 |  |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PUSCH |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND Steps 1-5 |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND pc\_ra\_Type0\_PUSCH AND Steps 6-10 |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.2.3.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of 1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and from 0 to 28. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and*nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.3.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.3.3.2-2.  Skip the execution of steps 2 to 5 for which the value of satisfies the condition 3824 <  < 3825.(Note 4)  Skip the execution of steps 1 to 5 for > 27 and  < 5. (Note3) | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.3.3.2-2. | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request, SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB* | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | (NxPDCP SDUs) | 2 | P |
| - | EXCEPTION : Steps 5Aa1 to 10 are executed if pc\_ra\_Type0\_PUSCH | - | *-* | - | - |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PUSCH-Config* with IE resourceAllocation set toresourceAllocationType0 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message.(Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of as per table 7.1.1.4.2.3.3.2-2A in BWP, time domain resource length L 3 to 14-S and from 0 to 28. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS1 + TBS2 is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.3.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.3.3.2-2.  Skip the execution of steps 7 to 10 for which the value of satisfies the condition 3824 <  < 3825. (Note 4)  Skip the execution of steps 6 to 10 for > 27 and  < 5. (Note 3) | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.3.3.2-2. | - | - | - | - |
| 8 | The SS transmits all PDCP SDUs (NSDUs) as created in step 7 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 9 | After the reception of 2 Scheduling Request SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 10 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 8 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 9? | --> | (NxPDCP SDUs) | 1 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: For > 27 and < 5, the combination results in higher coding rate and therefore leading to CRC errors in decoding UL data.  Note 4: Depending upon UE implementation of TBS determination as per clause 5.1.3.2 of TS 38.214 [15], 3824 <  < 3825, different step may be used by UEs for TBS determintation. When Resource Allocation Type is RA Type 1, =5,=123 and Time Domain Allocation Symbols = 4, the resulting  is 3824.05. | | | | | |

7.1.1.4.2.3.3.3 Specific message contents

None.

###### 7.1.1.4.2.4 UL-SCH transport block size selection / DCI format 0\_1 / RA type 0/RA Type 1 / 256QAM / Transform precoding disabled

7.1.1.4.2.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 0 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

(2)

**with** { UE in RRC\_CONNECTED state and mcs-Table is set as ‘qam256‘ }

**ensure that** {

**when** { UE has pending data for transmission and receives DCI format 0\_1 indicating resource allocation type 1 a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and a modulation and coding }

**then** { UE transmits MAC PDU's on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.1, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.2]

DCI format 0\_1 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0 or 3 bits, as defined in Subclause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with SUL in the cell or UEs configured with SUL in the cell but only PUCCH carrier in the cell is configured for PUSCH transmission; 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs  configured by higher layers, excluding the initial UL bandwidth part. The bit width for this field is determined as bits, where

-  if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;

- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;

If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active UL bandwidth part:

-  bits if only resource allocation type 0 is configured, where  is defined in Subclause 6.1.2.2.1 of [6, TS 38.214],

- bits if only resource allocation type 1 is configured, or  bits if both resource allocation type 0 and 1 are configured.

- If both resource allocation type 0 and 1 are configured, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the  LSBs provide the resource allocation as defined in Subclause 6.1.2.2.1 of [6, TS 38.214].

- For resource allocation type 1, the  LSBs provide the resource allocation as follows:

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if both resource allocation type 0 and 1 are configured for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bit width of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bit width of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, or 4 bits as defined in Subclause 6.1.2.1 of [6, TS38.214]. The bit width for this field is determined as bits, where *I* the number of entries in the higher layer parameter *pusch-AllocationList.*

- Frequency hopping flag – 0 or 1 bit:

- 0 bit if only resource allocation type 0 is configured or if the higher layer parameter *frequencyHopping* is not configured;

- 1 bit according to Table 7.3.1.1.2-34 otherwise, only applicable to resource allocation type 1, as defined in Subclause 6.3 of [6, TS 38.214].

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits:

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS38.213]

- SRS resource indicator – or  bits, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*', and  is the maximum number of supported layers for the PUSCH.

-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*nonCodeBook*';

-  bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where  is the number of configured SRS resources in the SRS resource set associated with the higher layer parameter *usage* of value '*codeBook*'.

- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *maxRank* and *codebookSubset*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebook,* and according to the values of higher layer parameters *maxRank* and *codebookSubset*.

- Antenna ports – number of bits determined by the following

- 2 bits as defined by Tables 7.3.1.1.2-6, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=1;

- 4 bits as defined by Tables 7.3.1.1.2-7, if *transformPrecoder=enabled*, *dmrs-Type*=1, and *maxLength*=2;

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if *transformPrecoder=disabled*, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if *transformPrecoder=disabled*, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bit width of this field equals , where  is the “Antenna ports” bit width derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and  is the “Antenna ports” bit widthderived according to *dmrs-UplinkForPUSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of  and .

- SRS request – 2 bits as defined by Table 7.3.1.1.2-24 for UEs not configured with SUL in the cell; 3 bits for UEs configured SUL in the cell where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24. This bit field may also indicate the associated CSI-RS according to Subclause 6.1.1.2 of [6, TS 38.214].

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSize*.

- CBG transmission information (CBGTI) – 0, 2, 4, 6, or 8 bits determined by higher layer parameter *maxCodeBlockGroupsPerTransportBlock* for PUSCH.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured and *transformPrecoder*=*disabled*, or if *transformPrecoder*=*enabled*, or if *maxRank=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) for transmission of one PT-RS port and two PT-RS ports respectively, and the DMRS ports are indicated by the Antenna ports field.

If “Bandwidth part indicator” field indicates a bandwidth part other than the active bandwidth part and the “PTRS-DMRS association” field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the “PTRS-DMRS association” field is not present for the indicated bandwidth part.

- beta\_offset indicator – 0 if the higher layer parameter *betaOffsets = semiStatic*; otherwise 2 bits as defined by Table 9.3-3 in [5, TS 38.213].

- DMRS sequence initialization – 0 if the higher layer parameter *transformPrecoder=enabled*; 1 bit if the higher layer parameter *transformPrecoder=disabled* and both *scramblingID0* and *scramblingID1* are configured in *DMRS-UplinkConfig*, for  selection defined in Subclause 6.4.1.1.1.1 of [4, TS 38.211].

- UL-SCH indicator – 1 bit. A value of “1” indicates UL-SCH shall be transmitted on the PUSCH and a value of “0” indicates UL-SCH shall not be transmitted on the PUSCH.

For a UE configured with SUL in a cell, if PUSCH is configured to be transmitted on both the SUL and the non-SUL of the cell and if the number of information bits in format 0\_1 for the SUL is not equal to the number of information bits in format 0\_1 for the non-SUL, zeros shall be appended to smaller format 0\_1 until the payload size equals that of the larger format 0\_1.

Table 7.3.1.1.2-1: Bandwidth part indicator

|  |  |
| --- | --- |
| Value of BWP indicator field | Bandwidth part |
| 2 bits |
| 00 | First bandwidth part configured by higher layers |
| 01 | Second bandwidth part configured by higher layers |
| 10 | Third bandwidth part configured by higher layers |
| 11 | Fourth bandwidth part configured by higher layers |

Table 7.3.1.1.2-2: Precoding information and number of layers, for 4 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2 or 3 or 4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 | 4 | 2 layers: TPMI=0 |
| … | … | … | … | … | … |
| 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 | 9 | 2 layers: TPMI=5 |
| 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 | 10 | 3 layers: TPMI=0 |
| 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 | 11 | 4 layers: TPMI=0 |
| 12 | 1 layer: TPMI=4 | 12 | 1 layer: TPMI=4 | 12-15 | reserved |
| … | … | … | … |  |  |
| 19 | 1 layer: TPMI=11 | 19 | 1 layer: TPMI=11 |  |  |
| 20 | 2 layers: TPMI=6 | 20 | 2 layers: TPMI=6 |  |  |
| … | … | … | … |  |  |
| 27 | 2 layers: TPMI=13 | 27 | 2 layers: TPMI=13 |  |  |
| 28 | 3 layers: TPMI=1 | 28 | 3 layers: TPMI=1 |  |  |
| 29 | 3 layers: TPMI=2 | 29 | 3 layers: TPMI=2 |  |  |
| 30 | 4 layers: TPMI=1 | 30 | 4 layers: TPMI=1 |  |  |
| 31 | 4 layers: TPMI=2 | 31 | 4 layers: TPMI=2 |  |  |
| 32 | 1 layers: TPMI=12 |  |  |  |  |
| … | … |  |  |  |  |
| 47 | 1 layers: TPMI=27 |  |  |  |  |
| 48 | 2 layers: TPMI=14 |  |  |  |  |
| … | … |  |  |  |  |
| 55 | 2 layers: TPMI=21 |  |  |  |  |
| 56 | 3 layers: TPMI=3 |  |  |  |  |
| … | … |  |  |  |  |
| 59 | 3 layers: TPMI=6 |  |  |  |  |
| 60 | 4 layers: TPMI=3 |  |  |  |  |
| 61 | 4 layers: TPMI=4 |  |  |  |  |
| 62-63 | reserved |  |  |  |  |

Table 7.3.1.1.2-3: Precoding information and number of layers for 4 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder=disabled* and *maxRank* = 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *partialAndNonCoherent* | Bit field mapped to index | *codebookSubset*= *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| … | … | … | … | … | … |
| 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 | 3 | 1 layer: TPMI=3 |
| 4 | 1 layer: TPMI=4 | 4 | 1 layer: TPMI=4 |  |  |
| … | … | … | … |  |  |
| 11 | 1 layer: TPMI=11 | 11 | 1 layer: TPMI=11 |  |  |
| 12 | 1 layers: TPMI=12 | 12-15 | reserved |  |  |
| … | … |  |  |  |  |
| 27 | 1 layers: TPMI=27 |  |  |  |  |
| 28-31 | reserved |  |  |  |  |

Table 7.3.1.1.2-4: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder=disabled* and *maxRank* = 2

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 2 layers: TPMI=0 | 2 | 2 layers: TPMI=0 |
| 3 | 1 layer: TPMI=2 | 3 | reserved |
| 4 | 1 layer: TPMI=3 |  |  |
| 5 | 1 layer: TPMI=4 |  |  |
| 6 | 1 layer: TPMI=5 |  |  |
| 7 | 2 layers: TPMI=1 |  |  |
| 8 | 2 layers: TPMI=2 |  |  |
| 9-15 | reserved |  |  |

Table 7.3.1.1.2-5: Precoding information and number of layers, for 2 antenna ports, if *transformPrecoder= enabled*, or if *transformPrecoder= disabled* and *maxRank* = 1

|  |  |  |  |
| --- | --- | --- | --- |
| Bit field mapped to index | *codebookSubset* = *fullyAndPartialAndNonCoherent* | Bit field mapped to index | *codebookSubset* = *nonCoherent* |
| 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 |
| 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 |
| 2 | 1 layer: TPMI=2 |  |  |
| 3 | 1 layer: TPMI=3 |  |  |
| 4 | 1 layer: TPMI=4 |  |  |
| 5 | 1 layer: TPMI=5 |  |  |
| 6-7 | reserved |  |  |

...

Table 7.3.1.1.2-33: VRB-to-PRB mapping

|  |  |
| --- | --- |
| Bit field mapped to index | VRB-to-PRB mapping |
| 0 | Non-interleaved |
| 1 | Interleaved |

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m*d of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.1]

In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size*configured for PUSCH and the size of the carrier bandwidth part as defined in Table 6.1.2.2.1-1.

Table 6.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Carrier Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | *2* | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

The total number of RBGs () for a uplink carrier bandwidth part *i* of sizePRBs is given by  where

- the size of the first RBG is ,

- the size of the last RBG is if and *P* otherwise.

- the size of all other RBG is *P*.

The bitmap is of size bits with one bitmap bit per RBG such that each RBG is addressable. The RBGs shall be indexed in the order of increasing frequency of the carrier bandwidth part and starting at the lowest frequency. The order of RBG bitmap is such that RBG 0 to RBG are mapped from MSB to LSB of the bitmap. The RBG is allocated to the UE if the corresponding bit value in the bitmap is 1, the RBG is not allocated to the UE otherwise.

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

- if *mcs-Table* in *PUSCH-Config* is set to 'qam256', and PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-Table* in *PUSCH-Config* is set to 'qam64LowSE', the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-Table* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 5.1.3.1-1 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-2: MCS index table 2 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| 0 | 2 | 120 | 0.2344 |
| 1 | 2 | 193 | 0.3770 |
| 2 | 2 | 308 | 0.6016 |
| 3 | 2 | 449 | 0.8770 |
| 4 | 2 | 602 | 1.1758 |
| 5 | 4 | 378 | 1.4766 |
| 6 | 4 | 434 | 1.6953 |
| 7 | 4 | 490 | 1.9141 |
| 8 | 4 | 553 | 2.1602 |
| 9 | 4 | 616 | 2.4063 |
| 10 | 4 | 658 | 2.5703 |
| 11 | 6 | 466 | 2.7305 |
| 12 | 6 | 517 | 3.0293 |
| 13 | 6 | 567 | 3.3223 |
| 14 | 6 | 616 | 3.6094 |
| 15 | 6 | 666 | 3.9023 |
| 16 | 6 | 719 | 4.2129 |
| 17 | 6 | 772 | 4.5234 |
| 18 | 6 | 822 | 4.8164 |
| 19 | 6 | 873 | 5.1152 |
| 20 | 8 | 682.5 | 5.3320 |
| 21 | 8 | 711 | 5.5547 |
| 22 | 8 | 754 | 5.8906 |
| 23 | 8 | 797 | 6.2266 |
| 24 | 8 | 841 | 6.5703 |
| 25 | 8 | 885 | 6.9141 |
| 26 | 8 | 916.5 | 7.1602 |
| 27 | 8 | 948 | 7.4063 |
| 28 | 2 | reserved | |
| 29 | 4 | reserved | |
| 30 | 6 | reserved | |
| 31 | 8 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.4.3 Test description

7.1.1.4.2.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value).

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.2.4.3.2 Test procedure sequence

Table 7.1.1.4.2.4.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.4.3.2-2: Number of downlink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 136 ≤ TBS ≤12128 note 2 | 1 | 8\*FLOOR((TBS– 128)/8) |
| 12129 ≤ TBS≤24200 | 2 | 8\*FLOOR((TBS– 200)/16) |
| 24201 ≤ TBS ≤ 36272 | 3 | 8\*FLOOR((TBS– 272)/24) |
| 36273 ≤ TBS ≤48344 | 4 | 8\*FLOOR((TBS– 344)/32) |
| 48345≤ TBS ≤60416 | 5 | 8\*FLOOR((TBS– 416)/40) |
| 60417 ≤ TBS ≤ 72488 | 6 | 8\*FLOOR((TBS–488)/48) |
| 72489 ≤ TBS ≤84560 | 7 | 8\*FLOOR((TBS– 560)/56) |
| 84561 ≤ TBS≤96632 | 8 | 8\*FLOOR((TBS–632)/64) |
| 96633< TBS ≤108704 | 9 | 8\*FLOOR((TBS–704)/72) |
| 10705 ≤ TBS ≤120776 | 10 | 8\*FLOOR((TBS– 776)/80) |
| 120777≤ TBS ≤132848 | 11 | 8\*FLOOR((TBS–848)/88) |
| 132849 ≤ TBS ≤ 144920 | 12 | 8\*FLOOR((TBS– 920)/96) |
| TBS> 144920 | 13 | 8\*FLOOR((TBS– 992)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | |

Table 7.1.1.4.2.4.3.2-2A: Bandwidth part Dependent Parameters for Resource allocation 0 with start of BWP assumed as 0

|  |  |  |  |
| --- | --- | --- | --- |
| = | Nominal RBG size *P (Configuration1)* | Size of last RBG | Allowed Values |
| 11 | 2 | 1 | All 1…11 |
| 18 | 2 | 2 | 2,4,6,8,10,12,16,18 |
| 24 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24 |
| 25 | 2 | 1 | All 1…25 |
| 31 | 2 | 1 | All 1…31 |
| 32 | 2 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32 |
| 38 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38 |
| 51 | 4 | 3 | 3,4,7,8,11,12,15,16,19,20,23,24,27,28,31,32,35,36,39,40,43,44,47,48,51 |
| 52 | 4 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52 |
| 65 | 4 | 1 | 1,4,5,8,9,12,13,16,17,20,21,24,25,28,29,32,33,36,37,40,41,44,45,48,49, 52,53,56,57,60,61,64,65 |
| 66 | 4 | 2 | 2,4,6,8,10,12,16,18,20,22,24,26,28,30,32,34,36,38,40,42,44,46,48,50,52, 54,56,58,60,62,64,66 |
| 79 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79 |
| 106 | 8 | 2 | 2,8,10,16,18,24,26,32,34,40,42,48,50,56,58,64,66,72,74,80,82,88,90,96, 92,104,106 |
| 107 | 8 | 3 | 3,8,11,16,19,24,27,32,35,40,43,48,51,56,59,64,67,72,75,80,83,88,91,96, 99,104,107 |
| 132 | 8 | 4 | 4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,68,72,76,80,84,88,92,96, 100,104, 108,112,116,120,124,128,132 |
| 133 | 8 | 5 | 5,8,13,16,21,24,29,32,37,40,45,48,53,56,61,64,69,72,77,80,85,88,93,96, 101,104, 109,112,117,120,125,128,133 |
| 135 | 8 | 7 | 7,8,15,16,23,24,31,32,39,40,47,48,55,56,63,64,71,72,79,80,87,88,95,96, 103,104, 111,112,119,120,127,128,135 |
| 160 | 16 | 16 | 16,32,48,64,80,96,112,128,144,160 |
| 216 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,152,160,168, 176,184,192,200,208,216 |
| 217 | 16 | 9 | 9,16,25,32,41,48,57,64,73,80,89,96,105,112,121,128,137,144,153,160,169, 176,185,192,201,208,217 |
| 264 | 16 | 8 | 8,16,24,32,40,48,56,64,72,80,88,96,104,112,120,128,136,144,160,168, 176,184,192,200,208,216,224,232,240,248,256,264 |
| 270 | 16 | 14 | 14,16,30,32,46,44,62,64,78,80,94,96,110,112, 126,128,142,144,158,160, 174, 176,190,192, 206,208,222,224,238,240, 254,256,270 |
| 273 | 16 | 1 | 1,16,17,32,33,48,49,64,65,80,81,96,97,112,113,128,129,144,145,160, 161,176,171, 192,193, 208,209, 224,225,240,241,256,257,272,273 |

Table 7.1.1.4.2.4.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comment | Condition |
| number of layers (ʋ) | 1 |  |  |
| mcs-Table | qam256 |  |  |
| resourceAllocation | dynamicSwitch |  | pc\_dynamicSwitchRA\_Type0\_1\_PUSCH |
|  | resourceAllocationType1 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND Steps 1-5 |
|  | resourceAllocationType0 |  | NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH AND pc\_ra\_Type0\_PUSCH AND Steps 6-10 |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.2.4.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of 1 to in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and from 0 to 27. | - | - | - | - |
| 1 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.4.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.4.3.2-2.  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 3) | - | - | - | - |
| 2 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.4.3.2-2. | - | - | - | - |
| 3 | After 300ms, the SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After 60ms of step 3 SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | (NxPDCP SDUs) | 2 | P |
| - | EXCEPTION : Steps 5Aa1 to 10 are executed if pc\_ra\_Type0\_PUSCH | - | *-* | - | - |
| - | EXCEPTION : Steps 5Aa1 to 5Aa2 are executed if NOT pc\_dynamicSwitchRA\_Type0\_1\_PUSCH | - | *-* | - | - |
| 5Aa1 | The SS transmits a NR RRCReconfiguration message including *PUSCH-Config* with IE resourceAllocation set to resourceAllocationType1 (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 5Aa2 | The UE transmit a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| - | EXCEPTION: Steps 6 to 10 are repeated for allowed values of as per Table 7.1.1.4.2.4.3.2-2A in BWP, time domain resource length L 3 to 14-S and from 0 to 27. | - | - | - | - |
| 6 | SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 7 to 10 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.4.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.4.3.2-2.  Skip the execution of steps 7 to 10 for which the TBS size equal to 3824 or 3840. (Note 3) | - | - | - | - |
| 7 | SS creates one or more PDCP SDUs depending on TBS in accordance with Table 7.1.1.4.2.4.3.2-2. | - | - | - | - |
| 8 | After 300ms, the SS transmits all PDCP SDUs (NSDUs) as created in step 7 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 9 | After 60ms of step 8 SS transmits UL Grant DCI 0\_1, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI: (DCI Format 0\_1, S, L,and *nPRB.*) | - | - |
| 10 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 8 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | (NxPDCP SDUs) | 1 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15]. | | | | | |

7.1.1.4.2.4.3.3 Specific message contents

[None].

###### 7.1.1.4.2.5 UL-SCH Transport Block Size selection / DCI format 0\_0 / Transform precoding and 64QAM

7.1.1.4.2.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and transform precoding enabled}

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_0 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and modulation and coding }

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.1, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.1.1]

DCI format 0\_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI or new-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –  bits where

-  is the size of the active UL bandwidth part in case DCI format 0\_0 is monitored in the UE specific search space and satisfying

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

- otherwise,  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if the higher layer parameter *frequencyHoppingOffsetLists* contains two offset values and  if the higher layer parameter *frequencyHoppingOffsetLists* contains four offset values

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1 and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If the UL/SUL indicator is present in DCI format 0\_0 and the higher layer parameter *pusch-Config* is not configured on both UL and SUL the UE ignores the UL/SUL indicator field in DCI format 0\_0, and the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured;

- If the UL/SUL indicator is not present in DCI format 0\_0, the corresponding PUSCH scheduled by the DCI format 0\_0 is for the UL or SUL for which high layer parameter *pucch-Config* is configured.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by TC-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –bits where

-  is the size of the initial UL bandwidth part.

- For PUSCH hopping with resource allocation type 1:

-  MSB bits are used to indicate the frequency offset according to Subclause 6.3 of [6, TS 38.214], where  if  and  otherwise

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- For non-PUSCH hopping with resource allocation type 1:

-  bits provides the frequency domain resource allocation according to Subclause 6.1.2.2.2 of [6, TS 38.214]

- Time domain resource assignment – 4 bits as defined in Subclause 6.1.2.1 of [6, TS 38.214]

- Frequency hopping flag – 1 bit.

- Modulation and coding scheme – 5 bits as defined in Subclause 6.1.3 of [6, TS 38.214], using Table 5.1.3.1-1

- New data indicator – 1 bit, reserved

- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2

- HARQ process number – 4 bits, reserved

- TPC command for scheduled PUSCH – 2 bits as defined in Subclause 7.1.1 of [5, TS 38.213]

- Padding bits, if required.

- UL/SUL indicator – 1 bit if the cell has two ULs and the number of bits for DCI format 1\_0 before padding is larger than the number of bits for DCI format 0\_0 before padding; 0 bit otherwise. The UL/SUL indicator, if present, locates in the last bit position of DCI format 0\_0, after the padding bit(s).

- If 1 bit, reserved, and the corresponding PUSCH is always on the same UL carrier as the previous transmission of the same TB

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in common search space and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space but does not satisfy at least one of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is larger than the payload size of the DCI format 1\_0 monitored in common search space for scheduling the same serving cell, the bit width of the frequency domain resource allocation field in the DCI format 0\_0 is reduced by truncating the first few most significant bits such that the size of DCI format 0\_0 equals to the size of the DCI format 1\_0.

If DCI format 0\_0 is monitored in UE specific search space and satisfies both of the following

- the total number of different DCI sizes monitored per slot is no more than 4 for the cell, and

- the total number of different DCI sizes with C-RNTI monitored per slot is no more than 3 for the cell

and if the number of information bits in the DCI format 0\_0 prior to padding is less than the payload size of the DCI format 1\_0 monitored in UE specific search space for scheduling the same serving cell, zeros shall be appended to the DCI format 0\_0 until the payload size equals that of the DCI format 1\_0.

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report on PUSCH by a DCI, the *Time domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the applied resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and *K2* is determined based on the corresponding list entries of the higher layer parameter *reportSlotConfig* in *CSI-ReportConfig* for the triggered CSI Reporting Settings. The *i*th codepoint of *K2* s determined as  where  is the *i*th codepoint of .

- The slot where the UE shall transmit the PUSCH is determined by *K2* as  where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively, and

- The starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- The PUSCH mapping type is set to Type A or Type B as defined in Subclause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} | {0,…,12} | {1,…,12} | {1,…,12} |

When the UE is configured with *aggregationFactorUL* > 1, the same symbol allocation is applied across the *aggregationFactorUL* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *aggregationFactorUL* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version when *aggregationFactorUL* > 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

If the UE procedure for determining slot configuration, as defined in subclause 11.1 of [6, TS 38.213], determines symbols of a slot allocated for PUSCH as downlink symbols, the transmission on that slot is omitted for multi-slot PUSCH transmission.

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI. Two uplink resource allocation schemes type 0 and type 1 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 is supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the *Frequency domain resource* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to ‘dynamicswitch’, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation*.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used.

If a bandwidth part indicator field is not configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the RB indexing for uplink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI, except for the case when DCI format 0\_0 is decoded in any PDCCH common search space in CORESET 0 in which case the initial bandwidth part shall be used. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part.

[38.214 clause 6.1.2.2.2]

n uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in the Type0-PDCCH common search space in CORESET 0 in which case the initial bandwidth part of size  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

[TS 38.214, clause 6.1.4.1]

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, or SP-CSI-RNTI, the transform precoding is enabled if *transformPrecoder* in *PUSCH-Config* is set to 'enabled', or if *transformPrecoder* in *PUSCH-Config* is not configured and *msg3-transformPrecoding* in *rach-ConfigCommon* is set to 'enabled'; otherwise the transform precoding is disabled.

For the PUSCH assigned by a DCI format 0\_0/0\_1 with CRC scrambled by CS-RNTI, or the PUSCH with configured grant using CS-RNTI, the transform precoding is enabled if *transformPrecoder* in *ConfiguredGrantConfig* is set to 'enabled'; otherwise the transform precoding is disabled.

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, TC-RNTI, or CS-RNTI, or SP-CSI-RNTI, or for a PUSCH with configured grant using CS-RNTI,

if *transformPrecoder* is disabled for this PUSCH transmission

...

else

- if *mcs-TableTransformPrecoder* in *PUSCH-Config* is set to 'qam256', and the PUSCH is scheduled with C-RNTI or SP-CSI-RNTI, and PUSCH is assigned by DCI format 0\_1,

- the UE shall use *IMCS* and Table 5.1.3.1.-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is not configured with new-RNTI, *mcs-TableTransformPrecoder* in *PUSCH-Config* is set to 'qam64LowSE', and the PUSCH is scheduled with C-RNTI, or SP-CSI-RNTI, and the PUSCH is assigned by a PDCCH in a UE-specific search space,

- the UE shall use *IMCS* and Table 6.1.4.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif the UE is configured with new-RNTI, and the PUSCH is scheduled with new-RNTI,

- the UE shall use *IMCS* and Table 6.1.4.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-TableTransformPrecoder* in *ConfiguredGrantConfig* is set to 'qam256', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- elseif *mcs-TableTransformPrecoder* in *ConfiguredGrantConfig* is set to 'qam64LowSE', and PUSCH is scheduled with CS-RNTI,

- the UE shall use *IMCS* and Table 6.1.4.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

- else

- the UE shall use *IMCS* and Table 6.1.4.1-1to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

end

For Table 6.1.4.1-1 and Table 6.1.4.1-2, if higher layer parameter *PUSCH-tp-pi2BPSK* is configured, *q* = 1 otherwise *q*=2.

Table 6.1.4.1-1: MCS index table for PUSCH with transform precoding and 64QAM

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order *Qm* | Target code Rate R x 1024 | Spectral  efficiency |
| **0** | q | 240/ q | 0.2344 |
| **1** | q | 314/ q | 0.3066 |
| **2** | 2 | 193 | 0.3770 |
| **3** | 2 | 251 | 0.4902 |
| **4** | 2 | 308 | 0.6016 |
| **5** | 2 | 379 | 0.7402 |
| **6** | 2 | 449 | 0.8770 |
| **7** | 2 | 526 | 1.0273 |
| **8** | 2 | 602 | 1.1758 |
| **9** | 2 | 679 | 1.3262 |
| **10** | ~~4~~ | 340 | 1.3281 |
| **11** | 4 | 378 | 1.4766 |
| **12** | 4 | 434 | 1.6953 |
| **13** | 4 | 490 | 1.9141 |
| **14** | 4 | 553 | 2.1602 |
| **15** | 4 | 616 | 2.4063 |
| **16** | 4 | 658 | 2.5703 |
| **17** | 6 | 466 | 2.7305 |
| **18** | 6 | 517 | 3.0293 |
| **19** | 6 | 567 | 3.3223 |
| **20** | 6 | 616 | 3.6094 |
| **21** | 6 | 666 | 3.9023 |
| **22** | 6 | 719 | 4.2129 |
| **23** | 6 | 772 | 4.5234 |
| **24** | 6 | 822 | 4.8164 |
| **25** | 6 | 873 | 5.1152 |
| **26** | 6 | 910 | 5.3320 |
| **27** | 6 | 948 | 5.5547 |
| **28** | q | reserved | |
| **29** | 2 | reserved | |
| **30** | 4 | reserved | |
| **31** | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or for a PUSCH scheduled by a DCI format 0\_0/0\_1 with CRC scrambled by C-RNTI, new-RNTI, TC-RNTI, CS-RNTI, or SP-CSI-RNTI.

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols of the PUSCH allocation within the slot,  is the number of REs for DM-RS per PRB in the scheduled duration including the overhead of the DM-RS CDM groups without data, as indicated by DCI format 0\_1 or as described for DCI format 0\_0 in Subclause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in*PUSCH-ServingCellConfig*. If the  is not configured (a value from 0, 6, 12, or 18), the  is assumed to be 0. For MSG3 transmission the  is always set to 0.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Subclause 5.1.3.2

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant, the TBS shall be determined from the most recent configured scheduling PDCCH.

[TS 38.214, clause 5.1.3.2]

2) Intermediate number of information bits (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-2 find the closest TBS that is not less than .

Table 5.1.3.2-2: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.5.3 Test description

7.1.1.4.2.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest mandatory UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.2.5.3.2 Test procedure sequence

Table 7.1.1.4.2.5.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.5.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TBS  [bits] | | Number of PDCP SDUs | | PDCP SDU size  [bits]  (Note 1) | |
| 136 ≤ TBS ≤12128 note 2 | | 1 | | 8\*FLOOR((TBS– 128)/8) | |
| 12129 ≤ TBS≤24200 | | 2 | | 8\*FLOOR((TBS– 200)/16) | |
| 24201 ≤ TBS ≤ 36272 | | 3 | | 8\*FLOOR((TBS– 272)/24) | |
| 36273 ≤ TBS ≤48344 | | 4 | | 8\*FLOOR((TBS– 344)/32) | |
| 48345≤ TBS ≤60416 | | 5 | | 8\*FLOOR((TBS– 416)/40) | |
| 60417 ≤ TBS ≤ 72488 | | 6 | | 8\*FLOOR((TBS–488)/48) | |
| 72489 ≤ TBS ≤84560 | | 7 | | 8\*FLOOR((TBS– 560)/56) | |
| 84561 ≤ TBS≤96632 | | 8 | | 8\*FLOOR((TBS–632)/64) | |
| 96633< TBS ≤108704 | | 9 | | 8\*FLOOR((TBS–704)/72) | |
| 10705 ≤ TBS ≤120776 | | 10 | | 8\*FLOOR((TBS– 776)/80) | |
| 120777≤ TBS ≤132848 | | 11 | | 8\*FLOOR((TBS–848)/88) | |
| 132849 ≤ TBS ≤ 144920 | | 12 | | 8\*FLOOR((TBS– 920)/96) | |
| 144921 ≤ TBS ≤ 156992 | | 13 | | 8\*FLOOR((TBS– 992)/104) | |
| 156993 ≤ TBS ≤ 169064 | | 14 | | 8\*FLOOR((TBS– 1064)/112) | |
| 169065 ≤ TBS ≤ 181136 | | 15 | | 8\*FLOOR((TBS– 1136)/120) | |
| 181137 ≤ TBS ≤ 193208 | | 16 | | 8\*FLOOR((TBS– 1208)/128) | |
| 193209 ≤ TBS ≤ 205280 | | 17 | | 8\*FLOOR((TBS– 1280)/136) | |
| 205281 ≤ TBS ≤ 217352 | | 18 | | 8\*FLOOR((TBS– 1352)/144) | |
| 217353 ≤ TBS ≤ 229424 | | 19 | | 8\*FLOOR((TBS– 1424)/152) | |
| TBS> 229424 | | 20 | | 8\*FLOOR((TBS– 1496)/160) | |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | | | | |

Table 7.1.1.4.2.5.3.2-3: Specific Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Comment |
| number of layers (ʋ) | 1 |  |
| *transformPrecoder* | enabled |  |

Table 7.1.1.4.2.5.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of 1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and from 0 to 27. | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.5.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.5.3.2-2  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 1)  Skip the execution of steps 1 to 5 for > 27 and  < 5. (Note2) | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.5.3.2-2. | - | - | - | - |
| 3 | The SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After the reception of 2 Scheduling Request , SS transmits UL Grant DCI 0\_0, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI Format 0\_0, S, L,and *nPRB.*) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N x PDCP SDU) | 1 | P |
| Note 1: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15].  Note 2: For > 27 and < 5, the resulting TBS is very small leading to CRC errors in decoding UL data. | | | | | |

7.1.1.4.2.5.3.3 Specific message contents

None.

###### 7.1.1.4.2.6 UL-SCH Transport Block Size selection / DCI format 0\_2

7.1.1.4.2.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has pending data for transmission and receives on PDCCH DCI format 0\_2 indicating a resource block assignment correspondent to physical resource blocks , Time domain resource assignment and modulation and coding}

**then** { UE transmits MAC PDU on PUSCH as per Modulation Coding scheme, time domain resource allocation and PRB's }

}

7.1.1.4.2.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212 clause 7.3.1.1.3, TS 38.214 clause 6.1.2.1, 6.1.2.2, 6.1.2.2.1, 6.1.2.2.2, 6.1.4.1, 5.1.3.1, 6.1.4.2 and 5.1.3.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.212, clause 7.3.1.1.3]

DCI format 0\_2 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_2 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0, 1, 2 or 3 bits determined by higher layer parameter *carrierIndicatorSizeDCI-0-2*, as defined in Clause 10.1 of [5, TS38.213].

- UL/SUL indicator – 0 bit for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell or UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell but only one carrier in the cell is configured for PUSCH transmission; otherwise, 1 bit as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs configured by higher layers, excluding the initial UL bandwidth part. The bitwidth for this field is determined as bits, where



- if , in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;



- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;



If a UE does not support active BWP change via DCI, the UE ignores this bit field.

- Frequency domain resource assignment – number of bits determined by the following:

- bits if only resource allocation type 0 is configured, where is defined in Clause 6.1.2.2.1 of [6, TS 38.214]



- bits if only resource allocation type 1 is configured, or bits if *resourceAllocationDCI-0-2-r16* is configured as '*dynamicSwitch'*, where is the size of the active UL bandwidth part, is defined as in clause 4.4.4.4 of [4, TS 38.211] and is given by higher layer parameter *resourceAllocationType1GranularityDCI-0-2.* If the higher layer parameter *resourceAllocationType1GranularityDCI-0-2* is not configured, is equal to 1.



- If *resourceAllocationDCI-0-2-r16* is configured as '*dynamicSwitch'*, the MSB bit is used to indicate resource allocation type 0 or resource allocation type 1, where the bit value of 0 indicates resource allocation type 0 and the bit value of 1 indicates resource allocation type 1.

- For resource allocation type 0, the LSBs provide the resource allocation as defined in Clause 6.1.2.2.1 of [6, TS 38.214].



- For resource allocation type 1, the LSBs provide the resource allocation as follows:



- For PUSCH hopping with resource allocation type 1:

- MSB bits are used to indicate the frequency offset according to Clause 6.3 of [6, TS 38.214], where if the higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* contains two offset values and if the higher layer parameter *frequencyHoppingOffsetListsDCI-0-2* contains four offset values



- bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]



- For non-PUSCH hopping with resource allocation type 1:

- bits provide the frequency domain resource allocation according to Clause 6.1.2.2.2 of [6, TS 38.214]



If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and if *resourceAllocationDCI-0-2-r16* is configured as '*dynamicSwitch'* for the indicated bandwidth part, the UE assumes resource allocation type 0 for the indicated bandwidth part if the bitwidth of the "Frequency domain resource assignment" field of the active bandwidth part is smaller than the bitwidth of the "Frequency domain resource assignment" field of the indicated bandwidth part.

- Time domain resource assignment – 0, 1, 2, 3, 4, 5 or 6 bits as defined in Clause 6.1.2.1 of [6, TS38.214]. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-2* if the higher layer parameter is configured, or *I* is the number of entries in the higher layer parameter *PUSCH-TimeDomainResourceAllocationList* if the higher layer parameter *PUSCH-TimeDomainResourceAllocationList* is configured and the higher layer parameter *pusch-TimeDomainAllocationListDCI-0-2* is not configured; otherwise *I* is the number of entries in the default table*.*



- Frequency hopping flag – 0 or 1 bit:

- 0 bit if the higher layer parameter *frequencyHoppingDCI-0-2* is not configured;

- 1 bit according to Table 7.3.1.1.1-3 otherwise, only applicable to resource allocation type 1, as defined in Clause 6.3 of [6, TS 38.214].

- Modulation and coding scheme –5 bits as defined in Clause 6.1.4.1 of [6, TS 38.214]

- New data indicator – 1 bit

- Redundancy version – 0, 1 or 2 bits determined by higher layer parameter *numberOfBitsForRV-DCI-0-2*

- If 0 bit is configured, *rvid* to be applied is 0;

- 1 bit according to Table 7.3.1.2.3-1;

- 2 bits according to Table 7.3.1.1.1-2.

- HARQ process number – 0, 1, 2, 3 or 4 bits determined by higher layer parameter *harq-ProcessNumberSizeDCI-0-2*

- Downlink assignment index – 0, 1, 2 or 4 bits

- 0 bit if the higher layer parameter *downlinkAssignmentIndexDCI-0-2* is not configured;

- 1, 2 or 4 bits otherwise,

- 1st downlink assignment index – 1 or 2 bits:

- 1 bit for semi-static HARQ-ACK codebook;

- 2 bits for dynamic HARQ-ACK codebook.

- 2nd downlink assignment index – 0 or 2 bits

- 2 bits for dynamic HARQ-ACK codebook with two HARQ-ACK sub-codebooks;

- 0 bit otherwise.

When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorDCI-0-2* is configured, if the bit width of the Downlink assignment index in DCI format 0\_2 for one HARQ-ACK codebook is not equal to that of the Downlink assignment index in DCI format 0\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller Downlink assignment index until the bit width of the Downlink assignment index in DCI format 0\_2 for the two HARQ-ACK codebooks are the same.

- TPC command for scheduled PUSCH – 2 bits as defined in Clause 7.1.1 of [5, TS38.213]

- SRS resource indicator – or bits, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*' or '*nonCodeBook*',



-  bits according to Tables 7.3.1.1.2-28/29/30/31 if the higher layer parameter *txConfig = nonCodebook*, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*nonCodeBook*' and



- if UE supports operation with *maxMIMO-LayersDCI-0-2* and the higher layer parameter *maxMIMO-LayersDCI-0-2* of *PUSCH-ServingCellConfig* of the serving cell is configured, *Lmax* is given by that parameter

- otherwise, *Lmax* is given by the maximum number of layers for PUSCH supported by the UE for the serving cell for non-codebook based operation.

- bits according to Tables 7.3.1.1.2-32 if the higher layer parameter *txConfig = codebook*, where is the number of configured SRS resources in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModListDCI-0-2*, and associated with the higher layer parameter *usage* of value '*codeBook*'.



- Precoding information and number of layers – number of bits determined by the following:

- 0 bits if the higher layer parameter *txConfig = nonCodeBook*;

- 0 bits for 1 antenna port and if the higher layer parameter *txConfig = codebook*;

- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2*, and *codebookSubsetDCI-0-2*;

- 4 or 5 bits according to Table 7.3.1.1.2-2A for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1,* the values of higher layer parameters *maxRankDCI-0-2=2,* transform precoder is disabled, and according to the value of higher layer parameter *codebookSubsetDCI-0-2*;

- 4 or 6 bits according to Table 7.3.1.1.2-2B for 4 antenna ports, if *txConfig = codebook, ul-FullPowerTransmission =fullpowerMode1,* the values of higher layer parameters *maxRankDCI-0-2=3 or 4,* transform precoder is disabled, and according to the value of higher layer parameter *codebookSubsetDCI-0-2*;

- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2* and *codebookSubsetDCI-0-2*;

- 3 or 4 bits according to Table 7.3.1.1.2-3A for 4 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1*, *maxRankDCI-0-2=1*, and according to whether transform precoder is enabled or disabled, and the value of higher layer parameter *codebookSubsetDCI-0-2*;

- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2* and *codebookSubsetDCI-0-2*;

- 2 bits according to Table 7.3.1.1.2-4A for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1*, transform precoder is disabled, the *maxRankDCI-0-2=2*, and *codebookSubsetDCI-0-2=nonCoherent*;

- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission* is not configured or configured to *fullpowerMode2* or configured to *fullpower,* and according to whether transform precoder is enabled or disabled, and the values of higher layer parameters *maxRankDCI-0-2* and *codebookSubsetDCI-0-2*;

- 2 bits according to Table 7.3.1.1.2-5A for 2 antenna ports, if *txConfig = codebook,* *ul-FullPowerTransmission =fullpowerMode1*, *maxRankDCI-0-2=1*, and according to whether transform precoder is enabled or disabled, and the value of higher layer parameter *codebookSubsetDCI-0-2*.

For the higher layer parameter *txConfig=codebook*, if *ul-FullPowerTransmission* is configured to *fullpowerMode2*, the values of higher layer parameters *maxRankDCI-0-2* is configured to be larger than 2, and at least one SRS resource with 4 antenna ports is configured in an SRS resource set with usage set to 'codebook' and an SRS resource with 2 antenna ports is indicated via SRI in the same SRS resource set, then Table 7.3.1.1.2-4 is used.

For the higher layer parameter *txConfig = codebook*, if different SRS resources with different number of antenna ports are configured, the bitwidth is determined according to the maximum number of ports in an SRS resource among the configured SRS resources in an SRS resource set with usage set to 'codebook'. If the number of ports for a configured SRS resource in the set is less than the maximum number of ports in an SRS resource among the configured SRS resources, a number of most significant bits with value set to '0' are inserted to the field.

- Antenna ports – number of bits determined by the following:

- 0 bit if higher layer parameter *antennaPortsFieldPresenceDCI-0-2* is notconfigured;

- 2, 3, 4, or 5 bits otherwise,

- 2 bits as defined by Tables 7.3.1.1.2-6, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=1, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 2 bits as defined by 7.3.1.1.2-6A, if transform precoder is enabled, and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=1, where nSCID is the scrambling identity for antenna ports defined in Clause 6.4.1.1.1.2, in [4, TS38.211];

- 4 bits as defined by Tables 7.3.1.1.2-7, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=2, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 4 bits as defined by Tables 7.3.1.1.2-7A, if transform precoder is enabled, and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=2, where *nSCID* is the scrambling identity for antenna ports defined in Clause 6.4.1.1.1.2, in [4, TS38.211];

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2* and *dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2* and is configured with *antennaPortsFieldPresenceDCI-0-2*, the bitwidth of this field equals , where is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2* and is the "Antenna ports" bitwidthderived according to *dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2*. A number of zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of and .



If a UE is not configured with higher layer parameter *antennaPortsFieldPresenceDCI-0-2,* antenna port(s) are defined assuming bit field index value 0 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23.

- SRS request – 0, 1, 2 or 3 bits

- 0 bit if the higher layer parameter *srs-RequestDCI-0-2* is not configured;

- 1 bit as defined by Table 7.3.1.1.3-1 if higher layer parameter *srs-RequestDCI-0-2 = 1* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 2 bits if higher layer parameter *srs-RequestDCI-0-2 = 1* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second bit is defined by Table 7.3.1.1.3-1;

- 2 bits as defined by Table 7.3.1.1.2-24 if higher layer parameter *srs-RequestDCI-0-2 = 2* and for UEs not configured with *supplementaryUplink* in *ServingCellConfig* in the cell;

- 3 bits if higher layer parameter *srs-RequestDCI-0-2 = 2* and for UEs configured with *supplementaryUplink* in *ServingCellConfig* in the cell, where the first bit is the non-SUL/SUL indicator as defined in Table 7.3.1.1.1-1 and the second and third bits are defined by Table 7.3.1.1.2-24;

- CSI request – 0, 1, 2, 3, 4, 5, or 6 bits determined by higher layer parameter *reportTriggerSizeDCI-0-2*.

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured in either *dmrs-UplinkForPUSCH-MappingTypeA* or *dmrs-UplinkForPUSCH-MappingTypeB* and transform precoder is disabled, or if transform precoder is enabled, or if *maxRankDCI-0-2=1*;

- 2 bits otherwise, where Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) when one PT-RS port and two PT-RS ports are configured by *maxNrofPorts* in *PTRS-UplinkConfig* respectively, and the DMRS ports are indicated by the Antenna ports field.

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and the "PTRS-DMRS association" field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the "PTRS-DMRS association" field is not present for the indicated bandwidth part.

- beta\_offset indicator – 0 bit if the higher layer parameter *betaOffsets = semiStatic*; otherwise 1 bit if 2 offset indexes are configured by higher layer parameter *dynamicDCI-0-2* as defined by Table 9.3-3A in [5, TS 38.213], and 2 bits if 4 offset indexes are configured by higher layer parameter *dynamicDCI-0-2* as defined by Table 9.3-3 in [5, TS 38.213].

When two HARQ-ACK codebooks are configured for the same serving cell and if higher layer parameter *priorityIndicatorDCI-0-2* is configured, if the bit width of the beta\_offset indicator in DCI format 0\_2 for one HARQ-ACK codebook is not equal to that of the beta\_offset indicator in DCI format 0\_2 for the other HARQ-ACK codebook, a number of most significant bits with value set to '0' are inserted to smaller beta\_offset indicator until the bit width of the beta\_offset indicator in DCI format 0\_2 for the two HARQ-ACK codebooks are the same.

- DMRS sequence initialization – 0 or 1 bit

- 0 bit if the higher layer parameter *dmrs-SequenceInitializationDCI-0-2* is not configured or if transform precoder is enabled;

- 1 bit if transform precoder is disabled and the higher layer parameter *dmrs-SequenceInitializationDCI-0-2* is configured.

- UL-SCH indicator – 1 bit. A value of "1" indicates UL-SCH shall be transmitted on the PUSCH and a value of "0" indicates UL-SCH shall not be transmitted on the PUSCH. Except for DCI format 0\_2 with CRC scrambled by SP-CSI-RNTI, a UE is not expected to receive a DCI format 0\_2 with UL-SCH indicator of "0" and CSI request of all zero(s).

- Open-loop power control parameter set indication – 0 or 1 or 2 bits.

- 0 bit if the higher layer parameter *p0-PUSCH-SetList* is not configured;

- 1 or 2 bits otherwise,

- 1 bit if SRS resource indicator is present in the DCI format 0\_2;

- 1 or 2 bits as determined by higher layer parameter *olpc-ParameterSetDCI-0-2* if SRS resource indicator is not present in the DCI format 0\_2;

- Priority indicator – 0 bit if higher layer parameter *priorityIndicatorDCI-0-2* is not configured; otherwise 1 bit as defined in Clause 9 in [5, TS 38.213].

- Invalid symbol pattern indicator – 0 bit if higher layer parameter *invalidSymbolPatternIndicatorDCI-0-2* is not configured; otherwise 1 bit as defined in Clause 6.1.2.1 in [6, TS 38.214].

A UE does not expect that the bit width of a field in DCI format 0\_2 with CRC scrambled by CS-RNTI is larger than corresponding bit width of same field in DCI format 0\_2 with CRC scrambled by C-RNTI for the same serving cell. If the bit width of a field in the DCI format 0\_2 with CRC scrambled by CS-RNTI is not equal to that of the corresponding field in the DCI format 0\_2 with CRC scrambled by C-RNTI for the same serving cell, a number of most significant bits with value set to '0' are inserted to the field in DCI format 0\_2 with CRC scrambled by CS-RNTI until the bit width equals that of the corresponding field in the DCI format 0\_2 with CRC scrambled by C-RNTI for the same serving cell.

Table 7.3.1.1.3-1: 1 bit SRS request in DCI format 0\_2 and DCI format 1\_2

|  |  |
| --- | --- |
| Value of SRS request field | Triggered aperiodic SRS resource set(s) for DCI format 0\_2 and 1\_2 |
| 0 | No aperiodic SRS resource set triggered |
| 1 | SRS resource set(s) configured with higher layer parameter *aperiodicSRS-ResourceTrigger* set to 1 or an entry in *aperiodicSRS-ResourceTriggerList* set to 1 |

[TS 38.214, clause 6.1.2.1]

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the '*Time domain resource assignment'* field value *m* of the DCI provides a row index *m* + 1to an allocated table. The determination of the used resource allocation table is defined in Clause 6.1.2.1.1. The indexed row defines the slot offset *K2*, the start and length indicator *SLIV*, or directly the start symbol *S* and the allocation length *L*, the PUSCH mapping type, and the number of repetitions (if *numberOfRepetitions* is present in the resource allocation table) to be applied in the PUSCH transmission.

When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report(s) by a '*CSI request'* field on a DCI, the '*Time domain resource assignment'* field value *m* of the DCI provides a row index *m* + 1to the allocated table as defined in Clause 6.1.2.1.1. The indexed row defines the start and length indicator SLIV, or directly the start symbol *S* and the allocation length *L*, and the PUSCH mapping type to be applied in the PUSCH transmission and the *K2* value is determined as , where  are the corresponding list entries of the higher layer parameter

- reportSlotOffsetListDCI-0-2, if PUSCH is scheduled by DCI format 0\_2 and reportSlotOffsetListDCI-0-2 is configured;

- *reportSlotOffsetListDCI-0-1*, if PUSCH is scheduled by DCI format 0\_1 and *reportSlotOffsetListDCI-0-1* is configured;

- *reportSlotOffsetList*, otherwise;

in *CSI-ReportConfig* for the  triggered CSI Reporting Settings and  is the *(m+1)*th entry of .

- The slot *Ks* where the UE shall transmit the PUSCH is determined by *K2* as *Ks* =, if UE is configured with ca-SlotOffset for at least one of the scheduled and scheduling cell, *Ks* =, otherwise, and where *n* is the slot with the scheduling DCI, K*2* is based on the numerology of PUSCH, and  and  are the subcarrier spacing configurations for PUSCH and PDCCH, respectively,



- and are the and the, respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell receiving the PDCCH, and are the and the,respectively, which are determined by higher-layer configured *ca-SlotOffset* for the cell transmitting the PUSCH, as defined in clause 4.5 of [4, TS 38.211], and



- for PUSCH scheduled by DCI format 0\_1, if *pusch-RepTypeIndicatorDCI-0-1* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. For PUSCH scheduled by DCI format 0\_2, if *pusch-RepTypeIndicatorDCI-0-2* is set to 'pusch-RepTypeB', the UE applies PUSCH repetition Type B procedure when determining the time domain resource allocation. Otherwise, the UE applies PUSCH repetition Type A procedure when determining the time domain resource allocation for PUSCH scheduled by PDCCH.

- For PUSCH repetition Type A, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are determined from the start and length indicator *SLIV* of the indexed row:

if  then



else



where, and

- For PUSCH repetition Type B, the starting symbol *S* relative to the start of the slot, and the number of consecutive symbols *L* counting from the symbol *S* allocated for the PUSCH are provided by *startSymbol* and *length* of the indexed row of the resource allocation table, respectively.

- For PUSCH repetition Type A, the PUSCH mapping type is set to Type A or Type B as defined in Clause 6.4.1.1.3 of [4, TS 38.211] as given by the indexed row.

- For PUSCH repetition Type B, the PUSCH mapping type is set to Type B.

The UE shall consider the *S* and *L* combinations defined in table 6.1.2.1-1 as valid PUSCH allocations

Table 6.1.2.1-1: Valid *S* and *L* combinations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PUSCH mapping type | Normal cyclic prefix | | | Extended cyclic prefix | | |
| *S* | *L* | *S+L* | *S* | *L* | *S+L* |
| Type A (repetition Type A only) | 0 | {4,…,14} | {4,…,14} | 0 | {4,…,12} | {4,…,12} |
| Type B | {0,…,13} | {1,…,14} | {1,…,14} for repetition Type A, {1,…,27} for repetition Type B | {0,…, 11} | {1,…,12} | {1,…,12} for repetition Type A, {1,…,23} for repetition Type B |

For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as

- if *numberOfRepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberOfRepetitions*;

- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*;

- otherwise *K=1*.

If a UE is configured with higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH*, the UE does not expect to be configured with *pusch-AggregationFactor*.

For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, … *K*-1, is determined according to table 6.1.2.1-2.

Table 6.1.2.1-2: Redundancy version for PUSCH transmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *rvid* indicated by the DCI scheduling the PUSCH | *rvid* to be applied to *n*th transmission occasion (repetition Type A) or *n*th actual repetition (repetition Type B) | | | |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| 0 | 0 | 2 | 3 | 1 |
| 2 | 2 | 3 | 1 | 0 |
| 3 | 3 | 1 | 0 | 2 |
| 1 | 1 | 0 | 2 | 3 |

[38.214 clause 6.1.2.2]

The UE shall determine the resource block assignment in frequency domain using the resource allocation field in the detected PDCCH DCI except for a PUSCH transmission scheduled by a RAR UL grant or fallbackRAR UL grant, in which case the frequency domain resource allocation is determined according to clause 8.3 of [6, 38.213] or a MsgA PUSCH transmission with frequency domain resource allocation determined according to clause 8.1A of [6, 38.213]. Three uplink resource allocation schemes type 0, type 1 and type 2 are supported. Uplink resource allocation scheme type 0 is supported for PUSCH only when transform precoding is disabled. Uplink resource allocation scheme type 1 and type 2 are supported for PUSCH for both cases when transform precoding is enabled or disabled.

If the scheduling DCI is configured to indicate the uplink resource allocation type as part of the '*Frequency domain resource'* assignment field by setting a higher layer parameter r*esourceAllocation* in *pusch-Config* to 'dynamicSwitch', for DCI format 0\_1 or setting a higher layer parameter *resourceAllocationDCI-0-2* in *pusch-Config* to 'dynamicSwitch' for DCI format 0\_2, the UE shall use uplink resource allocation type 0 or type 1 as defined by this DCI field. Otherwise the UE shall use the uplink frequency resource allocation type as defined by the higher layer parameter *resourceAllocation* for DCI format 0\_1 or the higher layer parameter *resourceAllocationDCI-0-2* for DCI format 0\_2. The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_1 and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured, uplink type 2 resource allocation is used.

The UE shall assume that when the scheduling PDCCH is received with DCI format 0\_0, then uplink resource allocation type 1 is used, except when any of the higher layer parameters *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured in which case uplink resource allocation type 2 is used.

The UE expects that either none or both of *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured.

If a bandwidth part indicator field is not configured in the scheduling DCI or the UE does not support active bandwidth part change via DCI, the RB indexing for uplink type 0, type 1 and type 2 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI and the UE supports active bandwidth part change via DCI, the RB indexing for uplink type 0, type 1, type 2 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI. The UE shall upon detection of PDCCH intended for the UE determine first the uplink bandwidth part and then the resource allocation within the bandwidth part. RB numbering starts from the lowest RB in the determined uplink bandwidth part.

[38.214 clause 6.1.2.2.1]

In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured in *pusch-Config* and the size of the bandwidth part as defined in Table 6.1.2.2.1-1.

Table 6.1.2.2.1-1: Nominal RBG size *P*

|  |  |  |
| --- | --- | --- |
| Bandwidth Part Size | Configuration 1 | Configuration 2 |
| 1 – 36 | *2* | 4 |
| 37 – 72 | 4 | 8 |
| 73 – 144 | 8 | 16 |
| 145 – 275 | 16 | 16 |

[38.214 clause 6.1.2.2.2]

In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active bandwidth part of size  PRBs except for the case when DCI format 0\_0 is decoded in any common search space in which case the size of the initial UL bandwidth part  shall be used.

An uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting virtual resource block () and a length in terms of contiguously allocated resource blocks. The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed.

When the DCI size for DCI format 0\_0 in USS is derived from the initial UL BWP with size  but applied to another active BWP with size of , an uplink type 1 resource block assignment field consists of a resource indication value (*RIV*) corresponding to a starting resource block and a length in terms of virtually contiguously allocated resource blocks .

The resource indication value is defined by

if  then



else



where, and where shall not exceed .

If , *K* is the maximum value from set {1, 2, 4, 8} which satisfies ; otherwise *K* = 1.

When the scheduling grant is received with DCI format 0\_2, an uplink type 1 resource allocation field consists of a resource indication value (*RIV*) corresponding to a starting resource block group *RBGstart*=0, 1, …, *NRBG*-1 and a length in terms of virtually contiguously allocated resource block groups *LRBGs*=1, …, *NRBG*, where the resource block groups are defined as in 6.1.2.2.1 with *P* defined by *resourceAllocationType1GranularityDCI-0-2* if the UE is configured with higher layer parameter *resourceAllocationType1GranularityDCI-0-2*, and *P*=1 otherwise*.* The resource indication value is defined by

if  then



else



where≥ 1 and shall not exceed .

[TS 38.214, clause 6.1.4.1]

For a PUSCH scheduled by RAR UL grant or

for a PUSCH scheduled by a fallbackRAR UL grant or

for a MsgA PUSCH transmission, or

for a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, or

for a PUSCH scheduled by a DCI format 0\_1 or DCI format 0\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, SP-CSI-RNTI, or

for a PUSCH with configured grant using CS-RNTI, and

if transform precoding is disabled for this PUSCH transmission according to Clause 6.1.3

- if *mcs-TableDCI-0-2* in *pusch-Config* is set to 'qam256', and PUSCH is scheduled by a PDCCH with DCI format 0\_2 with CRC scrambled by C-RNTI or SP-CSI-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-2 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel;

- elseif the UE is not configured with MCS-C-RNTI, *mcs-TableDCI-0-2* in *pusch-Config* is set to 'qam64LowSE', and the PUSCH is scheduled by a PDCCH by a PDCCH with DCI format 0\_2 with CRC scrambled by C-RNTI or SP-CSI-RNTI,

- the UE shall use *IMCS* and Table 5.1.3.1-3 to determine the modulation order (*Qm*) and Target code rate (*R*) used in the physical uplink shared channel.

[TS 38.214, clause 5.1.3.1]

Table 5.1.3.1-3: MCS index table 3 for PDSCH

|  |  |  |  |
| --- | --- | --- | --- |
| MCS Index *IMCS* | Modulation Order  *Qm* | Target code Rate *R* x [1024] | Spectral  efficiency |
| **0** | 2 | 30 | 0.0586 |
| **1** | 2 | 40 | 0.0781 |
| **2** | 2 | 50 | 0.0977 |
| **3** | 2 | 64 | 0.1250 |
| **4** | 2 | 78 | 0.1523 |
| **5** | 2 | 99 | 0.1934 |
| **6** | 2 | 120 | 0.2344 |
| **7** | 2 | 157 | 0.3066 |
| **8** | 2 | 193 | 0.3770 |
| **9** | 2 | 251 | 0.4902 |
| **10** | 2 | 308 | 0.6016 |
| **11** | 2 | 379 | 0.7402 |
| **12** | 2 | 449 | 0.8770 |
| **13** | 2 | 526 | 1.0273 |
| **14** | 2 | 602 | 1.1758 |
| **15** | 4 | 340 | 1.3281 |
| **16** | 4 | 378 | 1.4766 |
| **17** | 4 | 434 | 1.6953 |
| **18** | 4 | 490 | 1.9141 |
| **19** | 4 | 553 | 2.1602 |
| **20** | 4 | 616 | 2.4063 |
| **21** | 6 | 438 | 2.5664 |
| **22** | 6 | 466 | 2.7305 |
| **23** | 6 | 517 | 3.0293 |
| **24** | 6 | 567 | 3.3223 |
| **25** | 6 | 616 | 3.6094 |
| **26** | 6 | 666 | 3.9023 |
| **27** | 6 | 719 | 4.2129 |
| **28** | 6 | 772 | 4.5234 |
| **29** | 2 | reserved | |
| **30** | 4 | reserved | |
| **31** | 6 | reserved | |

[TS 38.214, clause 6.1.4.2]

For a PUSCH scheduled by RAR UL grant or

for a PUSCH scheduled by fallbackRAR UL grant or

for a PUSCH scheduled by a DCI format 0\_0 with CRC scrambled by C-RNTI, MCS-C-RNTI, TC-RNTI, CS-RNTI, or

for a PUSCH scheduled by a DCI format 0\_1 or DCI format 0\_2 with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or

for a PUSCH transmission with configured grant, or

for a MsgA PUSCH transmission,

if

- and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is disabled and a table other than Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled, the UE shall first determine the TBS as specified below:

The UE shall first determine the number of REs (*NRE*) within the slot:

- A UE first determines the number of REs allocated for PUSCH within a PRB  by

- , where is the number of subcarriers in the frequency domain in a physical resource block,  is the number of symbols *L* of the PUSCH allocation according to Clause 6.1.2.1 for scheduled PUSCH or Clause 6.1.2.3 for configured PUSCH,  is the number of REs for DM-RS per PRB in the allocated duration including the overhead of the DM-RS CDM groups without data, as described for PUSCH with a configured grant in Clause 6.1.2.3 or as indicated by DCI format 0\_1 or DCI format 0\_2 or as described for DCI format 0\_0 in Clause 6.2.2, and  is the overhead configured by higher layer parameter *xOverhead* in *PUSCH-ServingCellConfig*. If the  is not configured (a value from 6, 12, or 18), the  is assumed to be 0. For Msg3 or MsgA PUSCH transmission the  is always set to 0. In case of PUSCH repetition Type B,  is determined assuming a nominal repetition with the duration of *L* symbols without segmentation.

- A UE determines the total number of REs allocated for PUSCH  by where  is the total number of allocated PRBs for the UE.

- Next, proceed with steps 2-4 as defined in Clause 5.1.3.2

- For a PUSCH scheduled by fallbackRAR UL grant, UE assumes the TB size determined by the UL grant in the fallbackRAR shall be the same as the TB size used in the corresponding MsgA PUSCH transmission.

else if

-  and transform precoding is disabled and Table 5.1.3.1-2 is used, or

-  and transform precoding is enabled,

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant,

- the TBS shall be determined from *configuredGrantConfig* for a configured grant Type 1 PUSCH.

- the TBS shall be determined from the most recent PDCCH scheduling a configured grant Type 2 PUSCH.

else

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using . If there is no PDCCH for the same transport block using , and if the initial PUSCH for the same transport block is transmitted with configured grant,

- the TBS shall be determined from *configuredGrantConfig* for a configured grant Type 1 PUSCH.

- the TBS shall be determined from the most recent PDCCH scheduling a configured grant Type 2 PUSCH.

[TS 38.214, clause 5.1.3.2]

2) Unquantized intermediate variable (*Ninfo*) is obtained by .

If 

Use step 3 as the next step of the TBS determination

else

Use step 4 as the next step of the TBS determination

end if

3) When , TBS is determined as follows

- quantized intermediate number of information bits , where .

- use Table 5.1.3.2-1 find the closest TBS that is not less than .

Table 5.1.3.2-1: TBS for 

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | TBS | Index | TBS | Index | TBS | Index | TBS |
| 1 | 24 | 31 | 336 | 61 | 1288 | 91 | 3624 |
| 2 | 32 | 32 | 352 | 62 | 1320 | 92 | 3752 |
| 3 | 40 | 33 | 368 | 63 | 1352 | 93 | 3824 |
| 4 | 48 | 34 | 384 | 64 | 1416 |  |  |
| 5 | 56 | 35 | 408 | 65 | 1480 |  |  |
| 6 | 64 | 36 | 432 | 66 | 1544 |  |  |
| 7 | 72 | 37 | 456 | 67 | 1608 |  |  |
| 8 | 80 | 38 | 480 | 68 | 1672 |  |  |
| 9 | 88 | 39 | 504 | 69 | 1736 |  |  |
| 10 | 96 | 40 | 528 | 70 | 1800 |  |  |
| 11 | 104 | 41 | 552 | 71 | 1864 |  |  |
| 12 | 112 | 42 | 576 | 72 | 1928 |  |  |
| 13 | 120 | 43 | 608 | 73 | 2024 |  |  |
| 14 | 128 | 44 | 640 | 74 | 2088 |  |  |
| 15 | 136 | 45 | 672 | 75 | 2152 |  |  |
| 16 | 144 | 46 | 704 | 76 | 2216 |  |  |
| 17 | 152 | 47 | 736 | 77 | 2280 |  |  |
| 18 | 160 | 48 | 768 | 78 | 2408 |  |  |
| 19 | 168 | 49 | 808 | 79 | 2472 |  |  |
| 20 | 176 | 50 | 848 | 80 | 2536 |  |  |
| 21 | 184 | 51 | 888 | 81 | 2600 |  |  |
| 22 | 192 | 52 | 928 | 82 | 2664 |  |  |
| 23 | 208 | 53 | 984 | 83 | 2728 |  |  |
| 24 | 224 | 54 | 1032 | 84 | 2792 |  |  |
| 25 | 240 | 55 | 1064 | 85 | 2856 |  |  |
| 26 | 256 | 56 | 1128 | 86 | 2976 |  |  |
| 27 | 272 | 57 | 1160 | 87 | 3104 |  |  |
| 28 | 288 | 58 | 1192 | 88 | 3240 |  |  |
| 29 | 304 | 59 | 1224 | 89 | 3368 |  |  |
| 30 | 320 | 60 | 1256 | 90 | 3496 |  |  |

4) When , TBS is determined as follows.

- quantized intermediate number of information bits , where and ties in the round function are broken towards the next largest integer.

- if 

, where 

else

if 

, where 

else



end if

end if

7.1.1.4.2.6.3 Test description

7.1.1.4.2.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except set the NR Cell bandwidth and applicable BWP to maximum for the NR Band under test as specified in Table 5.3.5-1 in TS 38.101-1 [16] / TS 38.101-2 [17] (to enable testing of *nPRB* up to maximum value) and Short\_DCI condition is applied in NR Serving cell configuration.

Test frequency NRf1 is as specified in TS 38.508-1 [4] clause 4.3.1 using the common highest UL and DL channel bandwidth and using the default subcarrier spacing specified in TS 38.508-1 [4] clause 6.2.3.1.

7.1.1.4.2.6.3.2 Test procedure sequence

Table 7.1.1.4.2.6.3.2-1: Maximum TBS for different UE categories

|  |  |
| --- | --- |
| UE Category | Maximum number of bits of a UL-SCH transport block received within a TTI |
| TS 38.306 [23] clause 4.1.2 *require UE* without *ue-CategoryDL* and *ue-CategoryUL, to support Max TBS achievable based on max bandwidth of the Band under test.* | |

Table 7.1.1.4.2.6.3.2-2: Number of uplink PDCP SDUs and PDCP SDU size used as test data

|  |  |  |
| --- | --- | --- |
| TBS  [bits] | Number of PDCP SDUs | PDCP SDU size  [bits]  (Note 1) |
| 136 ≤ TBS ≤12128 note 2 | 1 | 8\*FLOOR((TBS– 128)/8) |
| 12129 ≤ TBS≤24200 | 2 | 8\*FLOOR((TBS– 200)/16) |
| 24201 ≤ TBS ≤ 36272 | 3 | 8\*FLOOR((TBS– 272)/24) |
| 36273 ≤ TBS ≤48344 | 4 | 8\*FLOOR((TBS– 344)/32) |
| 48345≤ TBS ≤60416 | 5 | 8\*FLOOR((TBS– 416)/40) |
| 60417 ≤ TBS ≤ 72488 | 6 | 8\*FLOOR((TBS–488)/48) |
| 72489 ≤ TBS ≤84560 | 7 | 8\*FLOOR((TBS– 560)/56) |
| 84561 ≤ TBS≤96632 | 8 | 8\*FLOOR((TBS–632)/64) |
| 96633< TBS ≤108704 | 9 | 8\*FLOOR((TBS–704)/72) |
| 10705 ≤ TBS ≤120776 | 10 | 8\*FLOOR((TBS– 776)/80) |
| 120777≤ TBS ≤132848 | 11 | 8\*FLOOR((TBS–848)/88) |
| 132849 ≤ TBS ≤ 144920 | 12 | 8\*FLOOR((TBS– 920)/96) |
| TBS> 144920 | 13 | 8\*FLOOR((TBS– 992)/104) |
| Note 1: Each PDCP SDU is limited to 1500 octets (to keep below maximum SDU size of ESM as specified in TS 24.301 [21] clause 9.9.4.12).  The PDCP SDU size of each PDCP SDU is  PDCP SDU size = (TBS – N\*PDCP header size – N\*AMD PDU header size - N\*MAC header size – Size of Timing Advance – RLC Status PDU size- MAC header for RLC Status PDU) / N, where  PDCP header size is 24 bits for the RLC AM and 18-bit SN case; AMD PDU header size is 24 bits with 18 bit SN;   MAC header size for AMD PDU = 16 or 24 bits depending on L=8 or 16 bits. Worst case 24 is taken.  Size of Timing Advance MAC CE with header is 16 bits (if no Timing Advance and/or RLC status needs to be sent, padding will occur instead).  RLC Status PDU size = 24 bits with 1 ACK\_SN, With a MAC header of 16 bits.  This gives:   PDCP SDU size = 8\*FLOOR((TBS – N\*24- N\*24 – N\*24 -56 )/(8\*N)) bits.  Note 2: According to the final PDCP SDU size formula in Note 1, the smallest TBS that can be tested is 136 bits. | | |

Table 7.1.1.4.2.6.3.2-2A: Void

Table 7.1.1.4.2.6.3.2-3: Specific Parameter

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Value | Comment | Condition |
| mcs-TableDCI-0-2-r16 | Not Present | qam64 per default |  |
| *rbg-Size* | Not present | configuration 1 applicable |  |
| NstartBWP | 0 |  |  |

Table 7.1.1.4.2.6.3.2-4: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| - | EXCEPTION: Steps 1 to 5 are repeated for allowed values of 1 to  in BWP, time domain resource as per Table 7.1.1.4.2.0-1 and from 0 to 28.  Skip the execution of steps for = 28 and < 4.  (Note 1) | - | - | - | - |
| 1 | The SS calculates or looks up TBS in TS 38.214 [15] based on the value of S, L,and *nPRB.* | - | - | - | - |
| - | EXCEPTION: Steps 2 to 5 are performed if TBS is less than or equal to UE capability "Maximum number of UL-SCH transport block bits received within a TTI" as specified in Table 7.1.1.4.2.6.3.2-1 and larger than or equal to 136 bits as specified in Table 7.1.1.4.2.6.3.2-2.  Skip the execution of steps 2 to 5 for which the TBS size equal to 3824 or 3840. (Note 2) | - | - | - | - |
| 2 | The SS creates one or more PDCP SDUs, depending on TBS, in accordance with Table 7.1.1.4.2.6.3.2-2. | - | - | - | - |
| 3 | After 300ms, the SS transmits all PDCP SDUs (NSDUs) as created in step 2 in a MAC PDU. | <-- | MAC PDU (NxPDCP SDUs) | - | - |
| 4 | After 60ms of step 3, SS transmits UL Grant DCI 0\_2, and values of S, L,and *nPRB*. | <-- | (UL Grant) (DCI Format 0\_2, S, L,and *nPRB.*) | - | - |
| 5 | CHECK: Does UE return the same number of PDCP SDUs with same content as transmitted by the SS in step 3 using Time, frequency Resources and modulation and coding scheme as configured by the SS in step 4? | --> | MAC PDU (N x PDCP SDU) | 1 | P |
| Note 1: For = 28 and < 4, the resulting TBS is very small leading to CRC errors in decoding UL data.  Note 2: There is ambiguity of TBS calculation when 3824.0 < Ninfo < 3825.0 in clause 5.1.3.2 of TS 38.214 [15]. | | | | | |

7.1.1.4.2.6.3.3 Specific message contents

Table 7.1.1.4.2.6.3.3-1: PUSCH-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeA-DCI-0-2-r16CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| dmrs-UplinkForPUSCH-MappingTypeB-DCI-0-2-r16CHOICE { |  |  |  |
| setup | DMRS-UplinkConfig |  |  |
| } |  |  |  |
| harq-ProcessNumberSizeDCI-0-2-r16 | 4 | nrofHARQ-ProcessesForPUSCH is 16 |  |
| numberOfBitsForRV-DCI-0-2-r16 | 2 |  |  |
| resourceAllocationDCI-0-2-r16 | resourceAllocationType1 |  |  |
| } |  |  |  |

#### 7.1.1.5 Discontinuous reception

##### 7.1.1.5.0 DRX Common Definitions

FirstSlot is the First DL Slot in the subframe, which is 0 for both FDD and TDD as per default configuration in 38.5081-1[4] TDD-UL-DL-Config Table 4.6.3-192

LastDLSlot is the Last DL Slot in a frame; for FDD numerology =0 it is slot 9, numerology=1 it is slot 19, numerology=2 it is slot 39. For TDD as per default configuration in 38.5081-1[4] TDD-UL-DL-Config Table 4.6.3-192, for numerology =0, it is slot 7, numerology=1 it is slot 16, numerology=3 it is slot 77

LastULSlot is the Last UL Slot in a frame; for FDD/TDD numerology =0 it is slot 9, numerology=1 it is slot 18(Second Last as 2 Consecutive UL Slots), numerology=3 it is slot 79; the PDCCH for UL grant is sent K2= 4 Slot earlier.

##### 7.1.1.5.1 DRX operation / Short cycle not configured / Parameters configured by RRC

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Long DRX cycle is configured and [(SFN \* 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset* }

**then** { UE starts the OnDurationTimer and monitors the PDCCH for OnDurationTimer PDCCH-Occasions}

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Long DRX cycle is configured and a new DL transmission is indicated on the PDCCH during Active Time }

**then** { UE starts or restarts the Drx-InactivityTimer and monitors the PDCCH for Drx-InactivityTimer PDCCH occasions starting from the next PDCCH occasion of the PDCCH occasion where the DL new transmission was indicated }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Long DRX cycle is configured and if a HARQ RTT Timer expires in this PDCCH Occasion and the data in the soft buffer of the corresponding HARQ process was not successfully decoded }

**then** { UE starts the drx-RetransmissionTimer-DL for the corresponding HARQ process and monitors the PDCCH for drx-RetransmissionTimer consecutive PDCCH Occasion }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Long DRX cycle is configured and an uplink grant for a pending HARQ retransmission can occur in this PDCCH occasion}

**then** { UE monitors the PDCCH in this PDCCH occasion }

}

7.1.1.5.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.7. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.7]

The MAC entity may be configured by RRC with a DRX functionality that controls the UE’s PDCCH monitoring activity for the MAC entity's C-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, and TPC-SRS-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other subclauses of this specification. When in RRC\_CONNECTED, if DRX is configured, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this subclause; otherwise the MAC entity shall monitor the PDCCH continuously.

RRC controls DRX operation by configuring the following timers:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates an new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycle* StartOffset: the Long DRX cycle and drx-StartOffset which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity.

When a DRX cycle is configured, the Active Time includes the time while:

- drx-onDurationTimer or drx-InactivityTimer or drx-RetransmissionTimerDL or drx-RetransmissionTimerUL or ra-ContentionResolutionTimer (as described in subclause 5.1.5) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in subclause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the random access preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in subclause 5.1.4).

When DRX is configured, the MAC entity shall:

1> if a MAC PDU is received in a configured downlink assignment:

2> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

2> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if a MAC PDU is transmitted in a configured uplink grant:

2> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a *drx-HARQ-RTT-TimerDL* expires:

2> if the data of the corresponding HARQ process was not successfully decoded:

3> start the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if an *drx-HARQ-RTT-TimerUL* expires:

2> start the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a DRX Command MAC CE or a Long DRX Command MAC CE is received:

2> stop *drx-onDurationTimer*;

2> stop *drx-InactivityTimer*.

1> if *drx-InactivityTimer* expires or a DRX Command MAC CE is received:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer in the first symbol after the expiry of drx-HARQ-RTT-TimerDL.*;

3> use the Short DRX Cycle.

2> else:

3> use the Long DRX cycle.

1> if *drx-ShortCycleTimer* expires:

2> use the Long DRX cycle.

1> if a Long DRX Command MAC CE is received:

2> stop *drx-ShortCycleTimer*;

2> use the Long DRX cycle.

1> if the Short DRX Cycle is used, and [(SFN x 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*); or

1> if the Long DRX Cycle is used, and [(SFN x 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> if *drx-SlotOffset* is configured:

3> start *drx-onDurationTimer* after *drx-SlotOffset from the beginning of the subframe*.

2> else:

3> start *drx-onDurationTimer*.

1> if the MAC entity is in Active Time:

2> monitor the PDCCH;

2> if the PDCCH indicates a DL transmission or if a DL assignment has been configured:

3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process immediately after the corresponding PUCCH transmission;

3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission or if a UL grant has been configured:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process immediately after the first repetition of the corresponding PUSCH transmission;

3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL or UL):

3> start or restart *drx-InactivityTimer*.

1> else (i.e. not part of the Active Time):

2> not report CQI/PMI/RI on PUCCH.

7.1.1.5.1.3 Test description

7.1.1.5.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.5.1.3.2 Test procedure sequence

Table 7.1.1.5.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits RRCReconfiguration to configure specific DRX parameters. (Note 6) | <-- | - | - | - |
| 2 | The UE transmits RRCReconfigurationComplete. (Note 7) | --> | - | - | - |
| 3 | In the first PDCCH occasion when the *Drx-onDurationTimer* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | 1 | P |
| 5 | At least drx-InactivityTimer PDCCH occasions after the transmission of the MAC PDU in Step 3 has been indicated (This means the next DRX cycle or later after Step 2) in the last PDCCH occasion while the *drx-onDurationTimer* is still running, the SS indicates the transmission a DL MAC PDU on the PDDCH. (Note 4). | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 5? | --> | HARQ ACK | 1 | P |
| 7 | drx-InactivityTimer PDCCH-occasions after the transmission of the MAC PDU transmitted in step 5 was indicated on the PDCCH, the SS indicates the transmission of a DL MAC PDU on the PDCCH. (Note 4) | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 7? | --> | HARQ ACK | 2 | P |
| 9 | At least drx-InactivityTimer PDCCH occasions after the transmission of the MAC PDU in Step 7 has been indicated (This means the next DRX cycle or later after Step 5) and in the last PDCCH occasion before the *Drx-onDurationTimer* expires, the SS indicates the transmission of a DL MAC PDU on the PDDCH. The DL MAC PDU transmitted is invalid. (Note 1, Note 4) | <-- | Invalid MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 9? | --> | HARQ NACK | 1 | P |
| 11 | In the first PDCCH occasion when the Drx-RetransmissionTimerDL for the MAC PDU in Step 9 is started (i.e. after expiry of *drx-HARQ-RTT-TimerDL after step 9)*, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 11? | --> | HARQ ACK | 3 | P |
| 13 | At least drx-InactivityTimer PDCCH occasions after the transmission of the DL MAC PDU in Step 11 has been indicated (This means the next DRX cycle or later after Step 11) and last PDCCH occasion before the *Drx-onDurationTimer* expires, the SS indicates the transmission of DL MAC PDU on the PDCCH. The DL MAC PDU transmitted is invalid. (Note 1, Note 4) | <-- | Invalid MAC PDU | - | - |
| 14 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 13? | --> | HARQ NACK | 1 | P |
| 15 | In the last PDCCH occasion when the drx-RetransmissionTimerDL for MAC PDU in Step 13 is still running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 16 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 15? | --> | HARQ ACK | 3 | P |
| 17 | The SS is configured for Uplink Grant Allocation Type [0]. At least drx-InactivityTimer PDCCH subframes after the transmission of the DL MAC PDU in Step 15 has been indicated in the last PDCCH occasion when the onDuratiopnTimer is still running (This means the next DRX cycle or later after Step 9), the SS indicates an UL grant to the UE on the PDCCH. (Note 4) | <-- | UL grant on PDCCH | - | - |
| 18 | Check: Does the UE transmit a Buffer Status Report on the UL indicating an empty buffer? | --> | Buffer Status Report MAC control element | 1 | P |
| 19 | In the last PDCCH occasion when the drx-RetransmissionTimer-UL for MAC PDU from Step 17 is still running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 20 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 19? | --> | HARQ ACK | 4 | P |
| Note 1: Invalid MAC PDU is a MAC PDU that fails the CRC check.  Note 2: All the DL MAC PDU are transmitted with the NDI set on the PDCCH.  Note 3: Timer tolerances for the MAC DRX related timers measured in PDCCH occasions is 0. These timers are: drx-InactivityTimer, drx-RetransmissionTimerDL, drx-RetransmissionTimerUL, drx-HARQ-RTT-TimerDL and drx-HARQ-RTT-TimerUL.  Note 4: The drx-InactivityTimer is started in the next PDCCH occasion of the PDCCH occasion where DL new transmission is indicated.  Note 5: The timer values expressed in number of slots.  Note 6: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 7: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.* | | | | | |

7.1.1.5.1.3.3 Specific message contents

Table 7.1.1.5.1.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.5.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig |  | NR |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| nonCriticalExtension::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.5.1.3.3-2: *CellGroupConfig* (Table 7.1.1.5.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer | ms20 |  |  |
| drx-InactivityTimer | ms10 |  |  |
| drx-HARQ-RTT-TimerDL | 56 | Number of slots=4 due to number of symbol per slot=14 | =0,1,2,3,4 ( 2 with normal CP) |
|  | 48 | Number of slots=4 due to number of symbol per slot=12 | = 2 with external CP |
| drx-HARQ-RTT-TimerUL | 56 | Number of slots=4 due to number of symbol per slot=14 | =0,1,2,3,4 ( 2 with normal CP) |
|  | 48 | Number of slots=4 due to number of symbol per slot=12 | = 2 with external CP |
| drx-RetransmissionTimerDL | sl8 |  |  |
| drx-RetransmissionTimerUL | sl8 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms640 | 7 |  |  |
| } |  |  |  |
| shortDRX | Not present |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.5.2 DRX operation / Short cycle not configured / Long DRX command MAC control element reception

7.1.1.5.2.1 Test Purpose (TP)

(1)

**with** { UE in CONNECTED mode }

**ensure that** {

**when** { long DRX cycle is configured and a DRX Command MAC control element is received }

**then** { UE successfully decodes the MAC control PDU }

}

(2)

**with** { UE in CONNECTED mode }

**ensure that** {

**when** { long DRX cycle is configured and the HARQ RTT Timer is running and a DRX Command MAC control element is received }

**then** { UE continues running the HARQ RTT timer }

}

(3)

**with** { UE in CONNECTED mode }

**ensure that** {

**when** { long DRX cycle is configured and the drx-RetransmissionTimer is running and a DRX Command MAC control element is received }

**then** { UE continues running the drx-RetransmissionTimer and monitors the PDCCH }

}

7.1.1.5.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.7. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.7]

The MAC entity may be configured by RRC with a DRX functionality that controls the UE’s PDCCH monitoring. Activity for the MAC entity's C-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, and TPC-SRS-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other subclauses of this specification. When in RRC\_CONNECTED, if DRX is configured, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this subclause; otherwise the MAC entity shall monitor the PDCCH continuously.

RRC controls DRX operation by configuring the following timers:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycle* StartOffset: the Long DRX cycle and drx-StartOffset which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity.

When a DRX cycle is configured, the Active Time includes the time while:

- drx-onDurationTimer or drx-InactivityTimer or drx-RetransmissionTimerDL or drx-RetransmissionTimerUL or ra-ContentionResolutionTimer (as described in subclause 5.1.5) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in subclause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the random access preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in subclause 5.1.4).

When DRX is configured, the MAC entity shall:

1> if a MAC PDU is received in a configured downlink assignment:

2> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

2> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if a MAC PDU is transmitted in a configured uplink grant:

2> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a *drx-HARQ-RTT-TimerDL* expires:

2> if the data of the corresponding HARQ process was not successfully decoded:

3> start the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if an *drx-HARQ-RTT-TimerUL* expires:

2> start the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a DRX Command MAC CE or a Long DRX Command MAC CE is received:

2> stop *drx-onDurationTimer*;

2> stop *drx-InactivityTimer*.

1> if *drx-InactivityTimer* expires or a DRX Command MAC CE is received:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer in the first symbol after the expiry of drx-HARQ-RTT-TimerDL.*;

3> use the Short DRX Cycle.

2> else:

3> use the Long DRX cycle.

1> if *drx-ShortCycleTimer* expires:

2> use the Long DRX cycle.

1> if a Long DRX Command MAC CE is received:

2> stop *drx-ShortCycleTimer*;

2> use the Long DRX cycle.

1> if the Short DRX Cycle is used, and [(SFN x 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*); or

1> if the Long DRX Cycle is used, and [(SFN x 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> if *drx-SlotOffset* is configured:

3> start *drx-onDurationTimer* after *drx-SlotOffset from the beginning of the subframe*.

2> else:

3> start *drx-onDurationTimer*.

1> if the MAC entity is in Active Time:

2> monitor the PDCCH;

2> if the PDCCH indicates a DL transmission or if a DL assignment has been configured:

3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process immediately after the corresponding PUCCH transmission;

3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission or if a UL grant has been configured:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process immediately after the first repetition of the corresponding PUSCH transmission;

3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL or UL):

3> start or restart *drx-InactivityTimer*.

1> else (i.e. not part of the Active Time):

2> not report CQI/PMI/RI on PUCCH.

7.1.1.5.2.3 Test description

7.1.1.5.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.5.2.3.2 Test procedure sequence

For FDD, *NormalSLT*(current SFN,current sub-frame, current slot,y)=y; For TDD, *NormalSLT*(current SFN, current slot,y) counts the minimum number of normal slots needed to cover y number of PDCCH-occasions(slots) until next PDCCH-occasion(slot) available, starting from current slot on current SFN.

Table 7.1.1.5.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits RRCReconfiguration to configure specific DRX parameters. (Note 5) | <-- | - | - | - |
| 2 | The UE transmits RRCReconfigurationComplete. (Note 6) | --> | - | - | - |
| 3 | In a PDCCH occasion which is X PDCCH sub frames before the PDCCH occasion in which the onDurationTimer expires, with X < drx-onDurationTimer, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits an MAC PDU. | <-- | MAC PDU | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | 1 | P |
| 5 | In a PDCCH occasion before the *drx-onDurationTimer* expires, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU with DRX MAC Control element.  UE successfully decodes the MAC PDU and starts the long DRX cycle. | <-- | MAC PDU(DRX MAC Control element) | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 6A | In a PDCCH occasion before the Long DRX cycle ends, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU | <-- | MAC PDU |  |  |
| 6B | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | F |
| 7 | On the next or later DRX cycle than the one used for Step 3 and on a PDCCH occasion which is X PDCCH sub frames before the PDCCH occasion in which the *onDurationTimer* expires, with X < drx-onDurationTimer,the SS indicates the transmission of a DL MAC PDU. The SS transmits an invalid MAC PDU. (Note 1) | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | - | P |
| 8A | In a PDCCH occasion before the *Drx-HARQ-RTT-TimerDL* for the MAC PDU indicated in Step 7 expires, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU with DRX MAC Control element. | <-- | MAC PDU(DRX MAC Control element) | - | - |
| 8B | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2,3 | P |
| 9 | In a PDCCH occasion when the *drx-RetransmissionTimer* for the MAC PDU indicated in Step 7 is still running,, the SS indicates the transmission of a DL MAC PDU. The SS transmits a DL MAC PDU with DRX MAC Control element. | <-- | MAC PDU(DRX MAC Control element) | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2,3 | P |
| 11 | In the last sub frame when the Drx-RetransmissionTimer for the DL MAC PDU indicated on the PDCCH in Step 7 is still running, the SS indicates the transmission of a DL MAC PDU. | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2,3 | P |
| Note 1: Invalid MAC PDU is a MAC PDU that fails the CRC check.  Note 2: All DL MAC PDUs are transmitted with the NDI set on the PDCCH.  Note 3: Timer tolerances for the MAC DRX related timers measured in PDCCH occasions(slots). These timers are: drx-InactivityTimer, drx-RetransmissionTimer, Drx-HARQ-RTT-TimerDL.  Note 5: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 6: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete* | | | | | |

7.1.1.5.2.3.3 Specific message contents

Table 7.1.1.5.2.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.5.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig |  | NR |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| nonCriticalExtension::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.5.2.3.3-2: *CellGroupConfig* (Table 7.1.1.5.2.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer | ms40 |  |  |
| drx-InactivityTimer | ms10 |  |  |
| drx-HARQ-RTT-TimerDL | 56 | Number of slots=4 due to number of symbol per slot=14 | =0,1,2,3,4 ( 2 with normal CP) |
|  | 48 | Number of slots=4 due to number of symbol per slot=12 | = 2 with external CP |
| drx-HARQ-RTT-TimerUL | 56 | Number of slots=4 due to number of symbol per slot=14 | =0,1,2,3,4 ( 2 with normal CP) |
|  | 48 | Number of slots=4 due to number of symbol per slot=12 | = 2 with external CP |
| drx-RetransmissionTimerDL | sl80 |  |  |
| drx-RetransmissionTimerUL | sl80 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms640 | 7 |  |  |
| } |  |  |  |
| shortDRX | Not present |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.5.3 DRX operation / Short cycle configured / Parameters configured by RRC

7.1.1.5.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Short DRX cycle and *drx-SlotOffset* is configured and [(SFN \* 10) + subframe number] modulo *drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*) }

**then** { UE starts the OnDurationTimer after *drx-SlotOffset* and monitors the PDCCH for OnDurationTimer PDCCH-subframes }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { drxShortCycleTimer is expired and [(SFN \* 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*: }

**then** { UE starts the OnDurationTimer after *drx-SlotOffset* and monitors the PDCCH for OnDurationTimer PDCCH-subframes }

}

7.1.1.5.3.2 Conformance requirements

Editor’s Note: The conformance requirements are based on running RAN2 CR

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clause 5.7. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.7]

The MAC entity may be configured by RRC with a DRX functionality that controls the UE’s PDCCH monitoring activity for the MAC entity's C-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, and TPC-SRS-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other subclauses of this specification.When in RRC\_CONNECTED, if DRX is configured, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this subclause; otherwise the MAC entity shall monitor the PDCCH continuously.

RRC controls DRX operation by configuring the following parameters:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity.

When a DRX cycle is configured, the Active Time includes the time while:

- drx-onDurationTimer or drx-InactivityTimer or drx-RetransmissionTimerDL or drx-RetransmissionTimerUL or ra-ContentionResolutionTimer (as described in subclause 5.1.5) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in subclause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in subclause 5.1.4).

…

1> if *drx-InactivityTimer* expires or a DRX Command MAC CE is received:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer* in the first symbol after the expiry of *drx-InactivityTimer* or in the first symbol after the end of DRX Command MAC CE reception;

3> use the Short DRX Cycle.

2> else:

3> use the Long DRX cycle.

1> if *drx-ShortCycleTimer* expires:

2> use the Long DRX cycle.

1> if a Long DRX Command MAC CE is received:

2> stop *drx-ShortCycleTimer*;

2> use the Long DRX cycle.

1> if the Short DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*); or

1> if the Long DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

7.1.1.5.3.3 Test description

7.1.1.5.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.5.3.3.2 Test procedure sequence

For FDD, *NormalSLT* (current SFN, current sub-frame, current slot, y) = y; For TDD, *NormalSLT* (current SFN, current slot, y) counts the minimum number of normal slots needed to cover y number of PDCCH-occasions(slots) until next PDCCH-occasion(slot) available, starting from current slot on current Subframe.

Table 7.1.1.5.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U – S | Message |  |  |
| 1 | SS transmits NR *RRCReconfiguration* message to configure specific DRX parameters for SpCell (Note1) | <-- | - | - | - |
| 2 | The UE transmitNR *RRCReconfigurationComplete* messages (Note 2) | --> | - | - | - |
| 3 | In the first PDCCH occasion, after the *drx-SlotOffset* when the *drx-onDurationTimer* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. (Note 3)(Note 4)(Note 5) | <-- | MAC PDU | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | - | - |
| 5 | At least *drx-InactivityTimer* after the transmission of the MAC PDU in Step 3 has been indicated (This means the next DRX cycle or later after Step 1) in the last PDCCH occasion while the *drx-onDurationTimer* is still running according to [(SFN \* 10) + subframe number] modulo *drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*)), the SS indicates the transmission a DL MAC PDU on the PDDCH. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 5? | --> | HARQ ACK | 1 | P |
| 7 | SS waits for *drx-ShortCycleTimer* to expire. | - | - | - | - |
| 8 | In the first PDCCH occasion after the *drx-SlotOffset* when the *drx-onDurationTimer* of *drx-LongCycle* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 9 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 8? | --> | HARQ ACK | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The drx-InactivityTimer is started in the first symbol after the end of the PDCCH reception where DL new transmission is indicated.  Note 4: When the *drx-InactivityTimer* expires, UE starts *drx-ShortCycleTimer* in the first symbol after the expiry of *drx-InactivityTimer*.  Note 5: The SS assumes that the UE starts in long DRX after configuration. | | | | | |

7.1.1.5.3.3.3 Specific message contents

Table 7.1.1.5.3.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.5.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig |  | NR |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| nonCriticalExtension::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.5.3.3.3-2: *CellGroupConfig* (Table 7.1.1.5.3.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer | ms20 |  |  |
| drx-InactivityTimer | Ms10 |  |  |
| drx-HARQ-RTT-TimerDL | 56 |  |  |
| drx-HARQ-RTT-TimerUL | 56 |  |  |
| drx-RetransmissionTimerDL | sl80 |  |  |
| drx-RetransmissionTimerUL | sl80 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms640 | 7 |  |  |
| } |  |  |  |
| shortDRX SEQUENCE { |  |  |  |
| drx-ShortCycle | Ms80 |  |  |
| drx-ShortCycleTimer | 7 |  |  |
| } |  |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.5.4 DRX operation / Short cycle configured / DRX command MAC control element reception

7.1.1.5.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Short DRX cycle is configured and a DRX Command MAC control element is received }

**then** { UE successfully decodes the MAC control PDU }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Short DRX cycle is configured and the HARQ RTT Timer is running and a DRX Command MAC control element is received }

**then** { UE continues running the HARQ RTT timer }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Short DRX cycle is configured and the drx-RetransmissionTimer-DL is running and a DRX Command MAC control element is received }

**then** { UE continues running the drx-RetransmissionTimer-DL and monitors the PDCCH }

}

7.1.1.5.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.7. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.7]

The MAC entity may be configured by RRC with a DRX functionality that controls the UE's PDCCH monitoring activity for the MAC entity's C-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, and TPC-SRS-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other subclauses of this specification. When in RRC\_CONNECTED, if DRX is configured, for all the activated Serving Cells, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this subclause; otherwise the MAC entity shall monitor the PDCCH continuously.

RRC controls DRX operation by configuring the following parameters:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process except for the broadcast process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process except for the broadcast process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity.

When a DRX cycle is configured, the Active Time includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* or *drx-RetransmissionTimerDL* or *drx-RetransmissionTimerUL* or *ra-ContentionResolutionTimer* (as described in subclause 5.1.5) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in subclause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in subclause 5.1.4).

When DRX is configured, the MAC entity shall:

1> if a MAC PDU is received in a configured downlink assignment:

2> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

2> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if a MAC PDU is transmitted in a configured uplink grant:

2> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a *drx-HARQ-RTT-TimerDL* expires:

2> if the data of the corresponding HARQ process was not successfully decoded:

3> start the *drx-RetransmissionTimerDL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerDL*.

1> if a *drx-HARQ-RTT-TimerUL* expires:

2> start the *drx-RetransmissionTimerUL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerUL*.

1> if a DRX Command MAC CE or a Long DRX Command MAC CE is received:

2> stop *drx-onDurationTimer*;

2> stop *drx-InactivityTimer*.

1> if *drx-InactivityTimer* expires or a DRX Command MAC CE is received:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer* in the first symbol after the expiry of *drx-InactivityTimer* or in the first symbol after the end of DRX Command MAC CE reception;

3> use the Short DRX Cycle.

2> else:

3> use the Long DRX cycle.

1> if *drx-ShortCycleTimer* expires:

2> use the Long DRX cycle.

1> if a Long DRX Command MAC CE is received:

2> stop *drx-ShortCycleTimer*;

2> use the Long DRX cycle.

1> if the Short DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*); or

1> if the Long DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

1> if the MAC entity is in Active Time:

2> monitor the PDCCH;

2> if the PDCCH indicates a DL transmission:

3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL or UL):

3> start or restart *drx-InactivityTimer* in the first symbol after the end of the PDCCH reception.

1> in current symbol n, if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this subclause:

2> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7].

1> if CSI masking (*csi-Mask*) is setup by upper layers:

2> in current symbol n, if *onDurationTimer* would not be running considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this subclause:

3> not report CSI on PUCCH.

1> else:

2> in current symbol n, if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this subclause:

3> not report CSI on PUCCH and semi-persistent CSI on PUSCH.

Regardless of whether the MAC entity is monitoring PDCCH or not, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] when such is expected.

The MAC entity needs not to monitor the PDCCH if it is not a complete PDCCH occasion (e.g. the Active Time starts or ends in the middle of a PDCCH occasion).

7.1.1.5.4.3 Test description

7.1.1.5.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.5.4.3.2 Test procedure sequence

For FDD, *NormalSLT*(current SFN, current subframe, current slot, y)=y; For TDD, *NormalSLT*(current SFN, current subframe, current slot, y) counts the minimum number of normal slots needed to cover y number of PDCCH-occasions (slots) until next PDCCH-occasion (slot) available, starting from current slot on current SFN.

Table 7.1.1.5.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR RRCReconfigurationmessage to configure specific DRX parameters for NR Cell. (Note 1) | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | The UE transmits NR RRCReconfigurationComplete message. (Note 2) | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | In a PDCCH occasion which is X subframes before the PDCCH occasion in which the *drx-onDurationTimer* expires, with X < *drx-onDurationTimer*-1, the SS indicates the transmission of a DL MAC PDU on the PDCCH. (Note 7) | <-- | MAC PDU | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | 1 | P |
| 5 | In a PDCCH occasion before the *drx-onDurationTimer* expires, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU with DRX MAC Control element. UE successfully decodes the MAC PDU. | <-- | MAC PDU (DRX MAC Control element) | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 5? | --> | HARQ ACK | 1 | P |
| 6A | In a PDCCH occasion before the short DRX cycle ends, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU | <-- | MAC PDU |  |  |
| 6B | Check: Does the UE transmit a HARQ ACK in step 6B? | --> | HARQ ACK | 1 | F |
| 7 | On the next or later DRX cycle than the one used for Step 3 and on a PDCCH occasion which is X PDCCH sub frames before the PDCCH occasion in which the *onDurationTimer* expires, with X < drx-onDurationTimer, the SS indicates the transmission of a DL MAC PDU. The SS transmits an invalid MAC PDU. (Note 3) | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ NACK for the DL MAC PDU in Step 7? | --> | HARQ NACK | 2,3 | P |
| 8A | In a PDCCH occasion before the *Drx-HARQ-RTT-TimerDL* for the MAC PDU indicated in Step 7 expires, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU with DRX MAC Control element. | <-- | MAC PDU(DRX MAC Control element) |  |  |
| 8B | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2,3 | P |
| 9 | In a PDCCH occasion which is Z slots before the slot in which the *drx-RetransmissionTimerDL* for the DL MAC PDU in Step 7 expires, with 1 <Z< *drx-RetransmissionTimerDL*, the SS indicates the transmission of a DL MAC PDU. The SS transmits a DL MAC PDU with DRX MAC Control element. | <-- | MAC PDU(DRX MAC Control element) | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 9? | --> | HARQ ACK | 2,3,1 | P |
| 11 | In the last PDCCH occasion when the *drx-RetransmissionTimerDL* for the DL MAC PDU indicated on the PDCCH in Step 7 is still running, the SS indicates the transmission of a DL MAC PDU. | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 11? | --> | HARQ ACK | 2,3 | P |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 3: Invalid MAC PDU is a MAC PDU that fails the CRC check.  Note 4: All DL MAC PDUs are transmitted with the NDI set on the PDCCH.  Note 5: Timer tolerances for the MAC DRX related timers measured in PDCCH occasions (slots). These timers are: *drx-InactivityTimer, drx-RetransmissionTimer, Drx-HARQ-RTT-TimerDL*.  Note 6: K is the time for given PDSCH to HARQ feedback of PUCCH and shall be shorter than drx-InactivityTimer. In this TC, the DCI format should be configured to not include the PDSCH-to-HARQ-timing-indicator field. When the UE schedules a PDSCH reception over a number of symbols where the last symbol is within slot n-k, the UE shall provide corresponding HARQ-ACK information in a PUCCH transmission within slot n-k+4 according to TS 38.321 clause 9.2.3. Thus, the maximum value of K is 4 slots in this test case.  Note 7: The SS assumes that the UE starts in long DRX after configuration. | | | | | |

7.1.1.5.4.3.3 Specific message contents

Table 7.1.1.5.4.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.5.4.3.2-1)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | | | | | |
| Information Element | | Value/remark | | Comment | | Condition | |
| RRCReconfiguration ::= SEQUENCE { | |  | |  | |  | |
| criticalExtensions CHOICE { | |  | |  | |  | |
| rrcReconfiguration SEQUENCE { | |  | |  | |  | |
| radioBearerConfig | | Not present | |  | |  | |
| secondaryCellGroup | | CellGroupConfig | | OCTET STRING (CONTAINING CellGroupConfig) | | EN-DC | |
| nonCriticalExtension := SEQUENCE {} | | Not present | |  | | EN-DC | |
| nonCriticalExtension := SEQUENCE{ | |  | |  | | NR | |
| masterCellGroup | | CellGroupConfig | | OCTET STRING (CONTAINING CellGroupConfig) | |  | |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | | Not present | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |

Table 7.1.1.5.4.3.3-2: *CellGroupConfig* (Table 7.1.1.5.4.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-n | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer | ms40 |  |  |
| drx-InactivityTimer | Ms10 |  |  |
| drx-HARQ-RTT-TimerDL | 56 |  |  |
| drx-HARQ-RTT-TimerUL | 56 |  |  |
| drx-RetransmissionTimerDL | Sl80 |  |  |
| drx-RetransmissionTimerUL | Sl80 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms640 | 7 |  |  |
| } |  |  |  |
| shortDRX SEQUENCE { |  |  |  |
| drx-ShortCycle | ms80 |  |  |
| drx-ShortCycleTimer | 7 |  |  |
| } |  |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.5.5 DRX operation / Short cycle configured / Long DRX command MAC control element reception

7.1.1.5.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { short DRX cycle is configured and a long DRX Command MAC control element is received }

**then** { UE successfully decodes the MAC control PDU }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Long DRX cycle and *drx-SlotOffset* is configured and [(SFN \* 10) + subframe number] modulo *drx-LongCycle*} = *drxStartOffset* }

**then** { UE starts the OnDurationTimer after *drx-SlotOffset* and monitors PDCCH for OnDurationTimer PDCCH-subframes }

}

7.1.1.5.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.7. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.7]

The MAC entity may be configured by RRC with a DRX functionality that controls the UE's PDCCH monitoring activity for the MAC entity's C-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, and TPC-SRS-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other clauses of this specification. When in RRC\_CONNECTED, if DRX is configured, for all the activated Serving Cells, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this clause; otherwise the MAC entity shall monitor the PDCCH as specified in TS 38.213 [6].

RRC controls DRX operation by configuring the following parameters:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process except for the broadcast process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process except for the broadcast process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity.

When a DRX cycle is configured, the Active Time includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* or *drx-RetransmissionTimerDL* or *drx-RetransmissionTimerUL* or *ra-ContentionResolutionTimer* (as described in clause 5.1.5) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clause 5.1.4).

When DRX is configured, the MAC entity shall:

1> if a MAC PDU is received in a configured downlink assignment:

2> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

2> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

1> if a MAC PDU is transmitted in a configured uplink grant:

2> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

1> if a *drx-HARQ-RTT-TimerDL* expires:

2> if the data of the corresponding HARQ process was not successfully decoded:

3> start the *drx-RetransmissionTimerDL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerDL*.

1> if a *drx-HARQ-RTT-TimerUL* expires:

2> start the *drx-RetransmissionTimerUL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerUL*.

1> if a DRX Command MAC CE or a Long DRX Command MAC CE is received:

2> stop *drx-onDurationTimer*;

2> stop *drx-InactivityTimer*.

1> if *drx-InactivityTimer* expires or a DRX Command MAC CE is received:

2> if the Short DRX cycle is configured:

3> start or restart *drx-ShortCycleTimer* in the first symbol after the expiry of *drx-InactivityTimer* or in the first symbol after the end of DRX Command MAC CE reception;

3> use the Short DRX Cycle.

2> else:

3> use the Long DRX cycle.

1> if *drx-ShortCycleTimer* expires:

2> use the Long DRX cycle.

1> if a Long DRX Command MAC CE is received:

2> stop *drx-ShortCycleTimer*;

2> use the Long DRX cycle.

1> if the Short DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*); or

1> if the Long DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

1> if the MAC entity is in Active Time:

2> monitor the PDCCH as specified in TS 38.213 [6];

2> if the PDCCH indicates a DL transmission:

3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL or UL):

3> start or restart *drx-InactivityTimer* in the first symbol after the end of the PDCCH reception.

1> in current symbol n, if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

2> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7];

2> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH.

1> if CSI masking (*csi-Mask*) is setup by upper layers:

2> in current symbol n, if *drx-onDurationTimer* would not be running considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

3> not report CSI on PUCCH.

NOTE: If a UE multiplexes a CSI configured on PUCCH with other overlapping UCI(s) according to the procedure specified in TS 38.213 [6] subclause 9.2.5 and this CSI multiplexed with other UCI(s) would be reported on a PUCCH resource outside DRX Active Time, it is up to UE implementation whether to report this CSI multiplexed with other UCI(s).

Regardless of whether the MAC entity is monitoring PDCCH or not, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] when such is expected.

The MAC entity needs not to monitor the PDCCH if it is not a complete PDCCH occasion (e.g. the Active Time starts or ends in the middle of a PDCCH occasion).

7.1.1.5.5.3 Test Description

7.1.1.5.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.5.5.3.2 Test procedure sequence

For FDD, *NormalSLT*=(current SFN, current sub-frame, current slot, y)=y; For TDD, *NormalSLT*(current SFN, current slot, y) counts the minimum number of normal slots needed to cover y number of PDCCH-occasions (slots) until next PDCCH-occasion(slot) available, starting from current slot on current SFN.

Table 7.1.1.5.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR RRCReconfiguration message to configure specific DRX parameters for NR Cell. (Note 1) | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 2 | The UE transmits NR RRCReconfigurationComplete message. (Note 2) | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | In a PDCCH occasion when the *drx-onDurationTimer* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits an valid MAC PDU. (Note 3) | <-- | MAC PDU | - | - |
| 4 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 3? | --> | HARQ ACK | 1 | P |
| 4A | Wait for the expiry of drx-InactivityTimer to ensure that UE starts the Short DRX Cycle. | - | - | - | - |
| 5 | In a PDCCH occasion before the *drx-onDurationTimer* expires, the SS indicates the transmission of a DL MAC PDU on the PDCCH. The SS transmits a DL MAC PDU with Long DRX MAC Control element. UE successfully decodes the MAC PDU. | <-- | MAC PDU (Long DRX MAC Control element) | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 5? | --> | HARQ ACK | 1 | P |
| 7 | In the first PDCCH occasion, after the drx-SlotOffset when the drx-onDurationTimer is running according to [(SFN \* 10) + subframe number] modulo *drx-LongCycle*) = (*drx-StartOffset*) modulo (*drx-LongCycle*)), the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 7? | --> | HARQ ACK | 2 | P |
| 9 | At least drx-InactivityTimer PDCCH occasions after the transmission of the MAC PDU in Step 7 has been indicated (This means the next DRX cycle or later after Step 7) in the last PDCCH occasion while the drx-onDurationTimer is still running, the SS indicates the transmission a DL MAC PDU on the PDDCH. (Note 7) | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 9? | --> | HARQ ACK | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The SS assumes that the UE starts in long DRX after configuration.  Note 4: All DL MAC PDUs are transmitted with the NDI set on the PDCCH.  Note 5: Timer tolerances for the MAC DRX related timers measured in PDCCH occasions (slots). These timers are: *drx-InactivityTimer, drx-RetransmissionTimer, Drx-HARQ-RTT-TimerDL*.  Note 6: Void  Note 7: The drx-InactivityTimer is started in the next PDCCH occasion of the PDCCH occasion where DL new transmission is indicated. | | | | | |

7.1.1.5.5.3.3 Specific message contents

Table 7.1.1.5.5.3.3-1: *RRCReconfiguration* (Step 1, Table 7.1.1.5.5.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig with conditions SRB2 and DRB1 |  | NR |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| nonCriticalExtension::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig with condition SRB2\_DRB1 |  | NR |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.5.5.3.3-2: *CellGroupConfig* (Table 7.1.1.5.5.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer | ms40 |  |  |
| drx-InactivityTimer | ms10 |  |  |
| drx-HARQ-RTT-TimerDL | 56 |  |  |
| drx-HARQ-RTT-TimerUL | 56 |  |  |
| drx-RetransmissionTimerDL | sl80 |  |  |
| drx-RetransmissionTimerUL | sl80 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms640 | 7 |  |  |
| } |  |  |  |
| shortDRX SEQUENCE { |  |  |  |
| drx-ShortCycle | ms80 |  |  |
| drx-ShortCycleTimer | 7 |  |  |
| } |  |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

#### 7.1.1.6 Semi-Persistent Scheduling

##### 7.1.1.6.1 Correct handling of DL assignment / Semi-persistent case

7.1.1.6.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in DL is enabled }

**ensure that** {

**when** { UE receives a DL assignment addressed to its stored CS-RNTI in slot y and with NDI set as 0 and PDCCH content indicates activation }

**then** {UE starts receiving DL MAC PDU in slots y+n\*[semiPersistSchedIntervalDL] where ‘n’ is positive integer starting at zero }

}

(2)

**with** { UE in RRC\_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU in slot y+n\*[semiPersistSchedIntervalDL] }

**ensure that** {

**when** { UE receives a DL assignment addressed to its CS-RNTI in slot p and with NDI set as 0, where p!= y+n\*[semiPersistSchedIntervalDL] }

**then** { UE starts receiving DL MAC PDU in slots p+n\*[semiPersistSchedIntervalDL] and stops receiving DL MAC PDU at slots y+n\*[semiPersistSchedIntervalDL]where ‘n’ is positive integer starting at zero }

}

(3)

**with** { UE in RRC\_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at slot p+n\*[semiPersistSchedIntervalDL] }

**ensure that** {

**when** { UE receives a DL assignment [for retransmission] addressed to its CS-RNTI in Slot z and with NDI set as 1, where z!= p+n\*[semiPersistSchedIntervalDL] }

**then** { UE receives MAC PDU as per the retransmission grant for CS-RNTI }

}

(4)

**with** { UE in RRC\_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU at slot y+n\*[semiPersistSchedIntervalDL] }

**ensure that** {

**when** { UE receives a DL assignment addressed to its C-RNTI in Slot p, such that p= y+n\*[semiPersistSchedIntervalDL] }

**then** { UE receives MAC PDU as per assignment addressed to its C-RNTI }

}

(5)

**with** { UE in RRC\_Connected state with DRB established and stored DL SPS grant to receive MAC PDU at slot z+n\*[semiPersistSchedIntervalDL] }

**ensure that** {

**when** { UE receives a RRC Message including sps-Configuration with sps-ConfigurationDL set as ‘disable’ and hence resulting in DL SPS grant deactivation }

**then** { UE deletes the stored sps-Configuration DL parameters and stops receiving DL MAC PDU’s as per stored SPS assignment in slot z+n\*[semiPersistSchedIntervalDL] }

}

(6)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in DL is enabled }

**ensure that** {

**when** { UE receives a DL assignment addressed to its stored CS-RNTI in slot p and with NDI set as 0 and PDCCH content indicates deactivation }

**then** {UE stops receiving DL MAC PDU’s as per stored SPS assignment }

}

7.1.1.6.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in TS 38.321, clause 5.3.1, 5.8.1 TS 38.300, clause 10.2 and TS 38.213 clause 102. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, or Temporary C‑RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity's C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's CS-RNTI or a configured downlink assignment:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the timeAlignmentTimer, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted,is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in subclause 5.8.1;

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit for the corresponding HARQ process to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (numberOfSlotsPerFrame ×*periodicity* ))] modulo nrofHARQ-Processes

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

[TS 38.321, clause 5.8.1]

Semi-Persistent Scheduling (SPS) is configured by RRC per Serving Cell and per BWP. Activation and deactivation of the DL SPS are independent among the Serving Cells.

For the DL SPS, a DL assignment is provided by PDCCH, and stored or cleared based on L1 signalling indicating SPS activation or deactivation.

RRC configures the following parameters when SPS is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *nrofHARQ-Processes*: the number of configured HARQ processes for SPS;

- *periodicity*: periodicity of configured downlink assignment for SPS.

When SPS is released by upper layers, all the corresponding configurations shall be released.

After a downlink assignment is configured for SPS, the MAC entity shall consider sequentially that the Nth downlink assignment occurs in the slot for which:

(*numberOfSlotsPerFrame* × SFN + slot number in the frame) =  
[(*numberOfSlotsPerFrame* × SFNstart time + slotstart time) + N × *periodicity* × *numberOfSlotsPerFrame* / 10] modulo (1024 × *numberOfSlotsPerFrame*)

where SFNstart time and slotstart time are the SFN and slot, respectively, of the first transmission of PDSCH where the configured downlink assignment was (re-)initialised.

[TS 38.300, clause 10.2]

In the downlink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible assignments when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

The gNB may pre-empt an ongoing PDSCH transmission to one UE with a latency-critical transmission to another UE. The gNB can configure UEs to monitor interrupted transmission indications using INT-RNTI on a PDCCH. If a UE receives the interrupted transmission indication, the UE may assume that no useful information to that UE was carried by the resource elements included in the indication, even if some of those resource elements were already scheduled to this UE.

In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated.

NOTE: when required, retransmissions are explicitly scheduled on PDCCH(s).

The dynamically allocated downlink reception overrides the configured downlink assignment in the same serving cell, if they overlap in time. Otherwise a downlink reception according to the configured downlink assignment is assumed, if activated.

When CA is configured, at most one configured downlink assignment can be signalled per serving cell. When BA is configured, at most one configured downlink assignment can be signalled per BWP. On each serving cell, there can be only one configured downlink assignment active at a time, and multiple configured downlink assignment can be simultaneously active on different serving cells only. Activation and deactivation of configured downlink assignments are independent among the serving cells.

[TS 38.213, clause 10.2]

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or configured UL grant Type 2 PDCCH if

- the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, and

- the new data indicator field for the enabled transport block is set to '0'.

Validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of DL SPS or configured UL grant Type 2. If validation is not achieved, the UE discards all the information in the DCI format.

Table 10.2-1: Special fields for DL SPS and UL grant Type 2 scheduling activation PDCCH validation

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1 | DCI format 1\_0 | DCI format 1\_1 |
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to '00' | set to '00' | For the enabled transport block: set to '00' |

Table 10.2-2: Special fields for DL SPS and UL grant Type 2 scheduling release PDCCH validation

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0 | DCI format 1\_0 |
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to '00' | set to '00' |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '1's | set to all '1's |

A UE is expected to provide HARQ-ACK information in response to a SPS PDSCH release after {} symbols from the last symbol of a PDCCH providing the SPS PDSCH release. If *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell with the PDCCH providing the SPS PDSCH release,  for ,  for , and  for , otherwise,  for ,  for ,  for , and  for , wherein  corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH providing the SPS PDSCH release and the SCS configuration of a PUCCH carrying the HARQ-ACK information in response to a SPS PDSCH release.

7.1.1.6.1.3 Test description

7.1.1.6.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.6.1.3.2 Test procedure sequence

Table 7.1.1.6.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits a DL assignment using UE’s CS-RNTI in Slot ‘Y’, NDI=0. | <-- | (DL SPS Grant) | - | - |
| 2 | The SS transmits in Slot ‘Y’, a DL MAC PDU containing a RLC PDU (DL-SQN=0) on UM DRB. | <-- | MAC PDU | - | - |
| 3 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 4 | The SS transmits in Slot ‘Y+X’, a DL MAC PDU containing a RLC PDU (DL-SQN=1) on DRB. (Note 1) | <-- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 6 | The SS transmits a DL assignment using UE’s CS-RNTI in Slot ‘P’, NDI=0;  (Where Y+X<P<Y+2X) | <-- | (DL SPS Grant) | - | - |
| 7 | The SS transmits in Slot ‘P’, a DL MAC PDU containing a RLC PDU (DL-SQN=2) on UM DRB. | <-- | MAC PDU | - | - |
| 8 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 9 | The SS transmits in Slot ‘Y+2X’, a DL MAC PDU containing a RLC PDU (DL-SQN=3) on UM DRB. | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 2 | F |
| 11 | The SS transmits a DL assignment using UE’s C-RNTI in Slot ‘P+X’, NDI=0. | <-- | (DL Grant) | - | - |
| 12 | The SS transmits in Slot ‘P+X’, a DL MAC PDU containing a RLC PDU (DL-SQN=3)on UM DRB.(Note2) | <-- | MAC PDU | - | - |
| 13 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 4 | P |
| 14 | The SS transmits in Slot ‘P+2X’, a DL MAC PDU containing a RLC PDU (DL-SQN=4) on UM DRB. | <-- | MAC PDU | - | - |
| 15 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 16 | The SS transmits a DL assignment using UE’s CS-RNTI in Slot ‘P+3X’, NDI=0. | <-- | (DL SPS Grant) | - | - |
| 17 | The SS transmits in Slot ‘P+3X’, a DL MAC PDU containing 1 RLC PDU’s (DL-SQN=5) on UM DRB; CRC is calculated in such a way will result in CRC error in UE. | <-- | MAC PDU | - | - |
| 18 | Check: Does the UE transmit a HARQ NACK? | --> | HARQ NACK | - | - |
| - | EXCEPTION: Step 19 and 20 shall be repeated until HARQ retransmission count = 3 is reached for MAC PDU at step 17.(Note 3) | - | - | - | - |
| 19 | The SS transmits a DL assignment using UE’s CS-RNTI in Slot ‘Z’, NDI=1;  Where (P+3X < Z <P+4X); The DL HARQ process is same as in step 18. | <-- | (DL SPS Grant) | - | - |
| 20 | The SS re-transmits in Slot ‘Z’, a DL MAC PDU containing a RLC PDU (DL-SQN=5) on UM DRB. | <-- | MAC PDU | - | - |
| - | EXCEPTION: Up to 3 HARQ NACK from the UE should be allowed at step 21(Note 3). | - | - | - | - |
| 21 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 3 | P |
| 22 | The SS Transmits a PDCCH [for DL SPS deactivation] using UE’s CS-RNTI in slot ‘Q’, NDI=0; Where (P+3X< Q <P+4X). | <-- | PDCCH [for DL SPS explicit release] | - | - |
| 23 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 6 | P |
| 24 | The SS transmits in Slot ‘P+5X’, a DL MAC PDU containing 1 RLC PDU’s (DL-SQN=6)on UM DRB; | <-- | MAC PDU | - | - |
| 25 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 6 | F |
| 26 | The SS Transmits a DL assignment using UE’s CS-RNTI in SF-Num ‘P+6X’, NDI=0 | <-- | (DL SPS Grant) | - | - |
| 27 | The SS transmits in SF-Num ‘P+6X’, a DL MAC PDU containing a RLC PDU (DL-SQN=6)on UM DRB | <-- | MAC PDU | - | - |
| 28 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 29 | SS transmits *NR* RRCReconfiguration to disable SPS-ConfigurationDL.(Note 4) | <-- | RRCReconfiguration | - | - |
| 30 | The UE transmits NR RRCReconfigurationComplete.(Note5) | --> | RRCReconfigurationComplete | - | - |
| 31 | The SS transmits in Slot ‘P+5X’, a DL MAC PDU containing 1 RLC PDU’s (DL-SQN=7) on UM DRB; | <-- | MAC PDU | - | - |
| 32 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK/NACK | 5 | F |
| Note 1: X is equal to semiPersistSchedIntervalDL in this document.  Note 2: The DL assignment for C-RNTI and hence the size of MAC PDU is different in size than stored CS-RNTI DL assignment in step 6. This assures UE is receiving DSCH data as per DL assignment for C-RNTI and not as per stored grant for CS-RNTI.  Note 3: The value 4 for the maximum number of HARQ retransmissions has been chosen based on an assumption that, given the radio conditions used in this test case, a UE soft combiner implementation should have sufficient retransmissions to be able to successfully decode the data in its soft buffer.  Note 4: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 5: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 6: As per TS 38.508-1[4], the default value for PDSCH slot offset (K0) is 0, hence the DL MAC PDU’s associated with DL SPS grant in Slot X are sent in same slot X. | | | | | |

7.1.1.6.1.3.3 Specific message contents

Table 7.1.1.6.1.3.3-1: *RRCReconfiguration* (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension := SEQUENCE{} | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.1.3.3-2: *CellGroupConfig* (Table 7.1.1.6.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { | |  |  |  |
| spCellConfig SEQUENCE { | |  |  |  |
| servCellIndex | | 1 |  |  |
|  | | Not present |  | NR |
| spCellConfigDedicated SEQUENCE { | |  |  |  |
| initialDownlinkBWP SEQUENCE { | |  |  |  |
| sps-Config CHOICE { | |  |  |  |
| setup SEQUENCE { | |  |  |  |
| periodicity | | ms40 |  |  |
| nrofHARQ-Processes | | 8 |  |  |
| n1PUCCH-AN SEQUENCE{ | |  |  |  |
| pucch-ResourceId | | 0 |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| physicalCellGroupConfig SEQUENCE { | |  |  |  |
| cs-RNTI CHOICE { | |  |  |  |
| setup SEQUENCE{ | |  |  |  |
| RNTI-Value | | ‘FFE0’H |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.6.1.3.3-3: *RRCReconfiguration* (step 29 of Table 7.1.1.6.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension := SEQUENCE{} | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.1.3.3-4: *CellGroupConfig* (Table 7.1.1.6.1.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { | |  |  |  |
| spCellConfig SEQUENCE { | |  |  |  |
| servCellIndex | | 1 |  |  |
|  | | Not present |  | NR |
| spCellConfigDedicated SEQUENCE { | |  |  |  |
| initialDownlinkBWP SEQUENCE { | |  |  |  |
| sps-Config CHOICE { | |  |  |  |
| release | | Null |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

##### 7.1.1.6.2 Correct handling of UL grant / configured grant Type 1

7.1.1.6.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in UL is enabled with Configured grant type 1 }

**ensure that** {

**when** { The symbol in which equation [(SFN × numberOfSlotsPerFrame × numberOfSymbolsPerSlot) + (slot number in the frame × numberOfSymbolsPerSlot) + symbol number in the slot] =

(timeDomainOffset × numberOfSymbolsPerSlot + S + N × periodicity) modulo (1024 × numberOfSlotsPerFrame × numberOfSymbolsPerSlot)is satisfied }

**then** { UE starts transmitting UL MAC PDU periodically in the symbol associated with the new re-configured grant }

}

(2)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 1 }

**ensure that** {

**when** { UE receives a new UL grant type 1 in an RRC message }

**then** { UE starts transmitting UL MAC PDU periodically in the symbol associated with the new re-configured grant }

}

(3)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 1 }

**ensure that** {

**when** { UE receives a RRC message including sps-Configuration with rrcConfiguredUplinkGrant set as ‘release’ }

**then** { UE deletes the stored configured UL Grant type 1 parameters and stops transmitting UL MAC PDU’s as per configured UL grant type 1 }

}

(4)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 1 }

**ensure that** {

**when** { UE receives a UL grant addressed to its CS-RNTI with NDI set as 1 for retransmission }

**then** { UE re-transmits MAC PDU as per the new grant }

}

(5)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 1 }

**ensure that** {

**when** { UE receives a UL grant addressed to its C-RNTI resulting in UL transmission overlap in time domain as configured grante type 1 }

**then** { UE transmits MAC PDU as per grant addressed to its C-RNTI }

}7.1.1.6.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321 clauses 5.4.1 and 5.8.2, 3GPP TS 38.300 clause 10.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in subclause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if the *configuredGrantTimer* for the corresponding HARQ process is not running:

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

where CURRENT\_symbol=(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a repetition bundle that takes place.

NOTE 2: A HARQ process is configured for a configured uplink grant if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*.

NOTE 3: If the MAC entity receives both a grant in a Random Access Response and an overlapping grant for its C-RNTI or CS-RNTI, requiring concurrent transmissions on the SpCell, the MAC entity may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or CS-RNTI.

[TS 38.321, clause 5.8.2]

There are two types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;

- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation.

Type 1 and Type 2 are configured by RRC per Serving Cell and per BWP. Multiple configurations can be active simultaneously only on different Serving Cells. For Type 2, activation and deactivation are independent among the Serving Cells. For the same Serving Cell, the MAC entity is configured with either Type 1 or Type 2.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *periodicity*: periodicity of the configured grant Type 1;

- *timeDomainOffset*: Offset of a resource with respect to SFN=0 in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]);

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

RRC configures the following parameters when the configured grant Type 2 is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *periodicity*: periodicity of the configured grant Type 2;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

Upon configuration of a configured grant Type 1 for a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset* and *S* (derived from *SLIV* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
 (*timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
[(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

When a configured uplink grant is released by upper layers, all the corresponding configurations shall be released and all corresponding uplink grants shall be cleared.

The MAC entity shall:

1> if the configured uplink grant confirmation has been triggered and not cancelled; and

1> if the MAC entity has UL resources allocated for new transmission:

2> instruct the Multiplexing and Assembly procedure to generate an Configured Grant Confirmation MAC CE as defined in subclause 6.1.3.7;

2> cancel the triggered configured uplink grant confirmation.

For a configured grant Type 2, the MAC entity shall clear the configured uplink grant immediately after first transmission of Configured Grant Confirmation MAC CE triggered by the configured uplink grant deactivation.

Retransmissions except for repetition of configured uplink grants use uplink grants addressed to CS-RNTI.

[TS 38.300, clause 10.3]

In the uplink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible grants for uplink transmission when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

In addition, with Configured Grants, the gNB can allocate uplink resources for the initial HARQ transmissions to UEs. Two types of configured uplink grants are defined:

- With Type 1, RRC directly provides the configured uplink grant (including the periodicity).

- With Type 2, RRC defines the periodicity of the configured uplink grant while PDCCH addressed to CS-RNTI can either signal and activate the configured uplink grant, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the uplink grant can be implicitly reused according to the periodicity defined by RRC, until deactivated.

The dynamically allocated uplink transmission overrides the configured uplink grant in the same serving cell, if they overlap in time. Otherwise an uplink transmission according to the configured uplink grant is assumed, if activated.

Retransmissions other than repetitions are explicitly allocated via PDCCH(s).

When CA is configured, at most one configured uplink grant can be signalled per serving cell. When BA is configured, at most one configured uplink grant can be signalled per BWP. On each serving cell, there can be only one configured uplink grant active at a time. A configured uplink grant for one serving cell can either be of Type 1 or Type 2. For Type 2, activation and deactivation of configured uplink grants are independent among the serving cells. When SUL is configured, a configured uplink grant can only be signalled for one of the 2 ULs of the cell.

7.1.1.6.2.3 Test description

7.1.1.6.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 and UM DRB should be established on NR Cell 1.

7.1.1.6.2.3.2 Test procedure sequence

Table 7.1.1.6.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR *RRCReconfiguration* messageto configure UL configured grant type 1 in SFN 900, *timeDomainOffset* is set to 5. (Note 1) | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| 2 | The UE transmits NR *RRCReconfigurationComplete* message. (Note 2) | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| 3 | SS transmits a DL MAC PDU containing 4 RLC SDUs of size 96 bytes in SFN 1022 on UM DRB. (Note 3) | <-- | MAC PDU (nine RLC SDUs) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU containing first RLC SDU in Symbol ‘x0’, Slot y0’, SFN ‘z0’ after the SFN in step 3 wraps around?  Where  [(z0 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y0 × *numberOfSymbolsPerSlot*) + x0] = (5 × *numberOfSymbolsPerSlo*t + S + 0 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). (Note 4) | --> | MAC PDU (one RLC SDU) | 1 | P |
| 5 | Check: Does the UE transmit a MAC PDU containing second RLC SDU in Symbol ‘x1’, Slot y1’, SFN ‘z1’?  Where  [(z1 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y1 × *numberOfSymbolsPerSlot*) + x1] = (5 × *numberOfSymbolsPerSlo*t + S + 1 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 1 | P |
| 6 | SS transmits NR *RRCReconfiguration* message to configure UL configured grant type 1 in SFN ‘z1 + 1’, *timeDomainOffset* is set to 35. | <-- | (NR RRC: *RRCReconfiguration)* | - | - |
| 7 | The UE transmits NR *RRCReconfigurationComplete.* message | --> | *(*NR RRC: *RRCReconfigurationComplete)* | - | - |
| 8 | Check: Does the UE transmit a MAC PDU containing third RLC SDU received in step 4 in Symbol ‘x2’, Slot y2’, SFN ‘z2’?  Where  [(z2 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y2 × *numberOfSymbolsPerSlot*) + x2] = (5 × *numberOfSymbolsPerSlo*t + S + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), N >= 2. | --> | MAC PDU (one RLC SDU) | 2 | F |
| 9 | Check: Does the UE transmit a MAC PDU containing fourth RLC SDU in Symbol ‘x3’, Slot y3’, SFN ‘z3’ after the SFN in step 8 wraps around?  Where  [(z3 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y3 × *numberOfSymbolsPerSlot*) + x3] = (35 × *numberOfSymbolsPerSlo*t + S + 0 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 2 | P |
| 10 | Check: Does the UE transmit a MAC PDU containing fifth RLC SDU in Symbol ‘x4’, Slot y4’, SFN ‘z4’?  Where  [(z4 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y4 × *numberOfSymbolsPerSlot*) + x4] = (35 × *numberOfSymbolsPerSlo*t + S + 1 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 2 | P |
| 11 | SS transmits a UL grant addressed to UE’s stored CS-RNTI with NDI set as 1 in Slot ‘p0’of PDCCH (p0 = floor ((y4 +2) \* (PDCCHSCS / PUSCHSCS))), allowing the UE to retransmit one loop back SDU. | <-- | (UL Grant) | - | - |
| 12 | Check: Does the UE retransmit the MAC PDU containing the same fifth RLC SDU as in step 10 in Symbol ‘S’ of Slot ‘q’ of PUSCH?  i.e., in the PUSCH slot q = floor (p0 \* (PUSCHSCS / PDCCHSCS)) + K2. (Note 5) | --> | MAC PDU (one RLC SDU) | 4 | P |
| 13 | Check: Does the UE transmit a MAC PDU containing sixth RLC SDU in Symbol ‘x5’, Slot y5’, SFN ‘z5’?  Where  [(z5 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y5 × *numberOfSymbolsPerSlot*) + x5] = (35 × *numberOfSymbolsPerSlo*t + S + 2 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 1 | P |
| 14 | SS transmits a UL Grant using UE’s C-RNTI in in Slot ‘p1’ of PDCCH allowing UE to transmit a MAC PDU containing two RLC SDU, where p1 = floor ((z6 × *numberOfSlotsPerFrame* - K2) \* (PDCCHSCS / PUSCHSCS)). (Note 6)  Where  [(z6 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y6 × *numberOfSymbolsPerSlot*) + x6] = (35 × *numberOfSymbolsPerSlo*t + S + 3 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | <-- | (UL Grant) | - | - |
| 15 | Check: Does the UE transmit a MAC PDU containing seventh and eight RLC SDU’s in Symbol ‘x6’, Slot y6’, SFN ‘z6’? | --> | MAC PDU (two RLC SDU’s) | 5 | P |
| 16 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘x7’, Slot y7’, SFN ‘z7’?  Where  [(z7 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y7 × *numberOfSymbolsPerSlot*) + x7] = (35 × *numberOfSymbolsPerSlo*t + S + 4 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 1 | P |
| 17 | After step 16, SS transmits NR *RRCReconfiguration* message to release UL configured grant type 1 in SFN ‘z4 + 1’*.* | <-- | (NR RRC: *RRCReconfiguration* | - | - |
| 18 | The UE transmits NR *RRCReconfigurationComplete* message*.* | --> | (NR RRC: *RRCReconfigurationComplete* | - | - |
| 19 | SS transmits a DL MAC PDU containing one RLC SDU of size 96 bytes in SFN ‘z7 + 10’. | <-- | MAC PDU (one RLC SDU) |  |  |
| 20 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘x8’, Slot y8’, SFN ‘z8’?  Where  [(z8 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y8 × *numberOfSymbolsPerSlot*) + x8] = (35 × *numberOfSymbolsPerSlo*t + S + 8 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 3 | F |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 3: According to the setting parameters in Table 7.1.1.6.2.3.3-2, TB size for configured grant type 1 is 808 bits, which is enough to allow the UE to transmit one PDU at a time (96 bytes RLC SDU + 1 byte UM RLC Header + 2 bytes MAC Sub PDU header + 2 bytes for short BSR or padding).  Note 4: S is the starting symbol relative to the slot of the first PUSCH transmission for new configured grant type 1. The value of S can be obtained from TS 38.508-1 [4], Table 4.6.3-122.  Note 5: q is the slot where the UE shall transmit the PUSCH and is determined by  as  where  is the slot with the scheduling DCI,  is based on the numerology of PUSCH. S is the starting symbol relatived to the start of the slot q according to TS 38.214 clause 6.1.2.1.  Note 6: The UL grant addressed to C-RNTI should result in UL transmission overlap in time domain as configured grant type 1. | | | | | |

7.1.1.6.2.3.3 Specific message contents

Table 7.1.1.6.2.3.3-1: *RRCReconfiguration* (step 1 and step 6, Table 7.1.1.6.2.3.2-1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | | | | |
| Information Element | | Value/remark | | Comment | Condition | |
| RRCReconfiguration ::= SEQUENCE { | |  | |  |  | |
| criticalExtensions CHOICE { | |  | |  |  | |
| rrcReconfiguration SEQUENCE { | |  | |  |  | |
| radioBearerConfig | | Not present | |  |  | |
| secondaryCellGroup | | CellGroupConfig | | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC | |
|  | | Not Present | |  | NR | |
| nonCriticalExtension := SEQUENCE {} | | Not present | |  | | EN-DC |
| nonCriticalExtension := SEQUENCE{ | |  | |  | NR | |
| masterCellGroup | | CellGroupConfig | | OCTET STRING (CONTAINING CellGroupConfig) |  | |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | | Not present | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |

Table 7.1.1.6.2.3.3-2: *CellGroupConfig* (Table 7.1.1.6.2.3.3-2: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList | Not present |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig SEQUENCE { |  |  |  |
| cs-RNTI CHOICE { |  |  |  |
| setup SEQUENCE{ |  |  |  |
| RNTI-Value | ‘FFE0’H |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| servCellIndex | Not present |  | NR |
|  | 1 |  | EN-DC |
| reconfigurationWithSync | Not present |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplink SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 10 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1[4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym40x14 |  | 15kHz |
| periodicity | Sym80x14 |  | 30kHz |
| periodicity | Sym160x14 |  | 60kHz |
| periodicity | Sym320x14 |  | 120kHz |
| rrc-ConfiguredUplinkGrant SEQUENCE{ |  |  |  |
| timeDomainOffset | 5 |  | For Step 1 |
| 35 |  | For Step 6 |
| timeDomainAllocation | 0 | Reference TS 38.508-1 [4], Table 4.6.3-122 |  |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB = 2 PRB,  RBstart = 0,  NBWPsize is the size [PRBs] of the active carrier bandwidth part and ontained in TS.38.508-1 [4] clause 4.3.1.1. | FR1\_FDD, FR1\_TDD |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB=9 PRB,  RBstart = 0and  NBWPsize is the size [PRBs] of the active carrier bandwidth part and ontained in TS.38.508-1 [4] clause 4.3.1.2. | FR2\_TDD |
| antennaPort | 0 |  |  |
| precodingAndNumberOfLayers | 0 |  |  |
| srs-ResourceIndicator | Not present |  |  |
| mcsAndTBS | 18 |  | FR1\_FDD, FR1\_TDD |
| 25 |  | FR2\_TDD |
| pathlossReferenceIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| PUSCH-TimeDomainResourceAllocationList SEQUENCE { |  |  |  |
| k2 | n8 |  | FR1 and FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 0011011 | Start symbol(S)=0, Length(L)=14 | FR1 |
| startSymbolAndLength | 0001110 | S=0, L=2 | FR2 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.2.3.3-3: *RRCReconfiguration* (step 11, Table 7.1.1.6.2.3.2-1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | | | | |
| Information Element | | Value/remark | | Comment | Condition | |
| RRCReconfiguration ::= SEQUENCE { | |  | |  |  | |
| criticalExtensions CHOICE { | |  | |  |  | |
| rrcReconfiguration SEQUENCE { | |  | |  |  | |
| radioBearerConfig | Not present | | |  |  | |
| secondaryCellGroup | CellGroupConfig | | | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC | |
|  | Not present | | |  | NR | |
| nonCriticalExtension := SEQUENCE {} | | Not present | |  | | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  | | |  | NR | |
| masterCellGroup | CellGroupConfig | | | OCTET STRING (CONTAINING CellGroupConfig) |  | |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | Not present | | |  |  | |
| } |  | | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |
| } | |  | |  |  | |

Table 7.1.1.6.2.3.3-4: *CellGroupConfig* (Table 7.1.1.6.2.3.3-3: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplink SEQUENCE { |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| release | Null |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.6.3 Correct handling of UL grant / configured grant Type 2

7.1.1.6.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in UL is enabled }

**ensure that** {

**when** { UE receives an UL configured grant type 2 addressed to its stored CS-RNTI with NDI set as 0 and PDCCH content indicates SPS activation }

**then** { UE starts transmitting UL MAC PDU periodically in the symbol associated with the configured grant }

}

(2)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 2 }

**ensure that** {

**when** {UE receives a UL grant addressed to its CS-RNTI with NDI set as 0 }

**then** { UE starts transmitting UL MAC PDU periodically in the symbol associated with the new re-configured grant }

}

(3)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 2 }

**ensure that** {

**when** { UE receives a UL grant addressed to its CS-RNTI with NDI set as 1 for retransmission }

**then** { UE re-transmits MAC PDU as per the new grant }

}

(4)

**with**{ UE in RRC\_Connected state with DRB established and configured UL grant type 2 }

**ensure that** {

**when** { UE receives a UL grant addressed to its C-RNTI resulting in UL transmission overlap in time domain as configured grante type 2 }

**then** { UE transmits MAC PDU as per grant addressed to its C-RNTI }

}

(5)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 2 }

**ensure that** {

**when** {UE receives a RRC message including sps-Configuration with sps-ConfigurationUL set as ‘disable’ and hence resulting in UL SPS grant deactivation }

**then** { UE deletes the stored sps-Configuration UL parameters and stops transmitting UL MAC PDU’s as per configured UL grant type 2 }

}

(6)

**with**{ UE in RRC\_Connected state with DRB established and configured UL grant type 2 }

**ensure that** {

**when**{ If in the symbol in which UL Configured Grant type 2 is available but the HARQ buffer is empty (no data for transmission) }

**then**{ UE ignores the UL configured grant type 2 and does not send any MAC PDU }

}

(7)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in UL is enabled }

**ensure that** {

**when** { UE receives UL configured grant type 2 addressed to its stored CS-RNTI in slot p and with NDI set as 0 and PDCCH content indicates SPS deactivation }

**then** {UE transmits configured Grant Confirmation MAC CE confirming the deactivation and stops transmitting UL MAC PDU’s as per configured UL grant type 2}

}

7.1.1.6.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321 clauses 5.4.1 and 5.8.2, 3GPP TS 38.300 clauses 10.3 and TS 38.213 clause 102. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, or configured semi-persistently by RRC. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the correponding HARQ process, if configured.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in subclause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if the *configuredGrantTimer* for the corresponding HARQ process is not running:

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

where CURRENT\_symbol=(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

NOTE 1: CURRENT\_symbol refers to the symbol index of the first transmission occasion of a repetition bundle that takes place.

NOTE 2: A HARQ process is configured for a configured uplink grant if the configured uplink grant is activated and the associated HARQ process ID is less than *nrofHARQ-Processes*.

NOTE 3: If the MAC entity receives both a grant in a Random Access Response and an overlapping grant for its C-RNTI or CS-RNTI, requiring concurrent transmissions on the SpCell, the MAC entity may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or CS-RNTI.

[TS 38.321, clause 5.8.2]

There are two types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;

- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation.

Type 1 and Type 2 are configured by RRC per Serving Cell and per BWP. Multiple configurations can be active simultaneously only on different Serving Cells. For Type 2, activation and deactivation are independent among the Serving Cells. For the same Serving Cell, the MAC entity is configured with either Type 1 or Type 2.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *periodicity*: periodicity of the configured grant Type 1;

- *timeDomainOffset*: Offset of a resource with respect to SFN=0 in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]);

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

RRC configures the following parameters when the configured grant Type 2 is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *periodicity*: periodicity of the configured grant Type 2;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant.

Upon configuration of a configured grant Type 1 for a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset* and *S* (derived from *SLIV* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
 (*timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider that the uplink grant recurs associated with each symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
[(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*), for all N >= 0.

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

When a configured uplink grant is released by upper layers, all the corresponding configurations shall be released and all corresponding uplink grants shall be cleared.

The MAC entity shall:

1> if the configured uplink grant confirmation has been triggered and not cancelled; and

1> if the MAC entity has UL resources allocated for new transmission:

2> instruct the Multiplexing and Assembly procedure to generate an Configured Grant Confirmation MAC CE as defined in subclause 6.1.3.7;

2> cancel the triggered configured uplink grant confirmation.

For a configured grant Type 2, the MAC entity shall clear the configured uplink grant immediately after first transmission of Configured Grant Confirmation MAC CE triggered by the configured uplink grant deactivation.

Retransmissions except for repetition of configured uplink grants use uplink grants addressed to CS-RNTI.

[TS 38.300, clause 10.3]

In the uplink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible grants for uplink transmission when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

In addition, with Configured Grants, the gNB can allocate uplink resources for the initial HARQ transmissions to UEs. Two types of configured uplink grants are defined:

- With Type 1, RRC directly provides the configured uplink grant (including the periodicity).

- With Type 2, RRC defines the periodicity of the configured uplink grant while PDCCH addressed to CS-RNTI can either signal and activate the configured uplink grant, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the uplink grant can be implicitly reused according to the periodicity defined by RRC, until deactivated.

The dynamically allocated uplink transmission overrides the configured uplink grant in the same serving cell, if they overlap in time. Otherwise an uplink transmission according to the configured uplink grant is assumed, if activated.

Retransmissions other than repetitions are explicitly allocated via PDCCH(s).

When CA is configured, at most one configured uplink grant can be signalled per serving cell. When BA is configured, at most one configured uplink grant can be signalled per BWP. On each serving cell, there can be only one configured uplink grant active at a time. A configured uplink grant for one serving cell can either be of Type 1 or Type 2. For Type 2, activation and deactivation of configured uplink grants are independent among the serving cells. When SUL is configured, a configured uplink grant can only be signalled for one of the 2 ULs of the cell.

[TS 38.213, clause 10.2]

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or configured UL grant Type 2 PDCCH if

- the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, and

- the new data indicator field for the enabled transport block is set to '0'.

Validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of DL SPS or configured UL grant Type 2. If validation is not achieved, the UE discards all the information in the DCI format.

Table 10.2-1: Special fields for DL SPS and UL grant Type 2 scheduling activation PDCCH validation

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1 | DCI format 1\_0 | DCI format 1\_1 |
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to '00' | set to '00' | For the enabled transport block: set to '00' |

Table 10.2-2: Special fields for DL SPS and UL grant Type 2 scheduling release PDCCH validation

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0 | DCI format 1\_0 |
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to '00' | set to '00' |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '1's | set to all '1's |

A UE is expected to provide HARQ-ACK information in response to a SPS PDSCH release after symbols from the last symbol of a PDCCH providing the SPS PDSCH release. If *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell with the PDCCH providing the SPS PDSCH release,  for ,  for , and  for , otherwise,  for ,  for ,  for , and  for , wherein  corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH providing the SPS PDSCH release and the SCS configuration of a PUCCH carrying the HARQ-ACK information in response to a SPS PDSCH release.



7.1.1.6.3.3 Test description

7.1.1.6.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 and UM DRB should be established on NR Cell 1.The loop back size is set to accommodate one RLC SDU in UL of same size as one RLC SDU in DL and 1 byte MAC subheader for Configured Grant Confirmation MAC CE.

7.1.1.6.3.3.2 Test procedure sequence

Table 7.1.1.6.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR *RRCReconfiguration* message to configure UL configured grant type 2. (Note 1) | <-- | (NR RRC: *RRCReconfiguration* | - | - |
| 2 | The UE transmits NR *RRCReconfigurationComplete* message. (Note 2) | --> | (NR RRC: *RRCReconfigurationComplete* | - | - |
| 3 | SS transmits a DL MAC PDU containing 6 RLC SDUs on UM DRB. | <-- | MAC PDU | - | - |
| 4 | The UE transmits a Scheduling Request, indicating that loop back SDUs are ready for transmission in UL RLC. | --> | (SR) | - | - |
| 5 | SS transmits a UL configured grant type 2 addressed to UE’s stored CS-RNTI in Slot ‘n’ of PDCCH, NDI=0, allowing the UE to transmit one loop back SDU and 1 byte MAC subheader for Configured Grant Confirmation MAC CE. | <-- | (UL configured Grant type 2) | - | - |
| 6 | Check: Does the UE transmit a MAC PDU containing one RLC SDU and a Configured Grant Confirmation MAC CE in Symbol ‘S’ of Slot ‘y’ of PUSCH as per grant in step 5?  i.e., in the PUSCH slot y=floor (n \* (PUSCHSCS / PDCCHSCS)) + K2. (Note 3) | --> | MAC PDU | 1 | P |
| 7 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘S’ of Slot ‘y + x’ of PUSCH as per grant in step 5? (Note 4) | --> | MAC PDU | 1 | P |
| 8 | SS transmits a UL configured grant type 2 addressed to UE’s stored CS-RNTI in Slot ‘p’ of PDCCH (p = floor (p0 \* (PDCCHSCS / PUSCHSCS))), NDI = 0, allowing the UE to transmit one loop back SDU and 1 byte MAC subheader for Configured Grant Confirmation MAC CE,  Where p0 is the slot of PUSCH with y + x < p0 < y + 2x - K2. | <-- | (UL configured Grant type 2) | - | - |
| 9 | Check: Does the UE transmit a MAC PDU containing one RLC SDU and 1 byte MAC subheader for Configured Grant Confirmation MAC CE in Symbol ‘S’ of Slot ‘z’ of PUSCH as per grant in step 8?  i.e., in the PUSCH slot z = floor (p \* (PUSCHSCS/ PDCCHSCS)) + K2. (Note 3) | --> | MAC PDU | 2 | P |
| 10 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘S’ of Slot ‘y + 2x’ as per grant in step 5? | --> | MAC PDU | 2 | F |
| 11 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘S’ of Slot ‘z + x’ of PUSCH as per grant in step 8? | --> | MAC PDU | 2 | P |
| 12 | SS transmits a UL configured grant type 2 addressed to UE’s stored CS-RNTI in Slot ‘q’ of PDCCH (q = floor (q0 \* (PDCCHSCS / PUSCHSCS))), NDI = 1; allowing the UE to transmit one loop back SDU. The UL HARQ process is the same as in step 11,  Where q0 is the slot of PUSCH with z + x < q0 < z + 2x - K2. | <-- | (UL configured Grant type 2) | - | - |
| 13 | Check: Does the UE transmit a MAC PDU containing the same RLC SDU as in step 11 in Symbol ‘S’ of Slot ‘w’ of PUSCH?  i.e., in the PUSCH slot w = floor (q \* (PUSCHSCS / PDCCHSCS)) + K2. (Note 3) | --> | MAC PDU | 3 | P |
| 14 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘S’ of Slot ‘z + 2x’ of PUSCH as per grant in step 8? | --> | MAC PDU | 1 | P |
| 15 | SS transmits a UL Grant using UE’s C-RNTI in in Slot ‘r’ of PDCCH allowing UE to transmit a MAC PDU containing one RLC SDU, where r = floor ((z + 3x - K2) \* (PDCCHSCS / PUSCHSCS)). | <-- | (UL Grant) | - | - |
| 16 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘S’ of Slot ‘z + 3x’ of PUSCH as per grant in step 8? | --> | MAC PDU | 4 | P |
| 17 | Check: Does the UE transmit a MAC PDU in Slot ‘z + 4x’ as per grant in containing zero MAC SDU? (Note 5) | --> | MAC PDU | 6 | F |
| 18 | SS transmits a DL MAC PDU containing 3 RLC SDUs on UM DRB after step 17. | <-- | MAC PDU |  |  |
| 19 | Check: Does the UE transmit a MAC PDU containing one RLC SDU in Symbol ‘S’ of Slot ‘z + 5x’ of PUSCH as per grant in step 8? | --> | MAC PDU | 1 | P |
| 20 | The SS transmits a PDCCH [for UL configured grant type 2 explicit release] using UE’s CS-RNTI in Symbol ‘S’ of slot ‘p’ with NDI=0. Where (z+5x< p <z+6x). | <-- | PDCCH [for UL configured grant type 2 explicit release] | - | - |
| 21 | Check: Does the UE transmit a MAC PDU containing a Configured Grant Confirmation MAC CE and one RLC SDU in ‘S’ of Slot ‘z + 6x’ of PUSCH as per grant in step 8? | --> | MAC PDU | 7 | P |
| 21A | Check: Does the UE transmit a MAC PDU containing one RLC SDU in ‘S’ of Slot ‘z + 7x’ of PUSCH as per grant in step 8? | --> | MAC PDU | 7 | F |
| 22 | SS transmits a UL configured grant type 2 addressed to UE’s stored CS-RNTI in Slot ‘j’ of PDCCH, NDI=0, allowing the UE to transmit one loop back SDU and 1 byte MAC subheader for Configured Grant Confirmation MAC CE. | <-- | (UL configured grant type 2) | - | - |
| 23 | Check: Does the UE transmit a MAC PDU containing one RLC SDU and a Configured Grant Confirmation MAC CE in Symbol ‘S’ of Slot ‘y’ of PUSCH as per grant in step 22?  i.e., in the PUSCH slot y=floor (n \* (PUSCHSCS / PDCCHSCS)) + K2. (Note 3) | --> | MAC PDU | 1 | P |
| 24 | SS transmits *RRCReconfiguration* to disable UL configured grant type 2*.* | <-- | NR RRC: *RRCReconfiguration* | - | - |
| 25 | The UE transmits *RRCReconfigurationComplete.* | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 26 | SS transmits a DL MAC PDU containing 1 RLC SDU. | <-- | MAC PDU | - | - |
| 27 | Check: Does the UE transmit a MAC PDU in Symbol ‘S’ of Slot ‘y + 10x’ of PUSCH as per grant in step 22. | --> | MAC PDU | 5 | F |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 3: y is the slot where the UE shall transmit the PUSCH and is determined by  as  where n is the slot with the scheduling DCI,  is based on the numerology of PUSCH. S is the starting symbol relatived to the start of the slot y according to TS 38.214 clause 6.1.2.1.  Note 4: x is equal to *periodicity /* 14in this test case.  Note 5: If the MAC entity does not generate a MAC PDU, one of the conditions which shall be satisfied is that there is no aperiodic CSI requested for this PUSCH transmission as specified in TS 38.321 clause 5.4.3.1.3. | | | | | |

7.1.1.6.3.3.3 Specific message contents

Table 7.1.1.6.3.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.6.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | Not present |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension := SEQUENCE {} | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.3.3.3-2: *CellGroupConfig* (Table 7.1.1.6.3.3.3-1: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList | Not present |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig SEQUENCE { |  |  |  |
| cs-RNTI CHOICE { |  |  |  |
| setup SEQUENCE{ |  |  |  |
| RNTI-Value | ‘FFE0’H |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 9 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1 [4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 0 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym40x14 |  | 15kHz |
| periodicity | Sym80x14 |  | 30kHz |
| periodicity | Sym160x14 |  | 60kHz |
| periodicity | Sym320x14 |  | 120kHz |
| } |  |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| PUSCH-TimeDomainResourceAllocationList SEQUENCE { |  |  |  |
| k2 | 4 |  | FR1 |
|  | 8 |  | FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 0011011 |  | FR1 |
| startSymbolAndLength | 0001110 |  | FR2 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.3.3.3-3: *RRCReconfiguration* (step 24 of Table 7.1.1.6.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | Not present |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension := SEQUENCE {} | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.3.3.3-4: *CellGroupConfig* (Table 7.1.1.6.3.3.3-3: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| cellGroupId | 1 |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplink SEQUENCE { |  |  |  |
| configuredGrantConfig CHOICE { |  |  |  |
| release | Null |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.6.4 Correct handling of DL assignment / Multi Semi-persistent configuration

7.1.1.6.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in DL is enabled }

**ensure that** {

**when** { UE receives a DL assignment addressed to its stored CS-RNTI in slot y and with NDI set as 0 with *sps-ConfigIndex*=0}

**then** {UE starts receiving DL MAC PDU in slots y+n\*[semiPersistSchedIntervalDL] where ‘n’ is positive integer starting at zero }

}

(2)

**with** { UE in RRC\_Connected state with DRB established and stored DL SPS assignment to receive MAC PDU in slot y+n\*[semiPersistSchedIntervalDL] }

**ensure that** {

**when** { UE receives another DL assignment addressed to its CS-RNTI in slot p and with NDI set as 0 associated with *sps-ConfigIndex*=1, where p!= y+n\*[semiPersistSchedIntervalDL] }

**then** { UE starts receiving DL MAC PDU in slots p+n\*[semiPersistSchedIntervalDL] and continue receiving DL MAC PDU at slots y+n\*[semiPersistSchedIntervalDL]where ‘n’ is positive integer starting at zero }

}

7.1.1.6.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in TS 38.321, clause 5.3.1, 5.8.1 TS 38.300, clause 10.2, and TS 38.213, clause 10.2. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.3.1]

Downlink assignments received on the PDCCH both indicate that there is a transmission on a DL-SCH for a particular MAC entity and provide the relevant HARQ information.

When the MAC entity has a C-RNTI, Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion during which it monitors PDCCH and for each Serving Cell:

1> if a downlink assignment for this PDCCH occasion and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI, or Temporary C‑RNTI:

2> if this is the first downlink assignment for this Temporary C-RNTI:

3> consider the NDI to have been toggled.

2> if the downlink assignment is for the MAC entity's C-RNTI, and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the MAC entity's CS-RNTI or a configured downlink assignment:

3> consider the NDI to have been toggled regardless of the value of the NDI.

2> indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity.

1> else if a downlink assignment for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> indicate the presence of a downlink assignment for this Serving Cell and deliver the associated HARQ information to the HARQ entity.

2> if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate SPS deactivation:

4> clear the configured downlink assignment for this Serving Cell (if any);

4> if the *timeAlignmentTimer*, associated with the TAG containing the Serving Cell on which the HARQ feedback is to be transmitted, is running:

5> indicate a positive acknowledgement for the SPS deactivation to the physical layer.

3> else if PDCCH content indicates SPS activation:

4> store the downlink assignment for this Serving Cell and the associated HARQ information as configured downlink assignment;

4> initialise or re-initialise the configured downlink assignment for this Serving Cell to start in the associated PDSCH duration and to recur according to rules in clause 5.8.1;

For each Serving Cell and each configured downlink assignment, if configured and activated, the MAC entity shall:

1> if the PDSCH duration of the configured downlink assignment does not overlap with the PDSCH duration of a downlink assignment received on the PDCCH for this Serving Cell:

2> instruct the physical layer to receive, in this PDSCH duration, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;

2> set the HARQ Process ID to the HARQ Process ID associated with this PDSCH duration;

2> consider the NDI bit for the corresponding HARQ process to have been toggled;

2> indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity.

For configured downlink assignments without *harq-ProcID-Offset*, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (*numberOfSlotsPerFrame* × *periodicity*))] modulo *nrofHARQ-Processes*

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

NOTE 1: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned Serving Cell is used to calculate the HARQ Process ID used for configured downlink assignments.

For configured downlink assignments with *harq-ProcID-Offset*, the HARQ Process ID associated with the slot where the DL transmission starts is derived from the following equation:

HARQ Process ID = [floor (CURRENT\_slot × 10 / (numberOfSlotsPerFrame × periodicity))] modulo nrofHARQ-Processes + harq-ProcID-Offset

where CURRENT\_slot = [(SFN × *numberOfSlotsPerFrame*) + slot number in the frame] and *numberOfSlotsPerFrame* refers to the number of consecutive slots per frame as specified in TS 38.211 [8].

NOTE 2: CURRENT\_slot refers to the slot index of the first transmission occasion of a bundle of configured downlink assignment.

When the MAC entity needs to read BCCH, the MAC entity may, based on the scheduling information from RRC:

1> if a downlink assignment for this PDCCH occasion has been received on the PDCCH for the SI-RNTI;

2> indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity.

[TS 38.321, clause 5.8.1]

Semi-Persistent Scheduling (SPS) is configured by RRC per Serving Cell and per BWP. Multiple assignments can be active simultaneously in the same BWP. Activation and deactivation of the DL SPS are independent among the Serving Cells.

For the DL SPS, a DL assignment is provided by PDCCH, and stored or cleared based on L1 signalling indicating SPS activation or deactivation.

RRC configures the following parameters when the SPS is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *nrofHARQ-Processes*: the number of configured HARQ processes for SPS;

- *harq-ProcID-Offset*: Offset of HARQ process for SPS;

- *periodicity*: periodicity of configured downlink assignment for SPS.

When the SPS is released by upper layers, all the corresponding configurations shall be released.

After a downlink assignment is configured for SPS, the MAC entity shall consider sequentially that the Nth downlink assignment occurs in the slot for which:

(*numberOfSlotsPerFrame* × SFN + slot number in the frame) =  
[(*numberOfSlotsPerFrame* × SFNstart time + slotstart time) + N × *periodicity* × *numberOfSlotsPerFrame* / 10] modulo (1024 × *numberOfSlotsPerFrame*)

where SFNstart time and slotstart time are the SFN and slot, respectively, of the first transmission of PDSCH where the configured downlink assignment was (re-)initialised.

NOTE: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned Serving Cell is used to calculate the occurrences of configured downlink assignments.

[TS 38.300, clause 10.2]

In the downlink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible assignments when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

The gNB may pre-empt an ongoing PDSCH transmission to one UE with a latency-critical transmission to another UE. The gNB can configure UEs to monitor interrupted transmission indications using INT-RNTI on a PDCCH. If a UE receives the interrupted transmission indication, the UE may assume that no useful information to that UE was carried by the resource elements included in the indication, even if some of those resource elements were already scheduled to this UE.

In addition, with Semi-Persistent Scheduling (SPS), the gNB can allocate downlink resources for the initial HARQ transmissions to UEs: RRC defines the periodicity of the configured downlink assignments while PDCCH addressed to CS-RNTI can either signal and activate the configured downlink assignment, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the downlink assignment can be implicitly reused according to the periodicity defined by RRC, until deactivated.

NOTE: When required, retransmissions are explicitly scheduled on PDCCH(s).

The dynamically allocated downlink reception overrides the configured downlink assignment in the same serving cell, if they overlap in time. Otherwise a downlink reception according to the configured downlink assignment is assumed, if activated.

The UE may be configured with up to 8 active configured downlink assignments for a given BWP of a serving cell. When more than one is configured:

- The network decides which of these configured downlink assignments are active at a time (including all of them); and

- Each configured downlink assignment is activated separately using a DCI command and deactivation of configured downlink assignments is done using a DCI command, which can either deactivate a single configured downlink assignment or multiple configured downlink assignments jointly.

[TS 38.213, clause 10.2]

A UE validates, for scheduling activation or scheduling release, a DL SPS assignment PDCCH or a configured UL grant Type 2 PDCCH if

- the CRC of a corresponding DCI format is scrambled with a CS-RNTI provided by *cs-RNTI*, and

- the new data indicator field in the DCI format for the enabled transport block is set to '0', and

- the DFI flag field, if present, in the DCI format is set to '0', and

- if validation is for scheduling activation and if the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format is present, the PDSCH-to-HARQ\_feedback timing indicator field does not provide an inapplicable value from *dl-DataToUL-ACK-r16*.

If a UE is provided a single configuration for UL grant Type 2 PUSCH or for SPS PDSCH, validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-1 or Table 10.2-2.

If a UE is provided more than one configurations for UL grant Type 2 PUSCH or for SPS PDSCH, a value of the HARQ process number field in a DCI format indicates an activation for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively. Validation of the DCI format is achieved if the RV field for the DCI format is set as in Table 10.2-3.

If a UE is provided more than one configuration for UL grant Type 2 PUSCH or for SPS PDSCH

- if the UE is provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a corresponding entry for scheduling release of one or more UL grant Type 2 PUSCH or SPS PDSCH configurations

- if the UE is not provided *ConfiguredGrantConfigType2DeactivationStateList* or *sps-ConfigDeactivationStateList*, a value of the HARQ process number field in a DCI format indicates a release for a corresponding UL grant Type 2 PUSCH or for a SPS PDSCH configuration with a same value as provided by *ConfiguredGrantConfigIndex* or by *sps-ConfigIndex*, respectively.

Validation of the DCI format is achieved if all fields for the DCI format are set according to Table 10.2-4.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of DL SPS or configured UL grant Type 2. If validation is not achieved, the UE discards all the information in the DCI format.

Table 10.2-1: Special fields for single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2 | DCI format 1\_1 |
| HARQ process number | set to all '0's | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

Table 10.2-2: Special fields for single DL SPS or single UL grant Type 2 scheduling release PDCCH validation when a UE is provided a single SPS PDSCH or UL grant Type 2 configuration in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2 |
| HARQ process number | set to all '0's | set to all '0's |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with  set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*  set to all '1's for FDRA Type 1 |

Table 10.2-3: Special fields for a single DL SPS or single UL grant Type 2 scheduling activation PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_2 | DCI format 1\_1 |
| Redundancy version | set to all '0's | set to all '0's | For the enabled transport block: set to all '0's |

Table 10.2-4: Special fields for a single or multiple DL SPS and UL grant Type 2 scheduling release PDCCH validation when a UE is provided multiple DL SPS or UL grant Type 2 configurations in the active DL/UL BWP of the scheduled cell

|  |  |  |
| --- | --- | --- |
|  | DCI format 0\_0/0\_1/0\_2 | DCI format 1\_0/1\_1/1\_2 |
| Redundancy version | set to all '0's | set to all '0's |
| Modulation and coding scheme | set to all '1's | set to all '1's |
| Frequency domain resource assignment | set to all '0's for FDRA Type 2 with  set to all '1's, otherwise | set to all '0's for FDRA Type 0 or for *dynamicSwitch*  set to all '1's for FDRA Type 1 |

A UE is expected to provide HARQ-ACK information in response to a SPS PDSCH release after symbols from the last symbol of a PDCCH providing the SPS PDSCH release. If *processingType2Enabled* of *PDSCH-ServingCellConfig* is set to *enable* for the serving cell with the PDCCH providing the SPS PDSCH release, for , for , and for , otherwise, for , for , for , and for , wherein corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH providing the SPS PDSCH release and the SCS configuration of a PUCCH carrying the HARQ-ACK information in response to a SPS PDSCH release.



7.1.1.6.4.3 Test description

7.1.1.6.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink and that the UM DRB is configured according to Table 7.1.1.6.4.3.1-1.

Table 7.1.1.6.4.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink UM RLC sn-FieldLength | IF (pc\_um\_WithShortSN ) size6  ELSE size12 |
| Downlink UM RLC sn-FieldLength | F (pc\_um\_WithShortSN ) size6  ELSE size12 |

7.1.1.6.4.3.2 Test procedure sequence

Table 7.1.1.6.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits *NR* RRCReconfiguration to config SPS-ConfigurationDL.(Note 2) | <-- | RRCReconfiguration | - | - |
| 2 | The UE transmits NR RRCReconfigurationComplete.(Note 3) | --> | RRCReconfigurationComplete | - | - |
| 3 | The SS transmits a DL assignment using UE’s CS-RNTI associated with *sps-ConfigIndex*=0 in Slot ‘Y’, NDI=0 | <-- | (DL SPS Grant) | - | - |
| 4 | The SS transmits in Slot ‘Y’, a DL MAC PDU containing a RLC PDU on UM DRB. | <-- | MAC PDU | - | - |
| 5 | Check: does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 6 | The SS transmits in Slot ‘Y+X’, a DL MAC PDU containing a RLC PDU on DRB. (Note 1) | <-- | MAC PDU | - | - |
| 7 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 1 | P |
| 8 | SS transmits *NR* RRCReconfiguration to add another SPS-ConfigurationDL.(Note 2) | <-- | RRCReconfiguration | - | - |
| 9 | The UE transmits NR RRCReconfigurationComplete.(Note 3) | --> | RRCReconfigurationComplete | - | - |
| 10 | The SS transmits a DL assignment using UE’s CS-RNTI associated with *sps-ConfigIndex*=1 in Slot ‘P’, NDI=0;  (Where Y+X<P<Y+2X) | <-- | (DL SPS Grant) | - | - |
| 11 | The SS transmits in Slot ‘P’, a DL MAC PDU containing a RLC PDU on UM DRB. | <-- | MAC PDU | - | - |
| 12 | Check: Does the UE transmit a HARQ ACK? | --> | HARQ ACK | 2 | P |
| 13 | The SS transmits in Slot ‘Y+2X’, a DL MAC PDU containing a RLC PDU on UM DRB. | <-- | MAC PDU | - | - |
| 14 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK | 2 | P |
| 15 | The SS transmits in Slot ‘P+X’, a DL MAC PDU containing a RLC PDU (DL-SQN=1) on UM DRB. | <-- | MAC PDU | - | - |
| 16 | Check: Does the UE transmit a HARQ Feedback? | --> | HARQ ACK | 2 | P |
| 17 | SS transmits *NR* RRCReconfiguration to disable SPS-ConfigurationDL.(Note 2) | <-- | RRCReconfiguration | - | - |
| 18 | The UE transmits NR RRCReconfigurationComplete.(Note 3) | --> | RRCReconfigurationComplete | - | - |
| Note 1: X is equal to semiPersistSchedIntervalDL in this document.  Note 2: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 3: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.*  Note 4: As per TS 38.508-1[4], the default value for PDSCH slot offset (K0) is 0, hence the DL MAC PDU’s associated with DL SPS grant in Slot X are sent in same slot X. | | | | | |

7.1.1.6.4.3.3 Specific message contents

Table 7.1.1.6.4.3.3-1: *RRCReconfiguration* (step 1/8, Table 7.1.1.6.4.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.4.3.3-2: *CellGroupConfig* (in Table 7.1.1.6.4.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| physicalCellGroupConfig | PhysicalCellGroupConfig | Table 7.1.1.6.4.3.3-3 |  |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | 1 |  | EN-DC |
|  | Not present |  | NR |
| spCellConfigDedicated SEQUENCE { |  |  |  |
| initialDownlinkBWP SEQUENCE { |  |  |  |
| sps-ConfigToAddModList-r16 ::= SEQUENCE (SIZE (1..maxNrofSPS-Config-r16)) OF SPS-Config { |  |  |  |
| SPS-Config ::= SEQUENCE [1] { |  | The first SPS configuration entry | STEP 1 |
| setup SEQUENCE { |  |  |  |
| periodicity | ms160 |  |  |
| nrofHARQ-Processes | 8 |  |  |
| sps-ConfigIndex-r16 | 0 |  |  |
| harq-ProcID-Offset-r16 | 0 |  |  |
| sps-ConfigIndex-r16 | 0 |  |  |
| } |  |  |  |
| SPS-Config ::= SEQUENCE [2] { |  | The second SPS configuration entry | STEP 8 |
| setup SEQUENCE { |  |  |  |
| periodicity | ms160 |  |  |
| nrofHARQ-Processes | 8 |  |  |
| sps-ConfigIndex-r16 | 1 |  |  |
| harq-ProcID-Offset-r16 | 8 |  |  |
| sps-ConfigIndex-r16 | 1 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.4.3.3-3: PhysicalCellGroupConfig(Table 7.1.1.6.4.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-106 | | | |
| Information Element | Value/remark | Comment | Condition |
| PhysicalCellGroupConfig ::= SEQUENCE { |  |  |  |
| cs-RNTI | ‘FFE0’H |  |  |
| } |  |  |  |

Table 7.1.1.6.4.3.3-4: *RRCReconfiguration* (step 17 of Table 7.1.1.6.4.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) | EN-DC |
|  | Not present |  | NR |
| nonCriticalExtension | Not present |  | EN-DC |
| nonCriticalExtension := SEQUENCE{ |  |  | NR |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.4.3.3-5: *CellGroupConfig* (Table 7.1.1.6.4.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { | |  |  |  |
| spCellConfig SEQUENCE { | |  |  |  |
| servCellIndex | | 1 |  |  |
|  | | Not present |  | NR |
| spCellConfigDedicated SEQUENCE { | |  |  |  |
| initialDownlinkBWP SEQUENCE { | |  |  |  |
| sps-ConfigToReleaseList-r16 SEQUENCE (SIZE (1..maxNrofSPS-Config-r16)) OF SPS-ConfigIndex-r16 { | | 2 entries | Release all the SPS entries configured previously |  |
| SPS-ConfigIndex-r16[1] | | 0 |  |  |
| SPS-ConfigIndex-r16[2] | | 1 |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

##### 7.1.1.6.5 Correct handling of UL grant / Multi configured uplink grants

7.1.1.6.5.1 Test Purpose (TP)(1)

**with** { UE in RRC\_Connected state with DRB established and sps-Configuration in UL is enabled with Configured grant type 1 }

**ensure that** {

**when** { The symbol in which equation [(SFN × numberOfSlotsPerFrame × numberOfSymbolsPerSlot) + (slot number in the frame × numberOfSymbolsPerSlot) + symbol number in the slot] =

(timeDomainOffset × numberOfSymbolsPerSlot + S + N × periodicity) modulo (1024 × numberOfSlotsPerFrame × numberOfSymbolsPerSlot)is satisfied }

**then** { UE starts transmitting UL MAC PDU periodically in the symbol associated with the new re-configured grant }

}

(2)

**with** { UE in RRC\_Connected state with DRB established and configured UL grant type 1 }

**ensure that** {

**when** { UE receives another UL grant type 1 in an RRC message with timeDomainOffset 15}

**then** { UE starts transmitting UL MAC PDU in symbol with timeDomainOffset 15 and continue transmitting UL MAC PDU in symbol with timeDomainOffset 5}

}

7.1.1.6.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in TS 38.321, clause 5.4.1, 5.8.2 TS 38.300, clause 10.3. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.4.1]

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

3> stop the *cg-RetransmissionTimer* for the corresponding HARQ process, if running.

2> deliver the uplink grant and the associated HARQ information to the HARQ entity.

1> else if an uplink grant for this PDCCH occasion has been received for this Serving Cell on the PDCCH for the MAC entity's CS-RNTI:

2> if the NDI in the received HARQ information is 1:

3> consider the NDI for the corresponding HARQ process not to have been toggled;

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured;

3> stop the *cg-RetransmissionTimer* for the corresponding HARQ process, if running;

3> deliver the uplink grant and the associated HARQ information to the HARQ entity.

2> else if the NDI in the received HARQ information is 0:

3> if PDCCH contents indicate configured grant Type 2 deactivation:

4> trigger configured uplink grant confirmation.

3> else if PDCCH contents indicate configured grant Type 2 activation:

4> trigger configured uplink grant confirmation;

4> store the uplink grant for this Serving Cell and the associated HARQ information as configured uplink grant;

4> initialise or re-initialise the configured uplink grant for this Serving Cell to start in the associated PUSCH duration and to recur according to rules in clause 5.8.2;

4> stop the *configuredGrantTimer* for the corresponding HARQ process, if running;

4> stop the *cg-RetransmissionTimer* for the corresponding HARQ process, if running.

For each Serving Cell and each configured uplink grant, if configured and activated, the MAC entity shall:

1> if the MAC entity is configured with *lch-basedPrioritization*, and the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received in a Random Access Response or with the PUSCH duration of an uplink grant addressed to Temporary C-RNTI or the PUSCH duration of a MSGA payload for this Serving Cell; or

1> if the MAC entity is not configured with *lch-basedPrioritization*, and the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response or the PUSCH duration of a MSGA payload for this Serving Cell:

2> set the HARQ Process ID to the HARQ Process ID associated with this PUSCH duration;

2> if, for the corresponding HARQ process, the *configuredGrantTimer* is not running and *cg-RetransmissionTimer* is not configured (i.e. new transmission):

3> consider the NDI bit for the corresponding HARQ process to have been toggled;

3> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

2> else if the *cg-RetransmissionTimer* for the corresponding HARQ process is configured and not running, then for the corresponding HARQ process:

3> if the *configuredGrantTimer* is not running, and the HARQ process is not pending (i.e. new transmission):

4> consider the NDI bit to have been toggled;

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

3> else if the previous uplink grant delivered to the HARQ entity for the same HARQ process was a configured uplink grant (i.e. retransmission on configured grant):

4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity.

For configured uplink grants neither configured with *harq-ProcID-Offset2* nor with *cg-RetransmissionTimer*, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol/*periodicity*)] modulo *nrofHARQ-Processes*

For configured uplink grants with *harq-ProcID-Offset2*, the HARQ Process ID associated with the first symbol of a UL transmission is derived from the following equation:

HARQ Process ID = [floor(CURRENT\_symbol / *periodicity*)] modulo *nrofHARQ-Processes* + *harq-ProcID-Offset2*

where CURRENT\_symbol = (SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slot number in the frame × *numberOfSymbolsPerSlot* + symbol number in the slot), and *numberOfSlotsPerFrame* and *numberOfSymbolsPerSlot* refer to the number of consecutive slots per frame and the number of consecutive symbols per slot, respectively as specified in TS 38.211 [8].

[TS 38.321, clause 5.8.2]There are two types of transmission without dynamic grant:

- configured grant Type 1 where an uplink grant is provided by RRC, and stored as configured uplink grant;

- configured grant Type 2 where an uplink grant is provided by PDCCH, and stored or cleared as configured uplink grant based on L1 signalling indicating configured uplink grant activation or deactivation.

Type 1 and Type 2 are configured by RRC for a Serving Cell per BWP. Multiple configurations can be active simultaneously in the same BWP. For Type 2, activation and deactivation are independent among the Serving Cells. For the same BWP, the MAC entity can be configured with both Type 1 and Type 2.

RRC configures the following parameters when the configured grant Type 1 is configured:

- *cs-RNTI*: CS-RNTI for retransmission;

- *periodicity*: periodicity of the configured grant Type 1;

- *timeDomainOffset*: Offset of a resource with respect to SFN = *timeReferenceSFN* in time domain;

- *timeDomainAllocation*: Allocation of configured uplink grant in time domain which contains *startSymbolAndLength* (i.e. *SLIV* in TS 38.214 [7]) or *startSymbol* (i.e. *S* in TS 38.214 [7]);

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant;

- *harq-ProcID-Offset*: offset of HARQ process for configured grant for operation with shared spectrum channel access;

- *harq-ProcID-Offset2*: offset of HARQ process for configured grant;

- *timeReferenceSFN*: SFN used for determination of the offset of a resource in time domain. The UE uses the closest SFN with the indicated number preceding the reception of the configured grant configuration.

RRC configures the following parameters when the configured grant Type 2 is configured:

- *cs-RNTI*: CS-RNTI for activation, deactivation, and retransmission;

- *periodicity*: periodicity of the configured grant Type 2;

- *nrofHARQ-Processes*: the number of HARQ processes for configured grant;

- *harq-ProcID-Offset*: offset of HARQ process for configured grant for operation with shared spectrum channel access;

- *harq-ProcID-Offset2*: offset of HARQ process for configured grant.

RRC configures the following parameters when retransmissions on configured uplink grant is configured:

- *cg-RetransmissionTimer*: the duration after a configured grant (re)transmission of a HARQ process when the UE shall not autonomously retransmit that HARQ process.

Upon configuration of a configured grant Type 1 for a BWP of a Serving Cell by upper layers, the MAC entity shall:

1> store the uplink grant provided by upper layers as a configured uplink grant for the indicated BWP of the Serving Cell;

1> initialise or re-initialise the configured uplink grant to start in the symbol according to *timeDomainOffset*, *timeReferenceSFN*, and *S* (derived from *SLIV* or provided by *startSymbol* as specified in TS 38.214 [7]), and to reoccur with *periodicity*.

After an uplink grant is configured for a configured grant Type 1, the MAC entity shall consider sequentially that the Nth (N >= 0) uplink grant occurs in the symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
 (*timeReferenceSFN* × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* *+* *timeDomainOffset* × *numberOfSymbolsPerSlot* + *S* + N × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*).

After an uplink grant is configured for a configured grant Type 2, the MAC entity shall consider sequentially that the Nth (N >= 0) uplink grant occurs in the symbol for which:

[(SFN × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (slot number in the frame × *numberOfSymbolsPerSlot*) + symbol number in the slot] =  
[(SFNstart time × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot* + slotstart time × *numberOfSymbolsPerSlot* + symbolstart time) + N × *periodicity*] modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*).

where SFNstart time, slotstart time, and symbolstart time are the SFN, slot, and symbol, respectively, of the first transmission opportunity of PUSCH where the configured uplink grant was (re-)initialised.

If *cg-nrofPUSCH-InSlot* or *cg-nrofSlots* is configured for a configured grant Type 1 or Type 2, the MAC entity shall consider the uplink grants occur in those additional PUSCH allocations as specified in clause 6.1.2.3 of TS 38.214 [7].

NOTE: In case of unaligned SFN across carriers in a cell group, the SFN of the concerned Serving Cell is used to calculate the occurrences of configured uplink grants.

When the configured uplink grant is released by upper layers, all the corresponding configurations shall be released and all corresponding uplink grants shall be cleared.

The MAC entity shall:

1> if at least one configured uplink grant confirmation has been triggered and not cancelled; and

1> if the MAC entity has UL resources allocated for new transmission:

2> if, in this MAC entity, at least one configured uplink grant is configured by *configuredGrantConfigToAddModList*:

3> instruct the Multiplexing and Assembly procedure to generate a Multiple Entry Configured Grant Confirmation MAC CE as defined in clause 6.1.3.31.

2> else:

3> instruct the Multiplexing and Assembly procedure to generate a Configured Grant Confirmation MAC CE as defined in clause 6.1.3.7.

2> cancel all triggered configured uplink grant confirmation(s).

For a configured grant Type 2, the MAC entity shall clear the configured uplink grant(s) immediately after first transmission of Configured Grant Confirmation MAC CE or Multiple Entry Configured Grant Confirmation MAC CE which confirms the configured uplink grant deactivation.

Retransmissions use:

- repetition of configured uplink grants; or

- received uplink grants addressed to CS-RNTI; or

- configured uplink grants with *cg-RetransmissionTimer* configured.

[TS 38.300, clause 10.3]

In the uplink, the gNB can dynamically allocate resources to UEs via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible grants for uplink transmission when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

The gNB may cancel a PUSCH transmission, or a repetition of a PUSCH transmission, or an SRS transmission of a UE for another UE with a latency-critical transmission. The gNB can configure UEs to monitor cancelled transmission indications using CI-RNTI on a PDCCH. If a UE receives the cancelled transmission indication, the UE shall cancel the PUSCH transmission from the earliest symbol overlapped with the resource or the SRS transmission overlapped with the resource indicated by cancellation (see clause 11.2A of TS 38.213 [38]).

In addition, with Configured Grants, the gNB can allocate uplink resources for the initial HARQ transmissions and HARQ retransmissions to UEs. Two types of configured uplink grants are defined:

- With Type 1, RRC directly provides the configured uplink grant (including the periodicity).

- With Type 2, RRC defines the periodicity of the configured uplink grant while PDCCH addressed to CS-RNTI can either signal and activate the configured uplink grant, or deactivate it; i.e. a PDCCH addressed to CS-RNTI indicates that the uplink grant can be implicitly reused according to the periodicity defined by RRC, until deactivated.

If the UE is not configured with enhanced intra-UE overlapping resources prioritization, the dynamically allocated uplink transmission overrides the configured uplink grant in the same serving cell, if they overlap in time. Otherwise an uplink transmission according to the configured uplink grant is assumed, if activated.

If the UE is configured with enhanced intra-UE overlapping resources prioritization, in case a configured uplink grant transmission overlaps in time with dynamically allocated uplink transmission or with another configured uplink grant transmission in the same serving cell, the UE prioritizes the transmission based on the comparison between the highest priority of the logical channels that have data to be transmitted and which are multiplexed or can be multiplexed in MAC PDUs associated with the overlapping resources. Similarly, in case a configured uplink grant transmissions or a dynamically allocated uplink transmission overlaps in time with a scheduling request transmission, the UE prioritizes the transmission based on the comparison between the priority of the logical channel which triggered the scheduling request and the highest priority of the logical channels that have data to be transmitted and which are multiplexed or can be multiplexed in MAC PDU associated with the overlapping resource. In case the MAC PDU associated with a deprioritized transmission has already been generated, the UE keeps it stored to allow the gNB to schedule a retransmission. The UE may also be configured by the gNB to transmit the stored MAC PDU as a new transmission using a subsequent resource of the same configured uplink grant configuration when an explicit retransmission grant is not provided by the gNB.

Retransmissions other than repetitions are explicitly allocated via PDCCH(s) or via configuration of a retransmission timer.

The UE may be configured with up to 12 active configured uplink grants for a given BWP of a serving cell. When more than one is configured, the network decides which of these configured uplink grants are active at a time (including all of them). Each configured uplink grant can either be of Type 1 or Type 2. For Type 2, activation and deactivation of configured uplink grants are independent among the serving cells. When more than one Type 2 configured grant is configured, each configured grant is activated separately using a DCI command and deactivation of Type 2 configured grants is done using a DCI command, which can either deactivate a single configured grant configuration or multiple configured grant configurations jointly.

When SUL is configured, the network should ensure that an active configured uplink grant on SUL does not overlap in time with another active configured uplink grant on the other UL configuration.

For both dynamic grant and configured grant, for a transport block, two or more repetitions can be in one slot, or across slot boundary in consecutive available slots with each repetition in one slot. For both dynamic grant and configured grant Type 2, the number of repetitions can be also dynamically indicated in the L1 signalling. The dynamically indicated number of repetitions shall override the RRC configured number of repetitions, if both are present.

7.1.1.6.5.3 Test description

7.1.1.6.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 and UM DRB should be established on NR Cell 1.

7.1.1.6.5.3.2 Test procedure sequence

Table 7.1.1.6.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits NR *RRCReconfiguration* messageto configure UL configured grant type 1 in SFN 900, *timeDomainOffset* is set to 5. | <-- | (NR RRC: *RRCReconfiguration*) | - | - |
| 2 | The UE transmits NR *RRCReconfigurationComplete* message. | --> | (NR RRC: *RRCReconfigurationComplete*) | - | - |
| 3 | SS transmits a DL MAC PDU containing 4 RLC SDUs of size 96 bytes in SFN 1022 on UM DRB. (Note 1) | <-- | MAC PDU (nine RLC SDUs) | - | - |
| 4 | Check: Does the UE transmit a MAC PDU containing first RLC SDU in Symbol ‘x0’, Slot y0’, SFN ‘z0’ after the SFN in step 3 wraps around?  Where  [(z0 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y0 × *numberOfSymbolsPerSlot*) + x0] = (5 × *numberOfSymbolsPerSlo*t + S + 0 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). (Note 2) | --> | MAC PDU (one RLC SDU) | 1 | P |
| 5 | Check: Does the UE transmit a MAC PDU containing second RLC SDU in Symbol ‘x1’, Slot y1’, SFN ‘z1’?  Where  [(z1 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y1 × *numberOfSymbolsPerSlot*) + x1] = (5 × *numberOfSymbolsPerSlo*t + S + 1 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 1 | P |
| 6 | SS transmits NR *RRCReconfiguration* message to add another configure UL configured grant type 1 in SFN ‘z1 + 1’, *timeDomainOffset* is set to 15. | <-- | (NR RRC: *RRCReconfiguration)* | - | - |
| 7 | The UE transmits NR *RRCReconfigurationComplete* message | --> | *(*NR RRC: *RRCReconfigurationComplete)* | - | - |
| 8 | Check: Does the UE transmit a MAC PDU containing third RLC SDU in Symbol ‘x0’, Slot y0’, SFN ‘z2’ after the SFN in step 6 wraps around?  Where  [(z2 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y0 × *numberOfSymbolsPerSlot*) + x0] = (5 × *numberOfSymbolsPerSlo*t + S + 0 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 2 | P |
| 9 | Check: Does the UE transmit a MAC PDU containing fourth RLC SDU in Symbol ‘x2’, Slot y2’, SFN ‘z2?  Where  [(z2 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y2 × *numberOfSymbolsPerSlot*) + x2] = (15 × *numberOfSymbolsPerSlo*t + S + 0 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 2 | P |
| 10 | Check: Does the UE transmit a MAC PDU containing fifth RLC SDU in Symbol ‘x1’, Slot y1’, SFN ‘z3’ after the SFN in step 8 wraps around?  Where  [(z3 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y3 × *numberOfSymbolsPerSlot*) + x3] = (5 × *numberOfSymbolsPerSlo*t + S + 1 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 2 | P |
| 11 | Check: Does the UE transmit a MAC PDU containing sixth RLC SDU in Symbol ‘x3’, Slot y3’, SFN ‘z3’?  Where  [(z3 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*) + (y3 × *numberOfSymbolsPerSlot*) + x3] = (15 × *numberOfSymbolsPerSlo*t + S + 1 × *periodicity*) modulo (1024 × *numberOfSlotsPerFrame* × *numberOfSymbolsPerSlot*). | --> | MAC PDU (one RLC SDU) | 2 | P |
| Note 1: According to the setting parameters in Table 7.1.1.6.2.3.3-2, TB size for configured grant type 1 is 808 bits, which is enough to allow the UE to transmit one PDU at a time (96 bytes RLC SDU + 1 byte UM RLC Header + 2 bytes MAC Sub PDU header + 2 bytes for short BSR or padding).  Note 2: S is the starting symbol relative to the slot of the first PUSCH transmission for new configured grant type 1. The value of S can be obtained from TS 38.508-1 [4], Table 4.6.3-122.  Note 3: q is the slot where the UE shall transmit the PUSCH and is determined by  as  where  is the slot with the scheduling DCI,  is based on the numerology of PUSCH. S is the starting symbol relative to the start of the slot q according to TS 38.214 clause 6.1.2.1.  Note 4: The UL grant addressed to C-RNTI should result in UL transmission overlap in time domain as configured grant type 1. | | | | | |

7.1.1.6.5.3.3 Specific message contents

Table 7.1.1.6.5.3.3-1: *RRCReconfiguration* (step 1 and step 6, Table 7.1.1.6.5.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | Not present |  |  |
| secondaryCellGroup | Not Present |  |  |
| nonCriticalExtension := SEQUENCE{ |  |  |  |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| dedicatedNAS-MessageList SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message {} | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.6.5.3.3-2: *CellGroupConfig* (Table 7.1.1.6.5.3.3-1: *RRCReconfiguration*)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList | Not present |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig SEQUENCE { |  |  |  |
| cs-RNTI CHOICE { |  |  |  |
| setup SEQUENCE{ |  |  |  |
| RNTI-Value | ‘FFE0’H |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfig SEQUENCE{ |  |  |  |
| servCellIndex | Not present |  |  |
| reconfigurationWithSync | Not present |  |  |
| spCellConfigDedicated SEQUENCE{ |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| schedulingRequestResourceToAddModList { |  |  |  |
| schedulingRequestResourceId | 1 |  |  |
| schedulingRequestID | 0 |  |  |
| periodicityAndOffset CHOICE { |  |  |  |
| sl20 | 10 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfigToAddModList-r16 SEQUENCE (SIZE (1..maxNrofConfiguredGrantConfig-r16)) OF ConfiguredGrantConfig { | 2 entries |  |  |
| configuredGrantConfig[1] SEQUENCE { |  | The first UL Grant configuration entry | Step1 |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1[4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym40x14 |  | 15kHz |
| periodicity | Sym80x14 |  | 30kHz |
| periodicity | Sym160x14 |  | 60kHz |
| periodicity | Sym320x14 |  | 120kHz |
| rrc-ConfiguredUplinkGrant SEQUENCE{ |  |  |  |
| timeDomainOffset | 5 |  |  |
| timeDomainAllocation | 0 | Reference TS 38.508-1 [4], Table 4.6.3-122 |  |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB = 2 PRB,  RBstart = 0,  NBWPsize is the size [PRBs] of the active carrier bandwidth part and contained in TS.38.508-1 [4] clause 4.3.1.1. | FR1\_FDD, FR1\_TDD |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB=9 PRB,  RBstart = 0and  NBWPsize is the size [PRBs] of the active carrier bandwidth part and contained in TS.38.508-1 [4] clause 4.3.1.2. | FR2\_TDD |
| antennaPort | 0 |  |  |
| precodingAndNumberOfLayers | 0 |  |  |
| srs-ResourceIndicator | Not present |  |  |
| mcsAndTBS | 18 |  | FR1\_FDD, FR1\_TDD |
|  | 25 |  | FR2\_TDD |
| pathlossReferenceIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| configuredGrantConfig[2] SEQUENCE { |  | The second UL Grant configuration entry | Step6 |
| cg-DMRS-Configuration | DMRS-UplinkConfig | Reference TS 38.508-1[4], Table 4.6.3-51 |  |
| uci-OnPUSCH CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| semiStatic SEQUENCE { | BetaOffsets |  |  |
| betaOffsetACK-Index1 | 9 |  |  |
| betaOffsetACK-Index2 | 9 |  |  |
| betaOffsetACK-Index3 | 9 |  |  |
| betaOffsetCSI-Part1-Index1 | 6 |  |  |
| betaOffsetCSI-Part1-Index2 | 6 |  |  |
| betaOffsetCSI-Part2-Index1 | 6 |  |  |
| betaOffsetCSI-Part2-Index2 | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceAllocation | ResourceAllocationType1 |  |  |
| powerControlLoopToUse | n0 |  |  |
| p0-PUSCH-Alpha | 1 |  |  |
| nrofHARQ-Processes | 16 |  |  |
| repK | n1 |  |  |
| periodicity | Sym40x14 |  | 15kHz |
| periodicity | Sym80x14 |  | 30kHz |
| periodicity | Sym160x14 |  | 60kHz |
| periodicity | Sym320x14 |  | 120kHz |
| rrc-ConfiguredUplinkGrant SEQUENCE{ |  |  |  |
| timeDomainOffset | 15 |  |  |
| timeDomainAllocation | 0 | Reference TS 38.508-1 [4], Table 4.6.3-122 |  |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB = 2 PRB,  RBstart = 0,  NBWPsize is the size [PRBs] of the active carrier bandwidth part and contained in TS.38.508-1 [4] clause 4.3.1.1. | FR1\_FDD, FR1\_TDD |
| frequencyDomainAllocation | BIT STRING (SIZE(18) | BIT STRING (SIZE(18), Equal to  NBWPsize \* (LRB-1) + RBstart), where  LRB=9 PRB,  RBstart = 0and  NBWPsize is the size [PRBs] of the active carrier bandwidth part and contained in TS.38.508-1 [4] clause 4.3.1.2. | FR2\_TDD |
| antennaPort | 0 |  |  |
| precodingAndNumberOfLayers | 0 |  |  |
| srs-ResourceIndicator | Not present |  |  |
| mcsAndTBS | 18 |  | FR1\_FDD, FR1\_TDD |
|  | 25 |  | FR2\_TDD |
| pathlossReferenceIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| PUSCH-TimeDomainResourceAllocationList SEQUENCE { |  |  |  |
| k2 | n8 |  | FR1 and FR2 |
| mappingType | typeB |  |  |
| startSymbolAndLength | 0011011 | Start symbol(S)=0, Length(L)=14 | FR1 |
| startSymbolAndLength | 0001110 | S=0, L=2 | FR2 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

#### 7.1.1.7 Activation/Deactivation of SCells

##### 7.1.1.7.1 Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer

###### 7.1.1.7.1.1 Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer / Intra-band Contiguous CA

7.1.1.7.1.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with SCell configured }

**ensure that** {

**when** { UE receives an SCell Activation/Deactivation MAC CE activating the Scell }

**then** { UE starts monitoring PDCCH on activated SCell }

}

(2)

**with**(UE in RRC\_CONNECTED state with SCell activated )

**ensure that** {

**when**{ UE receives a DL assignment on SCell PDCCH }

**then** { UE restarts the sCellDeactivationTimer }

}

(3)

**with** ( UE in RRC\_CONNECTED state with SCell activated )

**ensure that** {

**when**{ UE sCellDeactivationTimer expires }

**then** { UE deactivates the SCell and stops monitoring PDCCH on SCell }

}

(4)

**with** (UE in RRC\_CONNECTED state with SCell activated )

**ensure that** {

**when**{ UE receives a SCell Activation/Deactivation MAC CE deactivating the SCell }

**then** { UE deactivates the SCell and stops monitoring PDCCH on SCell }

}

(5)

**with**( UE in RRC\_CONNECTED state with SCell activated and UL CA is supported)

**ensure that** {

**when**{ UE receives a UL assignment on SCell and has data available for transmission }

**then** { UE transmits the UL MAC PDU }

}

7.1.1.7.1.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.9 and TS 38.331 clause 5.3.5.5.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.9]

If the MAC entity is configured with one or more SCells, the network may activate and deactivate the configured SCells. Upon configuration of an SCell, the SCell is deactivated.

The configured SCell(s) is activated and deactivated by:

- receiving the SCell Activation/Deactivation MAC CE described in subclause 6.1.3.10;

- configuring *sCellDeactivationTimer* timer per configured SCell (except the SCell configured with PUCCH, if any): the associated SCell is deactivated upon its expiry.

The MAC entity shall for each configured SCell:

1> if an SCell Activation/Deactivation MAC CE is received activating the SCell:

2> activate the SCell according to the timing defined in TS 38.213 [6]; i.e. apply normal SCell operation including:

3> SRS transmissions on the SCell;

3> CSI reporting for the SCell;

3> PDCCH monitoring on the SCell;

3> PDCCH monitoring for the SCell;

3> PUCCH transmissions on the SCell, if configured.

2> start or restart the *sCellDeactivationTimer* associated with the SCell in the slot when the SCell Activation/Deactivation MAC CE was received;

2> (re-)initialize any suspended configured uplink grants of configured grant Type 1 associated with this SCell according to the stored configuration, if any, and to start in the symbol according to rules in subclause 5.8.2;

2> trigger PHR according to subclause 5.4.6.

1> else if an SCell Activation/Deactivation MAC CE is received deactivating the SCell; or

1> if the *sCellDeactivationTimer* associated with the activated SCell expires:

2> deactivate the SCell according to the timing defined in TS 38.213 [6];

2> stop the *sCellDeactivationTimer* associated with the SCell;

2> stop the *bwp-InactivityTimer* associated with the SCell;

2> clear any configured downlink assignment and any configured uplink grant Type 2 associated with the SCell respectively;

2> suspend any configured uplink grant Type 1 associated with the SCell;

2> flush all HARQ buffers associated with the SCell.

1> if PDCCH on the activated SCell indicates an uplink grant or downlink assignment; or

1> if PDCCH on the Serving Cell scheduling the activated SCell indicates an uplink grant or a downlink assignment for the activated SCell; or

1> if a MAC PDU is transmitted in a configured uplink grant or received in a configured downlink assignment:

2> restart the *sCellDeactivationTimer* associated with the SCell.

1> if the SCell is deactivated:

2> not transmit SRS on the SCell;

2> not report CSI for the SCell;

2> not transmit on UL-SCH on the SCell;

2> not transmit on RACH on the SCell;

2> not monitor the PDCCH on the SCell;

2> not monitor the PDCCH for the SCell;

2> not transmit PUCCH on the SCell.

HARQ feedback for the MAC PDU containing SCell Activation/Deactivation MAC CE shall not be impacted by PCell, PSCell and PUCCH SCell interruptions due to SCell activation/deactivation in TS 38.133 [11].

When SCell is deactivated, the ongoing Random Access procedure on the SCell, if any, is aborted.

[TS 38.321, clause 6.1.3.10]

The SCell Activation/Deactivation MAC CE of one octet is identified by a MAC PDU subheader with LCID as specified in Table 6.2.1-1. It has a fixed size and consists of a single octet containing seven C-fields and one R-field. The SCell Activation/Deactivation MAC CE with one octet is defined as follows (Figure 6.1.3.10-1).

The SCell Activation/Deactivation MAC CE of four octets is identified by a MAC PDU subheader with LCID as specified in Table 6.2.1-1. It has a fixed size and consists of four octets containing 31 C-fields and one R-field. The SCell Activation/Deactivation MAC CE of four octets is defined as follows (Figure 6.1.3.10-2).

For the case with no Serving Cell with a *ServCellIndex* as specified in TS 38.331 [8] larger than 7, SCell Activation/Deactivation MAC CE of one octet is applied, otherwise SCell Activation/Deactivation MAC CE of four octets is applied.

- Ci: If there is an SCell configured for the MAC entity with *SCellIndex* i as specified in TS 38.331 [8], this field indicates the activation/deactivation status of the SCell with *SCellIndex* i, else the MAC entity shall ignore the Ci field. The Ci field is set to "1" to indicate that the SCell with *SCellIndex* i shall be activated. The Ci field is set to "0" to indicate that the SCell with *SCellIndex* i shall be deactivated;

- R: Reserved bit, set to "0".



Figure 6.1.3.10-1: SCell Activation/Deactivation MAC CE of one octet



Figure 6.1.3.10-2: SCell Activation/Deactivation MAC CE of four octets

7.1.1.7.1.1.3 Test description

7.1.1.7.1.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that DRB is configured in RLC AM mode according to Table 7.1.1. 7.1.1.3.1-1 and in additionNR Cell 3 is configured as NR Active SCell.

Table 7.1.1. 7.1.1.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms80 |

7.1.1.7.1.1.3.2 Test procedure sequence

Table 7.1.1.7.1.1.3.2-1: Time instances of cell power level and parameter changes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Parameter** | **Unit** | **NR Cell 1** | **NR Cell 3** |
| T0 | SS/PBCH SSS EPRE | dBm/SCS | -85 | -85 |

Table 7.1.1.7.1.1.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | SS transmits an RRCReconfiguration message toconfigure NR SCell(NR Cell 3). Note 1 | <-- | (RRCReconfiguration) | - | - |
| 2 | The UE transmits RRCReconfigurationComplete message. Note 2 | --> | (RRCReconfigurationComplete) | - | - |
| 3 | The SS transmits Activation MAC control element to activate NR SCell on NR SpCell. | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=1)) | - | - |
| 4 | 200 ms after step 3, the SS indicates a new transmission on PDCCH of SCell and transmits a MAC PDU (containing an RLC PDU) | <-- | MAC PDU | - | - |
| 5 | Check: Does the UE transmit a Scheduling Request on PUCCH? | --> | (SR) | 1 | P |
| 6 | The SS sends an UL grant suitable for transmitting loop back PDU on NR SpCell. | <-- | (UL Grant) | - | - |
| 7 | The UE transmits a MAC PDU containing the loop back PDU corresponding to step 4. | --> | MAC PDU | - | - |
| 8 | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 7 on NR SpCell | <-- | MAC PDU | - | - |
| 9 | 400 ms(sCellDeactivationTimer = 320 ms) after step 4, the SS indicates a new transmission on PDCCH of NR SCell and transmits a MAC PDU (containing an RLC PDU) | <-- | MAC PDU | - | - |
| 10 | Check: Does the UE transmit a Scheduling Request on PUCCH in next 1 second? | --> | (SR) | 2 | F |
| 11 | The SS transmits Activation MAC control element to activate SCell on NR SpCell. | <-- | MAC PDU ((SCell Activation/Deactivation MAC CE of one octet (C1=1)) | - | - |
| 12 | 200 ms after step 11 The SS indicates a new transmission on PDCCH of NR SCell and transmits a MAC PDU (containing just padding or RLC status PDU, but no RLC data PDU) | <-- | MAC PDU | - | - |
| 13 | 400 ms after step 11 the SS indicates a new transmission on PDCCH of NR SCell and transmits a MAC PDU (containing an RLC PDU) | <-- | MAC PDU | - | - |
| 14 | Check: Does the UE transmit a Scheduling Request on PUCCH? | --> | (SR) | 1,3 | P |
| 15 | The SS sends an UL grant suitable for transmitting loop back PDU IF pc\_UL\_NR\_CA\_2CC on NR SCell ELSE on NR SpCell. | <-- | (UL Grant) | - | - |
| 16 | The UE transmits a MAC PDU containing the loop back PDU corresponding to step 14 | --> | MAC PDU | 5 | P |
| 17 | The SS transmits a MAC PDU containing RLC status PDU acknowledging reception of RLC PDU in step 16 | <-- | MAC PDU | - | - |
| 18 | The SS transmits Deactivation MAC control element to de-activate SCell on NR SpCell. | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=0)) | - | - |
| 19 | The SS indicates a new transmission on PDCCH of NR SCell and transmits a MAC PDU (containing an RLC PDU) | <-- | MAC PDU | - | - |
| 20 | Check: Does the UE transmit a Scheduling Request on PUCCH in the next 1 second? | --> | (SR) | 4 | F |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete.* | | | | | |

7.1.1.7.1.1.3.3 Specific message contents

Table 7.1.1.7.1.1.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.1.7.1.1.3.2-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| c1 CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig |  | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.7.1.1.3.3-2: CellGroupConfig (Table 7.1.1.7.1.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { | |  |  |  |
| sCellToAddModList SEQUENCE (SIZE (1..maxMeasId)) OF SCellConfig { | | 1 entry |  |  |
| SCellConfig[1] SEQUENCE { | |  | entry 1 |  |
| sCellIndex | | SCellIndex as per TS 38.508-1 [4] table 4.6.3-154 |  |  |
| sCellConfigCommon | | ServingCellConfigCommon |  |  |
| sCellConfigDedicated | | ServingCellConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.7.1.1.3.3-3: ServingCellConfigCommon (Table 7.1.1.7.1.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 3 |  |  |
| uplinkConfigCommon | Not present |  | Not pc\_UL\_NR\_CA\_2CC |
| } |  |  |  |

Table 7.1.1.7.1.1.3.3-4: ServingCellConfig (Table 7.1.1.7.1.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig | Not present |  | Not pc\_UL\_NR\_CA\_2CC |
| uplinkConfig SEQUENCE { |  |  | pc\_UL\_NR\_CA\_2CC |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| } |  |  |  |
| sCellDeactivationTimer | ms320 |  |  |
| } |  |  |  |

Table 7.1.1.7.1.1.3.3-5: BWP-UplinkDedicated (Table 7.1.1.7.1.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-15 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkDedicated ::= SEQUENCE { |  |  |  |
| pucch-Config | Not present |  |  |
| } |  |  |  |

###### 7.1.1.7.1.2 Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer / Inter-Band CA

The scope and description of the present TC is the same as test case 7.1.1.7.1.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA

- Cells configuration: NR Cell 10 replaces NR Cell 3

###### 7.1.1.7.1.3 Activation/Deactivation of SCells / Activation/Deactivation MAC control element reception / sCellDeactivationTimer / Intra-band non-Contiguous CA

The scope and description of the present TC is the same as test case 7.1.1.7.1.1 with the following differences:

- CA configuration: Intra-band non-Contiguous CA replaces Intra-band Contiguous CA

#### 7.1.1.8 Bandwidth Part (BWP) operation

##### 7.1.1.8.1 Bandwidth Part (BWP) operation UL/DL

7.1.1.8.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives BandwidthPart-Config IE included in RRC Message received on SpCell (i.e. PSCell in case of EN-DC or PCell in case of SA) }

**then** { UE starts normal MAC operation in the FirstActive UL and DL Bandwidth part }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a DL DCI format 1\_1 assigning a BWP different than the previously configured BWP }

**then** { UE starts normal MAC operation in the received new BWP }

}

(3)

**with** { UE in RRC\_CONNECTED }

**ensure that** {

**when** { UE receives a UL DCI format 0\_1 assigning a BWP different than the previously configured BWP }

**then** { UE starts normal MAC operation in the received new BWP }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE determines that a RACH Procedure is triggered in SpCell (i.e. PSCell in case of EN-DC or PCell in case of SA) and PRACH occasions are not configured }

**then** { UE initiates the PRACH procedure in the initial BWP }

}

(5)

**with** { UE in RRC\_Connected State with defaultDownlinkBWP configured }

**ensure that** {

**when** { UE bwp-InactivityTimer expires }

**then** { UE performs BWP switching to a BWP indicated by the defaultDownlinkBWP }

}

(6)

**with** { UE in RRC\_Connected State with defaultDownlinkBWP configured and Active BWP is different than defaultDownlinkBWP and bwp-InactivityTimer is running }

**ensure that** {

**when** { UE receives UL assignment or DL grant addressed to its C-RNTI }

**then** { UE restarts the bwp-InactivityTimer }

}

7.1.1.8.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.211 clause 4.4.5, TS 38.212 clause 7.3.1.1.2 and 7.3.1.2.2, TS 38.321 clause 5.15 and TS 38.331 clause 5.3.5.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.211, clause 4.4.5]

A bandwidth part is a subset of contiguous common resource blocks defined in subclause 4.4.4.3 for a given numerology  in bandwidth part  on a given carrier. The starting position  and the number of resource blocks  in a bandwidth part shall fulfil  and , respectively. Configuration of a bandwidth part is described in clause 12 of [5, TS 38.213].

A UE can be configured with up to four bandwidth parts in the downlink with a single downlink bandwidth part being active at a given time. The UE is not expected to receive PDSCH, PDCCH, or CSI-RS (except for RRM) outside an active bandwidth part.

A UE can be configured with up to four bandwidth parts in the uplink with a single uplink bandwidth part being active at a given time. If a UE is configured with a supplementary uplink, the UE can in addition be configured with up to four bandwidth parts in the supplementary uplink with a single supplementary uplink bandwidth part being active at a given time. The UE shall not transmit PUSCH or PUCCH outside an active bandwidth part. For an active cell, the UE shall not transmit SRS outside an active bandwidth part.

Unless otherwise noted, the description in this specification applies to each of the bandwidth parts. When there is no risk of confusion, the index may be dropped from , , , and .



[TS 38.212, clause 7.3.1.1.2]

DCI format 0\_1 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Carrier indicator – 0 or 3 bits, as defined in Subclause 10.1 of [5, TS 38.213].

- UL/SUL indicator – 0 bit for UEs not configured with SUL in the cell or UEs configured with SUL in the cell but only PUCCH carrier in the cell is configured for PUSCH transmission; 1 bit for UEs configured with SUL in the cell as defined in Table 7.3.1.1.1-1.

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of UL BWPs configured by higher layers, excluding the initial UL bandwidth part. The bitwidth for this field is determined as bits, where



- if , in which case the bandwidth part indicator is equivalent to the ascending order of the higher layer parameter *BWP-Id*;



- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;



If a UE does not support active BWP change via DCI, the UE ignores this bit field.

[TS 38.212, clause 7.3.1.2.2]

DCI format 1\_1 is used for the scheduling of PDSCH in one cell.

The following information is transmitted by means of the DCI format 1\_1 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bits

- The value of this bit field is always set to 1, indicating a DL DCI format

- Carrier indicator – 0 or 3 bits as defined in Subclause 10.1 of [5, TS 38.213].

- Bandwidth part indicator – 0, 1 or 2 bits as determined by the number of DL BWPs configured by higher layers, excluding the initial DL bandwidth part. The bitwidth for this field is determined as bits, where



- if , in which case the bandwidth part indicator is equivalent to the higher layer parameter *BWP-Id*;



- otherwise , in which case the bandwidth part indicator is defined in Table 7.3.1.1.2-1;



If a UE does not support active BWP change via DCI, the UE ignores this bit field.

[TS 38.321, clause 5.15]

In addition to clause 12 of TS 38.213 [6], this subclause specifies requirements on BWP operation.

A Serving Cell may be configured with one or multiple BWPs, and the maximum number of BWP per Serving Cell is specified in TS 38.213 [6].

The BWP switching for a Serving Cell is used to activate an inactive BWP and deactivate an active BWP at a time. The BWP switching is controlled by the PDCCH indicating a downlink assignment or an uplink grant, by the *bwp-InactivityTimer*, by RRC signalling, or by the MAC entity itself upon initiation of Random Access procedure. Upon RRC (re-)configuration of *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* for SpCell or activation of an SCell, the DL BWP and/or UL BWP indicated by *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* respectively (as specified in TS 38.331 [5]) is active without receiving PDCCH indicating a downlink assignment or an uplink grant. The active BWP for a Serving Cell is indicated by either RRC or PDCCH (as specified in TS 38.213 [6]). For unpaired spectrum, a DL BWP is paired with a UL BWP, and BWP switching is common for both UL and DL.

For each activated Serving Cell configured with a BWP, the MAC entity shall:

1> if a BWP is activated:

2> transmit on UL-SCH on the BWP;

2> transmit on RACH on the BWP, if PRACH occasions are configured;

2> monitor the PDCCH on the BWP;

2> transmit PUCCH on the BWP, if configured;

2> report CSI for the BWP;

2> transmit SRS on the BWP, if configured;

2> receive DL-SCH on the BWP;

2> (re-)initialize any suspended configured uplink grants of configured grant Type 1 on the active BWP according to the stored configuration, if any, and to start in the symbol according to rules in subclause 5.8.2.

1> if a BWP is deactivated:

2> not transmit on UL-SCH on the BWP;

2> not transmit on RACH on the BWP;

2> not monitor the PDCCH on the BWP;

2> not transmit PUCCH on the BWP;

2> not report CSI for the BWP;

2> not transmit SRS on the BWP;

2> not receive DL-SCH on the BWP;

2> clear any configured downlink assignment and configured uplink grant of configured grant Type 2 on the BWP;

2> suspend any configured uplink grant of configured grant Type 1 on the inactive BWP.

Upon initiation of the Random Access procedure on a Serving Cell, after the selection of carrier for performing Random Access procedure as specified in subclause 5.1.1, the MAC entity shall for the selected carrier of this Serving Cell:

1> if PRACH occasions are not configured for the active UL BWP:

2> switch the active UL BWP to BWP indicated by *initialUplinkBWP*;

2> if the Serving Cell is a SpCell:

3> switch the active DL BWP to BWP indicated by *initialDownlinkBWP*.

1> else:

2> if the Serving Cell is a SpCell:

3> if the active DL BWP does not have the same *bwp-Id* as the active UL BWP:

4> switch the active DL BWP to the DL BWP with the same *bwp-Id* as the active UL BWP.

1> stop the *bwp-InactivityTimer* associated with the active DL BWP of this Serving Cell, if running.

1> if the Serving Cell is SCell:

2> stop the *bwp-InactivityTimer* associated with the active DL BWP of SpCell, if running.

1> perform the Random Access procedure on the active DL BWP of SpCell and active UL BWP of this Serving Cell.

If the MAC entity receives a PDCCH for BWP switching of a Serving Cell, the MAC entity shall:

1> if there is no ongoing Random Access procedure associated with this Serving Cell; or

1> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in subclauses 5.1.4 and 5.1.5):

2> perform BWP switching to a BWP indicated by the PDCCH.

If the MAC entity receives a PDCCH for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, it is up to UE implementation whether to switch BWP or ignore the PDCCH for BWP switching, except for the PDCCH reception for BWP switching addressed to the C-RNTI for successful Random Access procedure completion (as specified in subclauses 5.1.4 and 5.1.5) in which case the UE shall perform BWP switching to a BWP indicated by the PDCCH. Upon reception of the PDCCH for BWP switching other than successful contention resolution, if the MAC entity decides to perform BWP switching, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching; if the MAC decides to ignore the PDCCH for BWP switching, the MAC entity shall continue with the ongoing Random Access procedure on the Serving Cell.

Upon reception of RRC (re-)configuration for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching.

The MAC entity shall for each activated Serving Cell configured with *bwp-InactivityTimer*:

1> if the *defaultDownlinkBWP-Id* is configured, and the active DL BWP is not the BWP indicated by the *defaultDownlinkBWP-Id*; or

1> if the *defaultDownlinkBWP-Id* is not configured, and the active DL BWP is not the *initialDownlinkBWP*:

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received on the active BWP; or

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received for the active BWP; or

2> if a MAC PDU is transmitted in a configured uplink grant or received in a configured downlink assignment:

3> if there is no ongoing random access procedure associated with this Serving Cell; or

3> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in subclauses 5.1.4 and 5.1.5):

4> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

2> if the *bwp-InactivityTimer* associated with the active DL BWP expires:

3> if the *defaultDownlinkBWP-Id* is configured:

4> perform BWP switching to a BWP indicated by the *defaultDownlinkBWP-Id*.

3> else:

4> perform BWP switching to the *initialDownlinkBWP*.

NOTE: If a Random Access procedure is initiated on an SCell, both this SCell and the SpCell are associated with this Random Access procedure.

1> if a PDCCH for BWP switching is received, and the MAC entity switches the active DL BWP:

2> if the *defaultDownlinkBWP-Id* is configured, and the MAC entity switches to the DL BWP which is not indicated by the *defaultDownlinkBWP-Id*; or

2> if the *defaultDownlinkBWP-Id* is not configured, and the MAC entity switches to the DL BWP which is not the *initialDownlinkBWP*:

3> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

[TS 38.331, clause 5.2.1]

System Information (SI) is divided into the *MIB* and a number of SIBs where:

- ...

- For a UE in RRC\_CONNECTED, the network can provide system information through dedicated signalling using the *RRCReconfiguration* message, e.g. if the UE has an active BWP with no common search space configured to monitor system information or paging.

- For PSCell and SCells, the network provides the required SI by dedicated signalling, i.e. within an *RRCReconfiguration* message. Nevertheless, the UE shall acquire MIB of the PSCell to get SFN timing of the SCG (which may be different from MCG). Upon change of relevant SI for SCell, RAN releases and adds the concerned SCell. For PSCell, SI can only be changed with Reconfiguration with Sync.

NOTE: The physical layer imposes a limit to the maximum size a SIB can take. The maximum *SIB1* or *SI message* size is 2976 bits.

[TS 38.331, clause 5.3.5.3]

The UE shall perform the following actions upon reception of the *RRCReconfiguration*:

...

1> if the UE is configured with E-UTRA *nr-SecondaryCellGroupConfig* (MCG is E-UTRA):

2> if *RRCReconfiguration* was received via SRB1:

3> submit the *RRCReconfigurationComplete* via the EUTRA MCG embedded in E-UTRA RRC message *RRCConnectionReconfigurationComplete* as specified in TS 36.331 [10];

3> if reconfigurationWithSync was included in spCellConfig of an SCG:

4> initiate the random access procedure on the SpCell, as specified in TS 38.321 [3];

...

NOTE: For EN-DC, in the case *RRCReconfiguration* is received via SRB1, the random access is triggered by RRC layer itself as there is not necessarily other UL transmission. In the case *RRCReconfiguration* is received via SRB3, the random access is triggered by the MAC layer due to arrival of *RRCReconfigurationComplete*.

7.1.1.8.1.3 Test description

7.1.1.8.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

7.1.1.8.1.3.2 Test procedure sequence

Table 7.1.1.8.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |
| 0 | The SS transmits RRCReconfiguration to configure the dedicated BWPs incl. the FirstActive BWP. (Note 1) (Note 4). | <-- | *(RRCReconfiguration)* | - | - |
| - | EXCEPTION: Steps 0Aa1 to 0Ab2 describe behaviour which depends on procedure parameters; the "lower case letter" identifies a step sequence that take place if a procedure parameter has a particular value. | - | - | - | - |
| 0Aa1 | IF *Connectivity* is *EN-DC* or *NGEN-DC*, the UE sends RRCReconfigurationComplete (Note 2). | --> | *(RRCReconfigurationComplete)* | - | - |
| 0Ab1 | IF *Connectivity* is *NR*, the SS allocates (transmitted in FirstActiveDownlinkBWP) an UL Grant with DCI format 0\_1 indicating FirstActiveUplinkBWP (BWP#1). | <-- | UL Grant | - | - |
| 0Ab2 | Check: Does the UE send RRCReconfigurationComplete in the FirstActive BWP configured? (Note 2) (Note 3) (Note 5) | --> | *(RRCReconfigurationComplete)* | 1 | P |
| 1 | The SS transmits a valid MAC PDU containing RLC PDU in the configured FirstActive Downlink BWP configured. | <-- | MAC PDU | - | - |
| 2 | After 100ms from step 1, the SS allocates (transmitted in FirstActiveDownlinkBWP) an UL Grant. | <-- | UL Grant | - | - |
| 3 | Check: Does the UE transmit a MAC PDU including one RLC SDU in the FirstActive BWP configured? (Note 5) | --> | MAC PDU | 1 | P |
| 4 | Void | - | - | - | - |
| 5 | The SS indicates on PDCCH (transmitted in Downlink BWP#1) DL DCI format 1\_1 with new BWP Id (= BWP #2) and transmits a MAC PDU containing RLC PDU on the newly configured BWP (i.e. Downlink BWP#2). | <-- | MAC PDU | - | - |
| 6 | After 100ms from step5, the SS allocates (transmitted in Downlink BWP#2) an UL Grant (with DCI indicating BWP#2), sufficient for loopback of the RLC SDU from step 5 in a Slot. (Note 3) | <-- | UL Grant | - | - |
| 7 | Check: Does the UE transmit a MAC PDU including one RLC SDU in the configured BWP (i.e. Uplink BWP#2)? (Note 5) | --> | MAC PDU | 2 | P |
| 8 | Void | - | - | - | - |
| 9 | The SS transmits a valid MAC PDU containing RLC PDU in the configured BWP (i.e. Downlink BWP#2). | <-- | MAC PDU | - | - |
| 10 | After 100ms from step 9 the SS indicates on PDCCH (transmitted in Downlink BWP#2) UL DCI format 0\_1 with new BWP Id (=IF pc\_bwp\_sameNumerology\_upto4, THEN BWP #3 ELSE BWP #1) and allocates an UL Grant, sufficient for loopback of the RLC SDU from step 9 in a Slot. | <-- | UL Grant | - | - |
| 11 | Check: Does the UE transmit a MAC PDU including one RLC SDU in the configured BWP (i.e. (IF pc\_bwp\_sameNumerology\_upto4, THEN BWP #3 ELSE BWP #1, for FDD and for TDD)? (Note 5) | --> | MAC PDU | 3 | P |
| 11A | The SS transmits a valid MAC PDU containing RLC PDU in the configured BWP (i.e. Downlink BWP#2 for FDD) or (IF pc\_bwp\_sameNumerology\_upto4, THEN BWP #3 ELSE BWP #1 for TDD). | <-- | MAC PDU | - | - |
| 12 | After 100ms from step 11A the SS indicates PDCCH order on CSS for contention-based random access (transmitted in Downlink BWP#2 for FDD OR (IF pc\_bwp\_sameNumerology\_upto4, THEN BWP #3 ELSE BWP #1 for TDD). | <-- | PDCCH Order  (ra-PreambleIndex = '000000'B) | - | - |
| 13 | Check: Does the UE send PRACH Preamble in the initial BWP (UL BWP#0)? | --> | PRACH Preamble | 4 | P |
| 13A | The SS transmits (in Downlink BWP #0) a MAC PDU addressed to UE RA-RNTI, containing RAR with matching RAPID in MAC sub header. | <-- | Random Access Response | - | - |
| 13B | The UE sends (in UL BWP#0) a msg3 in the grant associated to the received Random Access Response. | --> | msg3 (C-RNTI MAC CONTROL ELEMENT) | - | - |
| 13C | SS schedules (in Downlink BWP#0) PDCCH transmission for UE C-RNTI and allocates UL grant sufficient for the UE to loop back the data received at step 11a. | <-- | Contention Resolution | - | - |
| 13D | Check: Does the UE transmit a MAC PDU including one RLC SDU in the initial BWP (i.e. Uplink BWP#0)? (Note 5) | --> | MAC PDU | 4 | P |
| 14-15 | Void | - | *-* | - | - |
| 16 | The SS indicates on PDCCH (transmitted in Downlink BWP#0) DL DCI format 1\_1 with BWP Id (= BWP #1) and transmits a MAC PDU containing RLC PDU on the configured BWP (i.e. Downlink BWP#1). | <-- | *MAC PDU* | - | - |
| 17 | After 400 ms from step 16, the SS transmits another valid MAC PDU containing RLC PDU in the active BWP (i.e. Downlink BWP#1). | <-- | *MAC PDU* | - | - |
| 18 | After 400 ms from step 17, the SS allocates (transmitted in Downlink BWP#1) an UL Grant (with DCI indicating BWP#1), sufficient for loopback of a MAC PDU containing both RLC SDUs from steps 16 and 17 in a Slot. (Note 3) | <-- | *UL Grant* | - | - |
| 19 | Check: Does the UE transmit a MAC PDU containing both RLC SDUsin the active BWP (i.e. Uplink BWP#1)? (Note 5) | --> | *MAC PDU* | 5 | P |
| 20 | The SS waits 1000 ms from step 18 to ensure that the bwp-InactivityTimer expired and then transmits a valid MAC PDU containing RLC PDU in the BWP with defaultDownlinkBWP-Id (= Downlink BWP#2). | <-- | MAC PDU | - | - |
| 21 | The SS allocates (transmitted in the defaultDownlinkBWP, i.e. Downlink BWP#2) an UL Grant (with DCI indicating BWP#2), sufficient for loopback of the RLC SDU from step 20 in a Slot. (Note 3) | <-- | UL Grant | - | - |
| 22 | Check: Does the UE transmit a MAC PDU in Uplink BWP#2 (= BWP Id of the defaultDownlinkBWP)? (Note 5) | --> | MAC PDU | 6 | P |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete*.  Note 3: In paired spectrum (= FDD), the switching of Downlink BWP and Uplink BWP can happen independently. Whereas in TDD, the switching of BWP for Downlink and Uplink is always at the same time instance. Currently, the scope of the Test Purposes (TP) is considered to not cover checking of a BWP deviation which results from non-synchronized Downlink and Uplink BWP switching in FDD.  Note 4: After the preamble the UE is in RRC\_CONNECTED, therefore SRBs and DRBs are already established. The RRCReconfiguration message in step 1 and step 14 shall not contain any elements like e.g. "rlc-BearerToAddModList" whose value(s) remain unchanged since the preamble. The sole purpose of the RRCReconfiguration message in step 1 and 14 is to configure BWPs and related fields for switching of BWPs.  Note 5: When the UE does not use the expected BWP for the UL transmission the SS shall not receive the data what implicitly fails the test case. | | | | | |

7.1.1.8.1.3.3 Specific message contents

Table 7.1.1.8.1.3.3-0: Conditions for specific message contents

|  |  |
| --- | --- |
| Condition | Explanation |
| BWP#1 | Bandwidth part 1 |
| BWP#2 | Bandwidth part 2 |
| BWP#3 | Bandwidth part 3 |

Table 7.1.1.8.1.3.3-1: RRCReconfiguration (step 0)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 (see also Note 4 in Table 7.1.1.8.1.3.2-1) | | | |
| **Information Element** | | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig |  | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.8.1.3.3-1A: CellGroupConfig (Table 7.1.1.8.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig | Not present |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| servCellIndex | Not present |  |  |
| ServCellIndex |  | EN-DC |
| spCellConfigCommon | Not present |  |  |
| rlf-TimersAndConstants | Not present |  |  |
| spCellConfigDedicated | ServingCellConfig*-*Dedicated | Table 7.1.1.8.1.3.3-2 |  |
| } |  |  |  |
| reportUplinkTxDirectCurrent-v1530 | true |  |  |
| } |  |  |  |

Table 7.1.1.8.1.3.3-2: *ServingCellConfig-Dedicated* (Table 7.1.1.8.1.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4] Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| tdd-UL-DL-ConfigurationDedicated | Not present |  |  |
| TDD-UL-DL-ConfigDedicated |  | TDD |
| ..initialDownlinkBWP ::= SEQUENCE { |  |  |  |
| pdcch-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| pdsch-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |
| downlinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) BWP-Downlink { | 3 entries |  |  |
| BWP-Downlink[1] | BWP-Downlink-BWP-N with condition BWP#1 | entry 1 |  |
| BWP-Downlink[2] | BWP-Downlink-BWP-N with condition BWP#2 | entry 2 |  |
| BWP-Downlink[3] | BWP-Downlink-BWP-N with condition BWP#3 | entry 3 | pc\_bwp\_sameNumerology\_upto4 |
| } |  |  |  |
| firstActiveDownlinkBWP-Id | 1 |  |  |
| bwp-InactivityTimer | ms750 |  |  |
| defaultDownlinkBWP-Id | 2 |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP ::= SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| srs-Config CHOICE { |  |  |  |
| release | NULL |  |  |
| } |  |  |  |
| } |  |  |  |
| uplinkBWP-ToReleaseList | Not present |  |  |
| uplinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Uplink { | 3 entries |  |  |
| BWP-Uplink[1] | BWP-Uplink-BWP-N with condition BWP#1 | entry 1 |  |
| BWP-Uplink[2] | BWP-Uplink-BWP-N with condition BWP#2 | entry 2 |  |
| BWP-Uplink[3] | BWP-Uplink-BWP-N with condition BWP#3 | entry 3 | pc\_bwp\_sameNumerology\_upto4 |
| } |  |  |  |
| firstActiveUplinkBWP-Id | 1 |  |  |
| pusch-ServingCellConfig | Not present |  |  |
| } |  |  |  |
| pdcch-ServingCellConfig | Not present |  |  |
| pdsch-ServingCellConfig | Not present |  |  |
| csi-MeasConfig | CSI-MeasConfig for TRS |  | pc\_bwp-WithoutRestriction = True |
| } |  |  |  |

Table 7.1.1.8.1.3.3-2A: *BWP-Downlink-BWP-N* (Table 7.1.1.8.1.3.3-2 and Table 7.1.1.8.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-9 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-Downlink ::= SEQUENCE { |  |  |  |
| bwp-Id | 1 |  | BWP#1 |
|  | 2 |  | BWP#2 |
|  | 3 |  | BWP#3 |
| bwp-Common SEQUENCE { |  |  |  |
| genericParameters SEQUENCE { |  |  |  |
| locationAndBandwidth | 1381 | Note 1 | BWP#1 and pc\_bwp-WithoutRestriction = True |
|  | 1387 | Note 1 | BWP#2 and pc\_bwp-WithoutRestriction = True |
|  | 1393 | Note 1 | BWP#3 and pc\_bwp-WithoutRestriction = True |
|  | 6600 | Note 2 | BWP#1,2,3 and pc\_bwp-WithoutRestriction = False and 5MHz |
|  | 7975 | Note 3 | BWP#1 and pc\_bwp-WithoutRestriction = False |
|  | 9625 | Note 3 | BWP#2 and pc\_bwp-WithoutRestriction = False |
|  | 11275 | Note 3 | BWP#3 and pc\_bwp-WithoutRestriction = False |
|  | 12925 | Note 4 | BWP#1and pc\_bwp-WithoutRestriction = False and 100MHz |
|  | 14575 | Note 4 | BWP#2and pc\_bwp-WithoutRestriction = False and 100MHz |
|  | 16225 | Note 4 | BWP#3 and pc\_bwp-WithoutRestriction = False and 100MHz |
| } |  |  |  |
| pdcch-ConfigCommon | Not present | no cell specific configuration for dedicated BWP |  |
| pdsch-ConfigCommon | Not present | no cell specific configuration for dedicated BWP |  |
| } |  |  |  |
| bwp-Dedicated SEQUENCE { |  |  |  |
| pdcch-Config CHOICE { |  |  |  |
| setup | PDCCH-Config-BWP-N |  |  |
| } |  |  |  |
| pdsch-Config CHOICE { |  |  |  |
| setup | PDSCH-Config-BWP-N |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| Note 1: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=6 and RBStart=6,12,18 for BWP#1,2,3  Note 2: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=25 and RBStart=0 for BWP#1,2,3  Note 3: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=30,36,42 and RBStart=0 for BWP#1,2,3  Note 4: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=48,54,60 and RBStart=0 for BWP#1,2,3 | | | |

Table 7.1.1.8.1.3.3-2B: *PDCCH-Config-BWP-N* (Table 7.1.1.8.1.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE (SIZE (1..3)) OF ControlResourceSet { | 2 entries |  |  |
| ControlResourceSet[1] | ControlResourceSet-BWP-N with condition BWP#N | entry 1 |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE (SIZE (1..10)) OF SearchSpace { | 1 entry |  |  |
| SearchSpace[1] | SearchSpace-BWP-N with condition BWP#N | entry 1 |  |
| SearchSpace[2] | SearchSpace-CSS-BWP-N with condition BWP#N | entry 2 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.1.3.3-2C: *PDSCH-Config* (Table 7.1.1.8.1.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-100 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-Config ::= SEQUENCE { |  |  |  |
| tci-StatesToAddModList SEQUENCE(SIZE (1.. maxNrofTCI-States)) OF TCI-State { | 2 entries |  | pc\_bwp-WithoutRestriction = True |
| TCI-State[1] SEQUENCE { |  | entry 1 |  |
| tci-StateId | 0 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex | As per 38.508-1 Table 4.6.3-166 |  |
| bwp-id | Not present |  |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 1 |  |  |
| } |  |  |  |
| qcl-Type | type C |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex | As per 38.508-1 Table 4.6.3-166 |  |
| bwp-id | Not present | BWP ID |  |
| referenceSignal CHOICE { |  |  |  |
| ssb | 1 |  |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| TCI-State[2] SEQUENCE { |  | entry 2 |  |
| tci-StateId | 1 |  |  |
| qcl-type1 SEQUENCE { |  |  |  |
| cell | ServCellIndex | As per 38.508-1 Table 4.6.3-166 |  |
| bwp-id | 1 | BWP#1 |  |
|  | 2 | BWP#2 |  |
|  | 3 | BWP#3 |  |
| referenceSignal CHOICE { |  |  |  |
| csi-rs | 1 |  |  |
| } |  |  |  |
| qcl-Type | type A |  |  |
| } |  |  |  |
| qcl-type2 | Not present |  |  |
| qcl-type2 SEQUENCE { |  |  | FR2 |
| cell | ServCellIndex | As per 38.508-1 Table 4.6.3-166 |  |
| bwp-id | 1 | BWP#1 |  |
|  | 2 | BWP#2 |  |
|  | 3 | BWP#3 |  |
| referenceSignal CHOICE { |  |  |  |
| csi-rs | 1 |  |  |
| } |  |  |  |
| qcl-Type | type D |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| PDSCH-TimeDomainAllocationList::= SEQUENCE { | PDSCH-TimeDomainResourceAllocationList |  |  |
| } |  |  |  |

**Table 7.1.1.8.1.3.3-2CA: PDSCH-TimeDomainResourceAllocationList (Table 7.1.1.8.1.3.3-2C)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-TimeDomainAllocationList::= SEQUENCE { |  |  |  |
| PDSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  | entry 1 |  |
| k0 | 1 |  | pc\_bwp-SwitchingDelay\_Type1 AND SCS\_15KHz |
| 3 |  | pc\_bwp\_SwitchingDelay\_Type2 AND SCS\_15KHz |
| 2 |  | pc\_bwp-SwitchingDelay\_Type1 AND SCS\_30KHz |
| 5 |  | pc\_bwp\_SwitchingDelay\_Type2 AND SCS\_30KHz |
| 3 |  | pc\_bwp-SwitchingDelay\_Type1 AND SCS\_60KHz |
| 9 |  | pc\_bwp\_SwitchingDelay\_Type2 AND SCS\_60KHz |
| 6 |  | pc\_bwp-SwitchingDelay\_Type1 AND SCS\_120KHz |
| 18 |  | pc\_bwp\_SwitchingDelay\_Type2 AND SCS\_120KHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 53 | Start symbol(S)=2, Length(L)=12 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.1.3.3-2D: *ControlResourceSet-BWP-N* (Table 7.1.1.8.1.3.3-2B)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-28 | | | |
| Information Element | Value/remark | Comment | Condition |
| ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 9 |  | BWP#1 |
|  | 10 |  | BWP#2 |
|  | 11 |  | BWP#3 |
| frequencyDomainResources | 10000000 00000000 00000000 00000000 00000000 00000 | CORESET to use the least significant 6 RBs of each BWP |  |
| duration | 2 | SearchSpace duration of 2 symbols |  |
| tci-StatesPDCCH-ToAddList SEQUENCE(SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId { | 1 entry |  | pc\_bwp-WithoutRestriction = True |
| TCI-StateId[1] | 1 | TRS |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.1.3.3-2E: *SearchSpace-BWP-N* (Table 7.1.1.8.1.3.3-2B)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-162 with condition USS | | | |
| Information Element | Value/remark | Comment | Condition |
| SearchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceId | 37 |  | BWP#1 |
|  | 38 |  | BWP#2 |
|  | 39 |  | BWP#3 |
| controlResourceSetId | 9 |  | BWP#1 |
|  | 10 |  | BWP#2 |
|  | 11 |  | BWP#3 |
| nrofCandidates SEQUENCE { |  |  |  |
| aggregationLevel1 | n0 |  |  |
| aggregationLevel2 | n1 |  |  |
| aggregationLevel4 | n0 |  |  |
| aggregationLevel8 | n0 |  |  |
| aggregationLevel16 | n0 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.1.3.3-2F: *BWP-Uplink-BWP-N* (Table 7.1.1.8.1.3.3-2 and Table 7.1.1.8.1.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-Uplink ::= SEQUENCE { |  |  |  |
| bwp-Id | 1 |  | BWP#1 |
| 2 |  | BWP#2 |
| 3 |  | BWP#3 |
| bwp-Common SEQUENCE { |  |  |  |
| genericParameters SEQUENCE { |  |  |  |
| locationAndBandwidth | 1381 | Note 1 | BWP#1 and pc\_bwp-WithoutRestriction = True |
| 1387 | Note 1 | BWP#2 and pc\_bwp-WithoutRestriction = True |
| 1393 | Note 1 | BWP#3 and pc\_bwp-WithoutRestriction = True |
|  | 6600 | Note 2 | BWP#1,2,3 and pc\_bwp-WithoutRestriction = False and 5MHz |
|  | 7975 | Note 3 | BWP#1 and pc\_bwp-WithoutRestriction = False |
|  | 9625 | Note 3 | BWP#2and pc\_bwp-WithoutRestriction = False |
|  | 11275 | Note 3 | BWP#3 and pc\_bwp-WithoutRestriction = False |
|  | 12925 | Note 4 | BWP#1 and pc\_bwp-WithoutRestriction = False and 100MHz |
|  | 14575 | Note 4 | BWP#2and pc\_bwp-WithoutRestriction = False and 100MHz |
|  | 16225 | Note 4 | BWP#3 and pc\_bwp-WithoutRestriction = False and 100MHz |
| } |  |  |  |
| rach-ConfigCommon | Not present | No cell specific configuration for dedicated BWP |  |
| pusch-ConfigCommon | Not present | no cell specific configuration for dedicated BWP |  |
| pucch-ConfigCommon | *PUCCH-ConfigCommon-BWP-N* |  |  |
| } |  |  |  |
| bwp-Dedicated SEQUENCE { |  |  |  |
| pucch-Config CHOICE { |  |  |  |
| setup | PUCCH-Config-BWP-N |  |  |
| } |  |  |  |
| pusch-Config CHOICE { |  |  |  |
| setup | PUSCH-Config-BWP-N |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| Note 1:According to TS 38.214 [21] clause 6.1.2.2.2 with =275, LRBs=6 and RBStart=6,12,18 for BWP#1,2,3  Note 2: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=25 and RBStart=0 for BWP#1,2,3  Note 3: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=30,36,42 and RBStart=0 for BWP#1,2,3  Note 4: According to TS 38.214 [21] clause 5.1.2.2.2 with =275, LRBs=48,54,60 and RBStart=0 for BWP#1,2,3 | | | |

|  |  |
| --- | --- |
| Condition | Explanation |
| BWP#1 | Bandwidth part 1 |
| BWP#2 | Bandwidth part 2 |
| BWP#3 | Bandwidth part 3 |
| 5MHz | According to TS 38.508-1 [4] clause 6.2.3.1 with CBW=5Mhz |
| 100MHz | According to TS 38.508-1 [4] clause 6.2.3.1 with CBW=100Mhz |

Table 7.1.1.8.1.3.3-2G: *PUCCH-Config-BWP-N* (Table 7.1.1.8.1.3.3-2F)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-112 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-Config::= SEQUENCE { |  |  |  |
| resourceSetToAddModList SEQUENCE (SIZE (1..4)) OF PUCCH-ResourceSet { | 1 entry |  |  |
| PUCCH-ResourceSet[1] SEQUENCE { |  | entry 1 |  |
| pucch-ResourceSetId | 0 |  |  |
| resourceList SEQUENCE (SIZE (1..32)) OF PUCCH-ResourceId { | 1 entry |  |  |
| PUCCH-ResourceId[1] | 0 | entry 1 |  |
| } |  |  |  |
| maxPayloadSize | 256 |  |  |
| } |  |  |  |
| } |  |  |  |
| resourceToAddModList SEQUENCE (SIZE (1..128)) OF PUCCH-Resource { | 1 entry |  |  |
| PUCCH-Resource[1] SEQUENCE { |  | entry 1 |  |
| pucch-RessourceId | 0 |  |  |
| startingPRB | 0 |  | BWP#1 |
| 0 |  | BWP#2 |
| 0 |  | BWP#3 |
| intraSlotFrequencyHopping | disabled |  |  |
| secondHopPRB | Not Present |  |  |
| format CHOICE { |  |  |  |
| format0 SEQUENCE { |  |  |  |
| initialCyclicShift | 0 |  |  |
| nrofSymbols | 2 |  |  |
| startingSymbolIndex | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| BWP#1 | Bandwidth part 1 |
| BWP#2 | Bandwidth part 2 |
| BWP#3 | Bandwidth part 3 |

Table 7.1.1.8.1.3.3-2H: *PUSCH-Config-BWP-N* (Table 7.1.1.8.1.3.3-2F)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-118 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-Config ::= SEQUENCE { |  |  |  |
| pusch-TimeDomainAllocationList | PUSCH-TimeDomainResourceAllocationList | TS 38.508-1 [4] Table 4.6.3-122 |  |
| } |  |  |  |

Table 7.1.1.8.1.3.3-3: *PUCCH-ConfigCommon-BWP-N* (Table 7.1.1.8.1.3.3-2F)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-113 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-ConfigCommon ::= SEQUENCE { |  |  |  |
| pucch-ResourceCommon | Not Present |  |  |
| pucch-GroupHopping | enable |  |  |
| hoppingId | Not present |  |  |
| p0-nominal | Not Present |  |  |
| } |  |  |  |

**Table 7.1.1.8.1.3.3-4: *SearchSpace-CSS-BWP-N* (Table 7.1.1.8.1.3.3-2B)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[4], Table 4.6.3-162 with condition CSS | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| SearchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceId | 30 |  | BWP#1 |
|  | 31 |  | BWP#2 |
|  | 32 |  | BWP#3 |
| controlResourceSetId | 9 |  | BWP#1 |
|  | 10 |  | BWP#2 |
|  | 11 |  | BWP#3 |
| nrofCandidates SEQUENCE { |  |  |  |
| aggregationLevel1 | n0 |  |  |
| aggregationLevel2 | n1 |  |  |
| aggregationLevel4 | n0 |  |  |
| aggregationLevel8 | n0 |  |  |
| aggregationLevel16 | n0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

**Table 7.1.1.8.1.3.3-5: *CSI-MeasConfig for TRS* (Table 7.1.1.8.1.3.3-2)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[4] Table 4.6.3-38 | | | |
| Information Element | Value/remark | Comment | Condition |
| CSI-MeasConfig::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-Resource { | 2 entries in case of FR2  4 entries in case of FR1 | 2 entries in case of FR2  4 entries in case of FR1 |  |
| NZP-CSI-RS-Resource[1] | NZP-CSI-RS-Resource for TRS (1) | entry 1  CSI-RS resource 1 |  |
| NZP-CSI-RS-Resource[2] | NZP-CSI-RS-Resource for TRS (2) | entry 2  CSI-RS resource 2 |  |
| NZP-CSI-RS-Resource[3] | NZP-CSI-RS-Resource for TRS (3) | entry 3  CSI-RS resource 3 | FR1 |
| NZP-CSI-RS-Resource[4] | NZP-CSI-RS-Resource for TRS (4) | entry 4  CSI-RS resource 4 | FR1 |
| } |  |  |  |
| nzp-CSI-RS-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSet { | 1 entry |  |  |
| NZP-CSI-RS-ResourceSet[1] | NZP-CSI-RS-ResourceSet for TRS | entry 1 |  |
| } |  |  |  |
| csi-IM-ResourceToAddModList | Not present |  |  |
| csi-IM-ResourceSetToAddModList | Not present |  |  |
| csi-SSB-ResourceSetToAddModList | Not present |  |  |
| csi-ResourceConfigToAddModList SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfig { | 1 entry |  |  |
| CSI-ResourceConfig[1] | CSI-ResourceConfig for TRS | entry 1 |  |
| } |  |  |  |
| reportTriggerSize | Not present |  |  |
| aperiodicTriggerStateList SetupRelease | Not present |  |  |
| } |  |  |  |

**Table 7.1.1.8.1.3.3-6: NZP-CSI-RS-ResourceSet for TRS (Table 7.1.1.8.1.3.3-5)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[4] Table 4.6.3-87 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-ResourceSet ::= SEQUENCE { |  |  |  |
| nzp\_CSI\_ResourceSetId | 0 |  |  |
| nzp-CSI-RS-Resources SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId { | 2 entries in case of FR2  4 entries in case of FR1 |  |  |
| NZP-CSI-RS-ResourceId[1] | 0 | entry 1  CSI-RS resource 1 |  |
| NZP-CSI-RS-ResourceId[2] | 1 | entry 2  CSI-RS resource 2 |  |
| NZP-CSI-RS-ResourceId[3] | 2 | entry 3  CSI-RS resource 3 | FR1 |
| NZP-CSI-RS-ResourceId[4] | 3 | entry 4  CSI-RS resource 4 | FR1 |
| } |  |  |  |
| repetition | off |  |  |
| aperiodicTriggeringOffset | Not present |  |  |
| trs\_Info | true |  |  |
| } |  |  |  |

**Table 7.1.1.8.1.3.3-7: CSI-ResourceConfig for TRS (Table 7.1.1.8.1.3.3-5)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[4] Table 4.6.3-41 | | | |
| Information Element | Value/remark | Comment | Condition |
| CSI-ResourceConfig ::= SEQUENCE { |  |  |  |
| csi-ResourceConfigId | 0 |  |  |
| csi-RS-ResourceSetList CHOICE { |  |  |  |
| nzp-CSI-RS-SSB SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceSetList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)) OF NZP-CSI-RS-ResourceSetId { | 1 entry |  |  |
| NZP-CSI-RS-ResourceSetId[1] | 0 | entry 1 |  |
| } |  |  |  |
| csi-SSB-ResourceSetList | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| bwp-Id | BWP-Id |  |  |
| resourceType | periodic |  |  |
| } |  |  |  |

**Table 7.1.1.8.1.3.3-8: NZP-CSI-RS-Resource for TRS (Table 7.1.1.8.1.3.3-5)**

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1**[4]** Table 4.6.3-85 | | | |
| Information Element | Value/remark | Comment | Condition |
| NZP-CSI-RS-Resource ::= SEQUENCE { |  |  |  |
| nzp-CSI-RS-ResourceId | 0 | CSI-RS resource 1 |  |
| 1 | CSI-RS resource 2 |  |
| 2 | CSI-RS resource 3 |  |
| 3 | CSI-RS resource 4 |  |
| resourceMapping | CSI-RS-ResourceMapping for TRS |  |  |
| powerControlOffset | 0 |  |  |
| periodicityAndOffset | CSI-ResourcePeriodicityAndOffset for TRS |  |  |
| qcl-InfoPeriodicCSI-RS | TCI-StateId 0 |  |  |

##### 7.1.1.8.2

##### 7.1.1.8.3 Separate BWP / IDLE / RedCap

7.1.1.8.3.1 Test Purpose (TP)

(1)

**with** { UE supporting RedCap and in NR RRC\_IDLE state }

**ensure that** {

**when** { initialDownlinkBWP-RedCap is configured }

**then** { the UE shall monitor the PDCCH on the BWP configured by initialDownlinkBWP-RedCap }

}

(2)

**with** { UE supporting RedCap and in NR RRC\_IDLE state }

**ensure that** {

**when** { initialUplinkBWP-RedCap is configured and the UE needs to perform the Random Access procedure }

**then** { the UE shall perform the Random Access procedure by using the BWP configured by initialUplinkBWP-RedCap }

}

7.1.1.8.3.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.321, clause 5.15.1. Unless otherwise stated these are Rel-17 requirements.

[TS 38.321, clause 5.15.1]

A RedCap UE may be configured with a RedCap-specific initial UL BWP in *initialUplinkBWP-RedCap*, as specified in TS 38.331 [5].

Upon initiation of the Random Access procedure on a Serving Cell, after the selection of carrier for performing Random Access procedure as specified in clause 5.1.1, the MAC entity shall for the selected carrier of this Serving Cell:

1> if PRACH occasions are not configured for the active UL BWP:

2> if the UE is a RedCap UE; and

2> if *initialUplinkBWP-RedCap* is configured:

3> switch the active UL BWP to BWP configured by *initialUplinkBWP-RedCap*.

2> else:

3> switch the active UL BWP to BWP indicated by *initialUplinkBWP*.

2> if the Serving Cell is an SpCell:

3> if the UE is a RedCap UE; and

3> if *initialDownlinkBWP-RedCap* is configured:

4> switch the active DL BWP to BWP configured by *initialDownlinkBWP-RedCap*.

3> else:

4> switch the active DL BWP to BWP indicated by *initialDownlinkBWP*.

1> else:

2> if the Serving Cell is an SpCell:

3> if the active DL BWP does not have the same *bwp-Id* as the active UL BWP:

4> switch the active DL BWP to the DL BWP with the same *bwp-Id* as the active UL BWP.

1> stop the *bwp-InactivityTimer* associated with the active DL BWP of this Serving Cell, if running.

1> if the Serving Cell is SCell:

2> stop the *bwp-InactivityTimer* associated with the active DL BWP of SpCell, if running.

1> perform the Random Access procedure on the active DL BWP of SpCell and active UL BWP of this Serving Cell.

If the MAC entity receives a PDCCH for BWP switching of a Serving Cell, the MAC entity shall:

1> if there is no ongoing Random Access procedure associated with this Serving Cell; or

1> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4, 5.1.4a, and 5.1.5):

2> cancel, if any, triggered consistent LBT failure for this Serving Cell;

2> perform BWP switching to a BWP indicated by the PDCCH.

…

Upon reception of RRC (re-)configuration for BWP switching for a Serving Cell, cancel any triggered LBT failure in this Serving Cell.

The MAC entity shall for each activated Serving Cell configured with *bwp-InactivityTimer*:

1> if the *defaultDownlinkBWP-Id* is configured, and the active DL BWP is not the BWP indicated by the *defaultDownlinkBWP-Id*, and the active DL BWP is not the BWP indicated by the *dormantBWP-Id* if configured; or

1> if the *defaultDownlinkBWP-Id* is not configured, and if the UE is not a RedCap UE, and the active DL BWP is not the *initialDownlinkBWP*, and the active DL BWP is not the BWP indicated by the *dormantBWP-Id* if configured; or

1> if the *defaultDownlinkBWP-Id* is not configured and if the UE is a RedCap UE, and *initialDownlinkBWP-RedCap* is not configured, and the active DL BWP is not the *initialDownlinkBWP*, and the active DL BWP is not the BWP indicated by the *dormantBWP-Id* if configured; or

1> if the *defaultDownlinkBWP-Id* is not configured and if the UE is a RedCap UE, and *initialDownlinkBWP-RedCap* is configured, the active DL BWP is not the *initialDownlinkBWP-RedCap*, and the active DL BWP is not the BWP indicated by the *dormantBWP-Id* if configured:

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received on the active BWP; or

2> if a PDCCH addressed to G-RNTI or G-CS-RNTI configured for multicast indicating downlink assignment is received on the active BWP; or

2> if a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant is received for the active BWP; or

2> if a MAC PDU is transmitted in a configured uplink grant and LBT failure indication is not received from lower layers; or

2> if a MAC PDU is received in a configured downlink assignment for unicast or MBS multicast:

3> if there is no ongoing Random Access procedure associated with this Serving Cell; or

3> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4, 5.1.4a and 5.1.5):

4> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

2> if the *bwp-InactivityTimer* associated with the active DL BWP expires:

3> if the *defaultDownlinkBWP-Id* is configured:

4> perform BWP switching to a BWP indicated by the *defaultDownlinkBWP-Id*.

3> else:

4> if the UE is a RedCap UE; and

4> if *initialDownlinkBWP-RedCap* is configured:

5> perform BWP switching to the *initialDownlinkBWP-RedCap*.

4> else:

5> perform BWP switching to the *initialDownlinkBWP*.

NOTE: If a Random Access procedure is initiated on an SCell, both this SCell and the SpCell are associated with this Random Access procedure.

1> if a PDCCH for BWP switching is received, and the MAC entity switches the active DL BWP:

2> if the *defaultDownlinkBWP-Id* is configured, and the MAC entity switches to the DL BWP which is not indicated by the *defaultDownlinkBWP-Id* and is not indicated by the *dormantBWP-Id* if configured; or

2> if the *defaultDownlinkBWP-Id* is not configured, and the MAC entity switches to the DL BWP which is not the *initialDownlinkBWP* and is not indicated by the *dormantBWP-Id* if configured:

3> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

Upon initiation of the Random Access procedure, after selection of the carrier for performing Random Access procedure as specified in clause 5.1.1, if the UE is a RedCap UE in RRC\_IDLE or RRC\_INACTIVE mode, the MAC entity shall:

1> if *initialUplinkBWP-RedCap* is configured:

2> perform the Random Access procedure as specified in clause 5.1 by using the BWP configured by *initialUplinkBWP-RedCap*.

1> else:

2> perform the Random Access procedure as specified in clause 5.1 by using the BWP configured by *initialUplinkBWP*.

1> if *initialDownlinkBWP-RedCap* is configured:

2> monitor the PDCCH on the BWP configured by *initialDownlinkBWP-RedCap*.

1> else:

2> monitor the PDCCH on the BWP configured by *initialDownlinkBWP*.

7.1.1.8.3.3 Test description

7.1.1.8.3.3.1 Pre-test conditions

System Simulator:

- NR Cell 2.

UE:

- None

Preamble:

- The UE is in NR RRC\_Idle mode (state 1N-A) on NR Cell 1 according to 38.508-1 [4] Table 4.4A.2-1.

7.1.1.8.3.3.2 Test procedure sequence

Table 7.1.1.8.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS changes the SIB1 of NR Cell 1 to configure *initialDownlinkBWP-RedCap* and *initialUplinkBWP-RedCap*. | - | - | - | -- |
| 2 | The SS transmits a Short message on PDCCH using P-RNTI indicating a *systemInfoModification*. | <-- | PDCCH (DCI 1\_0): Short Message | - | - |
| 3 | Wait for 2.1\* modification period second for the UE to receive new system information.  (Note 1) | - | - | - | - |
| 4 | The SS transmits a *Paging* message within the BWP configured by *initialDownlinkBWP-RedCap*. | <-- | NR RRC: *Paging* | - | - |
| 5 | Check: Does the UE transmit an *RRCSetupRequest* message by setting LCID to 36? | --> | NR RRC: *RRCSetupRequest* | 1 | P |
| 6 | The SS transmits an *RRCSetup* message. | <-- | NR RRC: *RRCSetup* | - | - |
| 7 | Check: Does the UE transmit HARQ ACK for step 6 on PUCCH configured by *initialUplinkBWP-RedCap*? | --> | HARQ ACK | 2 | P |
| 8-13a1 | Steps 4-9a1 of Generic procedure as specified in TS 38.508-1 [4] Table 4.9.4.2.2-1 are performed. | - | - | - | - |
| Note 1: The modification period, expressed in number of radio frames = modificationPeriodCoeff \* defaultPagingCycle. | | | | | |

7.1.1.8.3.3.3 Specific message contents

Table 7.1.1.8.3.3.3-1: *SIB1* (step 1, Table 7.1.1.8.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-28 | | | |
| Information Element | | Value/remark | Comment | Condition |
| SIB1 ::= SEQUENCE { | |  |  |  |
| servingCellConfigCommon | | ServingCellConfigCommonSIB | Table 7.1.1.8.3.3.3-2 |  |
| } | |  |  |  |

Table 7.1.1.8.3.3.3-2: *ServingCellConfigCommonSIB* (Table 7.1.1.8.3.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-169 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommonSIB ::= SEQUENCE { |  |  |  |
| downlinkConfigCommon | DownlinkConfigCommonSIB | Table 7.1.1.8.3.3.3-3 |  |
| uplinkConfigCommon | UplinkConfigCommonSIB | Table 7.1.1.8.3.3.3-7 |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-3: *DownlinkConfigCommonSIB* (Table 7.1.1.8.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-53 | | | |
| Information Element | Value/remark | Comment | Condition |
| DownlinkConfigCommonSIB ::= SEQUENCE { |  |  |  |
| pei-Config-r17 | Not present |  |  |
| initialDownlinkBWP-RedCap-r17 | BWP-DownlinkCommon-RedCap | Table 7.1.1.8.3.3.3-4 |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-4: *BWP-DownlinkCommon-RedCap* (Table 7.1.1.8.3.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-10 with condition InitialBWP\_SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-DownlinkCommon ::= SEQUENCE { |  |  |  |
| pdcch-ConfigCommon CHOICE { |  |  |  |
| setup | PDCCH-ConfigCommon | Table 7.1.1.8.3.3.3-5 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-5: *PDCCH-ConfigCommon* (Table 7.1.1.8.3.3.3-4)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-96 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-ConfigCommon ::= SEQUENCE { |  |  |  |
| commonSearchSpaceList SEQUENCE (SIZE (1..4)) OF SearchSpace { | 3 entries |  |  |
| SearchSpace[1] | SearchSpace with condition CSS | entry 1 |  |
| SearchSpace[2] | SearchSpace with condition SISS | entry 2 |  |
| SearchSpace[3] | SearchSpace | entry 3, Table 7.1.1.8.3.3.3-6 |  |
| } |  |  |  |
| pagingSearchSpace | 4 |  |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-6: *SearchSpace* (Table 7.1.1.8.3.3.3-5)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-162 with condition CSS | | | |
| Information Element | Value/remark | Comment | Condition |
| SearchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceId | 4 |  |  |
| monitoringSlotPeriodicityAndOffset CHOICE { |  |  |  |
| sl10 | 2 |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-7: *UplinkConfigCommonSIB* (Table 7.1.1.8.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-202 | | | |
| Information Element | Value/remark | Comment | Condition |
| UplinkConfigCommonSIB ::= SEQUENCE { |  |  |  |
| UplinkConfigCommonSIB-v1700 ::= SEQUENCE { |  |  |  |
| initialUplinkBWP-RedCap-r17 | BWP-UplinkCommon | Table 7.1.1.8.3.3.3-8 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-8: *BWP-UplinkCommon* (Table 7.1.1.8.3.3.3-7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| pucch-ConfigCommon CHOICE { |  |  |  |
| setup | PUCCH-ConfigCommon | Table 7.1.1.8.3.3.3-9 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.8.3.3.3-9: *PUCCH-ConfigCommon* (Table 7.1.1.8.3.3.3-8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-113 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUCCH-ConfigCommon ::= SEQUENCE { |  |  |  |
| nrofPRBs | Not present |  |  |
| intra-SlotFH-r17 | fromLowerEdge |  |  |
| pucch-ResourceCommon-RedCap-r17 | 0 |  |  |
| additionalPRBOffset-r17 | n2 |  |  |
| } |  |  |  |

#### 7.1.1.9 MAC Reconfiguration and Reset

##### 7.1.1.9.1 MAC Reset

7.1.1.9.1.1 Test Purpose (TP)

(1)

**Void**

(2)

**with** { UE in RRC\_CONNECTED state )

**ensure that** {

**when**{ UE MAC is reset, due to reconfiguration with sync on same cell }

**then** { UE considers the next transmission for each DL HARQ process as very first }

}

(3)

**Void**

(4)

**with** ( UE in RRC\_CONNECTED state )

**ensure that** {

**when**{ UE MAC is reset, due to reconfiguration with sync on same cell }

**then** { UE flushes UL HARQ buffer }

}

(5)

**with** (UE in RRC\_CONNECTED state )

**ensure that** {

**when**{ UE MAC is reset, due to reconfiguration with sync on same cell }

**then** { UE Considers the next transmission for each UL HARQ process as very first }

}

7.1.1.9.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.12 and TS 38.331 clause 5.3.5.5.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.12]

If a reset of the MAC entity is requested by upper layers, the MAC entity shall:

1> initialize *Bj* for each logical channel to zero;

1> stop (if running) all timers;

1> consider all *timeAlignmentTimer*s as expired and perform the corresponding actions in subclause 5.2;

1> set the NDIs for all uplink HARQ processes to the value 0;

1> stop, if any, ongoing Random Access procedure;

1> discard explicitly signalled contention-free Random Access Resources, if any;

1> flush Msg3 buffer;

1> cancel, if any, triggered Scheduling Request procedure;

1> cancel, if any, triggered Buffer Status Reporting procedure;

1> cancel, if any, triggered Recommended bit rate query procedure;

1> cancel, if any, triggered Configured uplink grant confirmation;

1> cancel, if any, triggered Power Headroom Reporting procedure;

1> flush the soft buffers for all DL HARQ processes;

1> for each DL HARQ process, consider the next received transmission for a TB as the very first transmission;

1> release, if any, Temporary C-RNTI;

1> reset *BFI\_COUNTER*.

[TS 38.331, clause 5.3.5.5.2]

The UE shall perform the following actions to execute a reconfiguration with sync.

1> if the AS security is not activated, perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with the release cause '*other*' upon which the procedure ends;

1> stop timer T310 for the corresponding SpCell, if running;

1> start timer T304 for the corresponding SpCell with the timer value set to *t304*, as included in the *reconfigurationWithSync*;

1> if the *frequencyInfoDL* is included:

2> consider the target SpCell to be one on the SSB frequency indicated by the *frequencyInfoDL* with a physical cell identity indicated by the *physCellId*;

1> else:

2> consider the target SpCell to be one on the SSB frequency of the source SpCell with a physical cell identity indicated by the *physCellId*;

1> start synchronising to the DL of the target SpCell;

1> apply the specified BCCH configuration defined in 9.1.1.1;

1> acquire the *MIB,* which is scheduled as specified in TS 38.213 [13];

NOTE 1: The UE should perform the reconfiguration with sync as soon as possible following the reception of the RRC message triggering the reconfiguration with sync, which could be before confirming successful reception (HARQ and ARQ) of this message.

NOTE 2: The UE may omit reading the MIB if the UE already has the required timing information, or the timing information is not needed for random access.

1> reset the MAC entity of this cell group;

1> consider the SCell(s) of this cell group, if configured, to be in deactivated state;

1> apply the value of the *newUE-Identity* as the C-RNTI for this cell group;

1> configure lower layers in accordance with the received s*pCellConfigCommon*;

1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *reconfigurationWithSync.*

7.1.1.9.1.3 Test description

7.1.1.9.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0.

Table 7.1.1.9.1.3.1-1: Void

7.1.1.9.1.3.2 Test procedure sequence

Table 7.1.1.9.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0 | The SS stops the default downlink retransmission. (Note 4)  SS ignores scheduling requests and does not allocate any uplink grant until after step 3 | - | - | - | - |
| 1 | The SS transmits a MAC PDU containing one RLC SDU with P field set 0 on DRB | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 2 | Void | - | - | - | - |
| 3 | The SS transmits NR *RRCReconfiguration* message with reconfigurationWithSync with the same SpCell. (Note 1) | <-- | RRCReconfiguration | - | - |
| - | EXCEPTION: Steps 4 and 4a can happen in any order | - | - | - | - |
| 4 | The UE transmits an NR *RRCReconfigurationComplete* message. (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 4a-5 | Void | - | - | - | - |
| 5A | The SS ignores scheduling requests and does not allocate any uplink grant. |  |  |  |  |
| 6 | The SS transmits a MAC PDU containing RLC SDU with P field set 0 on DRB. The HARQ Process and NDI on PDCCH is same as in step 1. The SS shall ensure that the HARQ process used at step 1 will not be used in between steps 3 and 5. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 7 | Check: Does the UE transmit a scheduling request? | --> | (SR) | 2 | P |
| - | Exception: The SS ignores following scheduling requests before step 9. | - | - | - | - |
| 8 | The SS allocates 1 UL Grant with size 384 bits and NDI indicates new transmission. (Note 5) | <-- | Uplink Grant | - | - |
| 9 | The UE transmits a MAC PDU including one RLC SDU with P field set 1. | --> | MAC PDU | - | - |
| 9A | The SS transmits a STATUS PDU on a different HARQ process than used in step 6. | <-- | STATUS PDU | - | - |
| 10-16 | Void | - | - | - | - |
| 16A | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 17 | The SS transmits a MAC PDU containing RLC SDU with P field set 0 on DRB. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 18 | The UE transmits a scheduling request | --> | (SR) | - | - |
|  | Exception: The SS ignores following scheduling requests before step 20. | - | - | - | - |
| 19 | The SS allocates an UL Grant with size 384 bits for one HARQ process X, and NDI indicates new transmission. (Note 5) | <-- | Uplink Grant | - | - |
| 20 | The UE transmit a MAC PDU including one RLC SDU with P field set 1. | --> | MAC PDU | - | - |
| 20A | The SS transmits a STATUS PDU on a different HARQ process than used in step 17. | <-- | STATUS PDU | - | - |
| 21 | Void |  |  |  |  |
| 22 | The SS transmits NR *RRCReconfiguration* message with reconfigurationWithSync with the same SpCelll. Note 1 | <-- | RRCReconfiguration | - | - |
| 23 | The UE transmits an NR *RRCReconfigurationComplete* message. Note 2 |  | RRCReconfigurationComplete | - | - |
| 24 | Void |  |  |  |  |
| 24A | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 25 | The SS transmits a MAC PDU containing RLC SDU with P field set 0 on DRB. The HARQ Process and NDI on PDCCH is same as in step 17. The SS shall ensure that the HARQ process used at step 17 will not be used in between steps 22 and 23. | <-- | MAC PDU (1 RLC SDU of 40 bytes on DRB) | - | - |
| 26 | The UE transmits a scheduling request | --> | (SR) | - | - |
|  | Exception: The SS ignores following scheduling requests before step 28. | - | - | - | - |
| 27 | The SS allocates an UL Grant with with size 384 bits corresponding to HARQ process X, with NDI not toggled compared to step 19, and NDI indicates new transmission. (Note 5) | <-- | Uplink Grant | - | - |
| 28 | Check: Does UE transmit a MAC PDU including one RLC SDU of 40 bytes on DRB and P field is set 1? | --> | MAC PDU | 4,5 | P |
| 29 | The SS transmits a STATUS PDU on a different HARQ process than used in step 25 | <-- | STATUS PDU | - | - |
| Note 1: for EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: for EN-DC the NR *RRCReconfigurationComplete* message is contained in RRCConnectionReconfigurationComplete.  Note 3: RLC re-establishment on DRB is used to make sure UE discard RLC PDU.  Note 4: The SS stops the default downlink retransmission to avoid HARQ ACK for the retransmission of DRB data at step 1.  Note 5: The UL grant of 384 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit one PDU at a time (40 bytes RLC SDU + 3 bytes RLC Header + 2 bytes MAC Sub PDU header + 2 bytes for short BSR or padding). | | | | | |

7.1.1.9.1.3.3 Specific message contents

Table 7.1.1.9.1.3.3-0: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

Table 7.1.1.9.1.3.3-1: *RRCReconfiguration* for NR(steps 3 and 22 of Table 7.1.1.9.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig according to TS 38.508-1 [4], table 4.6.3-132 with with condition DRBn | n set to the default DRB of the first PDU session | NR |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig according to TS 38.508-1 [4], table 4.6.3-19 with condition PCell\_change |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.9.1.3.3-2: *RRCConnectionReconfiguration* for EN-DC (step 3 and 22 of Table 7.1.1.9.1.3.2-1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation Path: 36.508 Table 4.6.1-8 | | | | | | |
| Information Element | | Value/remark | | Comment | | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { | |  | |  | |  |
| criticalExtensions CHOICE { | |  | |  | |  |
| c1 CHOICE{ | |  | |  | |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE { | |  | |  | |  |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nr-Config-r15 CHOICE { |  | |  | |  | |
| nr-SecondaryCellGroupConfig-r15 | OCTET STRING including the RRCReconfiguration message and the IE secondaryCellGroup according TS 38.508-1 [67], table 4.6.1-13 with condition EN-DC\_HO | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [67], table 4.6.3-132 with conditions EN-DC\_DRB | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |

#### 7.1.1.10 Other Procedures

##### 7.1.1.10.1 DataInactivityTimer expiry

7.1.1.10.1.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_CONNECTED state and *dataInactivityTimer* configured and running }

**ensure that** {

**when** { UE receives or transmits MAC SDU from DRB }

**then** { UE restarts the *dataInactivityTimer* }

}

(2)

**with** { UE in NR RRC\_CONNECTED state and *dataInactivityTimer* configured and running }

**ensure that** {

**when** { UE detecting data inactivity on expiry of DataInactivityTimer }

**then** { UE enters RRC\_IDLE state }

}

7.1.1.10.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321 clause 5.19 and TS 38.331 clause 5.3.8.5.

[TS 38.321, clause 5.19]

The UE may be configured by RRC with a Data inactivity monitoring functionality, when in RRC\_CONNECTED. RRC controls Data inactivity operation by configuring the timer *dataInactivityTimer*.

When *dataInactivityTimer* is configured, the UE shall:

1> if any MAC entity receives a MAC SDU for DTCH logical channel, DCCH logical channel, or CCCH logical channel; or

1> if any MAC entity transmits a MAC SDU for DTCH logical channel, or DCCH logical channel:

2> start or restart *dataInactivityTimer*.

1> if the *dataInactivityTimer* expires:

2> indicate the expiry of the *dataInactivityTimer* to upper layers.

[TS 38.331 clause 5.3.8.5]

Upon receiving the expiry of *DataInactivityTimer* from lower layers while in RRC\_CONNECTED, the UE shall:

1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

7.1.1.10.1.3 Test description

7.1.1.10.1.3.1 Pre-test conditions

System Simulator:

- NR Cell 1.

UE:

- None.

Preamble:

- The UE is in state 3N-A and Test Mode Activated according to 38.508-1 [4] Table 4.4A.2-1 with UE test loop mode B is established IP PDU delay set to 6 seconds.

7.1.1.10.1.3.2 Test procedure sequence

Table 7.1.1.10.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS waits (dataInactivityTimer/2 + 1) seconds | - | - | - | - |
| 2 | SS transmits a downlink assignment including the C-RNTI assigned to the UE | <-- | (PDCCH (C-RNTI)) | - | - |
| 3 | SS transmits in the indicated downlink assignment a RLC PDU in a MAC PDU. | <-- | MAC PDU | - | - |
| 4 | Void | - | - | - | - |
| 5 | Void | - | - | - | - |
| 6 | Check: Does the UE transmits a MAC PDU containing Loop backed PDU on expiry of IP PDU delay? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 7-11 | Repeat steps 1-5 | - | - | - | - |
| 12 | Check: Does the UE transmits a MAC PDU containing Loop backed PDU? | --> | MAC PDU (containing 1 MAC sub PDU containing RLC SDU) | 1 | P |
| 13 | SS waits dataInactivityTimer seconds for the UE to enter RRC\_IDLE. | - |  | - | - |
| 14 | Check: Does the test result of generic test procedure in TS 38.508-1 [4] Table 4.9.5.2.2-1 indicate that the UE is in RRC\_IDLE? | - | *-* | 2 | - |

7.1.1.10.1.3.3 Specific Message Contents

Table 7.1.1.10.1.3.3-1: *MAC-CellGroupConfig* (preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1[4], table 4.6.3-68 | | | |
| Information Element | Value/Remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| dataInactivityTimer | s10 |  |  |
| } |  |  |  |

Table 7.1.1.10.1.3.3-2: CLOSE UE TEST LOOP (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 36.508-1 [7] table 4.7A-3 condition UE test loop mode B | | | |
| Information Element | Value/Remark | Comment | Condition |
| UE test loop mode B LB setup |  |  |  |
| IP PDU delay | '0000 0110'B | 6 seconds |  | |

##### 7.1.1.10.2 Recommended Bit Rate

7.1.1.10.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC Connected state and MMTEL call established}

**ensure that** {

**when** { IF upper Layers requested to query the gNB for the recommended bit rate for a logical channel and for a direction and bitRateQueryProhibitTimer is not running }

**then** { UE transmits a Recommended Bit Rate Query MAC Control Element}

}

(2)

**with**(UE in RRC Connected state and MMTEL call established)

**ensure that** {

**when**{ IF upper Layers requested to query the gNB for the recommended bit rate for a logical channel and for a direction and bitRateQueryProhibitTimer is running}

**then** { UE does not transmits a Recommended Bit Rate Query MAC Control Element}

}

(3)

**with** ( UE in RRC Connected state and MMTEL call established)

**ensure that** {

**when**{ UE receives MAC PDU from the gNB for the recommended bit rate for a logical channel and for a direction }

**then** { UE sends an HARQ ACK }

}

7.1.1.10.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clauses 5.18.10 and 6.1.20. Unless otherwise stated these are Rel-15 requirements.

[TS 38.321, clause 5.18.10]

The recommended bit rate procedure is used to provide the MAC entity with information about the bit rate which the gNB recommends. The bit rate is the recommended bit rate of the physical layer. Averaging window of default value 2000 ms will apply as specified in TS 26.114 [13].

The gNB may transmit the Recommended bit rate MAC CE to the MAC entity to indicate the recommended bit rate for the UE for a specific logical channel and a specific direction (either uplink or downlink). Upon reception of a Recommended bit rate MAC CE the MAC entity shall:

- indicate to upper layers the recommended bit rate for the indicated logical channel and direction.

The MAC entity may request the gNB to indicate the recommended bit rate for a specific logical channel and a specific direction. If the MAC entity is requested by upper layers to query the gNB for the recommended bit rate for a logical channel and for a direction (i.e. for uplink or downlink), the MAC entity shall:

1> if a Recommended bit rate query for this logical channel and this direction has not been triggered:

2> trigger a Recommended bit rate query for this logical channel, direction, and desired bit rate.

If the MAC entity has UL resources allocated for new transmission the MAC entity shall:

1> for each Recommended bit rate query that the Recommended Bit Rate procedure determines has been triggered and not cancelled:

2> if *bitRateQueryProhibitTimer* for the logical channel and the direction of this Recommended bit rate query is configured, and it is not running; and

2> if the MAC entity has UL resources allocated for new transmission and the allocated UL resources can accommodate a Recommended bit rate MAC CE plus its subheader as a result of LCP as defined in clause 5.4.3.1:

3> instruct the Multiplexing and Assembly procedure to generate the Recommended bit rate MAC CE for the logical channel and the direction of this Recommended bit rate query;

3> start the *bitRateQueryProhibitTimer* for the logical channel and the direction of this Recommended bit rate query;

3> cancel this Recommended bit rate query.

[TS 38.321, clause 6.1.20]

The Recommended bit rate MAC CE is identified by a MAC subheader with LCID as specified in Tables 6.2.1-1 and 6.2.1-2 for bit rate recommendation message from the gNB to the UE and bit rate recommendation query message from the UE to the gNB, respectively. It has a fixed size and consists of two octets defined as follows (Figure 6.1.3.20-1):

- LCID: This field indicates the identity of the logical channel for which the recommended bit rate or the recommended bit rate query is applicable. The length of the field is 6 bits;

- Uplink/Downlink (UL/DL): This field indicates whether the recommended bit rate or the recommended bit rate query applies to uplink or downlink. The length of the field is 1 bit. The UL/DL field set to 0 indicates downlink. The UL/DL field set to 1 indicates uplink;

- Bit Rate: This field indicates an index to Table 6.1.3.20-1. The length of the field is 6 bits. For bit rate recommendation the value indicates the recommended bit rate. For bit rate recommendation query the value indicates the desired bit rate;

- R: reserved bit, set to 0.



Figure 6.1.3.20-1: Recommended bit rate MAC CE

Table 6.1.3.20-1: Values (kbit/s) for Bit Rate field

|  |  |  |  |
| --- | --- | --- | --- |
| Index | NR Recommended Bit Rate value [kbit/s] | Index | NR Recommended Bit Rate value [kbit/s] |
| 0 | Note 1 | 32 | 700 |
| 1 | 0 | 33 | 800 |
| 2 | 9 | 34 | 900 |
| 3 | 11 | 35 | 1000 |
| 4 | 13 | 36 | 1100 |
| 5 | 17 | 37 | 1200 |
| 6 | 21 | 38 | 1300 |
| 7 | 25 | 39 | 1400 |
| 8 | 29 | 40 | 1500 |
| 9 | 32 | 41 | 1750 |
| 10 | 36 | 42 | 2000 |
| 11 | 40 | 43 | 2250 |
| 12 | 48 | 44 | 2500 |
| 13 | 56 | 45 | 2750 |
| 14 | 72 | 46 | 3000 |
| 15 | 88 | 47 | 3500 |
| 16 | 104 | 48 | 4000 |
| 17 | 120 | 49 | 4500 |
| 18 | 140 | 50 | 5000 |
| 19 | 160 | 51 | 5500 |
| 20 | 180 | 52 | 6000 |
| 21 | 200 | 53 | 6500 |
| 22 | 220 | 54 | 7000 |
| 23 | 240 | 55 | 7500 |
| 24 | 260 | 56 | 8000 |
| 25 | 280 | 57 | Reserved |
| 26 | 300 | 58 | Reserved |
| 27 | 350 | 59 | Reserved |
| 28 | 400 | 60 | Reserved |
| 29 | 450 | 61 | Reserved |
| 30 | 500 | 62 | Reserved |
| 31 | 600 | 63 | Reserved |
| Note 1: For bit rate recommendation message this index is used for indicating that no new recommendation on bit rate is given. | | | |

7.1.1.10.2.3 Test description

7.1.1.10.2.3.1 Pre-test conditions

System Simulator:

- NR Cell 1

- System information combination NR-1 as defined in TS 38.508-1 [4] clause 4.4.3.1.3 is used in NR cell.

UE:

- None.

Preamble:

- The UE is in 5GS state 1N-A according to TS 38.508-1 [4], clause 4.4A.2 Table 4.4A.2-1.

7.1.1.10.2.3.2 Test procedure sequence

Table 7.1.1.10.2.3.2-2: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | The procedure in table 4.9.15.2.2-1 in TS 38.508-1 [4] is performed. The bitRateQueryProhibitTimer for the Logical channel of MMTEL QoS Flow is configured as s3 (3 seconds). | - | - | - | - |
| 2 | Trigger the UE to perform Recommended Bit Rate query for direction Downlink via AT (+CGBRRREQ) or MMI command. | - | - | - | - |
| 3 | Check: Does the UE transmit a MAC PDU containing Recommended bit rate MAC CE with Uplink/Downlink (UL/DL) set as 0? | -> | MAC PDU | 1 | P |
| 4 | Trigger the UE to perform Recommended Bit Rate query for direction Uplink via AT (+CGBRRREQ) or MMI command. | - | - | - | - |
| 5 | Check: Does the UE transmit a MAC PDU containing Recommended bit rate MAC CE with Uplink/Downlink (UL/DL) set as 1? | -> | MAC PDU | 1 | P |
| 6 | SS transmits a MAC PDU containing Recommended bit rate MAC CE with Uplink/Downlink (UL/DL) set as 0 and Bit Rate same as value received in step 5. | <- | MAC PDU | - | - |
| 7 | Trigger the UE to perform Recommended Bit Rate query for direction Up Link via AT (+CGBRRREQ) or MMI command. | - | - | - | - |
| 8 | Check: Does the UE transmit a MAC PDU containing Recommended bit rate MAC CE ? | -> | MAC PDU | 2 | P |
| 9 | While bitRateQueryProhibitTimer is running (3 seconds) in UE, trigger the UE to perform Recommended Bit Rate query for direction Up Link via AT (+CGBRRREQ) or MMI command. | - | - | - | - |
| 10 | Check: While bitRateQueryProhibitTimer is running, does the UE transmit a MAC PDU containing Recommended bit rate MAC CE ? | -> | MAC PDU | 2 | F |
| 11 | Check: After bitRateQueryProhibitTimer expires, does the UE transmit a MAC PDU containing Recommended bit rate MAC CE with Uplink/Downlink (UL/DL) set as 1? | -> | MAC PDU | 2 | P |
| 12 | SS transmits a MAC PDU containing Recommended bit rate MAC CE with Uplink/Downlink (UL/DL) set as 1 and Bit Rate same as value received in step 11. | <- | MAC PDU | - | - |
| 13 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 12? | --> | HARQ ACK | 3 | P |
| Note: The bitRateQueryProhibitTimer is configured only for UL direction as per asn.1 definition. | | | | | |

7.1.1.10.2.3.3 Specific message contents

None

#### 7.1.1.11 NR Dual Connectivity

##### 7.1.1.11.1 DC power headroom reporting / PSCell activation and DL pathloss change reporting

7.1.1.11.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state on Pcell and PSCell is added }

**ensure that** {

**when** { phr is configured }

**then** { UE transmits a Power Headroom Report for the PCell and PSCell }

}

(2)

**with** { UE in RRC\_CONNECTED state with PSCell and with Power headroom reporting for phr-Tx-PowerFactorChange }

**ensure that** {

**when** { the DL Pathloss has changed more than phr-Tx-PowerFactorChange dB and phr-ProhibitTimer is running }

**then** { UE does not transmit a MAC PDU containing Power Headroom MAC Control Element }

}

(3)

**with** { UE in RRC\_CONNECTED state with PSCell and with Power headroom reporting for phr-Tx-PowerFactorChange }

**ensure that** {

**when** { the phr-ProhibitTimer expires and power headroom report is triggered due to DL Pathloss change }

**then** { UE transmits a MAC PDU containing Power Headroom MAC Control Element for the Pcell and PSCell }

}

7.1.1.11.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.321 clause 5.4.6

[TS 38.321, clause 5.4.6]

A Power Headroom Report (PHR) shall be triggered if any of the following events occur:

- *phr-ProhibitTimer* expires or has expired and the path loss has changed more than *phr-Tx-PowerFactorChange* dB for at least one activated Serving Cell of any MAC entity which is used as a pathloss reference since the last transmission of a PHR in this MAC entity when the MAC entity has UL resources for new transmission;

NOTE 1: The path loss variation for one cell assessed above is between the pathloss measured at present time on the current pathloss reference and the pathloss measured at the transmission time of the last transmission of PHR on the pathloss reference in use at that time, irrespective of whether the pathloss reference has changed in between.

- *phr-PeriodicTimer* expires;

- upon configuration or reconfiguration of the power headroom reporting functionality by upper layers, which is not used to disable the function;

- activation of an SCell of any MAC entity with configured uplink;

- addition of the PSCell (i.e. PSCell is newly added or changed);

- *phr-ProhibitTimer* expires or has expired, when the MAC entity has UL resources for new transmission, and the following is true for any of the activated Serving Cells of any MAC entity with configured uplink:

- there are UL resources allocated for transmission or there is a PUCCH transmission on this cell, and the required power backoff due to power management (as allowed by P-MPRc as specified in TS 38.101-1 [14], TS 38.101-2 [15], and TS 38.101-3 [16]) for this cell has changed more than *phr-Tx-PowerFactorChange* dB since the last transmission of a PHR when the MAC entity had UL resources allocated for transmission or PUCCH transmission on this cell.

NOTE 2: The MAC entity should avoid triggering a PHR when the required power backoff due to power management decreases only temporarily (e.g. for up to a few tens of milliseconds) and it should avoid reflecting such temporary decrease in the values of PCMAX,f,c/PH when a PHR is triggered by other triggering conditions.

If the MAC entity has UL resources allocated for a new transmission the MAC entity shall:

1> if it is the first UL resource allocated for a new transmission since the last MAC reset:

2> start *phr-PeriodicTimer*;

1> if the Power Headroom reporting procedure determines that at least one PHR has been triggered and not cancelled; and

1> if the allocated UL resources can accommodate the MAC CE for PHR which the MAC entity is configured to transmit, plus its subheader, as a result of LCP as defined in clause 5.4.3.1:

2> if *multiplePHR* with value *true* is configured:

3> for each activated Serving Cell with configured uplink associated with any MAC entity:

4> obtain the value of the Type 1 or Type 3 power headroom for the corresponding uplink carrier as specified in clause 7.7 of TS 38.213 [6] for NR Serving Cell and clause 5.1.1.2 of TS 36.213 [17] for E-UTRA Serving Cell;

4> if this MAC entity has UL resources allocated for transmission on this Serving Cell; or

4> if the other MAC entity, if configured, has UL resources allocated for transmission on this Serving Cell and *phr-ModeOtherCG* is set to *real* by upper layers:

5> obtain the value for the corresponding PCMAX,f,c field from the physical layer.

3> if *phr-Type2OtherCell* with value *true* is configured:

4> if the other MAC entity is E-UTRA MAC entity:

5> obtain the value of the Type 2 power headroom for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity);

5> if *phr-ModeOtherCG* is set to *real* by upper layers:

6> obtain the value for the corresponding PCMAX,f,c field for the SpCell of the other MAC entity (i.e. E-UTRA MAC entity) from the physical layer.

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Multiple Entry PHR MAC CE as defined in clause 6.1.3.9 based on the values reported by the physical layer.

2> else (i.e. Single Entry PHR format is used):

3> obtain the value of the Type 1 power headroom from the physical layer for the corresponding uplink carrier of the PCell;

3> obtain the value for the corresponding PCMAX,f,c field from the physical layer;

3> instruct the Multiplexing and Assembly procedure to generate and transmit the Single Entry PHR MAC CE as defined in clause 6.1.3.8 based on the values reported by the physical layer.

2> start or restart *phr-PeriodicTimer*;

2> start or restart *phr-ProhibitTimer*;

2> cancel all triggered PHR(s).

7.1.1.11.1.3 Test description

7.1.1.11.1.3.1 Pre-test conditions

System Simulator:

- NR Cell 1 is the PCell and NR Cell 10 is the PSCell.

- System information combination NR-4 as defined in TS 38.508-1 [4] clause 4.4.3.1.3 is used in all cells.

UE:

- None.

Preamble:

- The UE is in state NR RRC\_CONNECTED using generic procedure parameter Connectivity (*NR-DC*), Test Mode (*On*) associated with UE test loop mode A configured on NR Cell 1 according to TS 38.508-1 [4], clause 4.5.4.

7.1.1.11.1.3.2 Test procedure sequence

Table 7.1.1.11.1.3.2-0: Cell configuration power level changes over time for Conducted test environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 10 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -89 | -82 |  |
| **T2** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T3** | Cell-specific RS EPRE | dBm/SCS | -82 | -89 |  |
| **T4** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |

Table 7.1.1.11.1.3.2-0A: Cell configuration power level changes over time for OTA test environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 10 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |
| **T1** | Cell-specific RS EPRE | dBm/SCS | n/a | n/a |  |
| **T2** | Cell-specific RS EPRE | dBm/SCS | n/a | n/a |  |
| **T3** | Cell-specific RS EPRE | dBm/SCS | -82 | -91 |  |
| **T4** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 |  |

Table 7.1.1.11.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits UL grant on PCell and PSCell to the UE at every 10ms in PDCCH occasion. | <-- | - | - | - |
| 2 | SS transmits NR *RRCReconfiguration* message to configure to specific Power Headroom parameters for NR Cell | <-- | *RRCReconfiguration* | - | - |
| 3 | Check: Does the UE transmit a MAC PDU containing Multiple-Entry PHR MAC CE on PCell?  (Note 1) | --> | MAC PDU | 1 | P |
| 3A | Check: Does the UE transmit a MAC PDU containing Multiple-Entry PHR MAC CE on PSCell?  (Note 1) | --> | MAC PDU | 1 | P |
| 4 | The UE transmits an NR *RRCReconfigurationComplete* message including *nr-SCG-Response* (Note 1) | --> | *RRCReconfigurationComplete* | - | - |
| 5 | Void | - | - | - | - |
| - | EXCEPTION : Steps 6 to 12 shall be executed depending on PSCell Configuration.  (Note 3) | - | - | - | - |
| 6 | IF PSCell is configured as FR1 THEN Reduce SS power level for NR PCell so as to cause a DL\_Pathloss change at UE by 5dB, row T1 of Table 7.1.1.11.1.3.2-0. | - | - | - | - |
| 7 | Check: For 80% of *prohibitPHR-Timer* since step 3, does the UE transmit a MAC PDU containing Multiple-Entry PHR MAC CE on PCell? | --> | MAC PDU | 2 | F |
| 8 | Check: After *prohibitPHR-Timer* after step 3, does the UE transmit a MAC PDU containing Multiple-Entry PHR MAC CE on PCell? | --> | MAC PDU | 3 | P |
| 9 | Increase SS power level for NR PCell so as to cause a DL\_Pathloss change at UE by 5dB, row T2 of Table 7.1.1.11.1.3.2-0/0A. | - | - | - | - |
| 10 | Check: For 80% of *prohibitPHR-Timer* since step 8, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element on PCell? | --> | MAC PDU | 2 | F |
| 11 | Check: After *prohibitPHR-Timer* after step 8, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element on PCell? | --> | MAC PDU | 3 | P |
| 12 | Void | - | - | - | - |
| 13 | Reduce SS power level for NR PSCell so as to cause a DL\_Pathloss change at UE by 5dB, row T3 of Table 7.1.1.11.1.3.2-0/0A. | - | - | - | - |
| 14 | IF PSCell is configured as FR2 THEN Check: For 80% of *prohibitPHR-Timer* since step 3A, does the UE transmit a MAC PDU containing Multiple-Entry PHR MAC CE? | --> | MAC PDU | 2 | F |
| 15 | Check: Does the UE transmit a MAC PDU containing Multiple-Entry PHR MAC CE on PSCell? | --> | MAC PDU | 3 | P |
| 16 | Increase SS power level for NR PSCell so as to cause a DL\_Pathloss change at UE by 5dB, row T4 of Table 7.1.1.11.1.3.2-0/0A. | - | - | - | - |
| 17 | Check: For 80% of *prohibitPHR-Timer* since step 15, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element on PSCell? | --> | MAC PDU | 2 | F |
| 18 | Check: After *prohibitPHR-Timer* after step 15, does the UE transmit a MAC PDU containing Power Headroom MAC Control Element on PSCell? | --> | MAC PDU | 3 | P |
| 19 | The SS transmits an NR *RRCReconfiguration* message to disable Power Headroom reporting | <-- | *RRCReconfiguration* | - | - |
| 20 | The UE transmits an NR *RRCReconfigurationComplete* message to confirm the disabling of Power Headroom parameters | --> | *RRCReconfigurationComplete* | - | - |
| Note 1: Steps 3 and 4 can happen in any order.  Note 2: Void.  Note 3: Steps 6 to 12 are excluded when executed with FR1+FR2 band combination due to limitation in FR1 OTA requirements specified in 38.508-1 [4] clause 6.2.2.2.3. phr-Tx-PowerFactorChange for PCell is not tested due to this limitation | | | | | |

7.1.1.11.1.3.3 Specific Message Contents

Table 7.1.1.11.1.3.3-1: RRCReconfiguration (step 2, Table 7.1.1.11.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.2.2 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| rrc-TransactionIdentifier | | RRC-TransactionIdentifier |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| radioBearerConfig | | Not present |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| masterCellGroup | | CellGroupConfig-phr |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| mrdc-SecondaryCellGroupConfig CHOICE { | |  |  |  |
| setup SEQUENCE { | |  |  |  |
| mrdc-ReleaseAndAdd | | Not present |  |  |
| mrdc-SecondaryCellGroup CHOICE { | |  |  |  |
| nr-SCG | | RRCReconfiguration-SCG-phr | OCTET STRING (CONTAINING RRCReconfiguration) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.11.1.3.3-1A: RRCReconfiguration-SCG-phr (step 2, Table 7.1.1.11.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.2.2 | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| rrc-TransactionIdentifier | | RRC-TransactionIdentifier |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| radioBearerConfig | | Not present |  |  |
| secondaryCellGroup | | CellGroupConfig-phr |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.11.1.3.3-2: CellGroupConfig-phr (step 2, Table 7.1.1.11.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| cellGroupConfig::= SEQUENCE { |  |  |  |
| mac-CellGroupConfig SEQUENCE { |  |  |  |
| phr-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| phr-PeriodicTimer | infinity |  |  |
| phr-ProhibitTimer | sf500 |  |  |
| phr-Tx-PowerFactorChange | dB3 |  |  |
| multiplePHR | true |  |  |
| dummy | false |  |  |
| phr-Type2OtherCell | false |  |  |
| phr-ModeOtherCG | real |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

#### 7.1.1.12 UE power saving

##### 7.1.1.12.1 Void

##### 7.1.1.12.2 Void

##### 7.1.1.12.3 DRX adaptation / UE wakeup indication

7.1.1.12.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and long DRX is configured and [(SFN \* 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset* and DCP is configured }

**ensure that** {

**when** { a DCP indication with the value of wake-up indication 1 associated with the current DRX cycle has been received }

**then** { UE starts the drx-onDurationTimer after drx-SlotOffset from the beginning of the subframe and monitors the PDCCH }

}

(2)

**with** { UE in RRC\_CONNECTED state and long DRX is configured and [(SFN \* 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset* and DCP is configured and ps-wakeup is configured with value true }

**ensure that** {

**when** { DCP indication associated with this cycle has not been received }

**then** { UE starts the drx-onDurationTimer after drx-SlotOffset from the beginning of the subframe and monitors the PDCCH for OnDurationTimer PDCCH-Occasions }

}

(3)

**with** { UE in RRC\_CONNECTED state long DRX is configured and [(SFN \* 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset* and DCP is configured }

**ensure that** {

**when** { all DCP occasions in time domain occurred in DRX active time }

**then** { UE starts the drx-onDurationTimer after drx-SlotOffset from the beginning of the subframe and monitors the PDCCH }

}

(4)

**with** { UE in RRC\_CONNECTED state long DRX is configured and DCP is configured }

**ensure that** {

**when** { all DCP occasions in time domain occurred during measurement gap }

**then** { UE starts the drx-onDurationTimer after drx-SlotOffset from the beginning of the subframe and monitors the PDCCH }

}

(5)

**with** { UE in RRC\_CONNECTED state and long DRX is configured and [(SFN \* 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset* and DCP is configured }

**ensure that** {

**when** { a DCP indication with the value of wake-up indication 0 associated with the current DRX cycle has been received }

**then** { UE does not start the drx-onDurationTimer after drx-SlotOffset from the beginning of the subframe and skips monitoring the PDCCH }

}

7.1.1.12.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321, clause 5.7, TS 38.213, clause 10.3 and 7.3.1.3.7. Unless otherwise stated these are Rel-16 requirements.

[TS 38.321, clause 5.7]

The MAC entity may be configured by RRC with a DRX functionality that controls the UE's PDCCH monitoring activity for the MAC entity's C-RNTI, CI-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, and AI-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other clauses of this specification. When in RRC\_CONNECTED, if DRX is configured, for all the activated Serving Cells, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this clause; otherwise the MAC entity shall monitor the PDCCH as specified in TS 38.213 [6].

NOTE 1: If Sidelink resource allocation mode 1 is configured by RRC, a DRX functionality is not configured.

RRC controls DRX operation by configuring the following parameters:

- *drx-onDurationTimer*: the duration at the beginning of a DRX Cycle;

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity;

- *drx-RetransmissionTimerDL* (per DL HARQ process except for the broadcast process): the maximum duration until a DL retransmission is received;

- *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received;

- *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX Cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

- *drx-HARQ-RTT-TimerDL* (per DL HARQ process except for the broadcast process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity;

- *ps-Wakeup* (optional): the configuration to start associated *drx-onDurationTimer* in case DCP is monitored but not detected;

- *ps-TransmitOtherPeriodicCSI* (optional): the configuration to report periodic CSI that is not L1-RSRP on PUCCH during the time duration indicated by *drx-onDurationTimer* in case DCP is configured but associated *drx-onDurationTimer* is not started;

- *ps-TransmitPeriodicL1-RSRP* (optional): the configuration to transmit periodic CSI that is L1-RSRP on PUCCH during the time duration indicated by *drx-onDurationTimer* in case DCP is configured but associated *drx-onDurationTimer* is not started.

Serving Cells may be configured by RRC in two groups. When RRC does not configure a secondary DRX group, there is only one DRX group. When two DRX groups are configured each group of Serving Cells, which is called a DRX group, is configured by RRC with its own set of parameters: *drx-onDurationTimer*, *drx-InactivityTimer*. When two DRX groups are configured, the two groups share the following parameter values: *drx-SlotOffset*, *drx-RetransmissionTimerDL*, *drx-RetransmissionTimerUL*, *drx-LongCycleStartOffset*, *drx-ShortCycle* (optional), *drx-ShortCycleTimer* (optional), *drx-HARQ-RTT-TimerDL*, and *drx-HARQ-RTT-TimerUL*.

When a DRX cycle is configured, the Active Time for Serving Cells in a DRX group includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* configured for the DRX group is running; or

- *drx-RetransmissionTimerDL* or *drx-RetransmissionTimerUL* is running on any Serving Cell in the DRX group; or

- *ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or

- a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4); or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clauses 5.1.4 and 5.1.4a).

When DRX is configured, the MAC entity shall:

1> if the Long DRX Cycle is used, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:

2> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3:

3> if DCP indication associated with the current DRX Cycle received from lower layer indicated to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or

3> if all DCP occasion(s) in time domain, as specified in TS 38.213 [6], associated with the current DRX Cycle occurred in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last DCP occasion, or within BWP switching interruption length, or during a measurement gap; or

3> if *ps-Wakeup* is configured with value *true* and DCP indication associated with the current DRX Cycle has not been received from lower layers:

4> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

2> else:

3> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.

NOTE 2: In case of unaligned SFN across carriers in a cell group, the SFN of the SpCell is used to calculate the DRX duration.

1> if the DRX group is in Active Time:

2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];

2> if the PDCCH indicates a DL transmission:

3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;

NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating a non-numerical k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.

3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process.

3> if the PDSCH-to-HARQ\_feedback timing indicate a non-numerical k1 value as specified in TS 38.213 [6]:

4> start the *drx-RetransmissionTimerDL* in the first symbol after the PDSCH transmission for the corresponding HARQ process.

2> if the PDCCH indicates a UL transmission:

3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission;

3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

2> if the PDCCH indicates a new transmission (DL or UL) on a Serving Cell in this DRX group:

3> start or restart *drx-InactivityTimer* for this DRX group in the first symbol after the end of the PDCCH reception.

1> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3; and

1> if the current symbol n occurs within *drx-onDurationTimer* duration; and

1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause:

2> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7];

3> not report semi-persistent CSI configured on PUSCH;

3> if *ps-TransmitPeriodicL1-RSRP* is not configured with value *true*:

4> not report periodic CSI that is L1-RSRP on PUCCH.

3> if *ps-TransmitOtherPeriodicCSI* is not configured with value *true*:

4> not report periodic CSI that is not L1-RSRP on PUCCH.

1> else:

2> in current symbol n, if the DRX group would not be in Active Time considering grants/assignments scheduled on Serving Cell(s) in this DRX Group and DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause:

3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7] in this DRX group;

3> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH in this DRX group.

…

Regardless of whether the MAC entity is monitoring PDCCH or not on the Serving Cells in this DRX group, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] on the Serving Cells in this DRX group when such is expected.

The MAC entity needs not to monitor the PDCCH if it is not a complete PDCCH occasion (e.g. the Active Time starts or ends in the middle of a PDCCH occasion).

[TS 38.213, clause 10.3]

A UE configured with DRX mode operation [11, TS 38.321] can be provided the following for detection of a DCI format 2\_6 in a PDCCH reception on the PCell or on the SpCell [12, TS 38.331]

- a PS-RNTI for DCI format 2\_6 by *ps-RNTI*

- a number of search space sets, by *dci-Format2-6*, to monitor PDCCH for detection of DCI format 2\_6 on the active DL BWP of the PCell or of the SpCell according to a common search space as described in clause 10.1

- a payload size for DCI format 2\_6 by *sizeDCI-2-6*

- a location in DCI format 2\_6 of a Wake-up indication bit by *ps-PositionDCI-2-6*

- a '0' value for the Wake-up indication bit, when reported to higher layers, indicates to not start the *drx-onDurationTimer* for the next long DRX cycle [11, TS 38.321]

- a '1' value for the Wake-up indication bit, when reported to higher layers, indicates to start the *drx-onDurationTimer* for the next long DRX cycle [11, TS 38.321]

- a bitmap, when the UE is provided a number of groups of configured SCells by *dormancyGroupOutsideActiveTime*, where

- the bitmap location is immediately after the Wake-up indication bit location

- the bitmap size is equal to the number of groups of configured SCells where each bit of the bitmap corresponds to a group of configured SCells from the number of groups of configured SCells

- a '0' value for a bit of the bitmap indicates an active DL BWP, provided by *dormantBWP-Id*, for the UE [11, TS38.321] for each activated SCell in the corresponding group of configured SCells

- a '1' value for a bit of the bitmap indicates

- an active DL BWP, provided by *firstOutsideActiveTimeBWP-Id*, for the UE for each activated SCell in the corresponding group of configured SCells, if a current active DL BWP is the dormant DL BWP

- a current active DL BWP, for the UE for each activated SCell in the corresponding group of configured SCells, if the current active DL BWP is not the dormant DL BWP

- the UE sets the active DL BWP to the indicated active DL BWP

- an offset by *ps-Offset* indicating a time, where the UE starts monitoring PDCCH for detection of DCI format 2\_6 according to the number of search space sets, prior to a slot where the *drx-onDurationTimer* would start on the PCell or on the SpCell [11, TS 38.321]

- for each search space set, the PDCCH monitoring occasions are the ones in the first slots indicated by *duration*, or slot if *duration* is not provided, starting from the first slot of the first slots and ending prior to the start of *drx-onDurationTimer*.



On PDCCH monitoring occasions associated with a same long DRX Cycle, a UE does not expect to detect more than one DCI format 2\_6 with different values of the Wake-up indication bit for the UE or with different values of the bitmap for the UE.

The UE does not monitor PDCCH for detecting DCI format 2\_6 during Active Time [11, TS 38.321].

If a UE reports for an active DL BWP a *MinTimeGap* value that is X slots prior to the beginning of a slot where the UE would start the *drx-onDurationTimer*, the UE is not required to monitor PDCCH for detection of DCI format 2\_6 during the X slots, where X corresponds to the *MinTimeGap* value of the SCS of the active DL BWP in Table 10.3-1.

Table 10.3-1: Minimum time gap value X

|  |  |  |
| --- | --- | --- |
| SCS (kHz) | Minimum Time Gap X (slots) | |
| Value 1 | Value 2 |
| 15 | 1 | 3 |
| 30 | 1 | 6 |
| 60 | 1 | 12 |
| 120 | 2 | 24 |
| 480 | 8 | 96 |
| 960 | 16 | 192 |

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE detects DCI format 2\_6, the physical layer of a UE reports the value of the Wake-up indication bit for the UE to higher layers [11, TS 38.321] for the next long DRX cycle.

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE does not detect DCI format 2\_6, the physical layer of the UE does not report a value of the Wake-up indication bit to higher layers for the next long DRX cycle.

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE

- is not required to monitor PDCCH for detection of DCI format 2\_6, as described in clauses 10, 11.1, 12, and in clause 5.7 of [11, TS 38.321] for all corresponding PDCCH monitoring occasions outside Active Time prior to a next long DRX cycle, or

- does not have any PDCCH monitoring occasions for detection of DCI format 2\_6 outside Active Time of a next long DRX cycle

the physical layer of the UE reports a value of 1 for the Wake-up indication bit to higher layers for the next long DRX cycle.

[TS 38.212, clause 7.3.1.3.7]

DCI format 2\_6 is used for notifying the power saving information outside DRX Active Time for one or more UEs.

The following information is transmitted by means of the DCI format 2\_6 with CRC scrambled by PS-RNTI:

- block number 1, block number 2,…, block number *N*

where the starting position of a block is determined by the parameter *PSPositionDCI2-6* provided by higher layers for the UE configured with the block.

If the UE is configured with higher layer parameter *PS-RNTI* and *dci-Format2-6*, one block is configured for the UE by higher layers, with the following fields defined for the block:

- Wake-up indication - 1 bit

- SCell dormancy indication – 0 bit if higher layer parameter *Scell-groups-for-dormancy-outside-active-time* is not configured; otherwise 1, 2, 3, 4 or 5 bits bitmap determined according to higher layer parameter *Scell-groups-for-dormancy-outside-active-time,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *Scell-groups-for-dormancy-outside-active-time,* with MSB to LSB of the bitmap corresponding to the first to last configured SCell group.

The size of DCI format 2\_6 is indicated by the higher layer parameter *SizeDCI\_2-6*, according to Clause 10.3 of [5, TS 38.213].

7.1.1.12.3.3 Test description

7.1.1.12.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that set to return no data in uplink.

7.1.1.12.3.3.2 Test procedure sequence

Table 7.1.1.12.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits RRCReconfiguration to configure specific DCP parameters. (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 2 | The UE transmits RRCReconfigurationComplete. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 3 | Wait 1280ms to ensure UE is out DRX active time. | - | - | - | - |
| 3A | The SS transmits DCI 2-6 on the PDCCH within the PS-offset time before the start of next long DRX drx-onDurationTimer and the DCI 2-6 indicates not to start the next Drx-onDurationTimer. | <-- | (PDCCH (DCI 2-6)) | - | - |
| 3B | In a PDCCH occasion the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 3C | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 28? | --> | HARQ ACK | 5 | F |
| 4 | The SS transmits DCI 2-6 on the PDCCH within the PS-offset time before the start of next long DRX drx-onDurationTimer and the DCI 2-6 indicates to start the next Drx-onDurationTimer. | <-- | (PDCCH (DCI 2-6)) | - | - |
| 5 | In the first PDCCH occasion when the Drx-onDurationTimer is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 6 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 5? | --> | HARQ ACK | 1 | P |
| 7 | SS transmits RRCReconfiguration to configure ps-wakeup with value true. (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 8 | The UE transmits RRCReconfigurationComplete. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 9 | Wait 20ms to ensure UE is out DRX active time. | - | - | - | - |
| 10 | In the first PDCCH occasion when the *Drx-onDurationTimer* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 11 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 10? | --> | HARQ ACK | 2 | P |
| 12 | SS transmits RRCReconfiguration to configure specific DCP parameters. (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 13 | The UE transmits RRCReconfigurationComplete. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 14 | Wait 1280ms to ensure UE is out DRX active time. | - | - | - | - |
| 15 | The SS transmits DCI 2-6 on the PDCCH within the PS-offset time before the start of next long DRX drx-onDurationTimer and the DCI 2-6 indicates to start the next Drx-onDurationTimer. | <-- | (PDCCH (DCI 2-6)) | - | - |
| 16 | In the last PDCCH occasion when the *Drx-onDurationTimer* is running, the SS indicates the transmission of an invalid DL MAC PDU on the PDCCH. | <-- | Invalid MAC PDU | - | - |
| 17 | The UE transmit a HARQ NACK for the DL MAC PDU in Step 16. | --> | HARQ NACK | - | - |
| 17A | The SS transmits DCI 2-6 on the PDCCH within the PS-offset time before the start of next long DRX drx-onDurationTimer and the DCI 2-6 indicates not to start the next Drx-onDurationTimer. | <-- | (PDCCH (DCI 2-6)) | - | - |
| 18 | In the PDCCH occasion when the next *Drx-onDurationTimer* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 19 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 18? | --> | HARQ ACK | 3 | P |
| 20 | SS transmits RRCReconfiguration to configure specific measonfig parameters. (Note 1) | <-- | *RRCReconfiguration* | - | - |
| 21 | The UE transmits RRCReconfigurationComplete. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 22 | Wait 10ms to ensure UE is out DRX active time. | - | - | - | - |
| 22A | The SS transmits DCI 2-6 on the PDCCH within the PS-offset time before the start of next long DRX drx-onDurationTimer and the DCI 2-6 indicates not to start the next Drx-onDurationTimer. | <-- | (PDCCH (DCI 2-6)) | - | - |
| 23 | In the first PDCCH occasion when the *Drx-onDurationTimer* is running, the SS indicates the transmission of a DL MAC PDU on the PDCCH. | <-- | MAC PDU | - | - |
| 24 | Check: Does the UE transmit a HARQ ACK for the DL MAC PDU in Step 23? | --> | HARQ ACK | 4 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.1.12.3.3.3 Specific message contents

Table 7.1.1.12.3.3.3-1: RRCReconfiguration (step 1, 7 and 12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [6] | | | |
| **Information Element** | | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig |  | EN-DC |
| nonCriticalExtension := SEQUENCE {} | | Not present |  | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.12.3.3.3-2: CellGroupConfig (Table 7.1.1.12.3.3.3-1: RRCReconfiguration)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| cellGroupId | CellGroupId | TS 38.508-1 default value |  |
| mac-CellGroupConfig ::= SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup | DRX-Config | TS 38.508-1 default value |  |
| } |  |  |  |
| } |  |  |  |
| physicalCellGroupConfig::= SEQUENCE { |  |  |  |
| dcp-Config-r16 CHOICE { |  |  |  |
| setup | DCP-Config-r16 | TS 38.508-1 default value |  |
| } |  |  |  |
| } |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| spCellConfigDedicated | ServingCellConfig |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.3.3.3-3: ServingCellConfig (Table 7.1.1.13.3.3.3-2: CellGroupConfig)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4] Table 4.6.3-167 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| initialDownlinkBWP ::= SEQUENCE { |  |  |  |
| pdcch-Config CHOICE { |  |  | Step 1, Step 7, Step 12, Step 20 |
| setup | PDCCH-Config |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.3.3.3-4: PDCCH-Config (Table 7.1.1.12.3.3.3-3: BWP-DownlinkDedicated)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet ::= SEQUENCE { |  |  |  |
| controlResourceSetId | 1 |  |  |
| } |  |  |  |
| searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace { |  |  |  |
| searchSpace ::= SEQUENCE { |  |  |  |
| searchSpaceExt-r16 ::= SEQUENCE { |  |  |  |
| controlResourceSetId-r16 | 1 |  |  |
| searchSpaceType-r16 SEQUENCE { |  |  |  |
| common SEQUENCE { |  |  |  |
| dci-Format2-6-r16 SEQUENCE { |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| searchSpaceGroupIdList-r16 | Not present |  |  |
| freqMonitorLocations-r16 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.3.3.3-5: CellGroupConfig (Table 7.1.1.13.3.3.3-1: RRCReconfiguration step 7)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| cellGroupId | CellGroupId | TS 38.508-1 default value |  |
| mac-CellGroupConfig ::= SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup | DRX-Config | TS 38.508-1 default value |  |
| } |  |  |  |
| } |  |  |  |
| physicalCellGroupConfig::= SEQUENCE { |  |  |  |
| dcp-Config-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| ps-WakeUp-r16 | true |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.3.3.3-6: CellGroupConfig (Table 7.1.1.13.3.3.3-1: RRCReconfiguration step 12)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| cellGroupId | CellGroupId | TS 38.508-1 default value |  |
| mac-CellGroupConfig ::= SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer CHOICE { | ms10 |  |  |
| milliSeconds | ms10 |  |  |
| } |  |  |  |
| drx-InactivityTimer | ms6 |  |  |
| drx-HARQ-RTT-TimerDL | 56 |  |  |
| drx-HARQ-RTT-TimerUL | 56 |  |  |
| drx-RetransmissionTimerDL | sl320 |  |  |
| drx-RetransmissionTimerUL | sl320 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms20 | 0 |  |  |
| } |  |  |  |
| shortDRX | Not present |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| physicalCellGroupConfig::= SEQUENCE { |  |  |  |
| dcp-Config-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| ps-Offset-r16 | 40 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.3.3.3-7: RRCReconfiguration (step 20)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [6], Table 4.6.1-13 | | | |
| **Information Element** | | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig |  | EN-DC |
| measConfig ::= SEQUENCE { | |  |  |  |
| measObjectToAddModList SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasObjectToAddMod { | | 2 entries |  |  |
| MeasObjectToAddMod[1] SEQUENCE { | |  | entry 1 |  |
| measObjectId | | 1 |  |  |
| measObject CHOICE { | |  |  |  |
| measObjectNR SEQUENCE { | |  |  |  |
| ssbFrequency | | ARFCN-ValueNR for SSB of NR Cell 1 |  |  |
| absThreshSS-BlocksConsolidation | | Not present |  |  |
| nrofSS-BlocksToAverage | | Not present |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| MeasObjectToAddMod[2] SEQUENCE { | |  |  |  |
| measObjectId | | 2 |  |  |
| measObject CHOICE { | |  |  |  |
| measObjectNR SEQUENCE { | |  |  |  |
| ssbFrequency | | ARFCN-ValueNR for SSB of NR Cell 3 |  |  |
| absThreshSS-BlocksConsolidation | | Not present |  |  |
| nrofSS-BlocksToAverage | | Not present |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| reportConfigToAddModList SEQUENCE(SIZE (1..maxReportConfigId)) OF ReportConfigToAddMod { | | 1 entry |  |  |
| ReportConfigToAddMod[1] SEQUENCE { | |  | entry 1 |  |
| reportConfigId | | 1 |  |  |
| reportConfig CHOICE { | |  |  |  |
| reportConfigNR SEQUENCE { | |  |  |  |
| reportType CHOICE { | |  |  |  |
| eventTriggered SEQUENCE { | |  |  |  |
| eventId CHOICE { | |  |  |  |
| eventA3 SEQUENCE { | |  |  |  |
| a3-Offset CHOICE { | |  |  |  |
| rsrp | | 2 | 1 dB (2\*0.5 dB) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| reportAmount | | infinity |  |  |
| reportQuantityCell SEQUENCE { | |  |  |  |
| rsrp | | true |  |  |
| rsrq | | false |  |  |
| sinr | | false |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| measIdToAddModList SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasIdToAddMod { | | 1 entry |  |  |
| MeasIdToAddMod[1] SEQUENCE { | |  | entry 1 |  |
| measId | | 1 |  |  |
| measObjectId | | 2 |  |  |
| reportConfigId | | 1 |  |  |
| } | |  |  |  |
| } | |  |  |  |
| measGapConfig ::= SEQUENCE { | |  |  |  |
| gapUE CHOICE { | |  |  |  |
| setup SEQUENCE { | |  |  |  |
| gapOffset | | 34 |  |  |
| mgl | | ms6 |  |  |
| mgrp | | ms40 |  |  |
| mgta | | ms0 |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.12.3.3.3-8: CellGroupConfig (Table 7.1.1.12.3.3.3-7: RRCReconfiguration step 20)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| cellGroupId | CellGroupId | TS 38.508-1 default value |  |
| mac-CellGroupConfig ::= SEQUENCE { |  |  |  |
| drx-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| drx-onDurationTimer CHOICE { |  |  |  |
| milliSeconds | ms10 |  |  |
| } |  |  |  |
| drx-InactivityTimer | ms5 |  |  |
| drx-LongCycleStartOffset CHOICE { |  |  |  |
| ms40 | 39 |  |  |
| } |  |  |  |
| shortDRX | Not present |  |  |
| drx-SlotOffset | ms0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| physicalCellGroupConfig::= SEQUENCE { |  |  |  |
| dcp-Config-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| ps-Offset-r16 | 40 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.1.12.4 DRX adaptation / SCell dormancy indication

###### 7.1.1.12.4.1 DRX adaptation / SCell dormancy indication / Intra-band Contiguous CA

7.1.1.12.4.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with Scell configured and long DRX is configured and DCP is configured }

**ensure that** {

**when** { UE is outside DRX active time and receives the PDCCH indicating entering dormant BWP for SCell }

**then** { UE activates the BWP indicated by dormantBWP-Id and stops monitoring the PDCCH}

}

(2)

**with** { UE in RRC\_CONNECTED state with Scell configured and long DRX is configured and DCP is configured }

**ensure that** {

**when** { UE is outside DRX active time and the active DL BWP is dormant BWP and receives the PDCCH indicating leaving dormant BWP from SCell }

**then** { UE activates the BWP indicated by firstOutsideActiveTimeBWP-Id and starts normal MAC operation on the new BWP }

}

7.1.1.12.4.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.212, clause 7.3.1.3.7, TS 38.213, clause 10.3, TS 38.321, clause 5.15.1 and 5.9. Unless otherwise stated these are Rel-15 requirements.

[TS 38.212, clause 7.3.1.3.7]

DCI format 2\_6 is used for notifying the power saving information outside DRX Active Time for one or more UEs.

The following information is transmitted by means of the DCI format 2\_6 with CRC scrambled by PS-RNTI:

- block number 1, block number 2,…, block number *N*

where the starting position of a block is determined by the parameter *ps-PositionDCI-2-6* provided by higher layers for the UE configured with the block.

If the UE is configured with higher layer parameter *ps-RNTI* and *dci-Format2-6*, one block is configured for the UE by higher layers, with the following fields defined for the block:

- Wake-up indication - 1 bit

- SCell dormancy indication – 0 bit if higher layer parameter *dormancyGroupOutsideActiveTime* is not configured; otherwise 1, 2, 3, 4 or 5 bits bitmap determined according to higher layer parameter *dormancyGroupOutsideActiveTime,* where each bit corresponds to one of the SCell group(s) configured by higher layers parameter *dormancyGroupOutsideActiveTime,* with MSB to LSB of the bitmap corresponding to the first to last configured SCell group.

The size of DCI format 2\_6 is indicated by the higher layer parameter *sizeDCI-2-6*, according to Clause 10.3 of [5, TS 38.213].

[TS 38.213, clause 10.3]

A UE configured with DRX mode operation [11, TS 38.321] can be provided the following for detection of a DCI format 2\_6 in a PDCCH reception on the PCell or on the SpCell [12, TS 38.331]

- a PS-RNTI for DCI format 2\_6 by *ps-RNTI*

- a number of search space sets, by *dci-Format2-6*, to monitor PDCCH for detection of DCI format 2\_6 on the active DL BWP of the PCell or of the SpCell according to a common search space as described in Clause 10.1

- a payload size for DCI format 2\_6 by *sizeDCI\_2-6*

- a location in DCI format 2\_6 of a Wake-up indication bit by *psPositionDCI-2-6*

- a '0' value for the Wake-up indication bit, when reported to higher layers, indicates to not start the *drx-onDurationTimer* for the next long DRX cycle [11, TS 38.321]

- a '1' value for the Wake-up indication bit, when reported to higher layers, indicates to start the *drx-onDurationTimer* for the next long DRX cycle [11, TS 38.321]

- a bitmap, when the UE is provided a number of groups of configured SCells by *dormancyGroupOutsideActiveTime*, where

- the bitmap location is immediately after the Wake-up indication bit location

- the bitmap size is equal to the number of groups of configured SCells where each bit of the bitmap corresponds to a group of configured SCells from the number of groups of configured SCells

- a '0' value for a bit of the bitmap indicates an active DL BWP, provided by *dormantBWP-Id*, for the UE [11, TS38.321] for each activated SCell in the corresponding group of configured SCells

- a '1' value for a bit of the bitmap indicates

- an active DL BWP, provided by *firstOutsideActiveTimeBWP-Id*, for the UE for each activated SCell in the corresponding group of configured SCells, if a current active DL BWP is the dormant DL BWP

- a current active DL BWP, for the UE for each activated SCell in the corresponding group of configured SCells, if the current active DL BWP is not the dormant DL BWP

- an offset by *ps-Offset* indicating a time, where the UE starts monitoring PDCCH for detection of DCI format 2\_6 according to the number of search space sets, prior to a slot where the *drx-onDuarationTimer* would start on the PCell or on the SpCell [11, TS 38.321]

- for each search space set, the PDCCH monitoring occasions are the ones in the first slots indicated by *duration*, or slot if *duration* is not provided, starting from the first slot of the first slots and ending prior to the start of *drx-onDurationTimer*.



On PDCCH monitoring occasions associated with a same long DRX Cycle, a UE does not expect to detect more than one DCI format 2\_6 with different values of the Wake-up indication bit for the UE or with different values of the bitmap for the UE.

The UE does not monitor PDCCH for detecting DCI format 2\_6 during Active Time [11, TS 38.321].

If a UE reports for an active DL BWP a requirement of X slots prior to the beginning of a slot where the UE would start the *drx-onDurationTimer*, the UE is not required to monitor PDCCH for detection of DCI format 2\_6 during the X slots, where X corresponds to the requirement of the SCS of the active DL BWP in Table 10.3-1.

Table 10.3-1: Minimum time gap value X

|  |  |  |
| --- | --- | --- |
| SCS (kHz) | Minimum Time Gap X (slots) | |
| Value 1 | Value 2 |
| 15 | 1 | 3 |
| 30 | 1 | 6 |
| 60 | 1 | 12 |
| 120 | 2 | 24 |

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE detects DCI format 2\_6, the physical layer of a UE reports the value of the Wake-up indication bit for the UE to higher layers [11, TS 38.321] for the next long DRX cycle.

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE does not detect DCI format 2\_6, the physical layer of the UE does not report a value of the Wake-up indication bit to higher layers for the next long DRX cycle.

If a UE is provided search space sets to monitor PDCCH for detection of DCI format 2\_6 in the active DL BWP of the PCell or of the SpCell and the UE

- is not required to monitor PDCCH for detection of DCI format 2\_6, as described in Clauses 10, 11.1, 12, and in Clause 5.7 of [11, TS 38.321] for all corresponding PDCCH monitoring occasions outside Active Time prior to a next long DRX cycle, or

- does not have any PDCCH monitoring occasions for detection of DCI format 2\_6 outside Active Time of a next long DRX cycle

the physical layer of the UE reports a value of 1 for the Wake-up indication bit to higher layers for the next long DRX cycle.

…

If an active DL BWP provided by *dormantBWP-Id* for a UE on an activated SCell is not a default DL BWP for the UE on the activated SCell, as described in Clause 12, the BWP inactivity timer is not used for transitioning from the active DL BWP provided by *dormantBWP-Id* to the default DL BWP on the activated SCell.

[TS 38.321, clause 5.15.1]

In addition to clause 12 of TS 38.213 [6], this clause specifies requirements on BWP operation.

A Serving Cell may be configured with one or multiple BWPs, and the maximum number of BWP per Serving Cell is specified in TS 38.213 [6].

The BWP switching for a Serving Cell is used to activate an inactive BWP and deactivate an active BWP at a time. The BWP switching is controlled by the PDCCH indicating a downlink assignment or an uplink grant, by the *bwp-InactivityTimer*, by RRC signalling, or by the MAC entity itself upon initiation of Random Access procedure or upon detection of consistent LBT failure on SpCell. Upon RRC (re-)configuration of *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* for SpCell or activation of an SCell, the DL BWP and/or UL BWP indicated by *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* respectively (as specified in TS 38.331 [5]) is active without receiving PDCCH indicating a downlink assignment or an uplink grant. The active BWP for a Serving Cell is indicated by either RRC or PDCCH (as specified in TS 38.213 [6]). For unpaired spectrum, a DL BWP is paired with a UL BWP, and BWP switching is common for both UL and DL.

For each SCell a dormant BWP may be configured with *dormantBWP-Id* by RRC signalling as described in TS 38.331 [5]. Entering or leaving dormant BWP for SCells is done by BWP switching per SCell or per dormancy SCell group based on instruction from PDCCH (as specified in TS 38.213 [6]). The dormancy SCell group configurations are configured by RRC signalling as described in TS 38.331 [5]. Upon reception of the PDCCH indicating leaving dormant BWP, the DL BWP indicated by *firstOutsideActiveTimeBWP-Id* or by *firstWithinActiveTimeBWP-Id* (as specified in TS 38.331 [5] and TS 38.213 [6]) is activated. Upon reception of the PDCCH indicating entering dormant BWP, the DL BWP indicated by *dormantBWP-Id* (as specified in TS 38.331 [5]) is activated. The dormant BWP configuration for SpCell or PUCCH SCell is not supported.

For each activated Serving Cell configured with a BWP, the MAC entity shall:

1> if a BWP is activated and the active DL BWP for the Serving Cell is not the dormant BWP:

2> transmit on UL-SCH on the BWP;

2> transmit on RACH on the BWP, if PRACH occasions are configured;

2> monitor the PDCCH on the BWP;

2> transmit PUCCH on the BWP, if configured;

2> report CSI for the BWP;

2> transmit SRS on the BWP, if configured;

2> receive DL-SCH on the BWP;

2> (re-)initialize any suspended configured uplink grants of configured grant Type 1 on the active BWP according to the stored configuration, if any, and to start in the symbol according to rules in clause 5.8.2;

2> if *lbt-FailureRecoveryConfig* is configured:

3> stop the *lbt-FailureDetectionTimer*, if running;

3> set *LBT\_COUNTER* to 0;

3> monitor LBT failure indications from lower layers as specified in clause 5.21.2.

1> if a BWP is activated and the active DL BWP for the Serving Cell is dormant BWP:

2> stop the *bwp-InactivityTimer* of this Serving Cell, if running.

2> not monitor the PDCCH on the BWP;

2> not monitor the PDCCH for the BWP;

2> not receive DL-SCH on the BWP;

2> not report CSI on the BWP, report CSI except aperiodic CSI for the BWP;

2> not transmit SRS on the BWP;

2> not transmit on UL-SCH on the BWP;

2> not transmit on RACH on the BWP;

2> not transmit PUCCH on the BWP.

2> clear any configured downlink assignment and any configured uplink grant Type 2 associated with the SCell respectively;

2> suspend any configured uplink grant Type 1 associated with the SCell;

2> if configured, perform beam failure detection and beam failure recovery for the SCell if beam failure is detected.

1> if a BWP is deactivated:

2> not transmit on UL-SCH on the BWP;

2> not transmit on RACH on the BWP;

2> not monitor the PDCCH on the BWP;

2> not transmit PUCCH on the BWP;

2> not report CSI for the BWP;

2> not transmit SRS on the BWP;

2> not receive DL-SCH on the BWP;

2> clear any configured downlink assignment and configured uplink grant of configured grant Type 2 on the BWP;

2> suspend any configured uplink grant of configured grant Type 1 on the inactive BWP.

Upon initiation of the Random Access procedure on a Serving Cell, after the selection of carrier for performing Random Access procedure as specified in clause 5.1.1, the MAC entity shall for the selected carrier of this Serving Cell:

1> if PRACH occasions are not configured for the active UL BWP:

2> switch the active UL BWP to BWP indicated by *initialUplinkBWP*;

2> if the Serving Cell is an SpCell:

3> switch the active DL BWP to BWP indicated by *initialDownlinkBWP*.

1> else:

2> if the Serving Cell is an SpCell:

3> if the active DL BWP does not have the same *bwp-Id* as the active UL BWP:

4> switch the active DL BWP to the DL BWP with the same *bwp-Id* as the active UL BWP.

1> stop the *bwp-InactivityTimer* associated with the active DL BWP of this Serving Cell, if running.

1> if the Serving Cell is SCell:

2> stop the *bwp-InactivityTimer* associated with the active DL BWP of SpCell, if running.

1> perform the Random Access procedure on the active DL BWP of SpCell and active UL BWP of this Serving Cell.

If the MAC entity receives a PDCCH for BWP switching of a Serving Cell, the MAC entity shall:

1> if there is no ongoing Random Access procedure associated with this Serving Cell; or

1> if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI (as specified in clauses 5.1.4, 5.1.4a, and 5.1.5):

2> cancel, if any, triggered consistent LBT failure for this Serving Cell;

2> perform BWP switching to a BWP indicated by the PDCCH.

If the MAC entity receives a PDCCH for BWP switching for a Serving Cell(s) or a dormancy SCell group(s) while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, it is up to UE implementation whether to switch BWP or ignore the PDCCH for BWP switching, except for the PDCCH reception for BWP switching addressed to the C-RNTI for successful Random Access procedure completion (as specified in clauses 5.1.4, 5.1.4a, and 5.1.5) in which case the UE shall perform BWP switching to a BWP indicated by the PDCCH. Upon reception of the PDCCH for BWP switching other than successful contention resolution, if the MAC entity decides to perform BWP switching, the MAC entity shall stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching; if the MAC decides to ignore the PDCCH for BWP switching, the MAC entity shall continue with the ongoing Random Access procedure on the Serving Cell.

…

1> if a PDCCH for BWP switching is received, and the MAC entity switches the active DL BWP:

2> if the *defaultDownlinkBWP-Id* is configured, and the MAC entity switches to the DL BWP which is not indicated by the *defaultDownlinkBWP-Id* and is not indicated by the *dormantBWP-Id* if configured; or

2> if the *defaultDownlinkBWP-Id* is not configured, and the MAC entity switches to the DL BWP which is not the *initialDownlinkBWP* and is not indicated by the *dormantBWP-Id* if configured:

3> start or restart the *bwp-InactivityTimer* associated with the active DL BWP.

[TS 38.321, clause 5.9]

If the MAC entity is configured with one or more SCells, the network may activate and deactivate the configured SCells. Upon configuration of an SCell, the SCell is deactivated unless the parameter *sCellState* is set to *activated* for the SCell by upper layers.

The configured SCell(s) is activated and deactivated by:

- receiving the SCell Activation/Deactivation MAC CE described in clause 6.1.3.10;

- configuring *sCellDeactivationTimer* timer per configured SCell (except the SCell configured with PUCCH, if any): the associated SCell is deactivated upon its expiry;

- configuring *sCellState* per configured SCell: if configured, the associated SCell is activated upon SCell configuration.

The MAC entity shall for each configured SCell:

1> if an SCell is configured with *sCellState* set to *activated* upon SCell configuration, or an SCell Activation/Deactivation MAC CE is received activating the SCell:

2> if the SCell was deactivated prior to receiving this SCell Activation/Deactivation MAC CE; or

2> if the SCell is configured with *sCellState* set to *activated* upon SCell configuration:

3> if *firstActiveDownlinkBWP-Id* is not set to dormant BWP:

4> activate the SCell according to the timing defined in TS 38.213 [6]; i.e. apply normal SCell operation including:

5> SRS transmissions on the SCell;

5> CSI reporting for the SCell;

5> PDCCH monitoring on the SCell;

5> PDCCH monitoring for the SCell;

5> PUCCH transmissions on the SCell, if configured.

3> else (i.e. *firstActiveDownlinkBWP-Id* is set to dormant BWP):

4> stop the *bwp-InactivityTimer* of this Serving Cell, if running.

3> activate the DL BWP and UL BWP indicated by *firstActiveDownlinkBWP-Id* and *firstActiveUplinkBWP-Id* respectively.

2> start or restart the *sCellDeactivationTimer* associated with the SCell according to the timing defined in TS 38.213 [6];

2> if the active DL BWP is not the dormant BWP:

3> (re-)initialize any suspended configured uplink grants of configured grant Type 1 associated with this SCell according to the stored configuration, if any, and to start in the symbol according to rules in clause 5.8.2.2;

3> trigger PHR according to clause 5.4.6.

1> else if an SCell Activation/Deactivation MAC CE is received deactivating the SCell; or

1> if the *sCellDeactivationTimer* associated with the activated SCell expires:

2> deactivate the SCell according to the timing defined in TS 38.213 [6];

2> stop the *sCellDeactivationTimer* associated with the SCell;

2> stop the *bwp-InactivityTimer* associated with the SCell;

2> deactivate any active BWP associated with the SCell;

2> clear any configured downlink assignment and any configured uplink grant Type 2 associated with the SCell respectively;

2> clear any PUSCH resource for semi-persistent CSI reporting associated with the SCell;

2> suspend any configured uplink grant Type 1 associated with the SCell;

2> flush all HARQ buffers associated with the SCell;

2> cancel, if any, triggered consistent LBT failure for the SCell.

1> if PDCCH on the activated SCell indicates an uplink grant or downlink assignment; or

1> if PDCCH on the Serving Cell scheduling the activated SCell indicates an uplink grant or a downlink assignment for the activated SCell; or

1> if a MAC PDU is transmitted in a configured uplink grant and LBT failure indication is not received from lower layers; or

1> if a MAC PDU is received in a configured downlink assignment:

2> restart the *sCellDeactivationTimer* associated with the SCell.

1> if the SCell is deactivated:

2> not transmit SRS on the SCell;

2> not report CSI for the SCell;

2> not transmit on UL-SCH on the SCell;

2> not transmit on RACH on the SCell;

2> not monitor the PDCCH on the SCell;

2> not monitor the PDCCH for the SCell;

2> not transmit PUCCH on the SCell.

HARQ feedback for the MAC PDU containing SCell Activation/Deactivation MAC CE shall not be impacted by PCell, PSCell and PUCCH SCell interruptions due to SCell activation/deactivation in TS 38.133 [11].

When SCell is deactivated, the ongoing Random Access procedure on the SCell, if any, is aborted.

7.1.1.12.4.1.3 Test description

7.1.1.12.4.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.1.0 except that Test loop function(*Off*) System information combination NR-4 and in addition NR Cell 3 is configured as NR Active Scell.

7.1.1.12.4.1.3.2 Test procedure sequence

Table 7.1.1.12.4.1.3.2-1: Cell configuration power level changes over time for FR1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 3 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -88 | off | NR cell 1 is available and NR cell 3 is not available |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -88 | -88 | NR cell 1 and NR cell 3 are available |

Table 7.1.1.12.4.1.3.2-2: Cell configuration power level changes over time for FR2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Parameter | Unit | NR Cell 1 | NR Cell 3 | Remarks |
| **T0** | Cell-specific RS EPRE | dBm/SCS | -82 | off | NR cell 1 is available and NR cell 3 is not available |
| **T1** | Cell-specific RS EPRE | dBm/SCS | -82 | -82 | NR cell 1 and NR cell 3 are available |

Table 7.1.1.12.4.1.3.2-3: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0 | Set the power levels according to “T1” as per Table 7.1.1.12.4.1.3.2-1/2. |  |  |  |  |
| 1 | SS transmits an RRCReconfiguration message. (Note 1) | <-- |  |  |  |
| 2 | The UE transmits RRCReconfigurationComplete message. (Note 2) | --> |  |  |  |
| 3 | The SS transmits a SCell Activation MAC-CE to activate SCell (NR Cell 3). | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=1)) |  |  |
| 4 | The SS transmits DCI 2-6 within ps-Offset time before the start of next long DRX drx-onDurationTimer on NR Cell 1. (Note 3) | <-- | (PDCCH (DCI 2-6)) |  |  |
| 5 | The SS indicates a new transmission on PDCCH of SCell and transmits a MAC PDU on the initial BWP (BWP#0) when the Drx-onDurationTimer is running. | <-- | MAC PDU |  |  |
| 6 | Check: Does the UE transmit a HARQ ACK on the SCell for the DL MAC PDU in Step 5 within 5 seconds? | --> |  | 1 | F |
| 7 | The SS transmits DCI 2-6 within the ps-offset time before the start of next long DRX drx-onDurationTimer on NR Cell 1. (Note 4) | <-- | (PDCCH (DCI 2-6)) |  |  |
| 8 | The SS indicates a new transmission on PDCCH of SCell and transmits a MAC PDU on the active BWP (BWP#0) when the Drx-onDurationTimer is running. | <-- | MAC PDU |  |  |
| 9 | Check: Does the UE transmit a HARQ ACK on the SCell for the DL MAC PDU in Step 8? | --> | HARQ ACK | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The Wake-up indication is value 1 and the SCell dormancy indication is value 0 in the DCI 2-6.  Note 4: The Wake-up indication is value 1 and the SCell dormancy indication is value 1 in the DCI 2-6. | | | | | |

7.1.1.12.4.1.3.3 Specific message contents

Table 7.1.1.12.4.1.3.3-1: RRCReconfiguration (step 1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [6] | | | |
| **Information Element** | | **Value/remark** | **Comment** | **Condition** |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig |  | EN-DC |
| nonCriticalExtension SEQUENCE { | |  |  | NR |
| masterCellGroup | | CellGroupConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.12.4.1.3.3-2: CellGroupConfig (Table 7.1.1.12.4.3.3-1: RRCReconfiguration)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition SCell\_add | | | |
| Information Element | | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { | |  |  |  |
| cellGroupId | | CellGroupId | TS 38.508-1 default value |  |
| mac-CellGroupConfig ::= SEQUENCE { | |  |  |  |
| drx-Config CHOICE { | |  |  |  |
| setup | | DRX-Config | TS 38.508-1 default value |  |
| } | |  |  |  |
| } | |  |  |  |
| physicalCellGroupConfig::= SEQUENCE { | |  |  |  |
| dcp-Config-r16 CHOICE { | |  |  |  |
| setup | | DCP-Config-r16 | TS 38.508-1 default value |  |
| } | |  |  |  |
| } | |  |  |  |
| spCellConfig SEQUENCE { | |  |  |  |
| spCellConfigDedicated SEQUENCE { | |  |  |  |
| servingCellConfig SEQUENCE { | |  |  |  |
| initialDownlinkBWP SEQUENCE { | |  |  |  |
| pdcch-Config CHOICE { | |  |  |  |
| setup | | PDCCH-Config |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| sCellToAddModList SEQUENCE (SIZE (1..maxMeasId)) OF SCellConfig { | | 1 entry |  |  |
| SCellConfig[1] SEQUENCE { | |  | entry 1 |  |
| sCellIndex | | SCellIndex as per TS 38.508-1 [4] table 4.6.3-154 |  |  |
| sCellConfigCommon | | ServingCellConfigCommon |  |  |
| sCellConfigDedicated | | ServingCellConfig |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.1.12.4.1.3.3-3: PDCCH-Config (Table 7.1.1.12.4.3.3-2: CellGroupConfig)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4],Table 4.6.3-95 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCCH-Config::= SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SEQUENCE(SIZE (1..3)) OF ControlResourceSet ::= SEQUENCE { | 1 entry |  |  |
| ControlResourceSet[1] | ControlResourceSet | TS 38.508-1 default value |  |
| } |  |  |  |
| searchSpacesToAddModListExt-r16 SEQUENCE(SIZE (1..10)) OF SearchSpace { |  |  |  |
| searchSpaceExt-r16 ::= SEQUENCE { |  |  |  |
| controlResourceSetId-r16 | 1 |  |  |
| searchSpaceType-r16 SEQUENCE { |  |  |  |
| common SEQUENCE { |  |  |  |
| dci-Format2-6-r16 SEQUENCE { |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.4.1.3.3-4: ServingCellConfigCommon (Table 7.1.1.12.4.3.3-2: CellGroupConfig)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-168 with condition SCell\_add. | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 3 |  |  |
| } |  |  |  |

Table 7.1.1.12.4.1.3.3-5: ServingCellConfig (Table 7.1.1.12.4.3.3-2: CellGroupConfig)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-167 with condition SCell\_add | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| downlinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) BWP-Downlink { |  |  |  |
| BWP-Downlink | BWP-Downlink |  |  |
| } |  |  |  |
| firstActiveDownlinkBWP-Id | 0 |  |  |
| dormancyGroupID-r16 | 0 |  |  |
| dormantBWP-Config-r16 ::= SEQUENCE { |  |  |  |
| dormantBWP-Id-r16 | 1 |  |  |
| outsideActiveTimeConfig-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| firstOutsideActiveTimeBWP-Id-r16 | 0 |  |  |
| dormancyGroupOutsideActiveTime-r16 | 0 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| pdsch-ServingCellConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| pucch-Cell | 1 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.1.12.4.1.3.3-6: BWP-Downlink (Table 7.1.1.12.4.3.3-5: ServingCellConfig)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-9 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-Downlink ::= SEQUENCE { |  |  |  |
| bwp-Dedicated SEQUENCE { |  |  |  |
| pdcch-Config CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| controlResourceSetToAddModList SEQUENCE(SIZE (1..3)) OF ControlResourceSet { | 1 entry |  |  |
| ControlResourceSet[1] | ControlResourceSet | TS 38.508-1 default value |  |
| } |  |  |  |
| controlResourceSetToReleaseList | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

###### 7.1.1.12.4.2 DRX adaptation / SCell dormancy indication / Intra-band non Contiguous CA

The scope and description of the present TC is the same as test case 7.1.1.12.4.1 with the following differences:

- CA configuration: Intra-band non-Contiguous CA replaces Intra-band Contiguous CA

###### 7.1.1.12.4.3 DRX adaptation / SCell dormancy indication / Inter-band CA

The scope and description of the present TC is the same as test case 7.1.1.12.4.1 with the following differences:

- CA configuration: Inter-band CA replaces Intra-band Contiguous CA

- Cells configuration: NR Cell 10 replaces NR Cell 3

### 7.1.2 RLC

#### 7.1.2.1 Default Pre-Test Conditions for all RLC test cases

The following pre-test conditions shall be applied in all RLC test cases until the test case explicitly over writes these conditions.

##### 7.1.2.1.1 Default Pre-Test Conditions for AM RLC test cases

System Simulator:

- The SS configures the test environment in accordance to the execution conditions in Table 7.1.2.1.1-1.

UE:

- None

Preamble:

- The SS performs the generic procedure in [4] to get UE in state RRC\_CONNECTED in accordance to the execution conditions in Table 7.1.2.1.1-2 and the message condition UE TEST LOOP MODE A to return one UL PDCP SDU per DL PDCP SDU.

Table 7.1.2.1.1-1: Test environment

|  |  |  |
| --- | --- | --- |
| Execution Condition | Cell configuration | System Information Combination |
| IF pc\_NG\_RAN\_NR | NR Cell 1 | NR: System information Combination NR-1 |
| ELSE IF pc\_EN\_DC | E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NGEN\_DC | NG-RAN E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |

Table 7.1.2.1.1-2: Preamble parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Execution Condition | Multi-PDN / Multi-PDU Sessions Condition | Generic Procedure Parameters | Primary DRB used for Data testing |
| IF pc\_NG\_RAN\_NR | FALSE | Connectivity(*NR*),  Test loop function(*On*)  One DRB | Default DRB of the first PDU session on NR Cell |
| TRUE | Connectivity(*NR*),  Test loop function(*On*)  *N* DRBs (*N* ≥ 2) |  |
| ELSE IF pc\_EN\_DC | FALSE | Connectivity(*EN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*EN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NGEN\_DC | FALSE | Connectivity(*NGEN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*EN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |

Table 7.1.2.1.1-3: Message conditions

|  |  |
| --- | --- |
| Execution Condition | Message condition exceptions |
| IF pc\_NG\_RAN\_NR | Message with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_EN\_DC | Message condition MCG\_and\_SCG with condition SCG-DRB(1,0) is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NGEN\_DC | Message condition MCG\_and\_SCG with condition SCG-DRB(1,0) is used for step 7 in 4.5.4.2 according to [4] |

##### 7.1.2.1.2 Default Pre-Test Conditions for UM RLC test cases

Same Pre-test conditions as in clause 7.1.2.1.1 with the exceptions in Table 7.1.2.1.2-1.

Table 7.1.2.1.2-1: Message conditions

|  |  |
| --- | --- |
| Execution Condition | Message condition exceptions |
| IF pc\_NG\_RAN\_NR | Message with condition UM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_EN\_DC | Message condition MCG\_and\_SCG with condition SCG-DRB(0,1) is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NGEN\_DC | Message condition MCG\_and\_SCG with condition SCG-DRB(0,1) is used for step 7 in 4.5.4.2 according to [4] |

#### 7.1.2.2 RLC Unacknowledged mode

##### 7.1.2.2.1 UM RLC / Segmentation and reassembly / 6-bit SN / Segmentation Info (SI) field

7.1.2.2.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE receives UMD PDU containing a SI field set to 00 }

**then** { UE correctly decodes the received UMD PDU }

}

(2)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE receives a 6 bit SN configured UMD PDU containing a SI field set to 01 }

**then** { UE correctly decodes the received UMD PDU }

}

(3)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE receives a 6 bit SN configured UMD PDU containing a SI field set to 11 and SO field }

**then** { UE correctly decodes the received UMD PDU }

}

(4)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE receives a 6 bit SN configured UMD PDU containing a SI field set to 10 and SO field }

**then** { UE correctly decodes the received UMD PDU }

}

(5)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is sufficient to send whole SDU in one PDU }

**then** { UE transmits RLC SDU containing a SI field set to 00 }

}

(6)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is not sufficient to send whole SDU in one PDU }

**then** { UE transmits first RLC SDU segment containing a SI field set to 01 and including 6 bit SN }

}

(7)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is not sufficient to send whole SDU in one PDU }

**then** { UE transmits middle RLC SDU segment containing a SI field set to 11, including SO field and including 6 bit SN }

}

(8)

**with** { UE in RRC\_CONNECTED state configured for 6 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is not sufficient to send whole SDU in one PDU }

**then** { UE transmits last RLC SDU segment containing a SI field set to 10, including SO field and including 6 bit SN }

}

7.1.2.2.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.2.2.2.1, 5.2.2.2.2, 6.2.3.4 and 6.2.2.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.2.2.2.1]

The receiving UM RLC entity shall maintain a reassembly window according to state variable RX\_Next\_Highest as follows:

- a SN falls within the reassembly window if (RX\_Next\_Highest – UM\_Window\_Size) <= SN <RX\_Next\_Highest;

- a SN falls outside of the reassembly window otherwise.

When receiving an UMD PDU from lower layer, the receiving UM RLC entity shall:

- either deliver the UMD PDU after removing the RLC header, discard the received UMD PDU, or place it in the reception buffer (see sub clause 5.2.2.2.2);

- if the received UMD PDU was placed in the reception buffer:

- update state variables, reassemble and deliver RLC SDUs to upper layer and start/stop *t-Reassembly* as needed (see sub clause 5.2.2.2.3).

When *t-Reassembly* expires, the receiving UM RLC entity shall:

- update state variables, discard RLC SDU segments and start *t-Reassembly* as needed (see sub clause 5.2.2.2.4).

[TS 38.322, clause 5.2.2.2.2]

When an UMD PDU is received from lower layer, the receiving UM RLC entity shall:

- if the UMD PDU header does not contain an SN:

- remove the RLC header and deliver the RLC SDU to upper layer.

- else if (RX\_Next\_Highest – UM\_Window\_Size) <= SN < RX\_Next\_Reassembly:

- discard the received UMD PDU.

- else:

- place the received UMD PDU in the reception buffer.

[TS 38.322, clause 6.2.2.3]

UMD PDU consists of a Data field and an UMD PDU header. The UMD PDU header is byte aligned

When an UMD PDU contains a complete RLC SDU, the UMD PDU header only contains the SI and R fields.

An UM RLC entity is configured by RRC to use either a 6 bit SN or a 12 bit SN. An UMD PDU header contains the SN field only when the corresponding RLC SDU is segmented. An UMD PDU carrying the first segment of an RLC SDU does not carry the SO field in its header. The length of the SO field is 16 bits.



Figure 6.2.2.3-1: UMD PDU containing a complete RLC SDU



Figure 6.2.2.3-2: UMD PDU with 6 bit SN (No SO)



Figure 6.2.2.3-3: UMD PDU with 12 bit SN (No SO)



Figure 6.2.2.3-4: UMD PDU with 6 bit SN and with SO



Figure 6.2.2.3-5: UMD PDU with 12 bit SN and with SO

[TS 38.322, clause 6.2.3.4]

Length: 2 bits.

The SI field indicates whether a RLC PDU contains a complete RLC SDU or the first, middle, last segment of a RLC SDU.

Table 6.2.2.6-1: SI field interpretation

|  |  |
| --- | --- |
| Value | Description |
| 00 | Data field contains all bytes of a RLC SDU |
| 01 | Data field contains the first segment of a RLC SDU |
| 10 | Data field contains the last segment of a RLC SDU |
| 11 | Data field contains neither the first nor last segment of a RLC SDU |

7.1.2.2.1.3 Test description

7.1.2.2.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.2 with the exception for the UM DRB is configured according to Table 7.1.2.2.1.3.1-1.

Table 7.1.2.2.1.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink UM RLC sn-FieldLength | size6 |
| Downlink UM RLC sn-FieldLength | size6 |

7.1.2.2.1.3.2 Test procedure sequence

Table 7.1.2.2.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0 | The SS stops allocating any UL grant. | - | - | - | - |
| 1 | The SS transmits UMD PDU#1 containing a complete RLC SDU#1 (SI field = 00). | <-- | UMD PDU#1 | - | - |
| 2 | SS allocates an UL grant sufficient to loop back RLC SDU#1 in one RLC/MAC PDU | <-- | UL Grant | - | - |
| 3 | Check: Does the UE transmit RLC SDU#1? | --> | (RLC SDU#1) | 1,5 | P |
| 4 | The SS transmits UMD PDU#2 containing the first segment of RLC SDU#2 (SI field = 01). Note 3 | <-- | UMD PDU#2 | - | - |
| 5 | The SS transmits UMD PDU#3 containing the second segment of RLC SDU#2 (SI field = 11) and including SO field. Note 3 | <-- | UMD PDU#3 | - | - |
| 6 | The SS transmits UMD PDU#4 containing the last segment of RLC SDU#2 (SI field = 10) and including SO field. Note 3 | <-- | UMD PDU#4 | - | - |
| 7 | SS allocates 3 UL grants at an interval of 20 ms so as to loop back RLC SDU#2 in 3 RLC/MAC PDUs. Note 1 & 2 | <-- | UL Grants | - | - |
| 8 | Check: Does the UE transmit UMD PDU#2 containing the first segment of RLC SDU#2 (SI field = 01)? | --> | (RLC SDU#2, first segment) | 2,3,4,6 | P |
| 9 | Check: Does the UE transmit UMD PDU#3 containing the second segment of RLC SDU#2 (SI field = 11) and including SO field? | --> | (RLC SDU#2, second segment) | 2,3,4,7 | P |
| 10 | Check: Does the UE transmit UMD PDU#4 containing the last segment of RLC SDU#2 (SI field = 10) and including SO field? | --> | (RLC SDU#2, last segment) | 2,3,4,8 | P |
| Note 1: The UL grants for step 8,9,10 are sufficiently small (240 bits, LRBs & IMCS as per 38.523-3[3] annex B) that UE transmits RLC SDU#2 in 3 UL RLC PDUs by segmenting.  Note 2: The RLC PDU containing a segment shall be of size 208 bits resp. 224 bits and a MAC sub PDU header of 16 bits and a 16-bit MAC BSR CE included in step 8 resulting in a MAC PDU of size 240 bits.  Note 3: The data part in step 4 first segment not including SO is 200 bits (25 bytes). Step 5, second segment SO=25 and data is 200 bits (25 bytes). Step 6, third segment SO=25+25=50 and data is 200 bits (25 bytes). | | | | | |

7.1.2.2.1.3.3 Specific message contents

None.

##### 7.1.2.2.2 UM RLC / Segmentation and reassembly / 12-bit SN / Segmentation Info (SI) field

7.1.2.2.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE receives UMD PDU containing a SI field set to 00 }

**then** { UE correctly decodes the received UMD PDU }

}

(2)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE receives a 12 bit SN configured UMD PDU containing a SI field set to 01 }

**then** { UE correctly decodes the received UMD PDU }

}

(3)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE receives a 12 bit SN configured UMD PDU containing a SI field set to 11 and SO field }

**then** { UE correctly decodes the received UMD PDU }

}

(4)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE receives a 12 bit SN configured UMD PDU containing a SI field set to 10 and SO field }

**then** { UE correctly decodes the received UMD PDU }

}

(5)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is sufficient to send whole SDU in one PDU }

**then** { UE transmits RLC SDU containing a SI field set to 00 }

}

(6)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is not sufficient to send whole SDU in one PDU }

**then** { UE transmits first RLC SDU segment containing a SI field set to 01 and including 12 bit SN}

}

(7)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is not sufficient to send whole SDU in one PDU }

**then** { UE transmits middle RLC SDU segment containing a SI field set to 11, including SO field and including 12 bit SN }

}

(8)

**with** { UE in RRC\_CONNECTED state configured for 12 bit SN in RLC UM }

**ensure that** {

**when** { UE has UL SDU to send and UL grant available is not sufficient to send whole SDU in one PDU }

**then** { UE transmits last RLC SDU segment containing a SI field set to 10, including SO field and including 12 bit SN }

}

7.1.2.2.2.2 Conformance requirements

Same conformance requirements as clause 7.1.2.2.1.2

7.1.2.2.2.3 Test description

7.1.2.2.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.2 with the exception for the UM DRB is configured according to Table 7.1.2.2.2.3.1-1.

Table 7.1.2.2.2.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink UM RLC sn-FieldLength | size12 |
| Downlink UM RLC sn-FieldLength | size12 |

7.1.2.2.2.3.2 Test procedure sequence

Same test procedure sequence as 7.1.2.2.1.3.2 except that RLC UM SN is 12 bit and the data part in step 4 first segment not including SO is 192 bits (24 Bytes). Step 5, second segment SO=24 and data is 192 bits (24 bytes). Step 6, third segment SO=24+24=48 and data is 192 bits (24 bytes).

7.1.2.2.2.3.3 Specific message contents

None.

##### 7.1.2.2.3 UM RLC / 6-bit SN / Correct use of sequence numbering

7.1.2.2.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with UM RLC 6 bit SN }

**ensure that** {

**when** { UE transmits the first PDU which is segmented }

**then** { UE includes the SN field equal to 0 in each RLC segment }

}

(2)

**with** { UE in RRC\_CONNECTED state with UM RLC 6 bit SN }

**ensure that** {

**when** { UE transmit subsequent segmented PDUs }

**then** { UE includes the SN field incremented by 1 for each segmented PDU of one RLC SDU }

}

(3)

**with** { UE in RRC\_CONNECTED state with UM RLC 6 bit SN }

**ensure that** {

**when** { UE transmit segments belonging to more than 64 SDUs }

**then** { UE wraps the SN after transmitting the segments of 64 SDUs }

}

(4)

**with** { UE in RRC\_CONNECTED state with UM RLC 6 bit SN }

**ensure that** {

**when** { segments of more than 64 SDUs are sent to UE }

**then** { UE accepts PDUs with SNs that wrap around every 64 segmented SDUs }

}

7.1.2.2.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.322, clause 5.2.2.1.1, 5.2.2.2, 6.2.2.3, 6.2.3.3 and 7.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.2.2.1.1]

When submitting a UMD PDU to lower layer, the transmitting UM RLC entity shall:

- if the UMD PDU contains a segment of an RLC SDU, set the SN of the UMD PDU to TX\_Next;

- if the UMD PDU contains a segment that maps to the last byte of an RLC SDU, then increment TX\_Next by one.

[TS 38.322, clause 5.2.2.2]

The receiving UM RLC entity shall maintain a reassembly window according to state variable RX\_Next\_Highest as follows:

- a SN falls within the reassembly window if (RX\_Next\_Highest – UM\_Window\_Size) <= SN <RX\_Next\_Highest;

- a SN falls outside of the reassembly window otherwise.

When receiving an UMD PDU from lower layer, the receiving UM RLC entity shall:

- either deliver the UMD PDU after removing the RLC header, discard the received UMD PDU, or place it in the reception buffer (see sub clause 5.2.2.2.2);

- if the received UMD PDU was placed in the reception buffer:

- update state variables, reassemble and deliver RLC SDUs to upper layer and start/stop *t-Reassembly* as needed (see sub clause 5.2.2.2.3).

…

When an UMD PDU is received from lower layer, the receiving UM RLC entity shall:

- if the UMD PDU header does not contain an SN:

- remove the RLC header and deliver the RLC SDU to upper layer.

- else if (RX\_Next\_Highest – UM\_Window\_Size) <= SN < RX\_Next\_Reassembly:

- discard the received UMD PDU.

- else:

- place the received UMD PDU in the reception buffer.

…

When an UMD PDU with SN = x is placed in the reception buffer, the receiving UM RLC entity shall:

- if all byte segments with SN = x are received:

- reassemble the RLC SDU from all byte segments with SN = x, remove RLC headers and deliver the reassembled RLC SDU to upper layer;

- if x = RX\_Next\_Reassembly:

- update RX\_Next\_Reassembly to the SN of the first SN > current RX\_Next\_Reassembly that has not been reassembled and delivered to upper layer.

- else if x falls outside of the reassembly window:

- update RX\_Next\_Highest to x + 1;

- discard any UMD PDUs with SN that falls outside of the reassembly window;

- if RX\_Next\_Reassembly falls outside of the reassembly window:

- set RX\_Next\_Reassembly to the SN of the first SN >= (RX\_Next\_Highest – UM\_Window\_Size) that has not been reassembled and delivered to upper layer.

[TS 38.322, clause 6.2.2.3]

An UM RLC entity is configured by RRC to use either a 6 bit SN or a 12 bit SN. An UMD PDU header contains the SN field only when the corresponding RLC SDU is segmented.

[TS 38.322, clause 6.2.3.3]

The SN field indicates the sequence number of the corresponding RLC SDU. …. For RLC UM, the sequence number is incremented by one for every segmented RLC SDU..

[TS 38.322, clause 7.1]

All state variables and all counters are non-negative integers.

…

All state variables related to UM data transfer can take values from 0 to 63 for 6 bit SN or from 0 to 4095 for 12 bit SN. All arithmetic operations contained in the present document on state variables related to UM data transfer are affected by the UM modulus (i.e. final value = [value from arithmetic operation] modulo 64 for 6 bit SN and 4096 for 12 bit SN).

…

Each transmitting UM RLC entity shall maintain the following state variables:

a) TX\_Next

This state variable holds the value of the SN to be assigned for the next newly generated UMD PDU with segment. It is initially set to 0, and is updated after the UM RLC entity submits a UMD PDU including the last segment of an RLC SDU to lower layers.

Each receiving UM RLC entity shall maintain the following state variables and constant:

b) RX\_Next\_Reassembly – UM receive state variable

This state variable holds the value of the earliest SN that is still considered for reassembly. It is initially set to 0.

c) RX\_Timer\_Trigger – UM *t-Reassembly* state variable

This state variable holds the value of the SN following the SN which triggered *t-Reassembly*.

d) RX\_Next\_Highest– UM receive state variable

This state variable holds the value of the SN following the SN of the UMD PDU with the highest SN among received UMD PDUs. It serves as the higher edge of the reassembly window. It is initially set to 0.

7.1.2.2.3.3 Test description

7.1.2.2.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.2 with the exception for the UM DRB is configured according to Table 7.1.2.2.3.3.1-1.

Table 7.1.2.2.3.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink UM RLC sn-FieldLength | size6 |
| Downlink UM RLC sn-FieldLength | size6 |

7.1.2.2.3.3.2 Test procedure sequence

Table 7.1.2.2.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 0 | The SS stops allocating any UL grant. | - | - | - | - |
| 1 | The SS transmits UMD PDU#1 with 6 bit SN = 0 containing the first segment of RLC SDU#1 (SI field = 01). | <-- | UMD PDU#1 | - | - |
| 2 | The SS transmits UMD PDU#2 with 6 bit SN=0 containing the last segment of RLC SDU#1 (SI field = 10) and including SO field. | <-- | UMD PDU#2 | - | - |
| 3 | SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#1 in 2 RLC/MAC PDUs. (Note 1) | <-- | UL Grants | - | - |
| 4 | Check: Does the UE transmit UMD PDU#1 with 6 bit SN = 0 containing the first segment of RLC SDU#1 (SI field = 01)? | --> | (RLC SDU#1, first segment) | 1 | P |
| 5 | Check: Does the UE transmit UMD PDU#2 with 6 bit SN = 0 containing the last segment of RLC SDU#1 (SI field = 10)? | --> | (RLC SDU#1, last segment) | 1 | P |
| - | EXCEPTION: Steps 6 to 10 are executed 63 times, the initial value of k = 1, it is incremented by one for each iteration. | - | - | - | - |
| 6 | The SS transmits UMD PDU#(2\*k+1) with 6 bit SN = k containing the first segment of RLC SDU#(k+1) (SI field = 01). | <-- | UMD PDU#(2\*k+1) | - | - |
| 7 | The SS transmits UMD PDU#(2\*(k+1)) with 6 bit SN=k containing the last segment of RLC SDU#(k+1) (SI field = 10) | <-- | UMD PDU#(2\*(k+1)) | - | - |
| 8 | SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#(k+1) in 2 RLC/MAC PDUs. (Note 1) | <-- | UL Grants | - | - |
| 9 | Check: Does the UE transmit UMD PDU#(2\*k+1) with 6 bit SN = k containing the first segment of RLC SDU#(k+1) (SI field = 01)? (Note 2) | --> | (RLC SDU#(k+1), first segment) | 2 | P |
| 10 | Check: Does the UE transmit UMD PDU#(2\*(k+1)) with 6 bit SN = k containing the last segment of RLC SDU#(k+1) (SI field = 10) and including SO field? (Note 2) | --> | (RLC SDU#(k+1), last segment) | 2 | P |
| 11 | The SS transmits UMD PDU#129 with 6 bit SN = 0 containing the first segment of RLC SDU#65 (SI field = 01). | <-- | UMD PDU#129 | - | - |
| 12 | The SS transmits UMD PDU#130 with 6 bit SN= 0 containing the last segment of RLC SDU#65 (SI field = 10) and including SO field | <-- | UMD PDU#130 | - | - |
| 13 | SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#65 in 2 RLC/MAC PDUs. (Note 1) | <-- | UL Grants | - | - |
| 14 | Check: Does the UE transmit UMD PDU#129 with 6 bit SN = 0 containing the first segment of RLC SDU#65 (SI field = 01)? | --> | (RLC SDU#65, first segment) | 3.4 | P |
| 15 | Check: Does the UE transmit UMD PDU#130 with 6 bit SN = 0 containing the last segment of RLC SDU#65 (SI field = 10) and including SO field? | --> | (RLC SDU#65, last segment) | 3,4 | P |
| Note 1: The RLC SDU size shall be 12 octets which are segmented into 6 and 6 octets. With 2 octets of MAC header, 2 octets of Short BSR and 1 octet of RLC header (without SO) the first segment consists of 88 bits and a TBS of this size shall be allocated. With 2 octets of MAC header and 3 octets of RLC header (with SO) the second segment consists of 88 bits and a TBS of this size shall be allocated. (LRBs & IMCS as per 38.523-3[3] annex B)  Note 2: The verdict shall be provided each time (SN+1) mod 16 = 0. | | | | | |

7.1.2.2.3.3.3 Specific message contents

None.

##### 7.1.2.2.4 UM RLC / 12-bit SN / Correct use of sequence numbering

7.1.2.2.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with UM RLC 12 bit SN }

**ensure that** {

**when** { UE transmits the first PDU which is segmented }

**then** { UE includes the SN field equal to 0 in each RLC segment }

}

(2)

**with** { UE in RRC\_CONNECTED state with UM RLC 12 bit SN }

**ensure that** {

**when** { UE transmit subsequent segmented PDUs }

**then** { UE includes the SN field incremented by 1 for each segmented PDU of one RLC SDU}

}

(3)

**with** { UE in RRC\_CONNECTED state with UM RLC 12 bit SN }

**ensure that** {

**when** { UE transmit segments belonging to more than 4096 SDUs }

**then** { UE wraps the SN after transmitting the segments of 4096 SDUs }

}

(4)

**with** { UE in RRC\_CONNECTED state with UM RLC 12 bit SN }

**ensure that** {

**when** { segments of more than 4096 SDUs are sent to UE }

**then** { UE accepts PDUs with SNs that wrap around every 4096 segmented SDUs }

}

7.1.2.2.4.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.322, clause 5.2.2.1.1, 5.2.2.2, 6.2.2.3, 6.2.3.3 and 7.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.2.2.1.1]

When submitting a UMD PDU to lower layer, the transmitting UM RLC entity shall:

- if the UMD PDU contains a segment of an RLC SDU, set the SN of the UMD PDU to TX\_Next;

- if the UMD PDU contains a segment that maps to the last byte of an RLC SDU, then increment TX\_Next by one.

[TS 38.322, clause 5.2.2.2]

The receiving UM RLC entity shall maintain a reassembly window according to state variable RX\_Next\_Highest as follows:

- a SN falls within the reassembly window if (RX\_Next\_Highest – UM\_Window\_Size) <= SN <RX\_Next\_Highest;

- a SN falls outside of the reassembly window otherwise.

When receiving an UMD PDU from lower layer, the receiving UM RLC entity shall:

- either deliver the UMD PDU after removing the RLC header, discard the received UMD PDU, or place it in the reception buffer (see sub clause 5.2.2.2.2);

- if the received UMD PDU was placed in the reception buffer:

- update state variables, reassemble and deliver RLC SDUs to upper layer and start/stop *t-Reassembly* as needed (see sub clause 5.2.2.2.3).

…

When an UMD PDU is received from lower layer, the receiving UM RLC entity shall:

- if the UMD PDU header does not contain an SN:

- remove the RLC header and deliver the RLC SDU to upper layer.

- else if (RX\_Next\_Highest – UM\_Window\_Size) <= SN < RX\_Next\_Reassembly:

- discard the received UMD PDU.

- else:

- place the received UMD PDU in the reception buffer.

…

When an UMD PDU with SN = x is placed in the reception buffer, the receiving UM RLC entity shall:

- if all byte segments with SN = x are received:

- reassemble the RLC SDU from all byte segments with SN = x, remove RLC headers and deliver the reassembled RLC SDU to upper layer;

- if x = RX\_Next\_Reassembly:

- update RX\_Next\_Reassembly to the SN of the first SN > current RX\_Next\_Reassembly that has not been reassembled and delivered to upper layer.

- else if x falls outside of the reassembly window:

- update RX\_Next\_Highest to x + 1;

- discard any UMD PDUs with SN that falls outside of the reassembly window;

- if RX\_Next\_Reassembly falls outside of the reassembly window:

- set RX\_Next\_Reassembly to the SN of the first SN >= (RX\_Next\_Highest – UM\_Window\_Size) that has not been reassembled and delivered to upper layer.

[TS 38.322, clause 6.2.2.3]

An UM RLC entity is configured by RRC to use either a 6 bit SN or a 12 bit SN. An UMD PDU header contains the SN field only when the corresponding RLC SDU is segmented.

[TS 38.322, clause 6.2.3.3]

The SN field indicates the sequence number of the corresponding RLC SDU. … For RLC UM, the sequence number is incremented by one for every segmented RLC SDU.

[TS 38.322, clause 7.1]

All state variables and all counters are non-negative integers.

…

All state variables related to UM data transfer can take values from 0 to 63 for 6 bit SN or from 0 to 4095 for 12 bit SN. All arithmetic operations contained in the present document on state variables related to UM data transfer are affected by the UM modulus (i.e. final value = [value from arithmetic operation] modulo 64 for 6 bit SN and 4096 for 12 bit SN).

…

Each transmitting UM RLC entity shall maintain the following state variables:

a) TX\_Next

This state variable holds the value of the SN to be assigned for the next newly generated UMD PDU with segment. It is initially set to 0, and is updated after the UM RLC entity submits a UMD PDU including the last segment of an RLC SDU to lower layers.

Each receiving UM RLC entity shall maintain the following state variables and constant:

b) RX\_Next\_Reassembly – UM receive state variable

This state variable holds the value of the earliest SN that is still considered for reassembly. It is initially set to 0.

c) RX\_Timer\_Trigger – UM *t-Reassembly* state variable

This state variable holds the value of the SN following the SN which triggered *t-Reassembly*.

d) RX\_Next\_Highest– UM receive state variable

This state variable holds the value of the SN following the SN of the UMD PDU with the highest SN among received UMD PDUs. It serves as the higher edge of the reassembly window. It is initially set to 0.

7.1.2.2.4.3 Test description

7.1.2.2.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.2 with the exception for the UM DRB is configured according to Table 7.1.2.2.4.3.1-1.

Table 7.1.2.2.4.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink RLC sn-FieldLength | size12 |
| Downlink RLC sn-FieldLength | size12 |

7.1.2.2.4.3.2 Test procedure sequence

Table 7.1.2.2.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 1 | The SS transmits UMD PDU#1 with 12 bit SN = 0 containing the first segment of RLC SDU#1 (SI field = 01). | <-- | UMD PDU#1 | - | - |
| 2 | The SS transmits UMD PDU#2 with 12 bit SN=0 containing the last segment of RLC SDU#1 (SI field = 10) and including SO field | <-- | UMD PDU#2 | - | - |
| 3 | SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#1 in 2 RLC/MAC PDUs. (Note 1) | <-- | UL Grants | - | - |
| 4 | Check: Does the UE transmit UMD PDU#1 with 12 bit SN = 0 containing the first segment of RLC SDU#1 (SI field = 01)? | --> | (RLC SDU#1, first segment) | 1 | P |
| 5 | Check: Does the UE transmit UMD PDU#2 with 12 bit SN = 0 containing the last segment of RLC SDU#1 (SI field = 10)? | --> | (RLC SDU#1, last segment) | 1 | P |
| - | EXCEPTION: Steps 6 to 10 are executed 4095 times, the initial value of k = 1, it is incremented by one for each iteration. | - | - | - | - |
| 6 | The SS transmits UMD PDU#(2\*k+1) with 12 bit SN = k containing the first segment of RLC SDU#(k+1) (SI field = 01). | <-- | UMD PDU#(2\*k+1) | - | - |
| 7 | The SS transmits UMD PDU#(2\*(k+1)) with 12 bit SN=k containing the last segment of RLC SDU#(k+1) (SI field = 10) | <-- | UMD PDU#(2\*(k+1)) | - | - |
| 8 | SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#(k+1) in 2 RLC/MAC PDUs. (Note 1) | <-- | UL Grants | - | - |
| 9 | Check: Does the UE transmit UMD PDU#(2\*k+1) with 12 bit SN = k containing the first segment of RLC SDU#(k+1) (SI field = 01)? (Note 2) | --> | (RLC SDU#(k+1), first segment) | 2 | P |
| 10 | Check: Does the UE transmit UMD PDU#(2\*(k+1)) with 12 bit SN = k containing the last segment of RLC SDU#(k+1) (SI field = 10) and including SO field? (Note 2) | --> | (RLC SDU#(k+1), last segment) | 2 | P |
| 11 | The SS transmits UMD PDU#8193 with 12 bit SN = 0 containing the first segment of RLC SDU#4097 (SI field = 01). | <-- | UMD PDU#8193 | - | - |
| 12 | The SS transmits UMD PDU#8194 with 12 bit SN= 0 containing the last segment of RLC SDU#4097 (SI field = 10) and including SO field | <-- | UMD PDU#8194 | - | - |
| 13 | SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#4097 in 2 RLC/MAC PDUs. (Note 1) | <-- | UL Grants | - | - |
| 14 | Check: Does the UE transmit UMD PDU#8193 with 12 bit SN = 0 containing the first segment of RLC SDU#4097 (SI field = 01)? | --> | (RLC SDU#4097, first segment) | 3.4 | P |
| 15 | Check: Does the UE transmit UMD PDU#8194 with 12 bit SN = 0 containing the last segment of RLC SDU#4097 (SI field = 10) and including SO field? | --> | (RLC SDU#4097, last segment) | 3,4 | P |
| Note 1: The RLC SDU size shall be 10 octets which are segmented into 5 and 5 octets. With 2 octets of MAC header, 2 octets of Short BSR and 2 octets of RLC header (without SO) the first segment consists of 88 bits and a TBS of this size shall be allocated. With 2 octets of MAC header and 4 octets of RLC header (with SO) the second segment consists of 88 bits and a TBS of this size shall be allocated. (LRBs & IMCS as per 38.523-3[3] annex B)  Note 2: The verdict shall be provided each time (SN+1) mod 256 = 0. | | | | | |

7.1.2.2.4.3.3 Specific message contents

None.

##### 7.1.2.2.5 UM RLC / Receive Window operation and t-Reassembly expiry

7.1.2.2.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and using UM RLC }

**ensure that** {

**when** { UE receives a RLC PDU including SN and '(RX\_Next\_Highest – UM\_Window\_Size) <= SN < RX\_Next\_Highest }

**then** { UE discards any UMD PDUs with SN that falls outside of the reassembly window }

}

(2)

**with** { UE in RRC\_CONNECTED state and using UM RLC }

**ensure that** {

**when** { UE receives a RLC PDU including SN and '(RX\_Next\_Highest – UM\_Window\_Size) > SN or SN >= RX\_Next\_Reassembly' }

**then** { UE stores the PDU in receive buffer }

}

(3)

**with** { UE in RRC\_CONNECTED state and using UM RLC }

**ensure that** {

**when** { UE places a RLC PDU including SN into the reception buffer and all byte segments with that SN are received }

**then** { UE delivers the reassembled SDU to upper layers}

}

(4)

**with** { UE in RRC\_CONNECTED state and using UM RLC }

**ensure that** {

**when** { t-Reassembly expires }

**then** { UE updates RX\_Next\_Reassembly and discards all segments with SN < updated RX\_Next\_Reassembly }

}

7.1.2.2.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.2.2.2.1, 5.2.2.2.2, 5.2.2.2.3, 5.2.2.2.4 and 7.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.2.2.2.1]

The receiving UM RLC entity shall maintain a reassembly window according to state variable RX\_Next\_Highest as follows:

- a SN falls within the reassembly window if (RX\_Next\_Highest – UM\_Window\_Size) <= SN <RX\_Next\_Highest;

- a SN falls outside of the reassembly window otherwise.

When receiving an UMD PDU from lower layer, the receiving UM RLC entity shall:

- either deliver the UMD PDU to upper layer after removing the RLC header, discard the received UMD PDU, or place it in the reception buffer (see sub clause 5.2.2.2.2);

- if the received UMD PDU was placed in the reception buffer:

- update state variables, reassemble and deliver RLC SDUs to upper layer and start/stop *t-Reassembly* as needed (see sub clause 5.2.2.2.3).

When *t-Reassembly* expires, the receiving UM RLC entity shall:

- update state variables, discard RLC SDU segments and start *t-Reassembly* as needed (see sub clause 5.2.2.2.4).

[TS 38.322, clause 5.2.2.2.2]

When an UMD PDU is received from lower layer, the receiving UM RLC entity shall:

- if the UMD PDU header does not contain an SN:

- remove the RLC header and deliver the RLC SDU to upper layer.

- else if (RX\_Next\_Highest – UM\_Window\_Size) <= SN < RX\_Next\_Reassembly:

- discard the received UMD PDU.

- else:

- place the received UMD PDU in the reception buffer.

[TS 38.322, clause 5.2.2.2.3]

When an UMD PDU with SN = x is placed in the reception buffer, the receiving UM RLC entity shall:

- if all byte segments with SN = x are received:

- reassemble the RLC SDU from all byte segments with SN = x, remove RLC headers and deliver the reassembled RLC SDU to upper layer;

- if x = RX\_Next\_Reassembly:

- update RX\_Next\_Reassembly to the SN of the first SN > current RX\_Next\_Reassembly that has not been reassembled and delivered to upper layer.

- else if x falls outside of the reassembly window:

- update RX\_Next\_Highest to x + 1;

- discard any UMD PDUs with SN that falls outside of the reassembly window;

- if RX\_Next\_Reassembly falls outside of the reassembly window:

- set RX\_Next\_Reassembly to the SN of the first SN >= (RX\_Next\_Highest – UM\_Window\_Size) that has not been reassembled and delivered to upper layer.

- if *t-Reassembly* is running:

- if RX\_Timer\_Trigger <= RX\_Next\_Reassembly; or

- if RX\_Timer\_Trigger falls outside of the reassembly window and RX\_Timer\_Trigger is not equal to RX\_Next\_Highest; or

- if RX\_Next\_Highest = RX\_Next\_Reassembly + 1 and there is no missing byte segment of the RLC SDU associated with SN = RX\_Next\_Reassembly before the last byte of all received segments of this RLC SDU:

- stop and reset *t-Reassembly*.

- if *t-Reassembly* is not running (includes the case when *t-Reassembly* is stopped due to actions above):

- if RX\_Next\_Highest > RX\_Next\_Reassembly + 1; or

- if RX\_Next\_Highest = RX\_Next\_Reassembly + 1 and there is at least one missing byte segment of the RLC SDU associated with SN = RX\_Next\_Reassembly before the last byte of all received segments of this RLC SDU:

- start t-Reassembly;

- set RX\_Timer\_Trigger to RX\_Next\_Highest.

[TS 38.322, clause 5.2.2.2.4]

When *t-Reassembly* expires, the receiving UM RLC entity shall:

- update RX\_Next\_Reassembly to the SN of the first SN >= RX\_Timer\_Trigger that has not been reassembled;

- discard all segments with SN < updated RX\_Next\_Reassembly;

- if RX\_Next\_Highest > RX\_Next\_Reassembly + 1; or

- if RX\_Next\_Highest = RX\_Next\_Reassembly + 1 and there is at least one missing byte segment of the RLC SDU associated with SN = RX\_Next\_Reassembly before the last byte of all received segments of this RLC SDU:

- start t-Reassembly;

- set RX\_Timer\_Trigger to RX\_Next\_Highest.

[TS 38.322, clause 5.2.2.2.4]

This sub clause describes the state variables used in AM and UM entities in order to specify the RLC protocol. The state variables defined in this subclause are normative.

All state variables and all counters are non-negative integers.

...

All state variables related to UM data transfer can take values from 0 to 63 for 6 bit SN or from 0 to 4095 for 12 bit SN. All arithmetic operations contained in the present document on state variables related to UM data transfer are affected by the UM modulus (i.e. final value = [value from arithmetic operation] modulo 64 for 6 bit SN and 4096 for 12 bit SN).

When performing arithmetic comparisons of state variables or SN values, a modulus base shall be used.

...

RX\_Next\_Highest– UM\_Window\_Size shall be assumed as the modulus base at the receiving side of an UM RLC entity. This modulus base is subtracted from all the values involved, and then an absolute comparison is performed (e.g. (RX\_Next\_Highest– UM\_Window\_Size) <= SN < RX\_Next\_Highest is evaluated as [(RX\_Next\_Highest– UM\_Window\_Size) – (RX\_Next\_Highest– UM\_Window\_Size)] modulo 2[*sn-FieldLength*] <= [SN – (RX\_Next\_Highest– UM\_Window\_Size)] modulo 2[*sn-FieldLength*] < [RX\_Next\_Highest– (RX\_Next\_Highest– UM\_Window\_Size)] modulo 2[*sn-FieldLength*]), where *sn-FieldLength* is 6 or 12 for 6 bit SN and 12 bit SN, respectively.

...

Each transmitting UM RLC entity shall maintain the following state variables:

a) TX\_Next

This state variable holds the value of the SN to be assigned for the next newly generated UMD PDU with segment. It is initially set to 0, and is updated after the UM RLC entity submits a UMD PDU including the last segment of an RLC SDU to lower layers.

Each receiving UM RLC entity shall maintain the following state variables and constant:

b) RX\_Next\_Reassembly – UM receive state variable

This state variable holds the value of the earliest SN that is still considered for reassembly. It is initially set to 0.

c) RX\_Timer\_Trigger – UM *t-Reassembly* state variable

This state variable holds the value of the SN following the SN which triggered *t-Reassembly*.

d) RX\_Next\_Highest– UM receive state variable

This state variable holds the value of the SN following the SN of the UMD PDU with the highest SN among received UMD PDUs. It serves as the higher edge of the reassembly window. It is initially set to 0.

7.1.2.2.5.3 Test description

7.1.2.2.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.2 with the exception that the UM DRB is configured according to Table 7.1.2.2.5.3.1-1.

Table 7.1.2.2.5.3.1-1: RLC parameters

|  |  |
| --- | --- |
| t-Reassembly | ms200 |
| Uplink UM RLC sn-FieldLength | IF (pc\_um\_WithShortSN ) size6  ELSE size12 |
| Downlink UM RLC sn-FieldLength | F (pc\_um\_WithShortSN ) size6  ELSE size12 |

Table 7.1.2.2.5.3.1-2: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| t-Reordering | ms30 |

7.1.2.2.5.3.2 Test procedure sequence

Table 7.1.2.2.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 1 | The SS transmits UMD PDU#1 containing first segment of RLC SDU#1, SN=0. | <-- | UMD PDU#1 | - | - |
| 2 | 20 ms after step 1 the SS transmits UMD PDU#3 containing first segment of RLC SDU#2, SN=1. | <-- | UMD PDU#3 | - | - |
| 3 | 40 ms after step 1 the SS transmits UMD PDU#4 containing last segment of RLC SDU#2, SN=1. | <-- | UMD PDU#4 | - | - |
| 3A | 60 ms after step 1 the SS transmits UMD PDU#9 containing first segment of RLC SDU#5, SN=w | <-- | UMD PDU#9 | - | - |
| 3B | 80 ms after step 1 the SS transmits UMD PDU#10 containing last segment of RLC SDU#5, SN=w | <-- | UMD PDU#10 | - | - |
| 3C | 100 ms after step 1 the SS assigns 2 UL grants (UL grant allocation type 2) with a time spacing of 20 ms so as to loop back RLC SDU#2. | - | - | - | - |
| 4 | Check: Does the UE transmit RLC SDU#2? (Note 3) | --> | (RLC SDU#2) | 2,3 | P |
| 4A | Check: Does the UE transmit RLC SDU#5? (Note 4) | --> | (RLC SDU#5) | 2,3 | P |
| 5 | 160 ms after step 1 the SS transmits UMD PDU#2 last segment of RLC SDU#1, SN=0. | <-- | UMD PDU#2 | - | - |
| 5A | The SS starts the UL default grant transmissions. | - | - | - | - |
| 6 | Check: For 1 sec after step 5, does the UE transmit RLC SDU#1, SN=0? (Note 6) | --> | (RLC SDU#1) | 1 | F |
| 6A |  | - | - | - | - |
| 7 | The SS transmits UMD PDU#5 containing first segment of RLC SDU#3, SN=5. | <-- | UMD PDU#5 | - | - |
| 8 | Wait for 200 ms to ensure that *t-* Reassembly for the UMD PDU#5 expires. | - | - | - | - |
| 9 | The SS transmits UMD PDU#6 containing last segment of RLC SDU#3, SN=5 (Note 7). | <-- | UMD PDU#6 | - | - |
| 10 | Check: For 1 sec after step 9, does the UE transmit RLC SDU#3? (Note 7) | --> | (RLC SDU#3) | 4 | F |
| 11 | The SS transmits UMD PDU#7 containing first segment of RLC SDU#6, SN=8. | <-- | UMD PDU#7 | - | - |
| 12 | The SS transmits UMD PDU#8 containing last segment of RLC SDU#6, SN=8. | <-- | UMD PDU#8 | - | - |
| 13 | Check: Does the UE transmit RLC SDU#6? (Note 5) | --> | (RLC SDU#4) | 2,3 | P |
| Note 1: The RLC SDU size shall be 12 octets which are segmented into 7 and 5 octets.  Note 2: UL grant of 144 bits(LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit one PDU at a time( 12 bytes RLC SDU + 1 or 2 bytes RLC Header + 2 bytes MAC Sub PDU header + 2 or 3 bytes for short BSR and/or padding).  Note 3: The UE transmits the looped back PDCP data of RLC SDU#2 in a PDCP PDU with PDCP SN=0.  Note 4: The UE transmits the looped back PDCP data of RLC SDU#5 in a PDCP PDU with PDCP SN=1.  Note 5: The UE transmits the looped back PDCP data of RLC SDU#6 in a PDCP PDU with PDCP SN=2.  Note 6: The UE transmits the looped back PDCP data of RLC SDU#1 in a PDCP PDU with PDCP SN=2.  Note 7: The UE transmits the looped back PDCP data of RLC SDU#3 in a PDCP PDU with PDCP SN=2. | | | | | |

7.1.2.2.5.3.3 Specific message contents

None

##### 7.1.2.2.6 UM RLC / RLC re-establishment procedure

7.1.2.2.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and using UM RLC }

**ensure that** {

**when** { RLC re-establishment is performed upon request by RRC }

**then** { The UE discards all UMD PDUs where no RLC SDUs can be reassembled }

}

(2)

**with** { UE in RRC\_CONNECTED state and using UM RLC }

**ensure that** {

**when** { RLC re-establishment is performed upon request by RRC }

**then** { The UE resets variables TX\_Next, RX\_Next\_Reassembly, and RX\_Next\_Highest to their initial value of 0 }

}

7.1.2.2.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.1.2 and 7.1, TS 38.331 clause 5.3.5.5.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.1.2]

When upper layers request an RLC entity re-establishment, the UE shall:

- discard all RLC SDUs, RLC SDU segments, and RLC PDUs, if any;

- stop and reset all timers;

- reset all state variables to their initial values.

[TS 38.322, clause 7.1]

d) RX\_Next\_Highest – Highest received state variable

This state variable holds the value of the SN following the SN of the RLC SDU with the highest SN among received RLC SDUs. It is initially set to 0.

Each transmitting UM RLC entity shall maintain the following state variables:

a) TX\_Next

This state variable holds the value of the SN to be assigned for the next newly generated UMD PDU with segment. It is initially set to 0, and is updated after the UM RLC entity submits a UMD PDU including the last segment of an RLC SDU to lower layers.

Each receiving UM RLC entity shall maintain the following state variables and constant:

b) RX\_Next\_Reassembly – UM receive state variable

This state variable holds the value of the earliest SN that is still considered for reassembly. It is initially set to 0.

c) RX\_Timer\_Trigger – UM *t-Reassembly* state variable

This state variable holds the value of the SN following the SN which triggered *t-Reassembly*.

d) RX\_Next\_Highest– UM receive state variable

This state variable holds the value of the SN following the SN of the UMD PDU with the highest SN among received UMD PDUs. It serves as the higher edge of the reassembly window. It is initially set to 0.

[TS 38.331, clause 5.3.5.5.4]

For each *RLC-Bearer-Config* received in the *rlc-BearerToAddModList* IE the UE shall:

1> if the UE’s current configuration contains a RLC bearer with the received *logicalChannelIdentity*:

2> if *reestablishRLC* is received:

3> re-establish the RLC entity as specified in TS 38.322 [4];

2> reconfigure the RLC entity or entities in accordance with the received *rlc-Config*;

2> reconfigure the logical channel in accordance with the received *mac-LogicalChannelConfig*;

NOTE: The network does not re-associate an already configured logical channel with another radio bearer. Hence *servedRadioBearer* is not present in this case.

7.1.2.2.6.3 Test description

7.1.2.2.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.2 with the exception that the UM DRB is configured according to Table 7.1.2.2.6.3.1-1.

Table 7.1.2.2.6.3.1-1: RLC parameters

|  |  |
| --- | --- |
| t-Reassembly | ms200 |
| Uplink UM RLC sn-FieldLength | IF (pc\_um\_WithShortSN ) size6  ELSE size12 |
| Downlink UM RLC sn-FieldLength | IF (pc\_um\_WithShortSN ) size6  ELSE size12 |

7.1.2.2.6.3.2 Test procedure sequence

Table 7.1.2.2.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits UMD PDU#1. Header of UMD PDU#1 does not contain an SN. This PDU carries RLC SDU#1. | <-- | UMD PDU#1 | - | - |
| 2 | The UE transmits RLC SDU#1. | --> | (RLC SDU#1) | - | - |
| 3 | The SS transmits UMD PDU#2. Header of UMD PDU#2 contains SN=0. This PDU carries the first segment of SDU#2. | <-- | UMD PDU#2 | - | - |
| 4 | The SS transmits NR *RRCR*econfiguration message to trigger RLC re-establishment on DRB using Reconfig with sync procedure.  (Note 3)(Note 5) | <-- | *RRCReconfiguration* | - | - |
| 4A | The UE transmits a NR *RRCReconfigurationcomplete* message.  (Note 4) | --> | *RRCReconfigurationComplete* | - | - |
| 5 | 100 ms after step 4A the SS transmits UMD PDU#3. Header of UMD PDU#3 contains SN=0. This PDU carries the last segment of RLC SDU#2. The UE starts t-Reassembly. | <-- | UMD PDU#3 | - | - |
| 6 | Check: For 250 ms after step 5 does the UE transmit RLC SDU#2? | --> | (RLC SDU#2) | 1 | F |
| 6A | The SS stops allocating any UL grant. |  |  |  |  |
| 7 | 300 ms (1.5 \* t- Reassembly) after step 5 the SS transmits UMD PDU#4. This PDU carries the first segment of RLC SDU#3.SN=1. | <-- | UMD PDU#4 | - | - |
| 8 | 20 ms after step 7 the SS transmits UMD PDU#5. This PDU carries the second and last segment of RLC SDU#3.SN=1. | <-- | UMD PDU#5 | - | - |
| 8A | 20 ms after step 8 the SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#3 in 2 RLC/MAC PDUs. Note 1 & 2 | - | - | - | - |
| 9 | Check: Does the UE transmit first segment of RLC SDU#3? Header of UMD PDU contains SN=0. | --> | (RLC SDU#3 first segment) | 2 | P |
| 10 | Check: Does the UE transmit second and last segment of RLC SDU#3? Header of UMD PDU contains SN=0. | --> | (RLC SDU#3 last segment) | 2 | P |
| 10A | The SS starts the UL default grant transmissions |  |  |  |  |
| 11 | The SS transmits NR *RRCR*econfiguration message to trigger RLC re-establishment on DRB using Reconfig with sync procedure.  (Note 3) | <-- | *RRCReconfiguration* | - | - |
| 11A | The UE transmits a NR *RRCReconfigurationcomplete* message.  (Note 4) | --> | *RRCReconfigurationComplete* | - | - |
| 11B | The SS stops allocating any UL grant. |  |  |  |  |
| 12 | After 100 ms the SS transmits UMD PDU#6. Header of UMD PDU#6 contains SN=0. This PDU carries the first segment of SDU#4. | <-- | UMD PDU#6 | - | - |
| 13 | 20 ms after step 12 the SS transmits UMD PDU#7. Header of UMD PDU#6 contains SN=0. This PDU carries the secondsegment of SDU#4. | <-- | UMD PDU#7 | - | - |
| 13A | 20 ms after step 13 the SS allocates 2 UL grants at an interval of 20 ms so as to loop back RLC SDU#4 in 2 RLC/MAC PDUs. Note 1 & 2 | - | - | - | - |
| 14 | Check: Does the UE transmit first segment of RLC SDU#4? Header of UMD PDU contains SN=0. | --> | (RLC SDU#4 first segment) | 2 | P |
| 15 | Check: Does the UE transmit second and last segment of RLC SDU#4? Header of UMD PDU contains SN=0. | --> | (RLC SDU#4 last segment) | 2 | P |
| Note 1: For SN size = size6 the RLC SDU size shall be 12 octets which are segmented into 6 and 6 octets. With 2 octets of MAC BSR and 2 octets of MAC header and 1 octet of RLC header (without SO) the first segment consists of 88 bits and a TBS of this size shall be allocated. With 2 octets of MAC header and 3 octets of RLC header (with SO) the second segment consists of 88 bits and a TBS of this size shall be allocated. (LRBs & IMCS as per 38.523-3[3] annex B)  Note 2: For SN size = size12 the RLC SDU size shall be 10 octets which are segmented into 5 and 5 octets. With 2 octets of MAC BSR and 2 octets of MAC header and 2 octets of RLC header (without SO) the first segment consists of 88 bits and a TBS of this size shall be allocated. With 2 octets of MAC header and 4 octets of RLC header (with SO) the second segment consists of 88 bits and a TBS of this size shall be allocated. (LRBs & IMCS as per 38.523-3[3] annex B)  Note 3: For EN-DC, the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration as defined in Table 7.1.2.2.6.3.3-2  Note 4: For EN-DC, the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.2.2.6.3.3 Specific message contents

Table 7.1.2.2.6.3.3-1: *RRCReconfiguration* for NR (steps 4, 11, Table 7.1.2.2.6.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig according to TS 38.508-1 [4], table 4.6.3-132 with with conditions SRB1 and SRB2 and DRBn | n set to the default DRB of the first PDU session |  |
| } |  |  |  |
| nonCriticalExtension::= SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig according to TS 38.508-1 [4], table 4.6.3-19 with condition PCell\_change |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.2.2.6.3.3-2: *RRCConnectionReconfiguration for EN-DC* (steps 4, 11 Table 7.1.2.2.6.3.2-1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation Path: 36.508 Table 4.6.1-8 | | | | | | |
| Information Element | | | Value/remark | | Comment | | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { | | |  | |  | |  |
| criticalExtensions CHOICE { | | |  | |  | |  |
| c1 CHOICE{ | | |  | |  | |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE  { | | |  | |  | |  |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nr-Config-r15 CHOICE { |  | |  | |  | |
| nr-SecondaryCellGroupConfig-r15 | OCTET STRING including the RRCReconfiguration message and the IE secondaryCellGroup according TS 38.508-1 [67], table 4.6.1-13 with condition EN-DC\_HO | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [67], table 4.6.3-132 with conditions EN-DC\_DRB | |  | |  | |
| } |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |

#### 7.1.2.3 RLC Acknowledged Mode

##### 7.1.2.3.1 AM RLC / 12-bit SN / Segmentation and reassembly / Segmentation Info (SI) field

7.1.2.3.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 12 bit SN configured AMD PDU containing a SI field set to 00 }

**then** { UE correctly decodes the received AMD PDU }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 12 bit SN configured AMD PDU containing a SI field set to 01 }

**then** { UE correctly decodes the received AMD PDU }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 12 bit SN configured AMD PDU containing a SI field set to 11 and SO field }

**then** { UE correctly decodes the received AMD PDU }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 12 bit SN configured AMD PDU containing a SI field set to 10 and SO field }

**then** { UE correctly decodes the received AMD PDU }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send complete PDU }

**then** { UE transmits AMD PDU containing a complete AMD SDU and SI field set to 00 }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send first segment only }

**then** { UE transmits AMD PDU containing first segment of AMD SDU and SI field set to 01 }

}

(7)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send middle segment only }

**then** { UE transmits AMD PDU containing middle segment of AMD SDU and SI field set to 11, including SO field }

}

(8)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send last segment only }

**then** { UE transmits AMD PDU containing last segment of AMD SDU and SI field set to 10, including SO field }

}

7.1.2.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 6.2.2.4 and 6.2.3.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 6.2.2.4]

AMD PDU consists of a Data field and an AMD PDU header. The AMD PDU header is byte aligned.

An AM RLC entity is configured by RRC to use either a 12 bit SN or a 18 bit SN. The length of the AMD PDU header is two and three bytes respectively.

An AMD PDU header contains a D/C, a P, a SI, and a SN. An AMD PDU header contains the SO field only when the Data field consists of an RLC SDU segment which is not the first segment, in which case a 16 bit SO is present.



Figure 6.2.2.4-1: AMD PDU with 12 bit SN (No SO)



Figure 6.2.2.4-2: AMD PDU with 18 bit SN (No SO)



Figure 6.2.2.4-3: AMD PDU with 12 bit SN with SO



Figure 6.2.2.4-4: AMD PDU with 18 bit SN with SO

[TS 38.322, clause 6.2.3.4]

Length: 2 bits.

The SI field indicates whether an RLC PDU contains a complete RLC SDU or the first, middle, last segment of an RLC SDU.

Table 6.2.3.4-1: SI field interpretation

|  |  |
| --- | --- |
| Value | Description |
| 00 | Data field contains all bytes of an RLC SDU |
| 01 | Data field contains the first segment of an RLC SDU |
| 10 | Data field contains the last segment of an RLC SDU |
| 11 | Data field contains neither the first nor last segment of an RLC SDU |

7.1.2.3.1.3 Test description

7.1.2.3.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.1.3.1-1.

Table 7.1.2.3.1.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink SN-FieldLength-AM | size12 |
| Downlink SN-FieldLength-AM | size12 |

7.1.2.3.1.3.2 Test procedure sequence

Table 7.1.2.3.1.3.2-1: Main behaviour

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict | |
|  |  | U - S | Message |  |  | |
| 0 | The SS stops allocating any UL grant. | - | - | - | - |
| 1 | The SS transmits AMD PDU#1 containing a complete RLC SDU#1 (SI field = 00). | <-- | AMD PDU#1 | - | - | |
| 1A | 60 ms after Step1, SS allocates an UL grant sufficient to loop back RLC SDU#1 in one RLC/MAC PDU | <-- | UL Grant | - | - |
| 2 | Check: Does the UE transmit AMD PDU#1 containing a complete RLC SDU#1 (SI field = 00)? | --> | (RLC SDU#1) | 1,5 | P | |
| 3 | The SS transmits a STATUS PDU. | <-- | STATUS PDU (ACK SN=1) | - | - | |
| 4 | The SS transmits AMD PDU#2 containing the first segment of RLC SDU#2 (SI field = 01). Note 3 | <-- | AMD PDU#2 | - | - | |
| 5 | The SS transmits AMD PDU#3 containing the second segment of RLC SDU#2 (SI field = 11) and including SO field. Note 3 | <-- | AMD PDU#3 | - | - | |
| 6 | The SS transmits AMD PDU#4 containing the last segment of RLC SDU#2 (SI field = 10) and including SO field. Note 3 | <-- | AMD PDU#4 | - | - | |
| 6A | SS allocates 3 UL grants at an interval of 20 ms so as to loop back RLC SDU#2 in 3 RLC/MAC PDUs. (Note 1 and Note 2) | <-- | UL Grants | - | - | |
| 7 | Check: Does the UE transmit AMD PDU#2 containing the first segment of RLC SDU#2 (SI field = 01)? | --> | (RLC SDU#2) | 2,3,4,6 | P | |
| 8 | Check: Does the UE transmit AMD PDU#3 containing the middle segment of RLC SDU#2 (SI field = 11) and including SO field? | --> | (RLC SDU#2) | 2,3,4,7 | P | |
| 9 | Check: Does the UE transmit AMD PDU#4 containing the last segment of RLC SDU#2 (SI field = 10) and including SO field? | --> | (RLC SDU#2) | 2,3,4,8 | P | |
| 10 | The SS transmits a STATUS PDU. | <-- | STATUS PDU (ACK SN=2) | - | - | |
| Note 1: The UL grants for step 7,8,9 are sufficiently small (240 bits, LRBs & IMCS as per 38.523-3[3] annex B) that UE transmits RLC SDU#2 in 3 UL RLC PDUs by segmenting.  Note 2: The RLC PDU containing a segment shall be of size 208 bits resp. 224 bits and a MAC sub PDU header of 16 bits and a 16-bit MAC BSR CE included in step 8 resulting in a MAC PDU of size 240 bits.  Note 3: The data part in step 4 first segment not including SO is 192 bits (24 bytes). Step 5, second segment SO=24 and data is 192 bits (24 bytes). Step 6, third segment SO=24+24=48 and data is 192 bits (24 bytes). | | | | | | |

7.1.2.3.1.3.3 Specific message contents

None

##### 7.1.2.3.2 AM RLC / 18-bit SN / Segmentation and reassembly / Segmentation Info (SI) field

7.1.2.3.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 18 bit SN configured AMD PDU containing a SI field set to 00 }

**then** { UE correctly decodes the received AMD PDU or AMD PDU segment }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 18 bit SN configured AMD PDU containing a SI field set to 01 }

**then** { UE correctly decodes the received AMD PDU or AMD PDU segment }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 18 bit SN configured AMD PDU containing a SI field set to 11 and SO field }

**then** { UE correctly decodes the received AMD PDU or AMD PDU segment }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a 18 bit SN configured AMD PDU containing a SI field set to 10 and SO field }

**then** { UE correctly decodes the received AMD PDU or AMD PDU segment }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send complete PDU }

**then** { UE transmits AMD PDU containing a complete AMD SDU and SI field set to 00 }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send first segment only }

**then** { UE transmits AMD PDU containing first segment of AMD SDU and SI field set to 01 }

}

(7)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send middle segment only }

**then** { UE transmits AMD PDU containing middle segment of AMD SDU and SI field set to 11, including SO field }

}

(8)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE has UL RLC SDU to send and the UL Grant is sufficient to send last segment only }

**then** { UE transmits AMD PDU containing last segment of AMD SDU and SI field set to 10, including SO field }

}

7.1.2.3.2.2 Conformance requirements

Same conformance requirements as in clause 7.1.2.3.1.2

7.1.2.3.2.3 Test description

7.1.2.3.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.2.3.1-1.

Table 7.1.2.3.2.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink SN-FieldLength-AM | size18 |
| Downlink SN-FieldLength-AM | size18 |

7.1.2.3.2.3.2 Test procedure sequence

Same test procedure as in clause 7.1.2.3.1.3.2 except that SN is 18 bit and the data part in step 4 first segment not including SO is 184 bits (23 Bytes). Step 5, second segment SO=23 and data is 184 bits (23 bytes). Step 6, third segment SO=23+23=46 and data is 184 bits (23 bytes).

7.1.2.3.2.3.3 Specific message contents

None

##### 7.1.2.3.3 AM RLC / 12-bit SN / Correct use of sequence numbering

7.1.2.3.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN }**ensure that** {

**when** { UE transmits the PDU corresponding to first SDU } **then** { UE includes the SN field equal to 0 in PDU } }

(2)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN }**ensure that** {

**when**{ UE transmits subsequent SDUs } **then** { UE includes the SN field incremented by 1 per SDU of each PDU transmitted } }

(3)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN }**ensure that** {

**with** { UE transmits more than 4096 SDUs} **then** { UE wraps the SN after transmitting the 4096 SDUs}

}

(4)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN**ensure that** {

**with** { more than 4096 SDUs are sent to UE } t**hen** { UE accepts PDUs with SNs that wrap around every 4096 SDUs }

}

7.1.2.3.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.2.3.1.1, 5.2.3.2.1, 5.2.3.2.2, 6.2.2.4 and 7.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.2.3.2.1]

The receiving side of an AM RLC entity shall maintain a receiving window according to the state variable RX\_Next as follows:

- a SN falls within the receiving window if RX\_Next <= SN < RX\_Next + AM\_Window\_Size;

- a SN falls outside of the receiving window otherwise.

When receiving an AMD PDU from lower layer, the receiving side of an AM RLC entity shall:

- either discard the received AMD PDU or place it in the reception buffer (see sub clause 5.2.3.2.2);

- if the received AMD PDU was placed in the reception buffer:

- update state variables, reassemble and deliver RLC SDUs to upper layer and start/stop *t-Reassembly* as needed (see sub clause 5.2.3.2.3).

When *t-Reassembly* expires, the receiving side of an AM RLC entity shall:

- update state variables and start *t-Reassembly* as needed (see sub clause 5.2.3.2.4).

[TS 38.322, clause 5.2.3.2.2]

When an AMD PDU is received from lower layer, where the AMD PDU contains byte segment numbers y to z of an RLC SDU with SN = x, the receiving side of an AM RLC entity shall:

- if x falls outside of the receiving window; or

- if byte segment numbers y to z of the RLC SDU with SN = x have been received before:

- discard the received AMD PDU.

- else:

- place the received AMD PDU in the reception buffer;

- if some byte segments of the RLC SDU contained in the AMD PDU have been received before:

- discard the duplicate byte segments.

[TS 38.322, clause 6.2.2.4]

AMD PDU consists of a Data field and an AMD PDU header. The AMD PDU header is byte aligned.

An AM RLC entity is configured by RRC to use either a 12 bit SN or a 18 bit SN. The length of the AMD PDU header is two and three bytes respectively.

An AMD PDU header contains a D/C, a P, a SI, and a SN. An AMD PDU header contains the SO field only when the Data field consists of an RLC SDU segment which is not the first segment, in which case a 16 bit SO is present.



Figure 6.2.2.4-1: AMD PDU with 12 bit SN (No SO)



Figure 6.2.2.4-2: AMD PDU with 18 bit SN (No SO)



Figure 6.2.2.4-3: AMD PDU with 12 bit SN with SO



Figure 6.2.2.4-4: AMD PDU with 18 bit SN with SO

[TS 38.322, clause 7.1]

c) RETX\_COUNT – Counter

This counter counts the number of retransmissions of an RLC SDU or RLC SDU segment (see subclause 5.3.2). There is one RETX\_COUNT counter maintained per RLC SDU.

The receiving side of each AM RLC entity shall maintain the following state variables:

a) RX\_Next – Receive state variable

This state variable holds the value of the SN following the last in-sequence completely received RLC SDU, and it serves as the lower edge of the receiving window. It is initially set to 0, and is updated whenever the AM RLC entity receives an RLC SDU with SN = RX\_Next.

b) RX\_Next\_Status\_Trigger – *t-Reassembly* state variable

This state variable holds the value of the SN following the SN of the RLC SDU which triggered *t-Reassembly*.

c) RX\_Highest\_Status – Maximum STATUS transmit state variable

This state variable holds the highest possible value of the SN which can be indicated by "ACK\_SN" when a STATUS PDU needs to be constructed. It is initially set to 0.

d) RX\_Next\_Highest – Highest received state variable

This state variable holds the value of the SN following the SN of the RLC SDU with the highest SN among received RLC SDUs. It is initially set to 0.

Each transmitting UM RLC entity shall maintain the following state variables:

a) TX\_Next

This state variable holds the value of the SN to be assigned for the next newly generated UMD PDU with segment. It is initially set to 0, and is updated after the UM RLC entity submits a UMD PDU including the last segment of an RLC SDU to lower layers.

Each receiving UM RLC entity shall maintain the following state variables and constant:

b) RX\_Next\_Reassembly – UM receive state variable

This state variable holds the value of the earliest SN that is still considered for reassembly. It is initially set to 0.

c) RX\_Timer\_Trigger – UM *t-Reassembly* state variable

This state variable holds the value of the SN following the SN which triggered *t-Reassembly*.

d) RX\_Next\_Highest– UM receive state variable

This state variable holds the value of the SN following the SN of the UMD PDU with the highest SN among received UMD PDUs. It serves as the higher edge of the reassembly window. It is initially set to 0.

7.1.2.3.3.3 Test description

7.1.2.3.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.3.3.1-1.

Table 7.1.2.3.3.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink SN-FieldLength-AM | size12 |
| Downlink SN-FieldLength-AM | size12 |
| pollPDU | p2048 |
| pollByte | kB25 |

7.1.2.3.3.3.2 Test procedure sequence

Table 7.1.2.3.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 – 3a1 shall be repeated from j=0 to j= FLOOR(Maximum\_RLC\_SN/iteration\_size). (Note 1, 4, 6) | - | - | - | - |
| 1 | SS transmits in one slot, several RLC PDUs in a RLC PDU List, the number of RLC PDUs sent is defined by the iteration\_size. (Note 4, 5).  Each RLC PDU contains one RLC SDU. | <-- | RLC PDUs | - | - |
| - | EXCEPTION: In Step 2, SS may receive a RLC PDU or several RLC PDUs, then step 2 may be repeated multiple times until all RLC PDUs with SN=j\*iteration\_size to SN=(((j+1)\*iteration\_size)-1) for each iteration are received. | - | - | - | - |
| 2 | CHECK: Does UE transmit RLC PDUs with SN=0 for the first iteration and all RLC PDUs for each iteration?  (Note 2) (Note 7) | --> | RLC PDUs | 1,2 | P |
| - | EXCEPTION: Step 3a1 describes behaviour that depends on the contents of the AMD PDU transmitted at Step 2. | - | - | - | - |
| 3a1 | IF the UE has set the poll bit in the AMD PDU transmitted at Step 2 THEN the SS transmits a Status Report. | <-- | STATUS PDU | - | - |
| 4 | SS transmits a RLC PDU containing one RLC SDU. | <-- | RLC PDU | - | - |
| 5 | CHECK: Does UE transmit a RLC PDU with SN=0? | --> | RLC PDU | 3,4 | P |
| 6 | The SS transmits a STATUS PDU with ACK\_SN = 1. | <-- | STATUS PDU | - | - |
| Note 1: Maximum\_RLC\_SN = 2[*RLC-SN-SizeUL*] -1.  Note 2: The verdict shall be provided each time [(SN+1) mod 256 = 0] for 12 bit SN and [(SN+1) mod 4096 = 0] for 18 bit SN respectively.  Note 3: Void  Note 4: Iteration will be incremented by iteration\_size of 1 for 12 bit SN and iteration\_size of 25 for 18 bit SN. Small RLC SDU size will be used.  Note 5: SS shall transmit a RLC PDU list with size equal to iteration\_size and incrementing SN by 1 till SN = ((j + 1) \* iteration\_size)-1.  Note 6: The RLC SDU size shall be 4 octets(3 octets of PDCP header + 1 octet PDCP SDU).  Note 7: All RLC PDUs may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot). | | | | | |

7.1.2.3.3.3.3 Specific message contents

None.

##### 7.1.2.3.4 AM RLC / 18-bit SN / Correct use of sequence numbering

7.1.2.3.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN }**ensure that** {

**when** { UE transmits the PDU corresponding to first SDU } **then** { UE includes the SN field equal to 0 in PDU } }

(2)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN }**ensure that** {

**when**{ UE transmits subsequent SDUs } **then** { UE includes the SN field incremented by 1 per SDU of each PDU transmitted } }

(3)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN }**ensure that** {

**with** { UE transmits more than 262144 SDUs } **then** { UE wraps the SN after transmitting the 262144 SDUs }

}

(4)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN**ensure that** {

**with** { more than 262144 SDUs are sent to UE } t**hen** { UE accepts PDUs with SNs that wrap around every 262144 SDUs }

}

7.1.2.3.4.2 Conformance requirements

Same as conformance requirements in clause 7.1.2.3.3.2

7.1.2.3.4.3 Test description

7.1.2.3.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.4.3.1-1.

Table 7.1.2.3.4.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Uplink SN-FieldLength-AM | size18 |
| Downlink SN-FieldLength-AM | size18 |
| pollPDU | p2048 |
| pollByte | kB25 |

7.1.2.3.4.3.2 Test procedure sequence

Same as test procedure in clause 7.1.2.3.3.3.2

7.1.2.3.4.3.3 Specific message contents

None.

##### 7.1.2.3.5 AM RLC / 12-bit SN / Control of transmit window / Control of receive window

7.1.2.3.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN and pending uplink data for transmission }

**ensure that** {

**when** { AMD PDUs in transmission buffer fall outside TX\_Next\_Ack <= SN < TX\_Next\_Ack + AM\_Window\_Size }

**then** { UE does not transmit these AMD PDUs }

}

(2)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN and pending uplink data for transmission }

**ensure that** {

**when** { receiving a STATUS PDU where ACK\_SN acknowledges at least one AMD PDU not yet acknowledged }

**then** { UE transmits AMD PDUs within updated window range }

}

(3)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN }

**ensure that** {

**when** { the UE receives AMD PDUs with SN outside the upper boundary of the receive window }

**then** { the UE discards these AMD PDUs }

}

(4)

**with** { UE in RRC\_CONNECTED state with AM RLC 12 bit SN }

**ensure that** {

**when** { the receive window has been moved }

**then** { UE continues accepting AMD PDUs within updated window range }

}

7.1.2.3.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.2.3.2.1, 5.2.3.2.2, 5.2.3.2.3 and 7.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.2.3.2.2]

When an AMD PDU is received from lower layer, where the AMD PDU contains byte segment numbers y to z of an RLC SDU with SN = x, the receiving side of an AM RLC entity shall:

- if x falls outside of the receiving window; or

- if byte segment numbers y to z of the RLC SDU with SN = x have been received before:

- discard the received AMD PDU.

- else:

- place the received AMD PDU in the reception buffer;

- if some byte segments of the RLC SDU contained in the AMD PDU have been received before:

- discard the duplicate byte segments.

[TS 38.322, clause 5.2.3.2.3]

When an AMD PDU with SN = x is placed in the reception buffer, the receiving side of an AM RLC entity shall:

- if x >= RX\_Next\_Highest

- update RX\_Next\_Highest to x+ 1.

- if all bytes of the RLC SDU with SN = x are received:

- reassemble the RLC SDU from AMD PDU(s) with SN = x, remove RLC headers when doing so and deliver the reassembled RLC SDU to upper layer;

- if x = RX\_Highest\_Status,

- update RX\_Highest\_Status to the SN of the first RLC SDU with SN > current RX\_Highest\_Status for which not all bytes have been received.

- if x = RX\_Next:

- update RX\_Next to the SN of the first RLC SDU with SN > current RX\_Next for which not all bytes have been received.

- if *t-Reassembly* is running:

- if RX\_Next\_Status\_Trigger = RX\_Next; or

- if RX\_Next\_Status\_Trigger = RX\_Next + 1 and there is no missing byte segment of the SDU associated with SN = RX\_Next before the last byte of all received segments of this SDU; or

- if RX\_Next\_Status\_Trigger falls outside of the receiving window and RX\_Next\_Status\_Trigger is not equal to RX\_Next + AM\_Window\_Size:

- stop and reset *t-Reassembly*.

- if *t-Reassembly* is not running (includes the case *t-Reassembly* is stopped due to actions above):

- if RX\_Next\_Highest> RX\_Next +1; or

- if RX\_Next\_Highest = RX\_Next + 1 and there is at least one missing byte segment of the SDU associated with SN = RX\_Next before the last byte of all received segments of this SDU:

- start t-Reassembly;

- set RX\_Next\_Status\_Trigger to RX\_Next\_Highest.

[TS 38.322, clause 7.2]

a) AM\_Window\_Size

This constant is used by both the transmitting side and the receiving side of each AM RLC entity. AM\_Window\_Size = 2048 when a 12 bit SN is used, AM\_Window\_Size = 131072 when an 18 bit SN is used.

7.1.2.3.5.3 Test description

7.1.2.3.5.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.5.3.1-1.

Table 7.1.2.3.5.3.1-1: RLC parameters

|  |  |
| --- | --- |
| t-PollRetransmit | ms300 |
| pollPDU | infinity |
| pollByte | infinity |
| sn-FieldLength(UL-AM-RLC) | size12 |
| sn-FieldLength(DL-AM-RLC) | size12 |

7.1.2.3.5.3.2 Test procedure sequence

Table 7.1.2.3.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  | U - S | Message |
| 0 | The SS does not allocate any uplink grant. | - | - | - | - |
| - | EXCEPTION: The SS is configured for step 1 500 ms in advance. The transmissions are performed every second radio frame. Step 2 is started 100 ms after the first DL AMD PDU has been transmitted in step 1. | - | - | - | - |
| - | EXCEPTION: Step 1 a1 shall be repeated from j=0 to j= FLOOR((Maximum\_RLC\_SN/iteration size) -1, and the last repetition shall execute Step 1b1. (Note 1) (Note 3) (Note 4) (Note 6) | - | - | - | - |
| 1a1 | The SS transmits several RLC PDUs in a RLC PDU List, the number of RLC PDUs sent is defined by the iteration\_size.  Each RLC Data PDU contains one RLC SDU.  (Note 8) (Note 9) (Note 5) | <-- | RLC Data PDU (SN = j\*iteration\_ size, SN=(((j+1)\*iteration\_size)-1) | - | - |
| 1b1 | The SS transmits several RLC PDUs in a RLC PDU List, the number of RLC PDUs sent is defined by the iteration\_size+1.  Each RLC Data PDU contains one RLC SDU.  The SS transmits AMD PDU(SN=W+1) as last packet (Note 8) (Note 9) (Note 5) | <-- | RLC Data PDU (SN = j\*iteration\_ size, SN=(((j+1)\*iteration\_size)) | - | - |
| 1A | Void | - | - | - | - |
| 2 | In the following steps the SS transmits 1 UL grant in every second radio frame to enable the UE to return each received AMD PDU in one looped back AMD PDU. (Note 2) | <-- | (UL grants) | - | - |
| - | EXCEPTION: Step 2A shall be repeated from j=0 to j=FLOOR((Maximum\_RLC\_SN/iteration size). (Note 1) (Note 3) (Note 4) (Note 6) | - | - | - | - |
| - | EXCEPTION: In Step 2A, SS shall receive a RLC PDU and step 2A is repeated from SN=j\*iteration\_size to SN=(((j+1)\*iteration\_ size)-1). (Note 1) (Note 3) (Note 4) (Note 6) (Note 8) (Note 9) | - | - | - | - |
| 2A | Check: Does UE transmit a RLC Data PDU with the Poll bit not set and with SN=0 for the first RLC Data PDU and then incremented by 1 at each RLC Data PDU? (Note 7)(Note 10) | --> | RLC Data PDU (SN = j\*iteration\_ size, SN=(((j+1)\*iteration\_size)-1) | 1 | P |
| 3 | Check: Does the UE transmit the (W)st AMD PDU with the Poll bit set and with the contents of the SDU? | --> | AMD PDU(SN=W-1), Poll | 1 | P |
| 4 | The SS starts the UL default grant transmission. | - | - | - | - |
| 5 | Check: Does the UE transmit an AMD PDU within *t-PollRetransmit*/2? | --> | AMD PDU | 1 | F |
| 6 | The SS transmits a STATUS PDU to acknowledge the W uplink AMD PDUs with SN=0 to SN=W-1. ACK\_SN = W. | <-- | STATUS PDU | - | - |
| 7 | Check: Does the UE transmit an AMD PDU with the Poll bit set and with the contents of the SDU? | --> | AMD PDU(SN=W), Poll | 2 | P |
| 8 | The SS transmits a STATUS PDU with ACK\_SN = W+1. | <-- | STATUS PDU | - | - |
| 9 | The SS transmits the (W+2)nd AMD PDU containing a SDU to the UE with the Sequence Number field set to ((2W+1 mod AM\_Modulus) = 1) and the Polling bit set. (Note 3) (Note 5) | <-- | AMD PDU | - | - |
| 10 | Check: Does the UE transmit a STATUS PDU acknowledging W+1 SDUs? (ACK\_SN = W+1). (Note 1) | --> | STATUS PDU | 3 | P |
| 11 | The SS transmits the (W+2)nd AMD PDU to the UE with the Sequence Number field set to W+1 and the Polling bit set. (Note 5) | <-- | AMD PDU | - | - |
| - | EXCEPTION: Steps 12 and 13 can happen in any order | - | - | - | - |
| 12 | Check: Does the UE transmit a STATUS PDU acknowledging W+1 PDUs? (ACK\_SN field = W+2). (Note 11) | --> | STATUS PDU | 4 | P |
| 13 | Check: Does the UE transmit an AMD PDU with the same data as received in the corresponding DL AMD PDU in step 11? (Note 11) | --> | AMD PDU | 4 | P |
| 14 | The SS transmits a STATUS PDU with ACK\_SN = W+2. | <-- | STATUS PDU | - | - |
| Note 1: PDUs are numbered 1,2, …, W+2.  Note 2: 20 ms gap between transmissions both in DL and UL respectively allows TTCN to tolerate one HARQ retransmission (FDD/TDD) per transport block.  Note 3: AM\_Modulus is 4096 resp 262144 for SN size is size12 or size18.  Note 4: The RLC SDU size shall be 4 octets(3 octets of PDCP header + 1 octet PDCP SDU). If SN size is size18 is used the RLC SDU size shall be 7 octets. With 2 octets of BSR or padding, 2 octets of MAC header and 3 octets of RLC header (without SO) the RLC PDU consists of 56 bits and a TBS of 112 bits shall be allocated  Note 5: PDCP SN=W+1  Note 6: Maximum\_RLC\_SN = W-1.  Note 7: The verdict shall be provided each time (SN+1) mod 256 = 0 resp. (SN+1) mod 4096 = 0, if SN size is size12 or size18.  Note 8: Iteration will be 211 in case of len12bits. Small RLC SDU size will be used and no repetition will be needed.  Note 9: Iteration will be incremented by iteration\_size of 211 for SN len18bits. Small RLC SDU size will be used and it shall be repeated FLOOR(Maximum\_RLC\_SN/iteration\_size).  Note 10: -2 for the last iteration, as the last reception will be handled by step 3.  Note 11: STATUS PDU at step 12 and AMD PDU at step 13 may be received by SS in the same slot or in multiple slots | | | | | |

7.1.2.3.5.3.3 Specific message contents

None

##### 7.1.2.3.5a AM RLC / 18-bit SN / Control of transmit window / Control of receive window

7.1.2.3.5a.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN and pending uplink data for transmission }

**ensure that** {

**when** { AMD PDUs in transmission buffer fall outside TX\_Next\_Ack <= SN < TX\_Next\_Ack + AM\_Window\_Size }

**then** { UE does not transmit these AMD PDUs }

}

(2)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN and pending uplink data for transmission }

**ensure that** {

**when** { receiving a STATUS PDU where ACK\_SN acknowledges at least one AMD PDU not yet acknowledged }

**then** { UE transmits AMD PDUs within updated window range }

}

(3)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN }

**ensure that** {

**when** { the UE receives AMD PDUs with SN outside the upper boundary of the receive window }

**then** { the UE discards these AMD PDUs }

}

(4)

**with** { UE in RRC\_CONNECTED state with AM RLC 18 bit SN }

**ensure that** {

**when** { the receive window has been moved }

**then** { UE continues accepting AMD PDUs within updated window range }

}

7.1.2.3.5a.2 Conformance requirements

Same as conformance requirements in clause 7.1.2.3.5.2.

7.1.2.3.5a.3 Test description

7.1.2.3.5a.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.5a.3.1-1.

Table 7.1.2.3.5a.3.1-1: RLC parameters

|  |  |
| --- | --- |
| t-PollRetransmit | ms300 |
| pollPDU | infinity |
| pollByte | infinity |
| sn-FieldLength(UL-AM-RLC) | size18 |
| sn-FieldLength(DL-AM-RLC) | size18 |

7.1.2.3.5a.3.2 Test procedure sequence

Same as test procedure in clause 7.1.2.3.5.3.2

7.1.2.3.5a.3.3 Specific message contents

None.

##### 7.1.2.3.6 AM RLC / Polling for status

7.1.2.3.6.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { last data in the UL buffer is being transmitted }

**then** { UE transmits a Poll }

}

(2)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { the t-PollRetransmit timer expires }

**then** { UE transmits a Poll }

}

(3)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { PDU\_WITHOUT\_POLL >= pollPDU }

**then** { UE transmits a Poll }

}

(4)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { BYTE\_WITHOUT\_POLL >= pollByte }

**then** { UE transmits a Poll }

}

7.1.2.3.6.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.3.3.2, 7.3 and 7.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.3.3.2]

Upon notification of a transmission opportunity by lower layer, for each AMD PDU submitted for transmission such that the AMD PDU contains either a not previously transmitted RLC SDU or an RLC SDU segment containing not previously transmitted byte segment, the transmitting side of an AM RLC entity shall:

- increment PDU\_WITHOUT\_POLL by one;

- increment BYTE\_WITHOUT\_POLL by every new byte of Data field element that it maps to the Data field of the AMD PDU;

- if PDU\_WITHOUT\_POLL >= pollPDU; or

- if BYTE\_WITHOUT\_POLL >= pollByte:

- include a poll in the AMD PDU as described below.

Upon notification of a transmission opportunity by lower layer, for each AMD PDU submitted for transmission, the transmitting side of an AM RLC entity shall:

- if both the transmission buffer and the retransmission buffer becomes empty (excluding transmitted RLC SDUs or RLC SDU segments awaiting acknowledgements) after the transmission of the AMD PDU; or

- if no new RLC SDU can be transmitted after the transmission of the AMD PDU (e.g. due to window stalling);

- include a poll in the AMD PDU as described below.

NOTE: Empty RLC buffer (excluding transmitted RLC SDUs or RLC SDU segments awaiting acknowledgements) should not lead to unnecessary polling when data awaits in the upper layer. Details are left up to UE implementation.

To include a poll in an AMD PDU, the transmitting side of an AM RLC entity shall:

- set the P field of the AMD PDU to "1";

- set PDU\_WITHOUT\_POLL to 0;

- set BYTE\_WITHOUT\_POLL to 0.

After submitting an AMD PDU including a poll to lower layer and after incrementing of TX\_Next if necessary, the transmitting side of an AM RLC entity shall:

- set POLL\_SN to TX\_Next – 1;

- if *t-PollRetransmit* is not running:

- start t-PollRetransmit.

- else:

- restart t-PollRetransmit.

[TS 38.322, clause 5.3.3.4]

Upon expiry of *t-PollRetransmit*, the transmitting side of an AM RLC entity shall:

- if both the transmission buffer and the retransmission buffer are empty (excluding transmitted RLC SDU or RLC SDU segment awaiting acknowledgements); or

- if no new RLC SDU or RLC SDU segment can be transmitted (e.g. due to window stalling):

- consider the RLC SDU with SN = TX\_Next – 1 for retransmission; or

- consider any RLC SDU which has not been positively acknowledged for retransmission.

- include a poll in an AMD PDU as described in section 5.3.3.2.

[TS 38.322, clause 7.3]

a) t-PollRetransmit

This timer is used by the transmitting side of an AM RLC entity in order to retransmit a poll (see sub clause 5.3.3).

[TS 38.322, clause 7.4]

b) pollPDU

This parameter is used by the transmitting side of each AM RLC entity to trigger a poll for every pollPDU PDUs (see subclause 5.3.3).

c) pollByte

This parameter is used by the transmitting side of each AM RLC entity to trigger a poll for every pollByte bytes (see subclause 5.3.3).

7.1.2.3.6.3 Test description

7.1.2.3.6.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.6.3.1-1.

Table 7.1.2.3.6.3.1-1: RLC parameters

|  |  |
| --- | --- |
| t-PollRetransmit | ms400 |
| pollPDU | p256 |
| pollByte | kB25 |

7.1.2.3.6.3.2 Test procedure sequence

Table 7.1.2.3.6.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | During the whole test sequence, the SS should not allocate UL grants unless when explicitly stated so in the procedure. | - | - | - | - |
| 2 | The SS transmits 4 AMD PDUs such that 1 AMD PDU is sent every two radio frame, each containing an RLC SDU of 976 bits. (Note 2) | <-- | AMD PDU (SN=0)  AMD PDU (SN=1)  AMD PDU (SN=2)  AMD PDU (SN=3) | - | - |
| - | EXCEPTION: In parallel to the events described in step 3, the step specified in Table 7.1.2.3.6.3.2-2 should take place. | - | - | - | - |
| 3 | The SS waits for 100 ms after the first DL AMD PDU has been transmitted in step 2, then starts assigning UL grants in every second radio frame of size 1032 bits. (Note 1) (Note 2) | - | - | - | - |
| 4 | Check 1: Does the UE transmit an AMD PDU with a SN in range 0 to 3 and P=1?  Record time TB.  Check 2: Is (TB – TA) = *t-PollRetransmit*? | --> | AMD PDU | 2 | P |
| 5 | The SS starts the UL default grant transmission on reception of SR. | - | - | - | - |
| 6 | The SS transmits an RLC Status Report ACKing reception of PDU’s 0-3. | <-- | STATUS PDU | - | - |
| 7 | Check: Does the UE retransmit an AMD PDU within 1 sec? | --> | AMD PDU | 2 | F |
| 8 | The SS transmits NR RRCReconfiguration message changing *pollPDU* to p4.  (Note 3) | <-- | RRCReconfiguration | - | - |
| 8A | The UE transmits a NR *RRCReconfigurationcomplete* message.  (Note 4) | --> | RRCReconfigurationComplete | - | - |
| 9 | The SS stops allocating any UL grant. | - | - | - | - |
| 10 | The SS transmits 8 AMD PDUs such that 1 AMD PDU is sent every second radio frame, each containing an RLC SDU of 976 bits. (Note 2) | <-- | AMD PDU (SN=4)  AMD PDU (SN=5)  ...  AMD PDU (SN=11) | - | - |
| - | EXCEPTION: In parallel to the events described in step 11, the step specified in Table 7.1.2.3.6.3.2-3 should take place. | - | - | - | - |
| 11 | The SS waits for 100 ms after the first DL AMD PDU has been transmitted in step 10, then starts assigning UL grants (UL grant allocation type 2) in every second radio frame of size 1032 bits. (Note 1) (Note 2) | - | - | - | - |
| 12 | The SS transmits a Status Report with ACK\_SN=12, NACK\_SN=4, NACK\_SN=5, NACK\_SN=6 (constructed by NACK\_SN Range), NACK\_SN=8 and NACK\_SN=9 (constructed by NACK\_SN Range). | <-- | STATUS PDU | - | - |
| 12A | Void. | - | - | - | - |
| 13 | Check: Does the UE transmit AMD PDUs with the following SN and P values?  AMD PDU, SN=4, P=0  AMD PDU, SN=5, P=0  AMD PDU, SN=6, P=0  AMD PDU, SN=8, P=0  AMD PDU, SN=9, P=1 | --> | AMD PDU (SN=4, P=0)  AMD PDU (SN=5, P=0)  AMD PDU (SN=6, P=0)  AMD PDU (SN=8, P=0)  AMD PDU (SN=9, P=1) | 2 | P |
| 14 | The SS starts the UL default grant transmission on reception of SR. | - | - | - | - |
| 15 | The SS transmits a Status Report with ACK\_SN=12 and no NACK\_SN. | <-- | STATUS PDU | - | - |
| 16 | The SS transmits NR RRCReconfiguration message changing *pollPDU* to p256.  (Note 3) | <-- | RRCReconfiguration | - | - |
| 16A | The UE transmits a NR *RRCReconfigurationcomplete* message.  (Note 4) | --> | RRCReconfigurationComplete | - | - |
| 17 | The SS does not allocate any UL grant. | - | - | - | - |
| 18 | After 500 ms the SS transmits 412 AMD PDUs such that 1 AMD PDU is sent every second radio frame, each containing an RLC SDU of size 976 bits. (Note 2) | <-- | AMD PDU (SN=12)  AMD PDU (SN=13)  ...  AMD PDU (SN=423) | - | - |
| - | EXCEPTION: In parallel to the events described in step 19, the steps specified in Table 7.1.2.3.6.3.2-4 should take place. | - | - | - | - |
| 19 | The SS waits for 100 ms after the first DL AMD PDU has been transmitted in step 10, then starts assigning UL grants (UL grant allocation type 2) in every second radio frame of size 1032 bits. (Note 1) (Note 2) | - | - | - | - |
| 20 | The SS starts the UL default grant transmission | - | - | - | - |
| Note 1: UL grant of 1032 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to loop back one SDU of size 976 bits and one short BSR (16 bits) into each MAC PDU sent in the uplink (1032 bits - 24 bit AMD PDU header - 16 bit MAC BSR CE- 16 bit MAC PDU subheader). The UE will include an SDU of size 976 bits and one short BSR in the looped back MAC PDU.  Note 2: 20ms gap between transmissions both in DL and UL respectively allows TTCN to tolerate one HARQ retransmission (FDD/TDD) per transport block, if such happen (TS 38.523-3 [3]).  Note 3: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7] Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 4: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

Table 7.1.2.3.6.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit 4 AMD PDUs, with only the last one having the poll bit set? Record time TA when the PDU with the poll bit set is received at the SS. | --> | AMD PDUs | 1 | P |

Table 7.1.2.3.6.3.2-3: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit 8 AMD PDUs, with the poll bit set only in the 4th and the 8th PDUs? | --> | AMD PDUs | 3 | P |

Table 7.1.2.3.6.3.2-4: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit 205 AMD PDUs, with the poll bit set only in the last (205th) one? (Note 1) | --> | AMD PDUs | 4 | P |
| 2 | The SS transmits an RLC Status Report. | <-- | STATUS PDU | - | - |
| 3 | Check: Does the UE transmit 205 AMD PDUs, with the poll bit set only in the last (410th) one? (Note 1) | --> | AMD PDUs | 4 | P |
| 4 | The SS transmits an RLC Status Report. | <-- | STATUS PDU | - | - |
| 5 | Check: Does the UE transmit 2 AMD PDUs, with the poll bit set only in the last (412th ) one? | --> | AMD PDUs | 1 | P |
| 6 | The SS transmits an RLC Status Report. | <-- | STATUS PDU | - | - |
| Note 1: (976 bits x 205PDUs) / 8 = 25010 > 25 KB, with 1 kB = 1000 bytes (TS 38.331 [12], clause 3.2) | | | | | |

7.1.2.3.6.3.3 Specific message contents

Table 7.1.2.3.6.3.3-1: *RRCReconfiguration* (steps 8 and 16, Table 7.1.2.3.6.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.2.3.6.3.3-2: *CellGroupConfig* (Table 7.1.2.3.6.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 1 entry |  |  |
| RLC-BearerConfig[1] | RLC-BearerConfig | entry 1 |  |
| } |  |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig | Not present |  |  |
| spCellConfig | Not present |  |  |
| } |  |  |  |

Table 7.1.2.3.6.3.3-3: *RLC-BearerConfig* (Table 7.1.2.3.6.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-148 with condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-BearerConfig ::= SEQUENCE { |  |  |  |
| logicalChannelIdentity | Set to LCID of the DRB under test |  |  |
| rlc-Config | RLC-Config |  |  |
| } |  |  |  |

Table 7.1.2.3.6.3.3-4: *RLC-Config* (Table 7.1.2.3.6.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-149 with condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-Config ::= CHOICE { |  |  |  |
| am SEQUENCE { |  |  |  |
| ul-AM-RLC SEQUENCE { |  |  |  |
| sn-FieldLength | Not present |  |  |
| t-PollRetransmit | ms400 |  |  |
| pollPDU | p4 |  | step 8 |
|  | p256 |  | step 16 |
| pollByte | kB25 |  |  |
| } |  |  |  |
| dl-AM-RLC SEQUENCE { |  |  |  |
| sn-FieldLength | Not present |  |  |
| } |  |  |  |

##### 7.1.2.3.7 AM RLC / Receiver status triggers

7.1.2.3.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { Reception failure of an RLC data PDU is detected and t-Reassembly expires }

**then** { UE initiates Status Reporting }

}

(2)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { Status Reporting is triggered and t-StatusProhibit is running }

**then** { UE wait until t-StatusProhibit has expired to send Status Report}

}

(3)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { Polling from peer AM RLC entity is detected and the sequence number ‘x’ of the PDU that carries the Poll satisfies x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size }

**then** { UE initiates Status Reporting }

}

(4)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { Polling from peer AM RLC entity is detected and the sequence number ‘x’ of the PDU that carries the Poll does not satisfies x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size }

**then** { UE waits until ‘x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size’ before initiating Status Reporting}

}

(5)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { the UE needs to send a Status Report and the UL grant is not large enough to accommodate the whole report }

**then** { UE includes as many NACK\_SNs in the Status Report as allowed by the UL grant }

}

(6)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { the UE needs to send a Status Report and continuous sequence of RLC SDUs that have not been received yet }

**then** { UE includes NACK\_SN with NACK range }

}

7.1.2.3.7.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clause 5.3.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.3.4]

An AM RLC entity sends STATUS PDUs to its peer AM RLC entity in order to provide positive and/or negative acknowledgements of RLC SDUs (or portions of them).

Triggers to initiate STATUS reporting include:

- Polling from its peer AM RLC entity:

- When an AMD PDU with SN = x and the P field set to "1" is received from lower layer, the receiving side of an AM RLC entity shall:

- if the AMD PDU is to be discarded as specified in subclause 5.2.3.2.2; or

- if x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size:

- trigger a STATUS report.

- else:

- delay triggering the STATUS report until x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size.

NOTE 1: This ensures that the RLC Status report is transmitted after HARQ reordering.

- Detection of reception failure of an AMD PDU

- The receiving side of an AM RLC entity shall trigger a STATUS report when *t-Reassembly* expires.

NOTE 2: The expiry of *t-Reassembly* triggers both RX\_Highest\_Status to be updated and a STATUS report to be triggered, but the STATUS report shall be triggered after RX\_Highest\_Status is updated.

When STATUS reporting has been triggered, the receiving side of an AM RLC entity shall:

- if *t-StatusProhibit* is not running:

- at the first transmission opportunity indicated by lower layer, construct a STATUS PDU and submit it to lower layer.

- else:

- at the first transmission opportunity indicated by lower layer after *t-StatusProhibit* expires, construct a single STATUS PDU even if status reporting was triggered several times while *t-StatusProhibit* was running and submit it to lower layer.

When a STATUS PDU has been submitted to lower layer, the receiving side of an AM RLC entity shall:

- start t-StatusProhibit.

When constructing a STATUS PDU, the AM RLC entity shall:

- for the RLC SDUs with SN such that RX\_Next <= SN < RX\_Highest\_Status that has not been completely received yet, in increasing SN order of RLC SDUs and increasing byte segment order within RLC SDUs, starting with SN = RX\_Next up to the point where the resulting STATUS PDU still fits to the total size of RLC PDU(s) indicated by lower layer:

- for an RLC SDU for which no byte segments have been received yet:

- include in the STATUS PDU a NACK\_SN which is set to the SN of the RLC SDU.

- for a continuous sequence of byte segments of a partly received RLC SDU that have not been received yet:

- include in the STATUS PDU a set of NACK\_SN, SOstart and SOend.

- for a continuous sequence of RLC SDUs that have not been received yet:

- include in the STATUS PDU a set of NACK\_SN and NACK range;

- include in the STATUS PDU, if required, a pair of SOstart and SOend.

- set the ACK\_SN to the SN of the next not received RLC SDU which is not indicated as missing in the resulting STATUS PDU.

7.1.2.3.7.3 Test description

7.1.2.3.7.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.7.3.1-1.

Table 7.1.2.3.7.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-Reassembly* | ms150 |
| *t-StatusProhibit* | ms300 |
| *t-PollRetransmit* | ms500 |

7.1.2.3.7.3.2 Test procedure sequence

Table 7.1.2.3.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 1 | The SS transmits 4 AMD PDUs with SN=0, 1, 2, and 4. The SS sets the P field of all the AMD PDUs to 0. A time spacing of 20 ms is applied.  Record time TA when the AMD PDU with SN=4 is sent. | <-- | AMD PDU (SN=0, P=0)  AMD PDU (SN=1, P=0)  AMD PDU (SN=2, P=0)  AMD PDU (SN=4, P=0) | - | - |
| 2 | The SS waits for 70 ms after the transmission of the first AMD PDU to ensure UE RLC has all the required SDUs available and then assigns 3 UL grants (UL grant allocation type 2) with a time spacing of 20 ms of size 848 bits (UL Grant Allocation type 2). (Note 1) | <-- | (UL grants, 848 bits) | - | - |
| 3 | The UE transmits RLC SDU#1. | --> | (RLC SDU#1) | - | - |
| 4 | The UE transmits RLC SDU#2. | --> | (RLC SDU#2) | - | - |
| 5 | The UE transmits RLC SDU#3. | --> | (RLC SDU#3) | - | - |
| 6 | 60 ms after step 5, the SS transmits a STATUS PDU | <-- | STATUS PDU | - | - |
| 7 | 80 ms after step 5, the SS starts the UL default grant transmission. | - | - | - | - |
| 8 | Check 1: Does the UE transmit a Status Report with NACK\_SN=3 and ACK\_SN=5?  Record time TB (Note 5)  Check 2: (TB – TA) = *t-Reassembly*? | --> | STATUS PDU | 1 | P |
| 9 | 100 ms after the Status Report is received at Step 8, the SS transmits 4 AMD PDUs with SN=5, 6, 8 and 9. The SS sets the P field of all the AMD PDUs to 0. A time spacing of 20 ms is applied. | <-- | AMD PDU (SN=5, P=0)  AMD PDU (SN=6, P=0)  AMD PDU (SN=8, P=0)  AMD PDU (SN=9, P=0) | - | - |
| 10 | Check 1: Does the UE transmit a Status Report with NACK\_SN=3 and ACK\_SN=7?  Record time TC  Check 2: (TC – TB) = *t-StatusProhibit*? | --> | STATUS PDU | 2 | P |
| 11 | The SS ignores scheduling requests unless otherwise specified and does not allocate any uplink grant. | - | - | - | - |
| 12 | 200 ms after step 10, the SS transmits 2 AMD PDUs with SN=3, SN=7. The SS sets the P field of all the AMD PDUs to 0 except for that of the AMD PDU with SN=7. A time spacing of 20 ms is applied. | <-- | AMD PDU (SN=3, P=0)  AMD PDU (SN=7, P=1) | - | - |
| 13 | The SS waits for 100 ms after the transmission of the last AMD PDU to ensure UE RLC has all the required SDUs available and then assigns 1 UL grant (UL grant allocation type 3) of size 88 bits. (Note 2) | <-- | (UL grant, 88 bits) | - | - |
| 14 | Check: Does the UE transmit a Status Report with no NACK\_SN and ACK\_SN = 10? | --> | STATUS PDU | 3 | P |
| 15 | In the second frame following the one scheduled in step 13 the SS assigns 7 UL grants (UL grant allocation type 2) with a time spacing of 20 ms of size 848 bits. (Note 1) | <-- | (UL grant, 848 bits) | - | - |
| 16 | The UE transmits RLC SDU#4. | --> | (RLC SDU#4) | - | - |
| 17 | The UE transmits RLC SDU#5. | --> | (RLC SDU#5) | - | - |
| 18 | The UE transmits RLC SDU#6. | --> | (RLC SDU#6) | - | - |
| 19 | The UE transmits RLC SDU#7. | --> | (RLC SDU#7) | - | - |
| 20 | The UE transmits RLC SDU#8. | --> | (RLC SDU#8) | - | - |
| 21 | The UE transmits RLC SDU#9. | --> | (RLC SDU#9) | - | - |
| 22 | The UE transmits RLC SDU#10. | --> | (RLC SDU#10) | - | - |
| 23 | The SS transmits a STATUS PDU | <-- | STATUS PDU | - | - |
| 24 | After 300 ms the SS transmits an AMD PDU with SN=11 and P=0, and an AMD PDU with SN=12 and P=1.A time spacing of 20 ms is applied. | <-- | AMD PDU (SN=11, P=0)  AMD PDU (SN=12, P=1) | - | - |
| 25 | Check: Does the UE transmit a scheduling request within *t-Reassembly*/ 2 ms after the transmission of the first AMD PDU of Step 24? | --> | (SR) | 4 | F |
| 26 | At *t-Reassembly*/ 2 ms after the transmission of the second AMD PDU of Step 24, the SS transmits an AMD PDU with SN=10 and P=0. | <-- | AMD PDU (SN=10, P=0) | - | - |
| 27 | The SS waits for 60 ms to ensure UE RLC has all the required SDUs available and then assigns 1 UL grant (UL grant allocation type 3) of size 88 bits. (Note 2) | <-- | (UL grant, 88 bits) | - | - |
| 28 | Check: Does the UE transmit a Status Report with no NACK\_SN and ACK\_SN=13? | --> | STATUS PDU | 4 | P |
| 29 | The SS assigns 3 UL grants (UL grant allocation type 2) with a time spacing of 20 ms of size 848 bits. (Note 1) | <-- | (UL grant, 848 bits) | - | - |
| 30 | The UE transmits RLC SDU#11. | --> | (RLC SDU#11) | - | - |
| 31 | The UE transmits RLC SDU#12. | --> | (RLC SDU#12) | - | - |
| 32 | The UE transmits RLC SDU#13. | --> | (RLC SDU#13) | - | - |
| 33 | The SS transmits a STATUS PDU. | <-- | STATUS PDU | - | - |
| 34 | After 300 ms the SS transmits an AMD PDU with SN=17 and P=0, and an AMD PDU with SN=19 and P=1. A time spacing of 20 ms is applied. | <-- | AMD PDU (SN=17, P=0)  AMD PDU (SN=19, P=1) | - | - |
| 35 | The SS waits for *t-Reassembly* ms to ensure expiry. | - | - | - | - |
| 36 | 60 ms after step 35 the SS assigns an UL grant (UL grant allocation type 3) of size 88 bits. (Note 3) | <-- | (UL Grant, 88 bits) | - | - |
| 37 | Check: Does the UE transmit a Status Report with ACK\_SN=18 and NACK\_SN: 13 including NACK Range 4 (SN 13, 14, 15, 16)? | --> | STATUS PDU | 5,6 | P |
| 38 | After 300 ms the SS transmits an AMD PDU with SN=16 and P=1. | <-- | AMD PDU (SN=16, P=1) | - | - |
| 39 | 30 ms after step 38 the SS assigns an UL grant (UL grant allocation type 3) of size 112 bits. (Note 4) | <-- | (UL Grant, size 112) | - | - |
| 40 | Check: Does the UE transmit a Status Report with ACK\_SN=20 and NACK\_SN: 13 including NACK Range 3 (SN 13, 14, 15) and NACK\_SN=18 without NACK Range? | --> | STATUS PDU | 5,6 | P |
| 41 | 60 ms after step 38 the SS transmits 4 AMD PDUs with SN=13, 14, 15 and 18. A time spacing of 20 ms is applied. | <-- | AMD PDU (SN=13, P=0)  AMD PDU (SN=14, P=0)  AMD PDU (SN=15, P=0)  AMD PDU (SN=18, P=0) | - | - |
| 42 | 130 ms after the transmission of the first AMD PDU the SS assigns 7 UL grant (UL grant allocation type 3 with a time spacing of 20 ms of size 848 bits. (Note 1) | <-- | (UL grant, 848 bits) | - | - |
| 43 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#14) | - | - |
| 44 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#15) | - | - |
| 45 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#16) | - | - |
| 46 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#17) | - | - |
| 47 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#18) | - | - |
| 48 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#19) | - | - |
| 49 | The UE loopbacks the complete RLC SDU. | --> | (RLC SDU#20) | - | - |
| 50 | The SS transmits a STATUS PDU. | <-- | STATUS PDU | - | - |
| Note 1: UL grant of 848 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit one PDU at a time ( 99 bytes RLC SDU + 3 bytes RLC Header + 2 bytes MAC Sub PDU header + 2 bytes for short BSR or padding).  Note 2: UL grant of 88 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit a Status Report with ACK\_SN(3 byte) + 2 byte MAC PDU subheader and (2 byte short BSR). 4 Bytes additional space provided to confirm UE does not include NACK\_SN and conformant UE instead will include MAC Padding.  Note 3: UL grant of 88 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit (a Status Report with ACK\_SN (3 Bytes)and 1 NACK\_SNs with NACK Range(4 Bytes) + MAC PDU subheader (2 Bytes) + Short BSR (2 Byte).  Note 4: UL grant of 112 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit (a Status Report with ACK\_SN (3 Bytes)and 1 NACK\_SNs with NACK Range(4 Bytes) +NACK SN (3 Bytes) + MAC PDU subheader (2 Bytes) + Short BSR (2 Byte).  Note 5: Time TB should be recorded by factoring in the SR-Periodicity as configured in the *SchedulingRequestResourceConfig*->*periodicityAndOffset* | | | | | |

7.1.2.3.7.3.3 Specific message contents

None

##### 7.1.2.3.8 AM RLC / Reconfiguration of RLC parameters by upper layers

7.1.2.3.8.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { t-PollRetransmit value is changed during reconfiguration of RLC parameters by upper layers}

**then** { UE starts using new t-PollRetransmit value }

}

(2)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { t-Reassembly value is changed during reconfiguration of RLC parameters by upper layers }

**then** { UE starts using new t-Reassembly value }

}

(3)

**with** { UE in RRC\_CONNECTED state and using AM RLC }

**ensure that** {

**when** { t-StatusProhibit value is changed during reconfiguration of RLC parameters by upper layers }

**then** { UE starts using new t-StatusProhibit value }

}

7.1.2.3.8.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.322, clauses 5.3.3.1, 5.3.3.2, 5.3.3.3, 5.3.4 and 7.3. TS 38.331 clause 5.3.5.5.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.3.3.1]

An AM RLC entity can poll its peer AM RLC entity in order to trigger STATUS reporting at the peer AM RLC entity.

[TS 38.322, clause 5.3.3.2]

Upon notification of a transmission opportunity by lower layer, for each AMD PDU submitted for transmission such that the AMD PDU contains either a not previously transmitted RLC SDU or an RLC SDU segment containing not previously transmitted byte segment, the transmitting side of an AM RLC entity shall:

- increment PDU\_WITHOUT\_POLL by one;

- increment BYTE\_WITHOUT\_POLL by every new byte of Data field element that it maps to the Data field of the AMD PDU;

- if PDU\_WITHOUT\_POLL >= pollPDU; or

- if BYTE\_WITHOUT\_POLL >= pollByte:

- include a poll in the AMD PDU as described below.

Upon notification of a transmission opportunity by lower layer, for each AMD PDU submitted for transmission, the transmitting side of an AM RLC entity shall:

- if both the transmission buffer and the retransmission buffer becomes empty (excluding transmitted RLC SDUs or RLC SDU segments awaiting acknowledgements) after the transmission of the AMD PDU; or

- if no new RLC SDU can be transmitted after the transmission of the AMD PDU (e.g. due to window stalling);

- include a poll in the AMD PDU as described below.

NOTE: Empty RLC buffer (excluding transmitted RLC SDUs or RLC SDU segments awaiting acknowledgements) should not lead to unnecessary polling when data awaits in the upper layer. Details are left up to UE implementation.

To include a poll in an AMD PDU, the transmitting side of an AM RLC entity shall:

- set the P field of the AMD PDU to "1";

- set PDU\_WITHOUT\_POLL to 0;

- set BYTE\_WITHOUT\_POLL to 0.

After submitting an AMD PDU including a poll to lower layer and after incrementing of TX\_Next if necessary, the transmitting side of an AM RLC entity shall:

- set POLL\_SN to TX\_Next – 1;

- if *t-PollRetransmit* is not running:

- start t-PollRetransmit.

- else:

- restart t-PollRetransmit.

[TS 38.322, clause 5.3.3.3]

Upon reception of a STATUS report from the receiving RLC AM entity the transmitting side of an AM RLC entity shall:

- if the STATUS report comprises a positive or negative acknowledgement for the RLC SDU with sequence number equal to POLL\_SN:

- if *t-PollRetransmit* is running:

- stop and reset *t-PollRetransmit*.

[TS 38.322, clause 5.3.4]

Upon expiry of *t-PollRetransmit*, the transmitting side of an AM RLC entity shall:

- if both the transmission buffer and the retransmission buffer are empty (excluding transmitted RLC SDU or RLC SDU segment awaiting acknowledgements); or

- if no new RLC SDU or RLC SDU segment can be transmitted (e.g. due to window stalling):

- consider the RLC SDU with SN = TX\_Next – 1 for retransmission; or

- consider any RLC SDU which has not been positively acknowledged for retransmission.

- include a poll in an AMD PDU as described in section 5.3.3.2.

[TS 38.322, clause 7.3]

The following timers are configured by 3GPP TS 38.331 [5]:

a) t-PollRetransmit

This timer is used by the transmitting side of an AM RLC entity in order to retransmit a poll (see sub clause 5.3.3).

b) t-Reassembly

This timer is used by the receiving side of an AM RLC entity and receiving UM RLC entity in order to detect loss of RLC PDUs at lower layer (see sub clauses 5.2.2.2 and 5.2.3.2). If t-Reassembly is running, t-Reassembly shall not be started additionally, i.e. only one t-Reassembly per RLC entity is running at a given time.

c) t-StatusProhibit

This timer is used by the receiving side of an AM RLC entity in order to prohibit transmission of a STATUS PDU (see sub clause 5.3.4).

[TS 38.331, clause 5.3.5.5.4]

For each RLC-Bearer-Config received in the rlc-BearerToAddModList IE the UE shall:

1> if the UE’s current configuration contains a RLC bearer with the received *logicalChannelIdentity*:

2> if *reestablishRLC* is received:

3> re-establish the RLC entity as specified in TS 38.322 [4];

2> reconfigure the RLC entity or entities in accordance with the received *rlc-Config*;

2> reconfigure the logical channel in accordance with the received *mac-LogicalChannelConfig*;

NOTE: The network does not re-associate an already configured logical channel with another radio bearer. Hence *servedRadioBearer* is not present in this case.

7.1.2.3.8.3 Test description

7.1.2.3.8.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.8.3.1-1.

Table 7.1.2.3.8.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Parameter | Value |
| *t-Reassembly* | ms150 |
| *t-StatusProhibit* | ms300 |
| *t-PollRetransmit* | ms400 |
| *pollPDU* | infinity |
| *pollByte* | infinity |

7.1.2.3.8.3.2 Test procedure sequence

Table 7.1.2.3.8.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message/PDU/SDU |  |  |
| 1-29 | Same expected sequence as in Table 7.1.2.3.8.3.2-2 with (X=0, t-Reassembly = ms150, *t-StatusProhibit = ms300, t-PollRetransmit=ms400*) Note 1. | - | - | 1,2,3 | - |
| 30 | The SS transmits NR RRCReconfiguratioin message to reconfigure RLC in the UE and set:  - *t-Reassembly* to ms200,  - *t-StatusProhibit* to ms400,  - *t-PollRetransmit* to ms500.  (Note 1) | <-- | RRCReconfiguration | - | - |
| 30A | The UE transmits a NR *RRCReconfigurationcomplete* message.  (Note 2) | --> | RRCReconfigurationComplete | - | - |
| 31-59 | Same expected sequence as in Table 7.1.2.3.8.3.2-2 with (X=11, t-Reassembly = ms200, *t-StatusProhibit = ms400, t-PollRetransmit=ms500)*. | - | - | 1,2,3 | - |
| Note 1: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

Table 7.1.2.3.8.3.2-2: Behaviour Sequence (X, t-Reassembly, *t-StatusProhibit,t-PollRetransmit*)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message/PDU/SDU |  |  |
| 1 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 2 | The SS transmits 4 AMD PDUs with P=0 and SN=X, X+1, X+2 and X+4.  The SS record time TA when AMD PDU#5 (with SN=X+4) is sent. A time spacing of 20 ms is applied. | <-- | AMD PDU#1 (SN=X, P=0)  AMD PDU#2 (SN=X+1, P=0)  AMD PDU#3 (SN=X+2, P=0)  AMD PDU#5 (SN=X+4, P=0) | - | - |
| 3 | The SS waits for 70 ms after the transmission of the first AMD PDU to ensure UE RLC has all the required SDUs available and then assigns 3 UL grants of size 848 bits with a time spacing of 20 ms. (Note 1) | <-- | (UL grants, 848 bits) | - | - |
| 4 | The UE transmits RLC SDU#1+X. | --> | (RLC SDU#1+X) | - | - |
| 5 | The UE transmits RLC SDU#2+X. | --> | (RLC SDU#2+X) | - | - |
| 6 | The UE transmits RLC SDU#3+X. | --> | (RLC SDU#3+X) | - | - |
| 7 | 60 ms after step 3 the SS transmits a STATUS PDU. | <-- | STATUS PDU | - | - |
| 8 | The SS starts the UL default grant transmission. | - | - | - | - |
| 9 | Check 1: Does the UE transmit a STATUS PDU with NACK\_SN=X+3 and ACK\_SN=X+5? Record time TB (Note 5).  Check 2: Is (TB – TA ) = *t-Reassembly*? | --> | STATUS PDU | 2 | P |
| 10 | 100 ms after the Status Report received at Step 9, the SS sends 4 AMD PDUs with P=0 and SN=X+5, X+6, X+8 and X+9. A time spacing of 20 ms is applied. | <-- | AMD PDU#6 (SN=X+5, P=0)  AMD PDU#7 (SN=X+6, P=0)  AMD PDU#9 (SN=X+8, P=0)  AMD PDU#10 (SN=X+9, P=0) | - | - |
| 11 | Check 1: Does the UE transmit a Status Report with NACK\_SN=X+3 and ACK\_SN=X+7?  Record time TC  Check 2: (TC – TB) = *t-StatusProhibit?* | --> | STATUS PDU | 3 | P |
| 12 | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 13 | After 250 ms the SS transmits 3 AMD PDUs with SN=X+3, X+7 and X+9. The SS sets the P field of all the AMD PDUs to 0 except for that of the AMD PDU with SN=X+9. A time spacing of 20 ms is applied. | <-- | AMD PDU#4 (SN=X+3, P=0)  AMD PDU#8 (SN=X+7, P=0)  AMD PDU#10 (SN=X+9, P=1) | - | - |
| 14 | The SS waits for 150 ms after AMD PDU#4 transmission to ensure UE RLC has all the required SDUs available and then assigns 1 UL grant of size 88 bits (UL Grant Allocation type 3). (Note 2)(Note 4) | <-- | (UL grant, 88 bits) | - | - |
| 15 | The UE transmits a Status Report with no NACK\_SN and ACK\_SN=X+10. | --> | STATUS PDU | - | - |
| 16 | In the subframe following the one scheduled in step 14 the SS assigns 7 UL grants of size 848 bits (UL Grant Allocation type 2) with a time spacing of 20 ms. (Note 1) | <-- | (UL grants, 848 bits) | - | - |
| 17 | The UE transmits RLC SDU#4+X. | --> | (RLC SDU#4+X) | - | - |
| 18 | The UE transmits RLC SDU#5+X. | --> | (RLC SDU#5+X) | - | - |
| 19 | The UE transmits RLC SDU#6+X. | --> | (RLC SDU#6+X) | - | - |
| 20 | The UE transmits RLC SDU#7+X. | --> | (RLC SDU#7+X) | - | - |
| 21 | The UE transmits RLC SDU#8+X. | --> | (RLC SDU#8+X) | - | - |
| 22 | The UE transmits RLC SDU#9+X. | --> | (RLC SDU#9+X) | - | - |
| 23 | The UE transmits RLC SDU#10+X. | --> | (RLC SDU#10+X) | - | - |
| 24 | The SS transmits a STATUS PDU. | <-- | STATUS PDU | - | - |
| 25 | The SS transmits an AMD PDU to the UE. | <-- | AMD PDU#11 (SN=X+10, P=0) | - | - |
| 26 | The SS starts the UL default grant transmission. | - | - | - | - |
| 27 | The UE transmits an AMD PDU with the same data as received in the corresponding DL AMD PDU. Record time TD. | --> | AMD PDU#11 (SN=X+10, P=1) | - | - |
| 28 | Check 1: Does the UE set the poll bit as both the transmission and retransmission buffers become empty? Record time TE. Check 2: Is (TE – TD ) = *t-PollRetransmit*? | --> | AMD PDU#11 (SN=X+10, P=1) | 1 | P |
| 29 | The SS transmits a STATUS PDU | <-- | STATUS PDU | - | - |
| Note 1: UL grant of 848 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit one PDU at a time.  Note 2: UL grant of 88 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit a Status Report with ACK\_SN(3 byte) + 2 byte MAC PDU subheader and (2 byte short BSR). 4 Bytes additional space provided to confirm UE does not include NACK\_SN and conformant UE instead will include MAC Padding.  Note 3: Every DL AMD PDU contains 1 RLC SDU size of 99 bytes.  Note 4: Timing difference between step 11 to step 15 is equal to t-statusProhibit timer. UE starts SR from step 13 with AMD-PDU#4. 150 ms is chosen so that UE does not reach sr-transMax(n16) otherwise UE RACHes.  Note 5: Time TB should be recorded by factoring in the SR-Periodicity as configured in the *SchedulingRequestResourceConfig*->*periodicityAndOffset.* | | | | | |

7.1.2.3.8.3.3 Specific message contents

Table 7.1.2.3.8.3.3-1: *RRCReconfiguration* (step 30, Table 7.1.2.3.8.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.2.3.8.3.3-2: *CellGroupConfig* (Table 7.1.2.3.8.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 1 entry |  |  |
| RLC-BearerConfig[1] | RLC-BearerConfig | entry 1 |  |
| } |  |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig | Not present |  |  |
| spCellConfig | Not present |  |  |
| } |  |  |  |

Table 7.1.2.2.8.3.3-3: RLC-BearerConfig (Table 7.1.2.3.8.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-148 with condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-BearerConfig ::= SEQUENCE { |  |  |  |
| logicalChannelIdentity | Set to LCID of the DRB under test |  |  |
| rlc-Config | RLC-Config |  |  |
| } |  |  |  |

Table 7.1.2.2.8.3.3-4: *RLC-Config* (Table 7.1.2.3.8.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-149 with condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-Config ::= CHOICE { |  |  |  |
| am SEQUENCE { |  |  |  |
| ul-AM-RLC SEQUENCE { |  |  |  |
| sn-FieldLength | Not present |  |  |
| t-PollRetransmit | ms500 |  |  |
| } |  |  |  |
| dl-AM-RLC SEQUENCE { |  |  |  |
| sn-FieldLength | Not present |  |  |
| t-Reassembly | ms200 |  |  |
| t-StatusProhibit | ms400 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.2.3.9 AM RLC / Reassembling of AMD PDUs

7.1.2.3.9.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives AMD PDUs，and all bytes of the RLC SDU(s) with SN = x are received }

**then** { UE reassembles the RLC SDU(s) from AMD PDU(s) with SN = x }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { t-Reassembly expires }

**then** { update RX\_Highest\_Status to the SN of the first RLC SDU with SN >= RX\_Next\_Status\_Trigger for which not all bytes have been received }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {  
 **when** { UE receives AM PDU segments }

**then** { UE delivers reassembled RLC SDU to upper layer }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives duplicate RLC AM PDU segments }

**then** { UE discards duplicate RLC AMD PDU segments }

}

(5)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives RLC AMD PDU segments with segments lost }

**then** { UE transmits STATUS PDU to request retransmission of missing segments }

}

(6)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives overlapping RLC AMD PDU segments }

**then** { UE discards duplicate RLC AMD PDU byte segments }

}

(7)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives an AMD PDU with a SN gap }

**then** { UE sends STATUS PDU to request retransmissions of PDUs in the SN gap}

}

7.1.2.3.9.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: 3GPP TS 38.322 clauses 4.2.1.3.3, 5.2.3.2.1, 5.2.3.2.2, 5.2.3.2.3, 5.2.3.2.4 and 5.3.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 4.2.1.3.3]

When the receiving side of an AM RLC entity receives AMD PDUs, it shall:

- detect whether or not the AMD PDUs have been received in duplication, and discard duplicated AMD PDUs;

- detect the loss of AMD PDUs at lower layers and request retransmissions to its peer AM RLC entity;

- reassemble RLC SDUs from the received AMD PDUs and deliver the RLC SDUs to upper layer as soon as they are available.

[TS 38.322, clause 5.2.3.2.1]

The receiving side of an AM RLC entity shall maintain a receiving window according to the state variable RX\_Next as follows:

- a SN falls within the receiving window if RX\_Next <= SN < RX\_Next + AM\_Window\_Size;

- a SN falls outside of the receiving window otherwise.

When receiving an AMD PDU from lower layer, the receiving side of an AM RLC entity shall:

- either discard the received AMD PDU or place it in the reception buffer (see sub clause 5.2.3.2.2);

- if the received AMD PDU was placed in the reception buffer:

- update state variables, reassemble and deliver RLC SDUs to upper layer and start/stop t-Reassembly as needed (see sub clause 5.2.3.2.3).

When t-Reassembly expires, the receiving side of an AM RLC entity shall:

- update state variables and start t-Reassembly as needed (see sub clause 5.2.3.2.4).

[TS 38.322, clause 5.2.3.2.2]

When an AMD PDU is received from lower layer, where the AMD PDU contains byte segment numbers y to z of an RLC SDU with SN = x, the receiving side of an AM RLC entity shall:

- if x falls outside of the receiving window; or

- if byte segment numbers y to z of the RLC SDU with SN = x have been received before:

- discard the received AMD PDU.

- else:

- place the received AMD PDU in the reception buffer;

- if some byte segments of the RLC SDU contained in the AMD PDU have been received before:

- discard the duplicate byte segments.

[TS 38.322, clause 5.2.3.2.3]

When an AMD PDU with SN = x is placed in the reception buffer, the receiving side of an AM RLC entity shall:

- if x >= RX\_Next\_Highest

- update RX\_Next\_Highest to x+ 1.

- if all bytes of the RLC SDU with SN = x are received:

- reassemble the RLC SDU from AMD PDU(s) with SN = x, remove RLC headers when doing so and deliver the reassembled RLC SDU to upper layer;

- if x = RX\_Highest\_Status,

- update RX\_Highest\_Status to the SN of the first RLC SDU with SN > current RX\_Highest\_Status for which not all bytes have been received.

- if x = RX\_Next:

- update RX\_Next to the SN of the first RLC SDU with SN > current RX\_Next for which not all bytes have been received.

- if t-Reassembly is running:

- if RX\_Next\_Status\_Trigger = RX\_Next; or

- if RX\_Next\_Status\_Trigger = RX\_Next + 1 and there is no missing byte segment of the SDU associated with SN = RX\_Next before the last byte of all received segments of this SDU; or

- if RX\_Next\_Status\_Trigger falls outside of the receiving window and RX\_Next\_Status\_Trigger is not equal to RX\_Next + AM\_Window\_Size:

- stop and reset t-Reassembly.

- if t-Reassembly is not running (includes the case t-Reassembly is stopped due to actions above):

- if RX\_Next\_Highest> RX\_Next +1; or

- if RX\_Next\_Highest = RX\_Next + 1 and there is at least one missing byte segment of the SDU associated with SN = RX\_Next before the last byte of all received segments of this SDU:

- start t-Reassembly;

- set RX\_Next\_Status\_Trigger to RX\_Next\_Highest.

[TS 38.322, clause 5.2.3.2.4]

When t-Reassembly expires, the receiving side of an AM RLC entity shall:

- update RX\_Highest\_Status to the SN of the first RLC SDU with SN >= RX\_Next\_Status\_Trigger for which not all bytes have been received;

- if RX\_Next\_Highest> RX\_Highest\_Status +1: or

- if RX\_Next\_Highest = RX\_Highest\_Status + 1 and there is at least one missing byte segment of the SDU associated with SN = RX\_Highest\_Status before the last byte of all received segments of this SDU:

- start t-Reassembly;

- set RX\_Next\_Status\_Trigger to RX\_Next\_Highest.

[TS 38.322, clause 5.3.4]

An AM RLC entity sends STATUS PDUs to its peer AM RLC entity in order to provide positive and/or negative acknowledgements of RLC SDUs (or portions of them).

Triggers to initiate STATUS reporting include:

- Polling from its peer AM RLC entity:

- When an AMD PDU with SN = x and the P field set to "1" is received from lower layer, the receiving side of an AM RLC entity shall:

- if the AMD PDU is to be discarded as specified in subclause 5.2.3.2.2; or

- if x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size:

- trigger a STATUS report.

- else:

- delay triggering the STATUS report until x < RX\_Highest\_Status or x >= RX\_Next + AM\_Window\_Size.

NOTE 1: This ensures that the RLC Status report is transmitted after HARQ reordering.

- Detection of reception failure of an AMD PDU

- The receiving side of an AM RLC entity shall trigger a STATUS report when t-Reassembly expires.

NOTE 2: The expiry of t-Reassembly triggers both RX\_Highest\_Status to be updated and a STATUS report to be triggered, but the STATUS report shall be triggered after RX\_Highest\_Status is updated.

When STATUS reporting has been triggered, the receiving side of an AM RLC entity shall:

- if *t-StatusProhibit* is not running:

- at the first transmission opportunity indicated by lower layer, construct a STATUS PDU and submit it to lower layer.

- else:

- at the first transmission opportunity indicated by lower layer after *t-StatusProhibit* expires, construct a single STATUS PDU even if status reporting was triggered several times while *t-StatusProhibit* was running and submit it to lower layer.

When a STATUS PDU has been submitted to lower layer, the receiving side of an AM RLC entity shall:

- start *t-StatusProhibit*.

When constructing a STATUS PDU, the AM RLC entity shall:

- for the RLC SDUs with SN such that RX\_Next <= SN < RX\_Highest\_Status that has not been completely received yet, in increasing SN order of RLC SDUs and increasing byte segment order within RLC SDUs, starting with SN = RX\_Next up to the point where the resulting STATUS PDU still fits to the total size of RLC PDU(s) indicated by lower layer:

- for an RLC SDU for which no byte segments have been received yet:

- include in the STATUS PDU a NACK\_SN which is set to the SN of the RLC SDU.

- for a continuous sequence of byte segments of a partly received RLC SDU that have not been received yet:

- include in the STATUS PDU a set of NACK\_SN, SOstart and SOend.

- for a continuous sequence of RLC SDUs that have not been received yet:

- include in the STATUS PDU a set of NACK\_SN and NACK range;

- include in the STATUS PDU, if required, a pair of SOstart and SOend.

- set the ACK\_SN to the SN of the next not received RLC SDU which is not indicated as missing in the resulting STATUS PDU.

When STATUS reporting has been triggered, the receiving side of an AM RLC entity shall:

- if *t-StatusProhibit* is not running:

- at the first transmission opportunity indicated by lower layer, construct a STATUS PDU and submit it to lower layer.

- else:

- at the first transmission opportunity indicated by lower layer after *t-StatusProhibit* expires, construct a single STATUS PDU even if status reporting was triggered several times while *t-StatusProhibit* was running and submit it to lower layer.

When a STATUS PDU has been submitted to lower layer, the receiving side of an AM RLC entity shall:

- start *t-StatusProhibit*.

When constructing a STATUS PDU, the AM RLC entity shall:

- for the RLC SDUs with SN such that RX\_Next <= SN < RX\_Highest\_Status that has not been completely received yet, in increasing SN order of RLC SDUs and increasing byte segment order within RLC SDUs, starting with SN = RX\_Next up to the point where the resulting STATUS PDU still fits to the total size of RLC PDU(s) indicated by lower layer:

- for an RLC SDU for which no byte segments have been received yet:

- include in the STATUS PDU a NACK\_SN which is set to the SN of the RLC SDU.

- for a continuous sequence of byte segments of a partly received RLC SDU that have not been received yet:

- include in the STATUS PDU a set of NACK\_SN, SOstart and SOend.

- for a continuous sequence of RLC SDUs that have not been received yet:

- include in the STATUS PDU a set of NACK\_SN and NACK range;

- include in the STATUS PDU, if required, a pair of SOstart and SOend.

- set the ACK\_SN to the SN of the next not received RLC SDU which is not indicated as missing in the resulting STATUS PDU.

7.1.2.3.9.3 Test description

7.1.2.3.9.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception that the AM DRB is configured according to Table 7.1.2.3.9.3.1-1.

Table 7.1.2.3.9.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Parameter | Value |
| *t-Reassembly* | ms150 |
| *t-StatusProhibit* | ms300 |
| *t-PollRetransmit* | ms500 |

7.1.2.3.9.3.2 Test procedure sequence

Table 7.1.2.3.9.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure |  | Message Sequence | TP | Verdict |
|  |  | U - S | Message/PDU/SDU |  |  |
| 0 | The SS stops the UL grant transmission. | - | - | - | - |
| 1 | The SS transmits AMD PDU#1 containing a complete RLC SDU#4 (89 bytes and SI field=00). (Note 4) | <-- | AMD PDU#1 (SN=3) | - | - |
|
| 2 | The SS transmits AMD PDU#2 containing the last segment (44 bytes) of RLC SDU#1 (SI field=10, SO=45). | <-- | AMD PDU#2 (SN=0) segment 2 | - | - |
|
| 3 | The SS transmits AMD PDU#3 containing the last segment (44 bytes) of RLC SDU#2 (SI field=10, SO=45). | <-- | AMD PDU#3 (SN=1) segment 2 | - | - |
|
| 4 | The SS transmits AMD PDU#4 containing the first segment (45 bytes) of RLC SDU#2 (SI field=01). | <-- | AMD PDU#4 (SN=1) segment 1 | - | - |
|
| 5 | The SS transmits AMD PDU#5 containing the first segment (45 bytes) of RLC SDU#1 (SI field =01). | <-- | AMD PDU#5 (SN=0) segment 1 | - | - |
|
| 6 | The SS waits for 20 ms then SS transmits 2 uplink grants with a time spacing of 20 ms. (Note 1) | <-- | UL Grants | - | - |
| 7 | Check: Does the UE transmit an AMD PDU containing RLC SDU#1 in its data field? | --> | AMD PDU (RLC SDU#1) | 1,3 | P |
| 8 | Check: Does the UE transmit an AMD PDU containing RLC SDU#2 in its data field? | --> | AMD PDU (RLC SDU#2) | 1,3 | P |
| 9 | Void |  |  |  |  |
| 9A | 110 ms after step 5 the SS starts the UL default grant transmission. | <-- | UL Grant | - | - |
| 10 | Wait for t-reassembly of UE side to expire.  Check: Does the UE transmit an RLC STATUS PDU with NACK\_SN=2 and ACK\_SN=4 to correctly to inform SS of missing RLC SDU#3? | --> | STATUS PDU (ACK\_SN=4, NACK\_SN=2) | 2,7 | P |
| 10A | The SS stops the UL grant transmission. | - | - | - | - |
| 11 | 120 ms after step 10 the SS transmits AMD PDU#6 containing the first 45 bytes of SDU#3 in its data field. SO=0 and LSF=0. No header extension part is provided.(Note 5) | <-- | AMD PDU#6 (SN=2)  segment 1 | - | - |
| 11A | 20 ms after step 11 the SS transmits AMD PDU#6 containing the first 45 bytes of SDU#3 in its data field. SO=0 and LSF=0. No header extension part is provided. | <-- | AMD PDU#6 (SN=2)  segment 1 | - | - |
| 12 | 40 ms after step 11 the SS transmits AMD PDU#12 containing the last 44 bytes of SDU#3 in its data field, with the P-bit set. SO=45 and LSF=1. No header extension part is provided. | <-- | AMD PDU#12 (SN=2, P=1)  segment 2 | - | - |
| 13 | After the expiry of t-StatusProhibit timer started at step 10, the SS assigns 1 UL grant (UL grant allocation type 3) of size 88 bits. (Note 2) | <-- | UL Grant | - | - |
| 14 | Check: Does the UE transmit a STATUS PDU with ACK\_SN=4, thus acknowledging the reception of PDUs with SN=0 to SN=3, and no NACK\_SN provided? | --> | STATUS PDU | 1,3,4 | P |
| 14A | The SS waits for 40 ms to ensure UE has all the required SDUs available and then assigns 2 UL grants of 768 bits (Note 1). | <-- | UL Grant | - | - |
| 15 | Check: Does the UE transmit RLC SDU#3? | --> | (RLC SDU#3) | 1,3,4 | P |
| 15A | Check: Does the UE transmit RLC SDU#4 with the P-bit set? | --> | (RLC SDU#4) | 1,3,4 | P |
| 16 | The SS transmits a STATUS PDU. | <-- | STATUS PDU (ACK SN=4) | - | - |
| 17 | The SS transmits AMD PDU#7 containing the last segment (44 bytes) of RLC SDU#5 (SI field=10, SO=45). | <-- | AMD PDU#7 (SN=4) segment 2 | - | - |
| 17A | The SS starts the UL default grant transmission. | <-- | UL Grant | - | - |
| 18 | Wait for t-reassembly of UE side to expire.  Check: Does the UE transmit an RLC STATUS PDU with ACK\_SN=5, NACK\_SN=4 with SOStart=0 and SOEnd=44? | --> | STATUS PDU (ACK\_SN=5, NACK\_SN=4 with SOStart=0 /SOEnd=44) | 2,5 | P |
| 18A | The SS stops the UL grant transmission. | - | - | - | - |
| 19 | 160 ms after step 18 The SS transmits AMD PDU#8 containing the first segment (45 bytes) of RLC SDU#5 (SI field=01). (Note 6) | <-- | AMD PDU#8 (SN=4, P=1) segment 1 | - | - |
| 20 | Void |  |  |  |  |
| 21 | Void |  |  |  |  |
| 21A | After the expiry of t-StatusProhibit timer started at step 18, the SS assigns 1 UL grant (UL grant allocation type 3) of size 88 bits. (Note 2) | <-- | UL Grant | - | - |
| 22 | Check: Does the UE transmit an RLC STATUS PDU with ACK\_SN=5? | --> | STATUS PDU (ACK\_SN=5) | 1,3,5 | P |
| 22A | The SS waits for 100 ms then SS transmits one uplink grant. (Note 1) | <-- | UL Grant | - | - |
| 22B | Check: Does the UE transmit an AMD PDU containing RLC SDU#5 in its data field with the P-bit set? | --> | AMD PDU (RLC SDU#5) | 1,3,5 | P |
| 22C | The SS transmits a STATUS PDU | <-- | STATUS PDU (ACK SN=5) |  |  |
| 23 | The SS transmits AMD PDU#9 containing the last 29 bytes of RLC SDU#6 (SI field=10, SO=60). | <-- | AMD PDU#9 (SN=5) segment 3 | - | - |
| 23A | The SS starts the UL default grant transmission. | <-- | UL Grant | - | - |
| 24 | Wait for t-reassembly of UE side to expire.  Check: Does the UE transmit an RLC STATUS PDU with ACK\_SN=6, NACK\_SN=5 with SOStart=0 and SOEnd=59? | --> | STATUS PDU  (ACK\_SN=6, NACK\_SN=5 with SOStart=0 / SOEnd=59) | 2,5 | P |
| 25 | The SS transmits AMD PDU#10 containing the last 49 byte of RLC SDU#6 (SI field=10, SO=40). | <-- | AMD PDU#10 (SN=5)  segment 2 | - | - |
| 25A | Void. |  |  |  |  |
| 26 | Wait for t-reassembly of UE side to expire.  Check: Does the UE transmit an RLC STATUS PDU with ACK\_SN=6, NACK\_SN=5 with SOStart=0 and SOEnd=39? | --> | STATUS PDU (ACK\_SN=6, NACK\_SN=5 with SOStart=0 / SOEnd=39) | 2,6 | P |
| 26A | The SS stops the UL grant transmission. | - | - | - | - |
| 27 | 160 ms after step 26 The SS transmits AMD PDU#11 containing the first 40 bytes of RLC SDU#6 (SI field =01). | <-- | AMD PDU#11 (SN=5, P=1)  segment 1 | - | - |
| 28 | Void |  |  |  |  |
| 29 | Void |  |  |  |  |
| 29A | After the expiry of t-StatusProhibit timer started at step 26, the SS assigns 1 UL grant (UL grant allocation type 3) of size 88 bits. (Note 2, Note 7) | <-- | UL Grant | - | - |
| 30 | Check: Does the UE transmit an RLC STATUS PDU with ACK\_SN=6, thus acknowledging the reception of RLC SDUs with SN=0 to SN=5, and no NACK\_SN provided? | --> | STATUS PDU (ACK\_SN=6) | 1,3,6 | P |
| 30A | The SS transmits one uplink grant. (Note 1) | <-- | UL Grant | - | - |
| 30B | Check: Does the UE transmit an AMD PDU containing RLC SDU#6 in its data field with the P-bit set? | --> | AMD PDU (RLC SDU#6) | 1,3,6 | P |
| 31 | The SS transmits a STATUS PDU. | <-- | STATUS PDU (ACK SN=6) | - | - |
| Note 1: UL grant of 768 bits(LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit one PDU at a time( 89 bytes RLC SDU + 3 bytes RLC Header + 2 bytes MAC Sub PDU header + 2 bytes for short BSR or padding).  Note 2: UL grant of 88 bits (LRBs & IMCS as per 38.523-3 [3] annex B) is chosen to allow the UE to transmit a Status Report with ACK\_SN(3 byte) + 2 Bytes MAC PDU subheader and (2 Bytes short BSR). 4 Bytes additional space provided to confirm UE does include resp. does not include NACK\_SN and conformant UE instead will include MAC Padding.  Note 3: Void  Note 4: The PDUs in steps 1-5 are scheduled with a 20 ms time spacing. The UL grant provision in step 6 is scheduled 20 ms later That way this step sequence takes less than t-Reassembly.  Note 5: Timing difference between step 10 to step 14 is equal to t-statusProhibit timer. UE starts SR from step 12. 120 ms is chosen so that UE does not reach sr-transMax(n16) otherwise UE RACHes.  Note 6: Timing difference between step 18 to step 22 is equal to t-statusProhibit timer. UE starts SR from step 19. 160 ms is chosen so that UE does not reach sr-transMax(n16) otherwise UE RACHes.  Note 7: Timing difference between step 26 to step 30 is equal to t-statusProhibit timer. UE starts SR from step 27. 160 ms is chosen so that UE does not reach sr-transMax(n16) otherwise UE RACHes. | | | | | |

7.1.2.3.9.3.3 Specific message contents

None.

##### 7.1.2.3.10 AM RLC / Re-transmission of RLC PDU with and without re-segmentation

7.1.2.3.10.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { UE receives a STATUS PDU including a NACK\_SN for missing AMD PDUs and missing AMD PDUs can be transmitted as indicated by lower layer at the particular transmission opportunity }

**then** { UE successfully retransmits missing AMD PDUs without re-segmentation }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { NACK received for missing AMD PDUs and RETX\_COUNT < maxRetxThreshold }

**then** { UE retransmits AMD PDUs }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { AMD PDU to be retransmitted does not fit in new allocated TBS }

**then** { UE segments AMD PDU }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { AMD PDU segment to be retransmitted does not fit in new allocated TBS }

**then** { UE re-segments AMD PDU segment to fit TBS }

}

7.1.2.3.10.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.322, clauses 5.3.2, 6.2.2.5, 6.2.3.3, 6.2.3.4, 6.2.3.5, 6.2.3.7, 6.2.3.10, 6.2.3.12, 6.2.3.14 and 6.2.3.15. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.3.2]

The transmitting side of an AM RLC entity can receive a negative acknowledgement (notification of reception failure by its peer AM RLC entity) for an RLC SDU or an RLC SDU segment by the following:

- STATUS PDU from its peer AM RLC entity.

When receiving a negative acknowledgement for an RLC SDU or an RLC SDU segment by a STATUS PDU from its peer AM RLC entity, the transmitting side of the AM RLC entity shall:

- if the SN of the corresponding RLC SDU falls within the range TX\_Next\_Ack <= SN < = the highest SN of the AMD PDU among the AMD PDUs submitted to lower layer:

- consider the RLC SDU or the RLC SDU segment for which a negative acknowledgement was received for retransmission.

When an RLC SDU or an RLC SDU segment is considered for retransmission, the transmitting side of the AM RLC entity shall:

- if the RLC SDU or RLC SDU segment is considered for retransmission for the first time:

- set the RETX\_COUNT associated with the RLC SDU to zero.

- else, if it (the RLC SDU or the RLC SDU segment that is considered for retransmission) is not pending for retransmission already and the RETX\_COUNT associated with the RLC SDU has not been incremented due to another negative acknowledgment in the same STATUS PDU:

- increment the RETX\_COUNT.

- if RETX\_COUNT = *maxRetxThreshold*:

- indicate to upper layers that max retransmission has been reached.

When retransmitting an RLC SDU or an RLC SDU segment, the transmitting side of an AM RLC entity shall:

- if needed, segment the RLC SDU or the RLC SDU segment;

- form a new AMD PDU which will fit within the total size of AMD PDU(s) indicated by lower layer at the particular transmission opportunity;

- submit the new AMD PDU to lower layer.

When forming a new AMD PDU, the transmitting side of an AM RLC entity shall:

- only map the original RLC SDU or RLC SDU segment to the Data field of the new AMD PDU;

- modify the header of the new AMD PDU in accordance with the description in sub clause 6.2.2.4;

- set the P field according to sub clause 5.3.3.

[TS 38.322, clause 6.2.2.4]

AMD PDU consists of a Data field and an AMD PDU header. The AMD PDU header is byte aligned.

An AM RLC entity is configured by RRC to use either a 12 bit SN or a 18 bit SN. The length of the AMD PDU header is two and three bytes respectively.

An AMD PDU header contains a D/C, a P, a SI, and a SN. An AMD PDU header contains the SO field only when the Data field consists of an RLC SDU segment which is not the first segment, in which case a 16 bit SO is present.



Figure 6.2.2.4-1: AMD PDU with 12 bit SN (No SO)



Figure 6.2.2.4-2: AMD PDU with 18 bit SN (No SO)



Figure 6.2.2.4-3: AMD PDU with 12 bit SN with SO



Figure 6.2.2.4-4: AMD PDU with 18 bit SN with SO

[TS 38.322, clause 6.2.2.5]

STATUS PDU consists of a STATUS PDU payload and an RLC control PDU header.

RLC control PDU header consists of a D/C and a CPT field.

The STATUS PDU payload starts from the first bit following the RLC control PDU header, and it consists of one ACK\_SN and one E1, zero or more sets of a NACK\_SN, an E1, an E2 and an E3, and possibly a pair of a SOstart and a SOend or a NACK range field for each NACK\_SN.



Figure 6.2.2.5-1: STATUS PDU with 12 bit SN



Figure 6.2.2.5-2: STATUS PDU with 18 bit SN

[TS 38.322, clause 6.2.3.3]

Length: 12 bits or 18 bits (configurable) for AMD PDU. 6 bits or 12 bits (configurable) for UMD PDU.

The SN field indicates the sequence number of the corresponding RLC SDU. For RLC AM, the sequence number is incremented by one for every RLC SDU. For RLC UM, the sequence number is incremented by one for every segmented RLC SDU.

[TS 38.322, clause 6.2.3.4]

Length: 2 bits.

The SI field indicates whether an RLC PDU contains a complete RLC SDU or the first, middle, last segment of an RLC SDU.

Table 6.2.3.4-1: SI field interpretation

|  |  |
| --- | --- |
| Value | Description |
| 00 | Data field contains all bytes of an RLC SDU |
| 01 | Data field contains the first segment of an RLC SDU |
| 10 | Data field contains the last segment of an RLC SDU |
| 11 | Data field contains neither the first nor last segment of an RLC SDU |

[TS 38.322, clause 6.2.3.5]

Length: 16 bits

The SO field indicates the position of the RLC SDU segment in bytes within the original RLC SDU. Specifically, the SO field indicates the position within the original RLC SDU to which the first byte of the RLC SDU segment in the Data field corresponds. The first byte of the original RLC SDU is referred by the SO field value "0000000000000000", i.e., numbering starts at zero.

[TS 38.322, clause 6.2.3.7]

Length: 1 bit.

The P field indicates whether or not the transmitting side of an AM RLC entity requests a STATUS report from its peer AM RLC entity. The interpretation of the P field is provided in Table 6.2.3.7-1.

Table 6.2.3.7-1: P field interpretation

|  |  |
| --- | --- |
| Value | Description |
| 0 | Status report not requested |
| 1 | Status report is requested |

[TS 38.322, clause 6.2.3.10]

Length: 12 bits or 18 bits (configurable).

The ACK\_SN field indicates the SN of the next not received RLC SDU which is not reported as missing in the STATUS PDU. When the transmitting side of an AM RLC entity receives a STATUS PDU, it interprets that all RLC SDUs up to but not including the RLC SDU with SN = ACK\_SN have been received by its peer AM RLC entity, excluding those RLC SDUs indicated in the STATUS PDU with NACK\_SN, portions of RLC SDUs indicated in the STATUS PDU with NACK\_SN, SOstart and SOend, RLC SDUs indicated in the STATUS PDU with NACK\_SN and NACK\_range, and portions of RLC SDUs indicated in the STATUS PDU with NACK\_SN, NACK range, SOstart and SOend.

[TS 38.322, clause 6.2.3.12]

Length: 12 bits or 18 bits (configurable).

The NACK\_SN field indicates the SN of the RLC SDU (or RLC SDU segment) that has been detected as lost at the receiving side of the AM RLC entity.

[TS 38.322, clause 6.2.3.14]

Length: 16 bits.

The SOstart field (together with the SOend field) indicates the portion of the RLC SDU with SN = NACK\_SN (the NACK\_SN for which the SOstart is related to) that has been detected as lost at the receiving side of the AM RLC entity. Specifically, the SOstart field indicates the position of the first byte of the portion of the RLC SDU in bytes within the original RLC SDU. The first byte of the original RLC SDU is referred by the SOstart field value "0000000000000000", i.e., numbering starts at zero.

[TS 38.322, clause 6.2.3.15]

Length: 16 bits.

When E3 is 0, the SOend field (together with the SOstart field) indicates the portion of the RLC SDU with SN = NACK\_SN (the NACK\_SN for which the SOend is related to) that has been detected as lost at the receiving side of the AM RLC entity. Specifically, the SOend field indicates the position of the last byte of the portion of the RLC SDU in bytes within the original RLC SDU. The first byte of the original RLC SDU is referred by the SOend field value "0000000000000000", i.e., numbering starts at zero. The special SOend value "1111111111111111" is used to indicate that the missing portion of the RLC SDU includes all bytes to the last byte of the RLC SDU.

When E3 is 1, the SOend field indicates the portion of the RLC SDU with SN = NACK\_SN + NACK range - 1 that has been detected as lost at the receiving side of the AM RLC entity. Specifically, the SOend field indicates the position of the last byte of the portion of the RLC SDU in bytes within the original RLC SDU. The first byte of the original RLC SDU is referred by the SOend field value "0000000000000000", i.e., numbering starts at zero. The special SOend value "1111111111111111" is used to indicate that the missing portion of the RLC SDU includes all bytes to the last byte of the RLC SDU.

7.1.2.3.10.3 Test description

7.1.2.3.10.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception for the AM DRB is configured according to Tables 7.1.2.3.10.3.1-1.

Table 7.1.2.3.10.3.1-1: RLC settings

|  |  |
| --- | --- |
| Parameter | Value |
| *t-PollRetransmit* | ms150 |

7.1.2.3.10.3.2 Test procedure sequence

Table 7.1.2.3.10.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits one AMD PDU containing SDU#1 (91 bytes) in its data field. | <-- | AMD PDU#1 | - | - |
| 2 | The UE transmits one AMD PDU containing SDU#1 in its data field. | --> | AMD PDU#1 (SN=0) | - | - |
| 3 | The SS transmits one AMD PDU containing SDU#2 (91 bytes) in its data field. | <-- | AMD PDU#2 | - | - |
| 4 | The UE transmits one AMD PDU containing SDU#2 in its data field. | --> | AMD PDU#2 (SN=1) | - | - |
| 5 | The SS transmits a RLC STATUS PDU. ACK\_SN=2, NACK\_SN=0. | <-- | STATUS PDU | - | - |
| 6 | Check: Does the UE transmit the AMD PDU not yet acknowledged? | --> | AMD PDU#1 (SN=0) | 1 | P |
| 7 | The SS transmits a RLC STATUS PDU. ACK\_SN=2. | <-- | STATUS PDU | - | - |
| 8 | The SS transmits one AMD PDU containing SDU#3 (91 bytes) in its data field. | <-- | AMD PDU#3 | - | - |
| 9 | The UE transmits an AMD PDU containing SDU#3 in its data field. | --> | AMD PDU#3 (SN=2) | - | - |
| - | EXCEPTION: Steps 10 to 11 shall be repeated until RETX\_COUNT= maxRetxThreshold-1. | - | - | - | - |
| 10 | The SS transmits a RLC STATUS PDU. ACK\_SN=3 and NACK\_SN=2. | <-- | STATUS PDU | - | - |
| 11 | Check: Does the UE retransmit the AMD PDU not yet acknowledged? | --> | AMD PDU#3 (SN=2) | 2 | P |
| 12 | The SS transmits a RLC STATUS PDU. ACK\_SN=3. | <-- | STATUS PDU | - | - |
| 13 | The SS stops the UL grant transmission. | - | - | - | - |
| 14 | The SS transmits one AMD PDU containing SDU#4 (91 bytes) in its data field. | <-- | AMD PDU#4 (SN=3) | - | - |
| 15 | The SS waits for 60 ms and allocates one UL grant of size 808 bits.  (Note 1) | <-- | (UL grant, 808 bits) | - | - |
| 16 | The UE transmits an AMD PDU with the same data contents as received in the corresponding part of SDU#4? | --> | AMD PDU#4 (SN=3) | - | - |
| 17 | The SS transmits a STATUS PDU. This PDU nacks the AMD PDU with SN=3. ACK\_SN=4 and NACK\_SN=3. | <-- | STATUS PDU | - | - |
| 18 | The SS waits for 100 ms and then allocates 1 UL grant of size 408 bits (Note 2) | <-- | (UL grant, 408 bits) | - | - |
| 18A | The SS waits for 20 ms and then allocates 1 UL grant of size 456 bits (Note 5) | <-- | (UL grant, 456 bits) | - | - |
| 19 | Check: Does the UE transmit an SDU segment with SI=01 and SOEnd=43 and the same data contents at the received positions as in the original SDU#4? | --> | SDU#4 segment 1 (SN=3) | 3 | P |
| 20 | Check: Does the UE transmit an SDU segment with SI=10 and SOStart=44 and the same data contents at the received positions as in the original SDU#4? | --> | SDU#4 segment 2 (SN=3) | 3 | P |
| 21 | After 100 ms SS transmits a STATUS PDU. This PDU nacks the SDU with SN=3. NACK\_SN=3, SOStart=0, SOEnd=43 and ACK\_SN=4. | <-- | STATUS PDU | - | - |
| 22 | The SS waits for 100 ms and then allocates 2 UL grants (UL grant allocation type 2) at an interval of 20 ms of size 240 bits (Note 3, Note 6) | <-- | (UL grant, 240 bits) | - | - |
| 22A | Void |  |  | - | - |
| 23 | Check: Does the UE transmit an AMD PDU segment with SI=01 and SOEnd=22 and the same data contents at the received positions as in the original SDU#4? | --> | SDU#4 segment 1, first part (SN=3) | 4 | P |
| 24 | Check: Does the UE transmit an AMD PDU segment with SI=11, SOStart=23 and the same data contents at the received positions as in the original SDU#4? | --> | SDU#4 segment 1, second part (SN=3) | 4 | P |
| 25 | The SS transmits a STATUS PDU. This PDU acks the AMD PDUs with SN=3. ACK\_SN=4. | <-- | STATUS PDU | - | - |
| Note 1: UL grant of 808 bits=101 bytes (LRBs & IMCS as per 38.523-3[3] annex B) is chosen to allow the UE to transmit one PDU and 2 bytes short BSR + 3 bytes padding or 5 bytes padding at a time.  Note 2: UL grant of 408 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen such that UE will segment into 2 AMD PDUs. MAC PDU of 408 bits=51 bytes fit an AMD PDU payload of 44 bytes + 3 bytes for the first segment of the AMD PDU header + 2 bytes for MAC header + 2 bytes of MAC BSR CE.  Note 3: UL grant of 240 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen such that UE will segment into 2 AMD PDUs. MAC PDU of 240 bits=30 bytes fit an AMD PDU payload of = 23 bytes + 3 bytes for the first segment of the AMD PDU header + 2 bytes for MAC header + 2 bytes for MAC BSR CE.  Note 4: Void.  Note 5: UL grant of 456 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen such that UE will segment into 2 AMD PDUs. MAC PDU of 456 bits=57 bytes fit an AMD PDU payload of 46 bytes + 5 bytes for the first segment of the AMD PDU header + 2 bytes for MAC header +2 bytes for possible short BSR or padding  Note 6: UL grant of 240 bits (LRBs & IMCS as per 38.523-3[3] annex B) is chosen such that UE will segment into 2 AMD PDUs. MAC PDU of 240 bits=28 bytes fit an AMD PDU payload of 21 bytes + 3 bytes for the first segment of the AMD PDU header + 2 bytes for MAC header +2 bytes for possible short BSR or padding | | | | | |

7.1.2.3.10.3.3 Specific message contents

None.

##### 7.1.2.3.11 AM RLC / RLC re-establishment procedure

7.1.2.3.11.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { RLC re-establishment is performed upon request by RRC }

**then** { The UE discards all RLC SDUs, RLC SDU segments, and RLC PDUs, if any }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { RLC re-establishment is performed upon request by RRC }

**then** { The UE resets all state variables to their initial values }

}

7.1.2.3.11.2 Conformance requirements

References:

The conformance requirements covered in the present test case are specified in: TS 38.322, clauses 5.1.2, 7.1 and TS 38.331 clause 5.3.11. Unless otherwise stated these are Rel-15 requirements.

[TS 38.322, clause 5.1.2]

When upper layers request an RLC entity re-establishment, the UE shall:

- discard all RLC SDUs, RLC SDU segments, and RLC PDUs, if any;

- stop and reset all timers;

- reset all state variables to their initial values.

[TS 38.322, clause 7.1]

This sub clause describes the state variables used in AM and UM entities in order to specify the RLC protocol. The state variables defined in this subclause are normative.

All state variables and all counters are non-negative integers.

All state variables related to AM data transfer can take values from 0 to 4095 for 12 bit SN or from 0 to 262143 for 18 bit SN. All arithmetic operations contained in the present document on state variables related to AM data transfer are affected by the AM modulus (i.e. final value = [value from arithmetic operation] modulo 4096 for 12 bit SN and 262144 for 18 bit SN).

All state variables related to UM data transfer can take values from 0 to 63 for 6 bit SN or from 0 to 4095 for 12 bit SN. All arithmetic operations contained in the present document on state variables related to UM data transfer are affected by the UM modulus (i.e. final value = [value from arithmetic operation] modulo 64 for 6 bit SN and 4096 for 12 bit SN).

When performing arithmetic comparisons of state variables or SN values, a modulus base shall be used.

TX\_Next\_Ack and RX\_Next shall be assumed as the modulus base at the transmitting side and receiving side of an AM RLC entity, respectively. This modulus base is subtracted from all the values involved, and then an absolute comparison is performed (e.g. RX\_Next <= SN < RX\_Next + AM\_Window\_Size is evaluated as [RX\_Next – RX\_Next] modulo 2[*sn-FieldLength*] <= [SN – RX\_Next] modulo 2[*sn-FieldLength*] < [RX\_Next + AM\_Window\_Size – RX\_Next] modulo 2[*sn-FieldLength*]), where *sn-FieldLength* is 12 or 18 for 12 bit SN and 18 bit SN, respectively.

RX\_Next\_Highest– UM\_Window\_Size shall be assumed as the modulus base at the receiving side of an UM RLC entity. This modulus base is subtracted from all the values involved, and then an absolute comparison is performed (e.g. (RX\_Next\_Highest– UM\_Window\_Size) <= SN < RX\_Next\_Highest is evaluated as [(RX\_Next\_Highest– UM\_Window\_Size) – (RX\_Next\_Highest– UM\_Window\_Size)] modulo 2[*sn-FieldLength*] <= [SN – (RX\_Next\_Highest– UM\_Window\_Size)] modulo 2[*sn-FieldLength*] < [RX\_Next\_Highest– (RX\_Next\_Highest– UM\_Window\_Size)] modulo 2[*sn-FieldLength*]), where *sn-FieldLength* is 6 or 12 for 6 bit SN and 12 bit SN, respectively.

The transmitting side of each AM RLC entity shall maintain the following state variables:

a) TX\_Next\_Ack – Acknowledgement state variable

This state variable holds the value of the SN of the next RLC SDU for which a positive acknowledgment is to be received in-sequence, and it serves as the lower edge of the transmitting window. It is initially set to 0, and is updated whenever the AM RLC entity receives a positive acknowledgment for an RLC SDU with SN = TX\_Next\_Ack.

b) TX\_Next – Send state variable

This state variable holds the value of the SN to be assigned for the next newly generated AMD PDU. It is initially set to 0, and is updated whenever the AM RLC entity constructs an AMD PDU with SN = TX\_Next and contains an RLC SDU or the last segment of a RLC SDU.

c) POLL\_SN – Poll send state variable

This state variable holds the value of the highest SN of the AMD PDU among the AMD PDUs submitted to lower layer when POLL\_SN is set according to sub clause 5.3.3.2. It is initially set to 0.

The transmitting side of each AM RLC entity shall maintain the following counters:

a) PDU\_WITHOUT\_POLL – Counter

This counter is initially set to 0. It counts the number of AMD PDUs sent since the most recent poll bit was transmitted.

b) BYTE\_WITHOUT\_POLL – Counter

This counter is initially set to 0. It counts the number of data bytes sent since the most recent poll bit was transmitted.

c) RETX\_COUNT – Counter

This counter counts the number of retransmissions of an RLC SDU or RLC SDU segment (see subclause 5.3.2). There is one RETX\_COUNT counter maintained per RLC SDU.

The receiving side of each AM RLC entity shall maintain the following state variables:

a) RX\_Next – Receive state variable

This state variable holds the value of the SN following the last in-sequence completely received RLC SDU, and it serves as the lower edge of the receiving window. It is initially set to 0, and is updated whenever the AM RLC entity receives an RLC SDU with SN = RX\_Next.

b) RX\_Next\_Status\_Trigger – *t-Reassembly* state variable

This state variable holds the value of the SN following the SN of the RLC SDU which triggered *t-Reassembly*.

c) RX\_Highest\_Status – Maximum STATUS transmit state variable

This state variable holds the highest possible value of the SN which can be indicated by "ACK\_SN" when a STATUS PDU needs to be constructed. It is initially set to 0.

d) RX\_Next\_Highest – Highest received state variable

This state variable holds the value of the SN following the SN of the RLC SDU with the highest SN among received RLC SDUs. It is initially set to 0.

Each transmitting UM RLC entity shall maintain the following state variables:

a) TX\_Next

This state variable holds the value of the SN to be assigned for the next newly generated UMD PDU with segment. It is initially set to 0, and is updated after the UM RLC entity submits a UMD PDU including the last segment of an RLC SDU to lower layers.

Each receiving UM RLC entity shall maintain the following state variables and constant:

b) RX\_Next\_Reassembly – UM receive state variable

This state variable holds the value of the earliest SN that is still considered for reassembly. It is initially set to 0.

c) RX\_Timer\_Trigger – UM *t-Reassembly* state variable

This state variable holds the value of the SN following the SN which triggered *t-Reassembly*.

d) RX\_Next\_Highest– UM receive state variable

This state variable holds the value of the SN following the SN of the UMD PDU with the highest SN among received UMD PDUs. It serves as the higher edge of the reassembly window. It is initially set to 0.

[TS 38.331, clause 5.3.11]

UE shall:

1> reset MAC;

1> if T302 is running:

2> stop timer T302;

2> perform the actions as specified in 5.3.14.4;

1> stop all timers that are running except T320 and T325;

1> discard the UE Inactive AS context;

1> set the variable *pendingRnaUpdate* to *false*, if that is set to *true*;

1> discard the KgNB, the KRRCenc key, the KRRCint, the KUPint key and the KUPenc key, if any;

1> release all radio resources, including release of the RLC entity, the MAC configuration and the associated PDCP entity and SDAP for all established RBs;

1> indicate the release of the RRC connection to upper layers together with the release cause;

1> enter RRC\_IDLE and perform cell selection as specified in TS 38.304 [20], except if going to RRC\_IDLE was triggered by selecting an inter-RAT cell while T311 was running;

1> if going to RRC\_IDLE was triggered by reception of the *RRCRelease* message including a *waitTime*:

2> start timer T302 with the value set to the *waitTime*;

2> inform the upper layer that access barring is applicable for all access categories except categories '0' and '2'.

7.1.2.3.11.3 Test description

7.1.2.3.11.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.2.1.1 with the exception for the AM DRB is configured according to Table 7.1.2.3.11.3.1-1.

Table 7.1.2.3.11.3.1-1: RLC parameters

|  |  |
| --- | --- |
| Parameter | Value |
| *t-Reassembly* | ms200 |
| *t-PollRetransmit* | ms4000 |

Table 7.1.2.3.11.3.1-2: PDCP parameters

|  |  |
| --- | --- |
| Parameter | Value |
| *t-Reordering* | ms160 |
| *statusReportRequired* | Not present |

7.1.2.3.11.3.2 Test procedure sequence

Table 7.1.2.3.11.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | The SS ignores scheduling requests and does not allocate any uplink grant. | - | - | - | - |
| 1 | The SS creates 2 RLC SDUs of size 40 bytes segmented into two AMD PDUs each. AMD PDU#1 and AMD PDU#2 belong to RLC SDU#1, AMD PDU#3 and #4 belong to RLC SDU#2. SS transmits AMD PDU#1 (SN=0), AMD PDU#2 (SN=0) and AMD PDU#4 (SN=1). | <-- | AMD PDU#1  AMD PDU#2  AMD PDU#4 | - | - |
| 2 | 60 ms after sending PDU#1 in step 1 the SS allocates 1 UL grant of default size. | <-- | (UL grant) | - | - |
| 3 | The UE returns RLC SDU#1. | --> | (RLC SDU#1) | - | - |
| 4 | The SS does not acknowledge the reception of RLC SDU#1. | - | - | - | - |
| 5 | The SS transmits NR RRC*R*econfiguration message to trigger RLC re-establishment on DRB using Reconfig with sync procedure.  (Note 1) (Note 4) (Note 6) (Note 7) | <-- | *RRCReconfiguration* | - | - |
| 6 | The SS starts the UL default grant transmissions | *-* | - | - | - |
| - | EXCEPTION: Steps 7 and 8 can occur in any order. (Note 8) | - | *-* | - | - |
| 7 | The UE transmits a NR RRCReconfigurationComplete message. (Note 5) | --> | *RRCReconfigurationComplete* | - | - |
| 8 | The UE retransmits RLC SDU #1 (SN=0).  (Note 2) | --> | (RLC SDU#1) | - | - |
| 9 | SS transmits a STATUS PDU (ACK\_SN = 1). | <-- | STATUS PDU | - | - |
| 10 | SS transmits AMD PDU#3 with SN=0 and the P field set to "1" | <-- | AMD PDU#3 | - | - |
| 11 | Void |  |  |  |  |
| 12 | Check: For 1 second, does the UE return RLC SDU#2  (Note 3) | --> | (RLC SDU#2) | 1 | F |
| 13 | SS transmits AMD PDU#4 with SN=0 | <-- | AMD PDU#4 | - | - |
| 13A | UE transmits a STATUS PDU (ACK\_SN=1)  (Note 9) | --> | STATUS PDU | - | - |
| 14 | Check: Does the UE return RLC SDU#2 with SN=1?  (Note 9) | --> | (RLC SDU#2) | 2 | P |
| 15 | SS transmits a STATUS PDU (ACK\_SN = 2) | <-- | STATUS PDU | - | - |
| Note 1: Upon a RLC re-establishment a conformant UE discards any remaining AMD PDUs in the receiver and transmitter side, stops and resets all timers and resets all state variables to their initial values.  Note 2: The UE will retransmit the PDCP SDU associated with RLC SDU#1 in accordance to TS 38.323 clause 5.5  Note 3: AMD PDU#4 is discarded by a conformant UE in step 5.  Note 4: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_EmbedNR\_RRCRecon, EN-DC\_PSCell\_HO and RBConfig\_NoKeyChange.  Note 5: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 6: For NR, the RRCReconfiguration message is as per RRCReconfiguration-HO with condition RBConfig\_NoKeyChange according to 38.508-1 [4], Table 4.8.1-1A.  Note 7: The expiry of t-Reassembly timer started in step 1 will trigger STATUS PDU from the UE. This starts SR. The RRC reconfiguration is scheduled 300 ms in advance. sr-transMax is therefore set to n32 so that the UE does not reach sr-transMax and then RACHes before reconfiguring.  Note 8: Per 38.508-1 Table 4.6.3-66: *LogicalChannelConfig*, both SRB1 and DRB have the same logical channel priority with prioritisedBitRate as infinity.  Note 9 RLC PDUs at steps 13A and 14 may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot). | | | | | |

7.1.2.3.11.3.3 Specific message contents

Table 7.1.2.3.11.3.3-0: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n32 | 7.1.2.3.11.3.2-1 Note 7 |  |

Table 7.1.2.3.11.3.3-1: *RRCReconfiguration-HO* (step 5, Table 7.1.2.3.11.3.3-1)

|  |
| --- |
| Derivation Path: 38.508-1 [4], Table 4.8.1-1A with condition RBConfig\_NoKeyChange |

Table 7.1.2.3.11.3.3-2: Void

### 7.1.3 PDCP

#### 7.1.3.0 Default Pre-Test Conditions for all PDCP test cases

The following pre-test conditions shall be applied in all PDCP test cases until the test case explicitly over writes these conditions

System Simulator:

- The SS configures the test environment in accordance to the execution conditions in Table 7.1.3.0-1.

UE:

- None

Preamble:

- The SS performs the generic procedure in [4] to get UE in state RRC\_CONNECTED in accordance to the execution conditions in Table 7.1.3.0-2 and using the message condition UE TEST LOOP MODE A to return one UL PDCP SDU per DL PDCP SDU.

Table 7.1.3.0-1: Test environment

|  |  |  |
| --- | --- | --- |
| Execution Condition | Cell configuration | System Information Combination |
| IF pc\_NG\_RAN\_NR and Connectivity(*NR-DC*) | NR Cell 1 is PCell  NR Cell 10 is PSCell | NR System information Combination NR-1 |
| IF pc\_NG\_RAN\_NR | NR Cell 1 | NR System information Combination NR-1 |
| ELSE IF pc\_EN\_DC | E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NGEN\_DC | NG-RAN E-UTRA Cell 1 is PCell,  NR Cell 1 is PSCell | EUTRA: System information Combination 1  NR: N/A |
| ELSE IF pc\_NE\_DC | NR Cell 1 is PCell,  E-UTRA Cell 1 is PSCell | NR: System information Combination NR-1  EUTRA: N/A |

Table 7.1.3.0-2: Preamble parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Execution Condition | Multi-PDN / Multi-PDU Sessions Condition | Generic Procedure Parameters | Primary DRB used for Data testing |
| IF pc\_NG\_RAN\_NR | FALSE | Connectivity(*NR*),  Test loop function(*On*)  One DRB | Default DRB of the first PDU session on NR Cell |
| Connectivity(*NR-DC*),  DC bearer(One MN Terminated MCG bearer and OneSN Terminated SCG bearer),  Test loop function(*On*) | SN terminated SCG DRB |
| TRUE | Connectivity(*NR*),  Test loop function(*On*)  *N* DRBs (*N* ≥ 2) | Default DRB of the first PDU session on NR Cell |
| Connectivity(*NR-DC*),  DC bearer(N MN Terminated MCG bearers and One SN Terminated SCG bearer),  N DRBs (*N* ≥ 2)  Test loop function(*On*) | SN terminated SCG DRB |
| ELSE IF pc\_EN\_DC | FALSE | Connectivity(*EN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(*EN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NGEN\_DC | FALSE | Connectivity(*NGEN-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
| TRUE | Connectivity(NG*EN-DC*),  DC bearer(Two MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |
| ELSE IF pc\_NE\_DC | FALSE | Connectivity(*NE-DC*),  DC bearer(One MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) | SN Terminated SCG bearer unless explicitly specified in test case |
|  | TRUE | Connectivity(N*E-DC*),  DC bearer(*N* ≥ 2 MN Terminated MCG bearer and One *SN terminated SCG bearer*),  Test loop function(*On*) |  |

Table 7.1.3.0-3: Message conditions

|  |  |
| --- | --- |
| **Execution Condition** | **Message condition exceptions** |
| IF pc\_NG\_RAN\_NR | Message with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_EN\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NGEN\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.2 according to [4] |
| ELSE IF pc\_NE\_DC | Message condition MCG\_and\_SCG with condition AM is used for step 7 in 4.5.4.6 according to [4] |

#### 7.1.3.1 Maintenance of PDCP sequence numbers for radio bearers

##### 7.1.3.1.1 Maintenance of PDCP sequence numbers / User plane / 12 bit SN

7.1.3.1.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with PDCP configured for 12 bit SN}

**ensure that** {

**when** { UE transmits a PDCP Data SDU on a DRB }

**then** { UE increments SN with 1 for each transmitted PDU for SN=0 to Maximum\_PDCP\_SN (2[*pdcp-SN-SizeUL*] -1) }

}

(2)

**with** { UE in RRC\_CONNECTED state with PDCP configured for 12 bit SN }

**ensure that** {

**when** { UE transmits a PDCP Data SDU on a DRB and, after incrementation, TX\_NEXT is larger than the Maximum\_PDCP\_SN(2[*pdcp-SN-SizeUL*] -1) }

**then** { UE sets SN to 0 in the next transmitted PDCP SDU}

}

7.1.3.1.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clauses 5.2.1, 5.2.2.1 and 6.2.2.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.2.1]

At reception of a PDCP SDU from upper layers, the transmitting PDCP entity shall:

- start the *discardTimer* associated with this PDCP SDU (if configured).

For a PDCP SDU received from upper layers, the transmitting PDCP entity shall:

- associate the COUNT value corresponding to TX\_NEXT to this PDCP SDU;

NOTE 1: Associating more than half of the PDCP SN space of contiguous PDCP SDUs with PDCP SNs, when e.g., the PDCP SDUs are discarded or transmitted without acknowledgement, may cause HFN desynchronization problem. How to prevent HFN desynchronization problem is left up to UE implementation.

- perform header compression of the PDCP SDU as specified in the subclause 5.7.4;

- perform integrity protection, and ciphering using the TX\_NEXT as specified in the subclause 5.9 and 5.8, respectively;

- set the PDCP SN of the PDCP Data PDU to TX\_NEXT modulo 2[*pdcp-SN-Size*];

- increment TX\_NEXT by one;

- submit the resulting PDCP Data PDU to lower layer as specified below.

When submitting a PDCP Data PDU to lower layer, the transmitting PDCP entity shall:

- if the transmitting PDCP entity is associated with one RLC entity:

- submit the PDCP Data PDU to the associated RLC entity.

- else, if the transmitting PDCP entity is associated with two RLC entities:

- if *pdcpDuplication* is configured and activated:

- duplicate the PDCP Data PDU and submit the PDCP Data PDU to both associated RLC entities.

- else, if *pdcpDuplication* is configured but not activated:

- submit the PDCP Data PDU to the primary RLC entity.

- else:

- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 36.322 [5]) in the two associated RLC entities is less than *ul-DataSplitThreshold*:

- submit the PDCP Data PDU to the primary RLC entity.

- else:

- submit the PDCP Data PDU to either the primary RLC entity or the secondary RLC entity.

NOTE 2: If the transmitting PDCP entity is associated with two RLC entities, the UE should minimize the amount of PDCP PDUs submitted to lower layers before receiving request from lower layers and minimize the PDCP SN gap between PDCP PDUs submitted to two associated RLC entities to minimize PDCP reordering delay in the receiving PDCP entity.

[TS 38.323, clause 5.2.2.1]

In this section, following definitions are used:

- HFN(State Variable): the HFN part (i.e. the number of most significant bits equal to HFN length) of the State Variable;

- SN(State Variable): the SN part (i.e. the number of least significant bits equal to PDCP SN length) of the State Variable;

- RCVD\_SN: the PDCP SN of the received PDCP Data PDU, included in the PDU header;

- RCVD\_HFN: the HFN of the received PDCP Data PDU, calculated by the receiving PDCP entity;

- RCVD\_COUNT: the COUNT of the received PDCP Data PDU = [RCVD\_HFN, RCVD\_SN]

At reception of a PDCP Data PDU from lower layers, the receiving PDCP entity shall determine the COUNT value of the received PDCP Data PDU, i.e. RCVD\_COUNT, as follows:

- if RCVD\_SN < SN(RX\_DELIV) – Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) + 1.

- else if RCVD\_SN >= SN(RX\_DELIV) + Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) – 1.

- else:

- RCVD\_HFN = HFN(RX\_DELIV);

- RCVD\_COUNT = [RCVD\_HFN, RCVD\_SN].

After determining the COUNT value of the received PDCP Data PDU = RCVD\_COUNT, the receiving PDCP entity shall:

- if RCVD\_COUNT < RX\_DELIV; or

- if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:

- perform deciphering and integrity verification of the PDCP Data PDU using COUNT = RCVD\_COUNT;

- if integrity verification fails:

- indicate the integrity verification failure to upper layer;

- discard the PDCP Data PDU.

- else:

- perform deciphering and integrity verification of the PDCP Data PDU using COUNT = RCVD\_COUNT;

- if integrity verification fails:

- indicate the integrity verification failure to upper layer;

- discard the PDCP Data PDU.

If the received PDCP Data PDU with COUNT value = RCVD\_COUNT is not discarded above, the receiving PDCP entity shall:

- store the resulting PDCP SDU in the reception buffer;

- if RCVD\_COUNT >= RX\_NEXT:

- update RX\_NEXT to RCVD\_COUNT + 1.

- if *outOfOrderDelivery* is configured:

- deliver the resulting PDCP SDU to upper layers.

- if RCVD\_COUNT = RX\_DELIV:

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before;

- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from COUNT = RX\_DELIV;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers, with COUNT value > RX\_DELIV;

- if *t-Reordering* is running, and if RX\_DELIV >= RX\_REORD:

- stop and reset *t-Reordering*.

- if *t-Reordering* is not running (includes the case when *t-Reordering* is stopped due to actions above), and RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start t-Reordering.

[TS 38.322, clause 6.2.2.2]

Figure 6.2.2.2-1 shows the format of the PDCP Data PDU with 12 bits PDCP SN. This format is applicable for UM DRBs and AM DRBs.



Figure 6.2.2.2-1: PDCP Data PDU format with 12 bits PDCP SN

7.1.3.1.1.3 Test description

7.1.3.1.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 exception of PDCP parameters according to Table 7.1.3.1.1.3.1-1.

Table 7.1.3.1.1.3.1-1: PDCP parameters

|  |  |
| --- | --- |
| PDCP-Config pdcp-SN-SizeUL | len12bits |
| PDCP-Config pdcp-SN-SizeDL | len12bits |

7.1.3.1.1.3.2 Test procedure sequence

Table 7.1.3.1.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1 – 2 shall be repeated from j = 0 to j = FLOOR(Maximum\_PDCP\_SN/iteration\_size). (Note 1, 4) | - | - | - | - |
| 1 | SS transmits in one slot, several PDCP PDUs in a PDCP PDU list without header compression, the number of PDCP PDUs sent in each PDCP PDU list is defined by the iteration\_size. (Note 4, 5). | <-- | PDCP PDUs | - | - |
| - | EXCEPTION: In Step 2, SS may receive a PDCP PDU or several PDCP PDUs, then step 2 may be repeated multiple times until all PDCP PDUs with SN=j\*iteration\_size to SN=(((j+1)\* iteration\_size)-1) for each iteration are received. | - | - | - | - |
| 2 | CHECK: Does UE transmit PDCP PDUs with SN=0 for the first iteration and all PDCP PDUs for each iteration?  (Note 2) (Note 6) | --> | PDCP PDUs | 1 | P |
| 3 | SS transmits a PDCP PDU containing one PDCP SDU without header compression. | <-- | PDCP PDU | - | - |
| 4 | CHECK: Does UE transmit a PDCP PDU with SN=0? | --> | PDCP PDU | 2 | P |
| 5 | SS transmits a PDCP PDU containing one PDCP SDU without header compression. | <-- | PDCP PDU | - | - |
| 6 | CHECK: Does UE transmit a PDCP PDU with SN=1? | --> | PDCP PDU | 1 | P |
| Note 1: Maximum\_PDCP\_SN = 2[*pdcp-SN-SizeUL*] -1.  Note 2: The verdict shall be provided each time [(SN+1) mod 256 = 0] for 12 bit SN and [(SN+1) mod 4096 = 0] for 18 bit SN respectively.  Note 3: Void  Note 4: Iteration will be incremented by iteration\_size of 1 for 12 bit SN and iteration\_size of 25.for 18 bits SN. Small PDCP SDU size will be used.  Note 5: SS shall transmit a PDCP PDU list with size equal to iteration\_size and incrementing SN by 1 till SN = ((j+1)\*iteration\_size)-1.  Note 6 All PDCP PDUs may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot) | | | | | |

7.1.3.1.1.3.3 Specific message contents

None.

##### 7.1.3.1.2 Maintenance of PDCP sequence numbers / User plane / 18 bit SN

7.1.3.1.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with PDCP configured for 18 bit SN}

**ensure that** {

**when** { UE transmits a PDCP Data SDU on a DRB }

**then** { UE increments SN with 1 for each transmitted PDU for SN=0 to Maximum\_PDCP\_SN (2[*pdcp-SN-SizeUL*] -1) }

}

(2)

**with** { UE in RRC\_CONNECTED state with PDCP configured for 18 bit SN }

**ensure that** {

**when** { UE transmits a PDCP Data SDU on a DRB and, after incrementation, TX\_Next is larger than the Maximum\_PDCP\_SN (2[*pdcp-SN-SizeUL*] -1) }

**then** { UE sets SN to 0 in the next transmitted PDCP SDU}

}

7.1.3.1.2.2 Conformance requirements

Same as conformance requirements in clause 7.1.3.1.1.2

7.1.3.1.2.3 Test description

7.1.3.1.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 exception of PDCP parameters according to Table 7.1.3.1.2.3.1-1.

Table 7.1.3.1.2.3.1-1: PDCP parameters

|  |  |
| --- | --- |
| PDCP-Config pdcp-SN-SizeUL | len18bits |
| PDCP-Config pdcp-SN-SizeDL | len18bits |

7.1.3.1.2.3.2 Test procedure sequence

Same as test procedure in clause 7.1.3.1.1.3.2

7.1.3.1.2.3.3 Specific message contents

None.

#### 7.1.3.2 PDCP integrity protection

##### 7.1.3.2.1 Integrity protection / Correct functionality of integrity algorithm SNOW3G / SRB / DRB

(1)

**with** { UE in RRC\_CONNECTED state and SRB is configured with NR-PDCP}

**ensure that** {

**when** { Functionality of integrity algorithms with SNOW3G is taken into use on SRB }

**then** { UE performs correct integrity protection function in NR-PDCP entities associated with SRB }

}

(2)

**with** { UE in RRC\_CONNECTED state and NOT EN-DC }

**ensure that** {

**when** { Functionality of integrity algorithms with SNOW3G is taken into use on DRB }

**then** { UE performs correct integrity protection function in PDCP entities associated with DRB }

}

(3)

**with** { UE in RRC\_CONNECTED state and SRB3 is configured }

**ensure that** {

**when** { message on SRB 3 is received and fails the integrity protection check }

**then** { UE transmits *SCGFailureInformationNR* message with failure type 'srb3-IntegrityFailure' }

}

NOTE: TP2 (integrity on DRB) is not applicable to EN-DC as per 38.331 clause 6.3.2, the IE *PDCP-Config.drb.*integrityProtection is‘ Cond ConnectedTo5GC‘.

7.1.3.2.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clauses 5.9, 5.2.2.1, TS 33.501 clauses 5.6.2, D.3.1 and TS 38.331 clauses5.7.3.1, 5.7.3.2, 5.7.3.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.9]

The integrity protection function includes both integrity protection and integrity verification and is performed in PDCP, if configured. The data unit that is integrity protected is the PDU header and the data part of the PDU before ciphering. The integrity protection is always applied to PDCP Data PDUs of SRBs. The integrity protection is applied to PDCP Data PDUs of DRBs for which integrity protection is configured. The integrity protection is not applicable to PDCP Control PDUs.

The integrity protection algorithm and key to be used by the PDCP entity are configured by upper layers TS 38.331 [3] and the integrity protection method shall be applied as specified in TS 33.501 [6].

The integrity protection function is activated by upper layers TS 38.331 [3]. When security is activated, the integrity protection function shall be applied to all PDUs including and subsequent to the PDU indicated by upper layers TS 38.331 [3] for the downlink and the uplink, respectively.

NOTE: As the RRC message which activates the integrity protection function is itself integrity protected with the configuration included in this RRC message, this message needs first be decoded by RRC before the integrity protection verification could be performed for the PDU in which the message was received.

For downlink and uplink integrity protection and verification, the parameters that are required by PDCP for integrity protection are defined in TS 33.501 [6] and are input to the integrity protection algorithm. The required inputs to the integrity protection function include the COUNT value, and DIRECTION (direction of the transmission: set as specified in TS 33.501 [6]). The parameters required by PDCP which are provided by upper layers TS 38.331 [3] are listed below:

- BEARER (defined as the radio bearer identifier in TS 33.501 [6]. It will use the value RB identity –1 as in TS 38.331 [3]);

- KEY (the integrity protection keys for the control plane and for the user plane are KRRCint and KUPint, respectively).

At transmission, the UE computes the value of the MAC-I field and at reception it verifies the integrity of the PDCP Data PDU by calculating the X-MAC based on the input parameters as specified above. If the calculated X-MAC corresponds to the received MAC-I, integrity protection is verified successfully.

[TS 38.323, clause 5.2.2.1]

At reception of a PDCP Data PDU from lower layers, the receiving PDCP entity shall determine the COUNT value of the received PDCP Data PDU, i.e. RCVD\_COUNT, as follows:

- if RCVD\_SN < SN(RX\_DELIV) – Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) + 1.

- else if RCVD\_SN >= SN(RX\_DELIV) + Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) – 1.

- else:

- RCVD\_HFN = HFN(RX\_DELIV);

- RCVD\_COUNT = [RCVD\_HFN, RCVD\_SN].

After determining the COUNT value of the received PDCP Data PDU = RCVD\_COUNT, the receiving PDCP entity shall:

- perform deciphering and integrity verification of the PDCP Data PDU using COUNT = RCVD\_COUNT;

- if integrity verification fails:

- indicate the integrity verification failure to upper layer;

- discard the PDCP Data PDU;

- if RCVD\_COUNT < RX\_DELIV; or

- if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:

- discard the PDCP Data PDU;

[TS 33.501, clause 5.6.2]

All Identifiers and names specified in the present subclause are for 5G.

Each Integrity Algorithm used for 5G will be assigned a 4-bit identifier. The following values for integrity algorithms are defined:

"00002" NIA0 Null Integrity Protection algorithm;

"00012" 128-NIA1 128-bit SNOW 3G based algorithm;

"00102" 128-NIA2 128-bit AES based algorithm; and

"00112" 128-NIA3 128-bit ZUC based algorithm.

128-NIA1 is based on SNOW 3G (see TS35.215 [14]).

128-NIA2 is based on 128-bit AES [15] in CMAC mode [17].

128-NIA3 is based on 128-bit ZUC (see TS35.221 [18]).

Full details of the algorithms are specified in Annex D.

[TS 33.501, clause D.3.1.1]

The input parameters to the integrity algorithm are a 128-bit integrity key named KEY, a 32-bit COUNT, a 5-bit bearer identity called BEARER, the 1-bit direction of the transmission i.e. DIRECTION, and the message itself i.e. MESSAGE. The DIRECTION bit shall be 0 for uplink and 1 for downlink. The bit length of the MESSAGE is LENGTH.

Figure D.3.1.1-1 illustrates the use of the integrity algorithm NIA to authenticate the integrity of messages.



Figure D.3.1.1-1: Derivation of MAC-I/NAS-MAC (or XMAC-I/XNAS-MAC)

Based on these input parameters the sender computes a 32-bit message authentication code (MAC-I/NAS-MAC) using the integrity algorithm NIA. The message authentication code is then appended to the message when sent. For integrity protection algorithms, the receiver computes the expected message authentication code (XMAC-I/XNAS-MAC) on the message received in the same way as the sender computed its message authentication code on the message sent and verifies the data integrity of the message by comparing it to the received message authentication code, i.e. MAC-I/NAS-MAC.

[TS 38.331, clause 5.7.3.1]



Figure 5.7.3.1-1: SCG failure information

The purpose of this procedure is to inform EUTRAN or NR MN about an SCG failure the UE has experienced i.e. SCG radio link failure, e failure of SCG reconfiguration with sync, SCG configuration failure for RRC message on SRB3, SCG integrity check failure and exceeding the maximum uplink transmission timing difference.

[TS 38.331, clause 5.7.3.2]

A UE initiates the procedure to report SCG failures when SCG transmission is not suspended and when one of the following conditions is met:

1> upon detecting radio link failure for the SCG, in accordance with subclause 5.3.10.3;

1> upon reconfiguration with sync failure of the SCG, in accordance with subclause 5.3.5.9.3;

1> upon SCG configuration failure, in accordance with subclause 5.3.5.9.2;

1> upon integrity check failure indication from SCG lower layers, in accordance with subclause 5.3.5.9.1.

Upon initiating the procedure, the UE shall:

1> suspend SCG transmission for all SRBs and DRBs;

1> reset SCG-MAC;

1> stop T304, if running;

1> if the UE is operating in EN-DC:

2> initiate transmission of the *SCGFailureInformationNR* message as specified in TS 36.331 [10, 5.6.13a].

[TS 38.331, clause 5.7.3.3]

The UE shall set the SCG failure type as follows:

...

1> else, if the UE initiates transmission of the *SCGFailureInformationNR* message due to SRB3 IP check failure:

2> set the failureType as srb3-IntegrityFailure;

7.1.3.2.1.3 Test description

7.1.3.2.1.3.1 Pre-test conditions

- Same Pre-test conditions as in clause 7.1.3.0 with the exception that integrity protection algorithm ‘nia1 (SNOW3G)’ is configured.

- For EN\_DC, same Pre-test conditions as in clause 7.1.3.0 with the exception that integrity protection algorithms ‘nia1 (SNOW3G)’ and ‘eia1 (SNOW3G)’ are configured and without message condition UE TEST LOOP MODE A.

- For EN\_DC or NGEN\_DC, RRCConnectionReconfiguration message including MobilityControlInfo IE is transmitted on E-UTRA Cell 1 to reconfigure SRB1 and SRB2 from E-UTRA PDCP to NR PDCP.

7.1.3.2.1.3.2 Test procedure sequence

Table 7.1.3.2.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: Steps 1a1 to 1b2 describe behaviour that depends on UE configuration; the "lower case letter" identifies a step sequence that takes place depending on a particular configuration. | - | - | - | - |
| 1a1 | IF *Connectivity* is *EN-DC* or *NGEN-DC*, the SS sends EUTRA RRC *UECapabilityEnquiry* message including *RAT-Type* *eutra-nr* to the UE integrity protected. | <-- | RRC: *UECapabilityEnquiry* | - | - |
| 1a2 | Check: Does the UE send a EUTRA RRC *UECapabilityInformation* message integrity protected? | --> | RRC: *UECapabilityInformation* | 1 | P |
| 1b1 | ELSE the SS sends NR RRC *UECapabilityEnquiry* message to the UE. | <-- | NR RRC: *UECapabilityEnquiry* | - | - |
| 1b2 | Check: Does the UE send a NR RRC *UECapabilityInformation* message? | --> | NR RRC: *UECapabilityInformation* | 1 | P |
| - | EXCEPTION: Steps 2a1-2a4 describe behaviour that depends on UE configuration; the "lower case letter" identifies a step sequence that takes place if SRB3 is configured | - | - | - | - |
| 2a1 | IF *Connectivity* is *EN-DC* or *NGEN-DC*, IF pc\_srb3 then the SS transmits an *RRCReconfiguration* message to reconfigure NR MAC, sent on SRB3 integrity protected.  Note 1 | <-- | *RRCReconfiguration* | - | - |
| 2a2 | Check: Does the UE transmit an *RRCReconfigurationComplete* message on SRB3 integrity protected? | --> | *RRCReconfigurationComplete* | 1 | P |
| 2a3 | The SS sends *RRCReconfiguration* message to the UE integrity protected on SRB3. The MAC-I is corrupted so as to result in integrity failure at UE. | <-- | *RRCReconfiguration* | - | - |
| 2a4 | Check: Does the UE send *SCGFailureInformationNR* with failureType ‘srb3-IntegrityFailure’ on SRB1? | --> | *SCGFailureInformationNR* | 3 | P |
| - | EXCEPTION: Steps 3a1-3a2 describe behaviour that depends on whether 5GC is being emulated; the "lower case letter" identifies a step sequence that takes place if 5GC is being emulated. | - | - | - | - |
| 3a1 | SS transmits PDCP PDU on DRB integrity protected. | <-- | PDCP PDU | ***-*** | ***-*** |
| 3a2 | Check: Does the UE transmit looped back PDCP PDU integrity protected on DRB? | --> | PDCP PDU | 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration is contained in *RRCConnectionReconfiguration* Table 7.1.3.2.1.3.3-1 | | | | | |

7.1.3.2.1.3.3 Specific message contents

Table 7.1.3.2.1.3.3-1: *RRCConnectionReconfiguration (Preamble for EN-DC or NGEN-DC)*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation Path: 36.508 [7] Table 4.6.1-8 | | | | | | |
| Information Element | | | Value/remark | | Comment | | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { | | |  | |  | |  |
| criticalExtensions CHOICE { | | |  | |  | |  |
| c1 CHOICE{ | | |  | |  | |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE { | | |  | |  | |  |
| mobilityControlInfo | | | MobilityControlInfo-HO-SameCell | | As per Table 7.1.3.2.1.3.3-1A | |  |
| nonCriticalExtension ::= SEQUENCE { | | |  | |  | |  |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nr-Config-r15 CHOICE { |  | |  | |  | |
| setup SEQUENCE { |  | |  | |  | |
| nr-SecondaryCellGroupConfig-r15 | OCTET STRING including the RRCReconfiguration message according to TS 38.508-1 [4], table 4.6.1-13 with condition EN-DC\_HO | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| sk-Counter-r15 | Increment the value by 1 from the previous value | |  | |  | |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [4], Table 4.6.3-132 with conditions EN-DC\_DRB and Re-establish\_PDCP | |  | |  | |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [4], Table 4.6.3-132 with conditions EN-DC\_DRB and Re-establish\_PDCP and SRB3 | |  | | SRB3 | |
| nr-RadioBearerConfig2-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [4], table 4.6.3-132 with condition SRB\_NR\_PDCP | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |

|  |  |
| --- | --- |
| Condition | Explanation |
| SRB3 | Establishment of SRB3 |

Table 7.1.3.2.1.3.3-1A: *MobilityControlInfo-HO-SameCell* (Table 7.1.3.2.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.5-1 | | | |
| Information Element | Value/remark | Comment | Condition |
| MobilityControlInfo-HO ::= SEQUENCE { |  |  |  |
| targetPhysCellId | PhysicalCellIdentity of E-UTRA Cell 1 |  |  |
| carrierFreq | Not present |  |  |
| } |  |  |  |

Table 7.1.3.2.1.3.3-2: MAC-CellGroupConfig (step 2a1, Table 7.1.3.2.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| periodicBSR-Timer | sf10 | Different from default |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.2.1.3.3-3: *SCGFailureInformationNR* message (step 2a4, Table 7.1.3.2.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.1-18AA | | | |
| Information Element | Value/remark | Comment | Condition |
| SCGFailureInformationNR-r15::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| c1 CHOICE { |  |  |  |
| scgFailureInformationNR-r15 SEQUENCE { |  |  |  |
| failureReportSCG-NR-r15 SEQUENCE { |  |  |  |
| failureType-r15 | srb3-IntegrityFailure |  |  |
| measResultFreqListNR-r15 | Not checked |  |  |
| measResultSCG-r15 | Not checked |  |  |
| } |  |  |  |
| nonCriticalExtension SEQUENCE {} |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.2.1.3.3-4: *RRCReconfiguration (Preamble for NR/5GC)*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition NR | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration ::= SEQUENCE { | |  |  |  |
| radioBearerConfig | | RadioBearerConfig-IntegrityOnDRB |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.3.2.1.3.3-5: *RadioBearerConfig-IntegrityOnDRB (Preamble for NR/5GC)*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-132 with conditions SRB2 and DRB1 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry | Primary DRB as per Table 7.1.3.0-2 | DRB1 |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config | SDAP-Config |  |  |
| } |  |  |  |
| drb-Identity | DRB-Identity using condition DRB1 |  |  |
| reestablishPDCP | Not present |  |  |
| recoverPDCP | Not present |  |  |
| pdcp-Config | PDCP-Config-IntegrityOnDRB |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.2.1.3.3-6: *PDCP-Config-IntegrityOnDRB (Preamble for NR/5GC)*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-99 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| drb SEQUENCE { |  |  |  |
| discardTimer | infinity |  |  |
| pdcp-SN-Size-UL | len18bits |  |  |
| pdcp-SN-Size-DL | len18bits |  |  |
| headerCompression CHOICE { |  |  |  |
| notUsed | NULL |  |  |
| } |  |  |  |
| integrityProtection | enabled |  |  |
| statusReportRequired | true |  |  |
| outOfOrderDelivery | Not present |  |  |
| } |  |  |  |
| moreThanOneRLC | Not present |  |  |
| t-Reordering | Not present |  |  |
| } |  |  |  |

##### 7.1.3.2.2 Integrity protection / Correct functionality of integrity algorithm AES / SRB / DRB

7.1.3.2.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and SRB is configured with NR-PDCP }

**ensure that** {

**when** { Functionality of integrity algorithms with AES is taken into use on SRB }

**then** { UE performs correct integrity protection function in NR-PDCP entity associated with SRB }

}

(2)

**with** { UE in RRC\_CONNECTED state and NOT EN-DC }

**ensure that** {

**when** { Functionality of integrity algorithms with AES is taken into use on DRB }

**then** { UE performs correct integrity protection function in PDCP entities associated with DRB }

}

(3)

**with** { UE in RRC\_CONNECTED state and SRB3 is configured }

**ensure that** {

**when** { message on SRB 3 is received and fails the integrity protection check }

**then** { UE transmits *SCGFailureInformationNR* message with failure type as srb3-IntegrityFailure }

}

NOTE: TP2 (integrity on DRB) is not applicable to EN-DC as per TS 38.331 [12] clause 6.3.2, the IE *PDCP-Config.drb.*integrityProtection is 'Cond ConnectedTo5GC'.

7.1.3.2.2.2 Conformance requirements

Same conformance requirements as in clause 7.1.3.2.1.2

7.1.3.2.2.3 Test description

7.1.3.2.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.2.1.3.1 except that integrity protection algorithm ‘nia2 (AES)’ and ‘eia2 (AES)’ is configured.

7.1.3.2.2.3.2 Test procedure sequence

Same test procedure sequence as in clause 7.1.3.2.1.3.2.

7.1.3.2.2.3.3 Specific message contents

Same specific message contents as in clause 7.1.3.2.1.3.3 except for integrity protection algorithm ‘nia2 (AES)’ and ‘eia2 (AES)’.

##### 7.1.3.2.3 Integrity protection / Correct functionality of integrity algorithm ZUC / SRB / DRB

(1)

**with** { UE in RRC\_CONNECTED state and SRB is configured with NR-PDCP }

**ensure that** {

**when** { Functionality of integrity algorithms with ZUC is taken into use on SRB }

**then** { UE performs correct integrity protection function in NR-PDCP entities associated with SRB }

}

(2)

**with** { UE in RRC\_CONNECTED state and NOT EN-DC }

**ensure that** {

**when** { Functionality of integrity algorithms with ZUC is taken into use on DRB }

**then** { UE performs correct integrity protection function in PDCP entities associated with DRB }

}

(3)

**with** { UE in RRC\_CONNECTED state and SRB3 is configured }

**ensure that** {

**when** { message on SRB 3 is received and fails the integrity protection check }

**then** { UE transmits *SCGFailureInformationNR* message with failure type as srb3-IntegrityFailure }

}

NOTE: TP2 (integrity on DRB) is not applicable to EN-DC as per TS 38.331 [12] clause 6.3.2, the IE *PDCP-Config.drb.*integrityProtection is 'Cond ConnectedTo5GC.

7.1.3.2.3.2 Conformance requirements

Same conformance requirements as in clause 7.1.3.2.1.2.

7.1.3.2.3.3 Test description

7.1.3.2.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.2.1.3.1 except that integrity protection algorithm ‘nia3 (ZUC)’ and ‘eia3 (ZUC)’ is configured.

7.1.3.2.3.3.2 Test procedure sequence

Same test procedure sequence as in clause 7.1.3.2.1.3.2.

7.1.3.2.3.3.3 Specific message contents

Same specific message contents as in clause 7.1.3.2.1.3.3 except integrity protection algorithm ‘nia3 (ZUC)’ and ‘eia3 (ZUC)’.

#### 7.1.3.3 PDCP Ciphering and deciphering

##### 7.1.3.3.1 Ciphering and deciphering / Correct functionality of encryption algorithm SNOW3G / SRB / DRB

7.1.3.3.1.1 Test Purpose (TP)

(1)

(1)

**with** { UE in RRC\_CONNECTED state and SRB is configured with NR-PDCP }

**ensure that** {

**when** { Functionality of encryption algorithms with SNOW3G is taken into use on SRB }

**then** { UE performs correct ciphering/deciphering function in NR-PDCP entity associated with SRB }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Functionality of encryption algorithms with SNOW3G is taken into use on DRB }

**then** {UE performs correct ciphering/deciphering function in NR-PDCP entity associated with DRB }

}

7.1.3.3.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323 clause 5.8, TS 33.501 clauses 5.6.1, D.2.1.1 and TS 36.331 clause 6.3.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.8]

The ciphering function includes both ciphering and deciphering and is performed in PDCP, if configured. The data unit that is ciphered is the data part of the PDCP Data PDU (see subclause 6.3.3) except the SDAP header if included in the PDCP SDU, and the MAC-I (see subclause 6.3.4). The ciphering is not applicable to PDCP Control PDUs.

The ciphering algorithm and key to be used by the PDCP entity are configured by upper layers TS 38.331 [3] and the ciphering method shall be applied as specified in TS 33.501 [6].

The ciphering function is activated by upper layers TS 38.331 [3]. When security is activated, the ciphering function shall be applied to all PDCP Data PDUs indicated by upper layers TS 38.331 [3] for the downlink and the uplink, respectively.

For downlink and uplink ciphering and deciphering, the parameters that are required by PDCP for ciphering are defined in TS 33.501 [6] and are input to the ciphering algorithm. The required inputs to the ciphering function include the COUNT value, and DIRECTION (direction of the transmission: set as specified in TS 33.501 [6]).The parameters required by PDCP which are provided by upper layers TS 38.331 [3] are listed below:

- BEARER (defined as the radio bearer identifier in TS 33.501 [6]. It will use the value RB identity –1 as in TS 38.331 [3]);

- KEY (the ciphering keys for the control plane and for the user plane are KRRCenc and KUPenc, respectively).

[TS 33.501, clause 5.6.1]

All Identifiers and names specified in this subclause are for5G.

Each Encryption Algorithm used for 5G will be assigned a 4-bit identifier. The following values for ciphering algorithms are defined:

"00002" NEA0 Null ciphering algorithm;

"00012" 128-NEA1 128-bit SNOW 3G based algorithm;

"00102" 128-NEA2 128-bit AES based algorithm; and

"00112" 128-NEA3 128-bit ZUC based algorithm.

128-NEA1 is based on SNOW 3G (see TS35.215 [14]).

128-NEA2 is based on 128-bit AES [15] in CTR mode [16].

128-NEA3 is based on 128-bit ZUC (sseTS35.221 [18]).

Full details of the algorithms are specified in Annex D.

[TS 33.501, clause D.2.1.1]

The input parameters to the ciphering algorithm are a 128-bit cipher key named KEY, a 32-bit COUNT, a 5-bit bearer identity BEARER, the 1-bit direction of the transmission i.e. DIRECTION, and the length of the keystream required i.e. LENGTH. The DIRECTION bit shall be 0 for uplink and 1 for downlink.

Editor’s Note: For NAS layer security, the inputs may need to change depending on the solution that is selected for having simultaneous NAS connections for 3GPP and non-3GPP.

Figure D.2.1.1-1 illustrates the use of the ciphering algorithm NEA to encrypt plaintext by applying a keystream using a bit per bit binary addition of the plaintext and the keystream. The plaintext may be recovered by generating the same keystream using the same input parameters and applying a bit per bit binary addition with the ciphertext.



Figure D.2.1.1-1: Ciphering of data

Based on the input parameters the algorithm generates the output keystream block KEYSTREAM which is used to encrypt the input plaintext block PLAINTEXT to produce the output ciphertext block CIPHERTEXT.

The input parameter LENGTH shall affect only the length of the KEYSTREAM BLOCK, not the actual bits in it.

[TS 36.331, clause 6.3.3]

The IE *SecurityAlgorithmConfig* is used to configure AS integrity protection algorithm (SRBs) and AS ciphering algorithm (SRBs and DRBs).

…

| SecurityAlgorithmConfig field descriptions |
| --- |
| **cipheringAlgorithm**  Indicates the ciphering algorithm to be used for SRBs and DRBs, as specified in TS 33.501 [11]. The algorithms nea0-nea3 are identical to the LTE algorithms eea0-3. For EN-DC, the algorithms configured for bearers using KeNB shall be the same as for all bearers using KeNB. |
| **integrityProtAlgorithm**  For EN-DC, this IE indicates the integrity protection algorithm to be used for SRBs, as specified in TS 33.501 [11]. The algorithms nia0-nia3 is identical to the LTE algorithms eia0-3. For EN-DC, the algorithms configured for SRBs using KeNB shall be the same as for all SRBs using KeNB. |

7.1.3.3.1.3 Test description

7.1.3.3.1.3.1 Pre-test conditions

- Same Pre-test conditions as in clause 7.1.3.0 with the exception that ciphering algorithm ‘nea1 (SNOW3G)’ is configured.

- For EN\_DC or NGEN\_DC, same Pre-test conditions as in clause 7.1.3.0 with the exception that ciphering algorithms ‘eea1 (SNOW3G)’ and ‘nea1 (SNOW3G)’ are configured and without message condition UE TEST LOOP MODE A, then RRCConnectionReconfiguration message including MobilityControlInfo IE is transmitted on E-UTRA Cell 1 to reconfigure SRB1, SRB2 and MCG DRB from E-UTRA PDCP to NR PDCP and Test Loop Function (On) with UE test loop mode A (message condition UE TEST LOOP MODE A to return one UL PDCP SDU per DL PDCP SDU) according to TS 38.508-1 [4].

7.1.3.3.1.3.2 Test procedure sequence

Table 7.1.3.3.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U – S | Message |  |  |
| - | Exception steps 1a1 to 1b2 depends on UE configuration. | - | - | - | - |
| 1a1 | IF *Connectivity* is *EN-DC* or *NGEN-DC*,  the SS sends EUTRA RRC *UECapabilityEnquiry* including *RAT-Type* *eutra* message to the UE. | <-- | RRC*:UECapabilityEnquiry* | - | - |
| 1a2 | Check: Does the UE send a EUTRA RRC *UECapabilityInformation* message? | --> | RRC:*UECapabilityInformation* | 1 | P |
| 1b1 | ELSE the SS sends NR RRC *UECapabilityEnquiry* message to the UE. | <-- | NR RRC:*UECapabilityEnquiry* | - | - |
| 1b2 | Check: Does the UE send a NR RRC *UECapabilityInformation* message? | --> | NR RRC:*UECapabilityInformation* | 1 | P |
| - | EXCEPTION: steps 2a1-2a2 depends on UE configuration, executed if SCG DRB is configured | - | *-* | - | - |
| 2a1 | IF *Connectivity* is *EN-DC* or *NGEN-DC*, SS transmits PDCP PDU on SCG DRB ciphered. | <-- | PDCP PDU | - | - |
| 2a2 | Check: Does the UE transmit looped back PDCP PDU ciphered on SCG DRB? | --> | PDCP PDU | 2 | P |
| 3 | SS transmits PDCP PDU on MCG DRB ciphered. | <-- | PDCP PDU | - | - |
| 4 | Check: Does the UE transmit looped back PDCP PDU ciphered on MCG DRB? | --> | PDCP PDU | 2 | P |

7.1.3.3.1.3.3 Specific message contents

Table 7.1.3.3.1.3.3-1: *RRCConnectionReconfiguration (Preamble for EN-DC or NGEN-DC)*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Derivation Path: 36.508[47] Table 4.6.1-8 | | | | | | |
| Information Element | | | Value/remark | | Comment | | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { | | |  | |  | |  |
| criticalExtensions CHOICE { | | |  | |  | |  |
| c1 CHOICE{ | | |  | |  | |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE { | | |  | |  | |  |
| mobilityControlInfo | | | MobilityControlInfo-HO-SameCell | | As per Table 7.1.3.3.1.3.3-2 | |  |
| radioResourceConfigDedicated | | | RadioResourceConfigDedicated-DRB-Rel-Add | | As per Table 7.1.3.3.1.3.3-3 | |  |
| nonCriticalExtension ::= SEQUENCE { | | |  | |  | |  |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nonCriticalExtension ::= SEQUENCE { |  | |  | |  | |
| nr-Config-r15 CHOICE { |  | |  | |  | |
| setup SEQUENCE { |  | |  | |  | |
| nr-SecondaryCellGroupConfig-r15 | OCTET STRING including the RRCReconfiguration message according to TS 38.508-1 [4], table 4.6.1-13 with condition EN-DC\_HO. | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| sk-Counter-r15 | Increment the value by 1 from the previous value | |  | |  | |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [4], table 4.6.3-132 with condition EN-DC\_DRB and Re-establish\_PDCP | |  | |  | |
| nr-RadioBearerConfig2-r15 | OCTET STRING including RadioBearerConfig according TS 38.508-1 [4], table 4.6.3-132 with conditions SRB\_NR\_PDCP and MCG\_NR\_PDCP | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |
| } | |  | |  | |  | |

Table 7.1.3.3.1.3.3-2: *MobilityControlInfo-HO-SameCell* (Table 7.1.3.3.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.5-1 | | | |
| Information Element | Value/remark | Comment | Condition |
| MobilityControlInfo-HO ::= SEQUENCE { |  |  |  |
| targetPhysCellId | PhysicalCellIdentity of E-UTRA Cell 1 |  |  |
| carrierFreq | Not present |  |  |
| } |  |  |  |

Table 7.1.3.3.1.3.3-3: *RadioResourceConfigDedicated-DRB-Rel-Add* (Table 7.1.3.3.1.3.3-1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.3-19AAAAAD | | | | | |
| Information Element | | Value/remark | Comment | | Condition |
| RadioResourceConfigDedicated-SRB2-DRB ::= SEQUENCE { |  | |  |  | | |
| srb-ToAddModList | Not present | |  |  | | |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry | |  |  | | |
| drb-ToAddMod[1] | DRB-ToAddMod-DEFAULT (8) using condition AM except pdcp-Config not included | | entry 1  See TS 36.508 subclause 4.8.2 |  | | |
| } |  | |  |  | | |
| drb-ToReleaseList SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity { | 1 entry | |  |  | | |
| DRB-Identity[1] | 8 | | entry 1  Same as the DRB Identity associated with the default EPS bearer |  | | |
| } |  | |  |  | | |
| } |  | |  |  | | |

##### 7.1.3.3.2 Ciphering and deciphering / Correct functionality of encryption algorithm AES / SRB / DRB

7.1.3.3.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and SRB is configured with NR-PDCP }

**ensure that** {

**when** { Functionality of encryption algorithms with AES is taken into use on SRB }

**then** { UE performs correct ciphering/deciphering function in NR-PDCP entity associated with SRB }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { Functionality of encryption algorithms with AES is taken into use on DRB }

**then** {UE performs correct ciphering/deciphering function in NR-PDCP entity associated with DRB }

}

7.1.3.3.2.2 Conformance requirements

Same conformance requirement as in clause 7.1.3.3.1.2.

7.1.3.3.2.3 Test description

7.1.3.3.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.3.1.3.1 with the exception that ciphering algorithm ‘nea2 (AES)’ and ‘eea2 (AES)’ is configured.

7.1.3.3.2.3.2 Test procedure sequence

Same Test procedure sequence as in clause 7.1.3.3.1.3.2

7.1.3.3.2.3.3 Specific message contents

None

##### 7.1.3.3.3 Ciphering and deciphering / Correct functionality of encryption algorithm ZUC / SRB / DRB

7.1.3.3.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and SRB is configured with NR-PDCP}

**ensure that** {

**when** { Functionality of encryption algorithms with ZUC is taken into use on SRB }

**then** { UE performs correct ciphering/deciphering function in NR-PDCP entity associated with SRB }

}

(2)

**with** { UE in RRC\_CONNECTED state and DRB is configured with NR-PDCP}

**ensure that** {

**when** { Functionality of encryption algorithms with ZUC is taken into use on DRB }

**then** { UE performs correct ciphering/deciphering function in NR-PDCP entity associated with DRB }

}

7.1.3.3.3.2 Conformance requirements

Same conformance requirement as in clause 7.1.3.3.1.2.

7.1.3.3.3.3 Test description

7.1.3.3.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.3.1.3.1 with the exception that ciphering algorithm ‘nea3 (ZUC)’ and ‘eea3 (ZUC)’ is configured.

7.1.3.3.3.3.2 Test procedure sequence

Same Test procedure sequence as in clause 7.1.3.3.1.3.2.

7.1.3.3.3.3.3 Specific message contents

None

#### 7.1.3.4 PDCP Handover

##### 7.1.3.4.1 PDCP handover / Lossless handover / PDCP sequence number maintenance / PDCP status report to convey the information on missing or acknowledged PDCP SDUs at handover / In-order delivery and duplicate elimination in the downlink

7.1.3.4.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with default RB using RLC-AM }

**ensure that** {

**when** { UE is requested to make a lossless handover by SS }

**then** { UE creates a PDCP status report to SS }

}

(2)

**with** { UE in RRC\_CONNECTED state with default RB using RLC-AM }

**ensure that** {

**when** { UE is requested to make a lossless handover by SS }

**then** { UE retransmits the unacknowledged data }

}

(3)

**with** { UE in RRC\_CONNECTED state with default RB using RLC-AM }

**ensure that** {

**when** { UE is requested to make a lossless handover by SS }

**then** { UE achieves in-order delivery and discards a PDCP PDU already received in the downlink }

}

7.1.3.4.1.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.323, clauses 5.1.2, 5.2.2.1, 5.3, 5.4.1, 5.4.2 and 7.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.1.2]

When upper layers request a PDCP entity re-establishment, the UE shall additionally perform once the procedures described in this section. After performing the procedures in this section, the UE shall follow the procedures in subclause 5.2.

When upper layers request a PDCP entity re-establishment, the transmitting PDCP entity shall:

- for UM DRBs and AM DRBs, reset the header compression protocol for uplink and start with an IR state in U-mode (as defined in RFC 3095 [8] and RFC 4815 [9]) if *drb-ContinueROHC* is not configured in TS 38.331 [3];

- for UM DRBs and SRBs, set TX\_NEXT to the initial value;

- for SRBs, discard all stored PDCP SDUs and PDCP PDUs;

- apply the ciphering algorithm and key provided by upper layers during the PDCP entity re-establishment procedure;

- apply the integrity protection algorithm and key provided by upper layers during the PDCP entity re-establishment procedure;

- for UM DRBs, for each PDCP SDU already associated with a PDCP SN but for which a corresponding PDU has not previously been submitted to lower layers:

- consider the PDCP SDUs as received from upper layer;

- perform transmission of the PDCP SDUs in ascending order of the COUNT value associated to the PDCP SDU prior to the PDCP re-establishment without restarting the *discardTimer*, as specified in subclause 5.2.1;

- for AM DRBs, from the first PDCP SDU for which the successful delivery of the corresponding PDCP Data PDU has not been confirmed by lower layers, perform retransmission or transmission of all the PDCP SDUs already associated with PDCP SNs in ascending order of the COUNT values associated to the PDCP SDU prior to the PDCP entity re-establishment as specified below:

- perform header compression of the PDCP SDU as specified in the subclause 5.7.4;

- perform integrity protection and ciphering of the PDCP SDU using the COUNT value associated with this PDCP SDU as specified in the subclause 5.9 and 5.8;

- submit the resulting PDCP Data PDU to lower layer, as specified in subclause 5.2.1.

When upper layers request a PDCP entity re-establishment, the receiving PDCP entity shall:

- process the PDCP Data PDUs that are received from lower layers due to the re-establishment of the lower layers, as specified in the subclause 5.2.2.1;

- for SRBs, discard all stored PDCP SDUs and PDCP PDUs;

- for SRBs and UM DRBs, if *t-Reordering* is running:

- stop and reset *t-Reordering*;

- for UM DRBs, deliver all stored PDCP SDUs to the upper layers in ascending order of associated COUNT values after performing header decompression;

- for AM DRBs, perform header decompression for all stored PDCP SDUs if *drb-ContinueROHC* is not configured in TS 38.331 [3];

- for UM DRBs and AM DRBs, reset the header compression protocol for downlink and start with NC state in U-mode (as defined in RFC 3095 [8] and RFC 4815 [9]) if *drb-ContinueROHC* is not configured in TS 38.331 [3];

- for UM DRBs and SRBs, set RX\_NEXT and RX\_DELIV to the initial value;

- apply the ciphering algorithm and key provided by upper layers during the PDCP entity re-establishment procedure;

- apply the integrity protection algorithm and key provided by upper layers during the PDCP entity re-establishment procedure.

[TS 38.323, clause 5.2.2.1]

In this section, following definitions are used:

- HFN(State Variable): the HFN part (i.e. the number of most significant bits equal to HFN length) of the State Variable;

- SN(State Variable): the SN part (i.e. the number of least significant bits equal to PDCP SN length) of the State Variable;

- RCVD\_SN: the PDCP SN of the received PDCP Data PDU, included in the PDU header;

- RCVD\_HFN: the HFN of the received PDCP Data PDU, calculated by the receiving PDCP entity;

- RCVD\_COUNT: the COUNT of the received PDCP Data PDU = [RCVD\_HFN, RCVD\_SN].

At reception of a PDCP Data PDU from lower layers, the receiving PDCP entity shall determine the COUNT value of the received PDCP Data PDU, i.e. RCVD\_COUNT, as follows:

- if RCVD\_SN < SN(RX\_DELIV) – Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) + 1.

- else if RCVD\_SN >= SN(RX\_DELIV) + Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) – 1.

- else:

- RCVD\_HFN = HFN(RX\_DELIV);

- RCVD\_COUNT = [RCVD\_HFN, RCVD\_SN].

After determining the COUNT value of the received PDCP Data PDU = RCVD\_COUNT, the receiving PDCP entity shall:

- perform deciphering and integrity verification of the PDCP Data PDU using COUNT = RCVD\_COUNT;

- if integrity verification fails:

- indicate the integrity verification failure to upper layer;

- discard the PDCP Data PDU;

- if RCVD\_COUNT < RX\_DELIV; or

- if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:

- discard the PDCP Data PDU;

If the received PDCP Data PDU with COUNT value = RCVD\_COUNT is not discarded above, the receiving PDCP entity shall:

- store the resulting PDCP SDU in the reception buffer;

- if RCVD\_COUNT >= RX\_NEXT:

- update RX\_NEXT to RCVD\_COUNT + 1.

- if *outOfOrderDelivery* is configured:

- deliver the resulting PDCP SDU to upper layers.

- if RCVD\_COUNT = RX\_DELIV:

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before;

- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from COUNT = RX\_DELIV;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers, with COUNT value > RX\_DELIV;

- if *t-Reordering* is running, and if RX\_DELIV >= RX\_REORD:

- stop and reset *t-Reordering*.

- if *t-Reordering* is not running (includes the case when *t-Reordering* is stopped due to actions above), and RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

[TS 38.323, clause 5.3]

When the *discardTimer* expires for a PDCP SDU, or the successful delivery of a PDCP SDU is confirmed by PDCP status report, the transmitting PDCP entity shall discard the PDCP SDU along with the corresponding PDCP Data PDU. If the corresponding PDCP Data PDU has already been submitted to lower layers, the discard is indicated to lower layers.

For SRBs, when upper layers request a PDCP SDU discard, the PDCP entity shall discard all stored PDCP SDUs and PDCP PDUs.

NOTE: Discarding a PDCP SDU already associated with a PDCP SN causes a SN gap in the transmitted PDCP Data PDUs, which increases PDCP reordering delay in the receiving PDCP entity. It is up to UE implementation how to minimize SN gap after SDU discard.

[TS 38.323, clause 5.4.1]

For AM DRBs configured by upper layers to send a PDCP status report in the uplink (*statusReportRequired* in TS 38.331 [3]), the receiving PDCP entity shall trigger a PDCP status report when:

- upper layer requests a PDCP entity re-establishment;

- upper layer requests a PDCP data recovery.

If a PDCP status report is triggered, the receiving PDCP entity shall:

- compile a PDCP status report as indicated below by:

- setting the FMC field to RX\_DELIV;

- if RX\_DELIV < RX\_NEXT:

- allocating a Bitmap field of length in bits equal to the number of COUNTs from and not including the first missing PDCP SDU up to and including the last out-of-sequence PDCP SDUs, rounded up to the next multiple of 8, or up to and including a PDCP SDU for which the resulting PDCP Control PDU size is equal to 9000 bytes, whichever comes first;

- setting in the bitmap field as '0' for all PDCP SDUs that have not been received, and optionally PDCP SDUs for which decompression have failed;

- setting in the bitmap field as '1' for all PDCP SDUs that have been received;

- submit the PDCP status report to lower layers as the first PDCP PDU for transmission via the transmitting PDCP entity as specified in subclause 5.2.1..

[TS 38.323, clause 5.4.2]

For AM DRBs, when a PDCP status report is received in the downlink, the transmitting PDCP entity shall:

- consider for each PDCP SDU, if any, with the bit in the bitmap set to '1', or with the associated COUNT value less than the value of FMC field as successfully delivered, and discard the PDCP SDU as specified in the subclause 5.3.

[TS 38.323, clause 7.1]

This sub clause describes the state variables used in PDCP entities in order to specify the PDCP protocol. The state variables defined in this subclause are normative.

All state variables are non-negative integers, and take values from 0 to [232 – 1].

PDCP Data PDUs are numbered integer sequence numbers (SN) cycling through the field: 0 to [2[*pdcp-SN-Size*] – 1].

The transmitting PDCP entity shall maintain the following state variables:

a) TX\_NEXT

This state variable indicates the COUNT value of the next PDCP SDU to be transmitted. The initial value is 0.

The receiving PDCP entity shall maintain the following state variables:

a) RX\_NEXT

This state variable indicates the COUNT value of the next PDCP SDU expected to be received. The initial value is 0.

b) RX\_DELIV

This state variable indicates the COUNT value of the first PDCP SDU not delivered to the upper layers, but still waited for. The initial value is 0.

c) RX\_REORD

This state variable indicates the COUNT value following the COUNT value associated with the PDCP Data PDU which triggered *t-Reordering*.

7.1.3.4.1.3 Test description

7.1.3.4.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 except the following:

- 2 NR cells (NR Cell 1 and NR Cell 2) are configured with DRBs in RLC AM mode.

- The cell power levels are configured as per the Table 7.1.3.4.1.3.1-1.

- DRB of NR Cell 1 is configured according to Table 7.1.3.4.1.3.1-3.

Table 7.1.3.4.1.3.1-1: Time instances of cell power level in FR1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Parameter** | **Unit** | **EUTRA Cell 1** | **NR Cell 1** | **NR Cell 2** | **Remark** |
| T0 | Cell-specific RS EPRE | dBm/SCS | -85 | - | - |  |
| SS/PBCH  SSS EPRE | dBm/SCS | - | -88 | Off |  |
| T1 | Cell-specific RS EPRE | dBm/SCS | -85 | - | - |  |
| SS/PBCH  SSS EPRE | dBm/SCS | - | -88 | -82 |  |
| T2 | Cell-specific RS EPRE | dBm/SCS | -85 | - |  |  |
| SS/PBCH  SSS EPRE | dBm/SCS | - | -82 | -88 |  |

Table 7.1.3.4.1.3.1-2: Time instances of cell power level in FR2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Parameter** | **Unit** | **EUTRA Cell 1** | **NR Cell 1** | **NR Cell 2** | **Remark** |
| T0 | Cell-specific RS EPRE | dBm/SCS | -96 | - | - |  |
| SS/PBCH  SSS EPRE | dBm/SCS | - | -91 | Off |  |
| T1 | Cell-specific RS EPRE | dBm/SCS | -96 | - | - |  |
| SS/PBCH  SSS EPRE | dBm/SCS | - | -91 | -82 |  |
| T2 | Cell-specific RS EPRE | dBm/SCS | -96 | - |  |  |
| SS/PBCH  SSS EPRE | dBm/SCS | - | -82 | -91 |  |

Table 7.1.3.4.1.3.1-3: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms150 |

Table 7.1.3.4.1.3.1-4: MAC-CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508, clause Table 4.6.3-68 | | | |
| Information Element | Value/remark | Comment | Condition |
| MAC-CellGroupConfig ::= SEQUENCE { |  |  |  |
| bsr-Config SEQUENCE { |  |  |  |
| retxBSR-Timer | sf80 |  |  |
| } |  |  |  |

7.1.3.4.1.3.2 Test procedure sequence

Table 7.1.3.4.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS creates 5 PDCP Data PDUs and the TX\_NEXT is set to "0". | - | - | - | - |
| - | EXCEPTION: Step 2 and 3 shall be repeated for k=0 to 1(increment=1). | - | - | - | - |
| 2 | The SS sends the PDCP Data PDU#k via RLC-AM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k on NR Cell 1.  After having sent a PDU, the SS set TX\_NEXT = k+1. | <-- | PDCP PDU DATA #k | - | - |
| 3 | The UE sends the PDCP Data PDU#k via RLC-AM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k on NR Cell 1.  Data is previously received data from PDU #k. (Note 1) | --> | PDCP PDU DATA #k | - | - |
| 3A | The SS changes NR Cell 2 parameters according to the row "T1" in table 7.1.3.4.1.3.1-1(FR1) / 7.1.3.4.1.3.1-2(FR2). |  |  |  |  |
| - | EXCEPTION: Step 4 to 6 shall be repeated for m=2 to 4 (increment=1). | - | - | - | - |
| 4 | The SS is configured on NR Cell 1 not to send RLC acknowledgement (RLC ACK) to the next received RLC SDU to the UE. | - | - | - | - |
| 5 | The SS sends the PDCP Data PDU #m via RLC-AM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN =m.  After having sent a PDU, the SS set TX\_NEXT = m+1. (Note 6) | <-- | PDCP PDU DATA #m | - | - |
| 6 | The UE sends the PDCP Data PDU#m via RLC-AM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = m.  Data is previously received data from PDU #m. (Note 2) | --> | PDCP PDU DATA #m | - | - |
| 6A | Configure SS not to allocate UL grant to the UE in NR Cell 1 |  |  |  |  |
| 7 | Void | - | - | - | - |
| 8 | The SS transmits NR RRCReconfiguration message to perform SpCell change from NR Cell1 to NR Cell2  (Note 3) | <-- | *RRCReconfiguration* | - | - |
| 9 | The SS assigns UL grant during the Random Access procedure on NR Cell 2 to allow the UE to send PDCP status report.(Note 5) | - | *-* | - | - |
| - | EXCEPTION: Steps 10 and 11 can occur in any order. (Note 7) | - | - | - | - |
| 10 | The UE transmits a NR *RRCReconfigurationComplete* message.  (Note 4) | --> | *RRCReconfigurationComplete* | - | - |
| 11 | Check: Does the UE send PDCP Control PDUs via RLC-AM RB with the following content to the SS:  D/C field = 0 (PDCP control PDU) and PDU Type =000, FMC field = 5 on NR Cell 2? | --> | PDCP STATUS REPORT | 1 | P |
| 12 | The SS generates a PDCP status report message and sends it to UE: D/C field = 0 (PDCP control PDU) and PDU Type =000, FMC field = 2 on NR Cell 2. | <-- | PDCP STATUS REPORT | - | - |
| 13 | Configure the SS to allocate Default UL grants to the UE in NR Cell 2. | - | - | - | - |
| 14 | Void | - | - | - | - |
| - | EXCEPTION: Step 15 shall be repeated for m=2 to 4 (increment=1). | - | - | - | - |
| 15 | Check: Does the UE send the PDCP Data PDU #m via RLC-AM RB with the following content to the SS:  D/C field = 1 (PDCP Data PDU) and PDCP SN = m on NR Cell 2?  Note: Data is previously received data from PDU #m.  (Note 8) | --> | PDCP PDU DATA #m | 2 | P |
| 16 | The SS sends the PDCP Data PDU#5 via RLC-AM RB with the following content to the UE:  PDCP Data PDU #5 (  D/C field = 1 (PDCP Data PDU) and PDCP SN=5) on NR Cell 2. | <-- | PDCP DATA PDU#5 | - | - |
| 17 | The UE transmits a PDCP Data PDU via RLC-AM RB with the following content back to the SS:  D/C field = 1 (PDCP Data PDU) and PDCP SN=5 on NR Cell 2.  Note: Data is previously received packet in PDCP Data PDU#5.  (Note 1) | --> | PDCP DATA PDU #5 | - | - |
| 18 | TX\_NEXT is set to "6".  The SS creates a PDCP Data PDU#6 (not transmitted). | - | - | - | - |
| 19 | The TX\_NEXT is set to "7". The SS creates a PDCP Data PDU #7. | - | - | - | - |
| 20 | The SS sends PDCP Data PDU#7 via RLC-AM RB with the following content to the UE:  PDCP Data PDU#7;  D/C field = 1 (PDCP Data PDU) and PDCP SN=7 on NR Cell 2. | <-- | PDCP DATA PDU #7 | - | - |
| 21 | Check: Does the UE transmit a PDCP DATA PDU#7 on NR Cell 2? | --> | PDCP DATA PDU#7 | 3 | F |
| 21A | Configure SS not to allocate UL grant to the UE in NR Cell 1 | - | - | - | - |
| 22 | The SS changes NR Cell 1 and NR Cell 2 parameters according to row "T2" in Table 7.1.3.4.1.3.1-1(FR1) / 7.1.3.4.1.3.1-2(FR2). | - | - | - | - |
| 23 | The SS requests transmits NR RRCReconfiguration message to perform SpCell change from NR Cell2 to NR Cell1 with key change.  (Note 3) | <-- | *RRCReconfiguration* | - | - |
| 24 | SS assigns UL grant during the Random Access procedure on NR Cell 1 to allow the UE to send PDCP status report.(Note 5) | - | *-* | - | - |
| - | EXCEPTION: Steps 25 and 26 can occur in any order. (Note 7) | - | - | - | - |
| 25 | The UE transmits a NR *RRCReconfigurationComplete* message.  (Note 4) | --> | *RRCReconfigurationComplete* | - | - |
| 26 | The UE sends PDCP Control PDUs via RLC-AM RB with the following content to the SS: D/C field = 0 (PDCP control PDU) and PDU Type =000, FMC field = 6, Bitmap = 0x80 on NR Cell 1. | --> | PDCP STATUS REPORT | - | - |
| 27 | The SS generates a PDCP status report message and sends it to UE: D/C field = 0 (PDCP control PDU) and PDU Type =000, FMC field = 6 on NR Cell 1. | <-- | PDCP STATUS REPORT | - | - |
| 28 | Configure the SS to allocate Default UL grants to the UE in NR Cell 1 | - | - | - | - |
| 28A | The SS sends the PDCP Data PDU#5 via RLC-AM RB with the following content to the UE:  PDCP Data PDU #5 (  D/C field = 1 (PDCP Data PDU) and PDCP SN=5) on NR Cell 1. | <-- | PDCP DATA PDU#5 | - | - |
| 28B | Check: Does the UE transmit a PDCP Data PDU via RLC-AM RB with the following content back to the SS:  D/C field = 1 (PDCP Data PDU) and PDCP SN=5 on NR Cell 1 within the next 5 seconds? | --> | PDCP DATA PDU #5 | 3 | F |
| 29 | The SS sends the PDCP Data PDU#6 via RLC-AM RB with the following content to the UE:  PDCP Data PDU#6 (  D/C field = 1 (PDCP Data PDU) and PDCP SN=6) on NR Cell 1. | <-- | PDCP DATA PDU #6 | - | - |
| 30 | Check: Does the UE transmit a PDCP Data PDU via RLC-AM RB with the following content back to the SS?  D/C field = 1 (PDCP Data PDU) and PDCP SN=6 on NR Cell 1.  Note: Data is previously received packet in PDCP Data PDU#6  (Note 9) | --> | PDCP DATA PDU #6 | 3 | P |
| 31 | Check: Does the UE transmit PDCP Data PDU via RLC-AM RB with the following content back to the SS?  D/C field = 1 (PDCP Data PDU) and PDCP SN=7 on NR Cell 1.  Note: Data is previously received packet in PDCP Data PDU#7  (Note 9) | --> | PDCP DATA PDU #7 | 3 | P |
| Note 1: The SS acknowledges the received data.  Note 2: SS doesn’t send the RLC ACK for this data.  Note 3: For EN-DC the NR RRCReconfiguration *(Table* 7.1.3.4.1.3.3-1 with *cond EN-DC)* and *RadioBearerConfig* message (Table 7.1.3.4.1.3.3-2) are contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using conditions EN-DC\_EmbedNR\_RRCRecon, EN-DC\_PSCell\_HO and RBConfig\_KeyChange. IE sk-Counter-r15 is included with a value incremented by 1 than previous value.  Note 4: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 5: The PDCP STATUS REPORT PDU size shall be 6 octets with 3 octets of RLC header, 2 octets of MAC header and 3 octets of MAC BSR or padding, so TBS of 112 bits shall be allocated.  Note 6: PDCP PDU with m = 2 is sent at t = 0 and the subsequent PDCP PDUs are sent at t = (m-2)\*100.  Note 7: Per 38.508-1 Table 4.6.3-66: *LogicalChannelConfig*, both SRB1 and DRB have the same logical channel priority with prioritisedBitRate as infinity.  Note 8 PDCP PDUs at step 15 (m=2 to 4) may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot).  Note 9 PDCP PDUs at steps 30 and 31 may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot). | | | | | | |

7.1.3.4.1.3.3 Specific message contents

Table 7.1.3.4.1.3.3-0: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

Table 7.1.3.4.1.3.3-1: *RRCReconfiguration* (steps 8, 23)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig |  | NR |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| nonCriticalExtension::= SEQUENCE { |  |  | NR |
| masterCellGroup | CellGroupConfig |  |  |
| masterKeyUpdate ::= SEQUENCE { |  |  |  |
| keySetChangeIndicator | false |  |  |
| nextHopChainingCount | 0 |  |  |
| nas-Container | Not present | Horizontal key derivation |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.1.3.3-2: *RadioBearerConfig* (Table 7.1.3.4.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.3-132 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| drb-Identity | 2 | SCG DRB Id | EN-DC |
|  | Default DRB of the first PDU session |  | NR |
| reestablishPDCP | True |  |  |
| recoverPDCP | Not present |  |  |
| pdcp-Config | PDCP-Config |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.1.3.3-3: *PDCP-Config* (Table 7.1.3.4.1.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.3-99 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| drb SEQUENCE { |  |  |  |
| statusReportRequired | True |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.1.3.3-4: *CellGroupConfig* for EN-DC(Table 7.1.3.4.1.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.3-19 with condition PSCell\_change | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon | ServingCellConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.1.3.3-4A: *CellGroupConfig* for NR/5GC(Table 7.1.3.4.1.3.3-1)

|  |
| --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.3-19 with condition PCell\_change |

Table 7.1.3.4.1.3.3-5: Void

Table 7.1.3.4.1.3.3-6: Void

##### 7.1.3.4.2 PDCP handover / Non-lossless handover / PDCP sequence number maintenance

7.1.3.4.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with default RB using RLC-UM }

**ensure that** {

**when** { UE is requested to make a non-lossless handover by SS }

**then** { UE transmits next PDCP Data PDU with SN value 0 }

}

(2)

**with** { UE in RRC\_CONNECTED state with default RB using RLC-UM }

**ensure that** {

**when** { UE is requested to make a non-lossless handover by SS }

**then** { UE is able to receive next PDCP Data PDU with SN value 0 }

}

7.1.3.4.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clause 5.1.2. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.1.2]

When upper layers request a PDCP entity re-establishment, the UE shall additionally perform once the procedures described in this section. After performing the procedures in this section, the UE shall follow the procedures in subclause 5.2.

When upper layers request a PDCP entity re-establishment, the transmitting PDCP entity shall:

- for UM DRBs and AM DRBs, reset the header compression protocol for uplink and start with an IR state in U-mode (as defined in RFC 3095 [8] and RFC 4815 [9]) if *drb-ContinueROHC* is not configured in TS 38.331 [3];

- for UM DRBs and SRBs, set TX\_NEXT to the initial value;

- for SRBs, discard all stored PDCP SDUs and PDCP PDUs;

- apply the ciphering algorithm and key provided by upper layers during the PDCP entity re-establishment procedure;

- apply the integrity protection algorithm and key provided by upper layers during the PDCP entity re-establishment procedure;

- for UM DRBs, for each PDCP SDU already associated with a PDCP SN but for which a corresponding PDU has not previously been submitted to lower layers:

- consider the PDCP SDUs as received from upper layer;

- perform transmission of the PDCP SDUs in ascending order of the COUNT value associated to the PDCP SDU prior to the PDCP re-establishment without restarting the *discardTimer*.

- for AM DRBs, from the first PDCP SDU for which the successful delivery of the corresponding PDCP Data PDU has not been confirmed by lower layers, perform retransmission or transmission of all the PDCP SDUs already associated with PDCP SNs in ascending order of the COUNT values associated to the PDCP SDU prior to the PDCP entity re-establishment as specified below:

- perform header compression of the PDCP SDU as specified in the subclause 5.7.4;

- perform integrity protection and ciphering of the PDCP SDU using the COUNT value associated with this PDCP SDU as specified in the subclause 5.9 and 5.8;

- submit the resulting PDCP Data PDU to lower layer.

When upper layers request a PDCP entity re-establishment, the receiving PDCP entity shall:

- process the PDCP Data PDUs that are received from lower layers due to the re-establishment of the lower layers, as specified in the subclause 5.2.2.1;

- for SRBs, discard all stored PDCP SDUs and PDCP PDUs;

- for UM DRBs, if *t-Reordering* is running:

- stop and reset *t-Reordering*;

- deliver all stored PDCP SDUs to the upper layers in ascending order of associated COUNT values after performing header decompression.

- for AM DRBs, perform header decompression for all stored PDCP SDUs if *drb-ContinueROHC* is not configured in TS 38.331 [3];

- for UM DRBs and AM DRBs, reset the header compression protocol for downlink and start with NC state in U-mode (as defined in RFC 3095 [8] and RFC 4815 [9]) if *drb-ContinueROHC* is not configured in TS 38.331 [3];

- for UM DRBs and SRBs, set RX\_NEXT and RX\_DELIV to the initial value;

- apply the ciphering algorithm and key provided by upper layers during the PDCP entity re-establishment procedure;

- apply the integrity protection algorithm and key provided by upper layers during the PDCP entity re-establishment procedure.

7.1.3.4.2.3 Test description

7.1.3.4.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 except that the DRB under test is configured in RLC UM mode. For EN-DC, ciphering algorithm is configured as null on E-UTRA.

7.1.3.4.2.3.2 Test procedure sequence

Table 7.1.3.4.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS creates 3 PDCP Data PDUs and the TX\_NEXT is set to "0". | - | - | - | - |
| - | EXCEPTION: Step 2 and 3 shall be repeated for k=0 to 1 (increment=1). | - | - | - | - |
| 2 | The SS sends the PDCP Data PDU #k via RLC-UM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k.  After having sent a PDU, the SS set TX\_NEXT= k+1. | <-- | PDCP PDU DATA #k | - | - |
| 3 | The UE sends the PDCP Data PDU #k via RLC-UM RB with the following content to the SS:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k. | --> | PDCP PDU DATA #k | - | - |
| 4 | The SS transmits NR *RRCReconfiguration* message to trigger non-lossless handover to the same SpCell. (Note 1, Note 3 and Note4) | <-- | *RRCReconfiguration* | - | - |
| 5 | The UE transmits a NR *RRCReconfigurationComplete* message. (Note 2) | --> | *RRCReconfigurationComplete* | - | - |
| 6 | The SS sends the PDCP Data PDU #2 via RLC-UM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = 0.  After having sent a PDU, the SS set TX\_NEXT= 1. | <-- | PDCP PDU DATA #2 | - | - |
| 7 | Check: Does the UE send the PDCP Data PDU #2 via RLC-UM RB with the following content back to the SS:  D/C field = 1 (PDCP Data PDU) and PDCP SN = 0? | --> | PDCP PDU DATA #2 | 1, 2 | P |
| Note 1: For EN-DC the NR RRCReconfiguration message with SCG Key change (secondary to master)is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_PSCell\_HO and RBConfig\_KeyChange.  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 3: The RRCReconfiguration message triggers UE to perform the Random Access procedure, MAC reset, RLC and PDCP re-establishment.  Note 4: For NR, the RRCReconfiguration message with master key change is as per RRCReconfiguration-HO with condition RBConfig\_KeyChange according to 38.508-1 [4], Table 4.8.1-1A. | | | | | |

7.1.3.4.2.3 Specific message contents

Table 7.1.3.4.2.3-1: *RRCReconfiguration* for EN-DC (step 4, Table 7.1.3.4.2.3.2-1)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition EN-DC\_HO. |

Table 7.1.3.4.2.3-1A: *RRCReconfiguration* for NR/5GC (step 4, Table 7.1.3.4.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.8.1-1A with condition RBConfig\_KeyChange | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| masterKeyUpdate SEQUENCE { |  |  |  |
| keySetChangeIndicator | false | K |  |
| nextHopChainingCount | 0 | Horizontal key derivation |  |
| nas-Container | not present |  |  |
| } |  |  |  |

Table 7.1.3.4.2.3-2: *RadioBearerConfig* for EN-DC (step 4, Table 7.1.3.4.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-132 with condition EN-DC\_DRB AND Re-establish\_PDCP | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| securityConfig SEQUENCE { |  |  |  |
| securityAlgorithmConfig | SecurityAlgorithmConfig |  |  |
| keyToUse | master |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.2.3-3: SecurityAlgorithmConfig for EN-DC (Table 7.1.3.4.2.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-165 | | | |
| Information Element | Value/remark | Comment | Condition |
| SecurityAlgorithmConfig ::= SEQUENCE { |  |  |  |
| cipheringAlgorithm | nea0 |  |  |
| } |  |  |  |

Table 7.1.3.4.2.3-4: *CellGroupConfig* for EN-DC (step 4, Table 7.1.3.4.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PSCell\_change | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 1 entry |  | EN-DC |
| RLC-Bearer-Config[1] | RLC-BearerConfig with conditions UM and DRB2 and Re-establish\_RLC | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.2.3-5: *CellGroupConfig* for NR/5GC (step 4, Table 7.1.3.4.2.3.2-1)

|  |
| --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 with condition PCell\_change |

##### 7.1.3.4.3 PDCP handover / DAPS handover / Status reporting / Intra-frequency

7.1.3.4.3.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_CONNECTED state and supporting Intra-frequency DAPS handover }

**ensure that** {

**when** { UE receives an RRCReconfiguration message including a reconfigurationWithSync for Intra-frequency DAPS handover } **then** { PDCP entity associated with a DAPS bearer shall keep DL/UL reception/transmission with the source gNB }

}

(2)

**with** { UE in NR RRC\_CONNECTED state and supporting Intra-frequency DAPS handover and receiving an RRCReconfiguration message including a reconfigurationWithSync for Intra-frequency DAPS handover }

**ensure that** {

**when** { UE has performed random access procedure to the target cell successfully } **then** { UE shall perform uplink data switching }

}

(3)

**with** { UE in NR RRC\_CONNECTED state and supporting Intra-frequency DAPS handover and receiving an RRCReconfiguration message including a reconfigurationWithSync for Intra-frequency DAPS handover }

**ensure that** {

**when** { upper layer requests a uplink data switching } **then** { UE shall send a PDCP status report for the DAPS bearer }

}

(4)

**with** { UE in NR RRC\_CONNECTED state and supporting Intra-frequency DAPS handover and receiving an RRCReconfiguration message including a reconfigurationWithSync for Intra-frequency DAPS handover }

**ensure that** {

**when** { upper layer requests a PDCP entity reconfiguration and the associated RLC entity is released for a radio bearer } **then** { UE shall send a PDCP status report for the DAPS bearer }

}

7.1.3.4.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.331 clause 5.3.5.5.2 and TS 38323 clause 4.2.2, 5.4.1, 5.8, 5.9 and 5.13. Unless otherwise stated these are Rel-16 requirements.

[TS 38.331, clause 5.3.5.5.2]

The UE shall perform the following actions to execute a reconfiguration with sync.

1> if the AS security is not activated, perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with the release cause '*other*' upon which the procedure ends;

…

1> If any DAPS bearer is configured:

2> create a MAC entity for the target cell group with the same configuration as the MAC entity for the source cell group;

2> for each DAPS bearer:

3> establish an RLC entity or entities for the target cell group, with the same configurations as for the source cell group;

3> establish the logical channel for the target cell group, with the same configurations as for the source cell group;

NOTE 2b: In order to understand if a DAPS bearer is configured, the UE needs to check the presence of the field *daps-Config* within the *RadioBearerConfig* IE received in *radioBearerConfig* or *radioBearerConfig2*.

2> for each SRB:

3> establish an RLC entity for the target cell group, with the same configurations as for the source cell group;

3> establish the logical channel for the target cell group, with the same configurations as for the source cell group;

3> suspend SRBs for the source cell group;

NOTE 3: Void

2> apply the value of the *newUE-Identity* as the C-RNTI in the target cell group;

2> configure lower layers for the target SpCell in accordance with the received s*pCellConfigCommon*;

2> configure lower layers for the target SpCell in accordance with any additional fields, not covered in the previous, if included in the received reconfigurationWithSync.

[TS 38.323, clause 4.2.2]

The PDCP entities are located in the PDCP sublayer. Several PDCP entities may be defined for a UE. Each PDCP entity is carrying the data of one radio bearer. A PDCP entity is associated either to the control plane or the user plane depending on which radio bearer it is carrying data for.

Figure 4.2.2.1 represents the functional view of the PDCP entity for the PDCP sublayer; it should not restrict implementation. The figure is based on the radio interface protocol architecture defined in TS 38.300 [2].

For split bearers and DAPS bearers, routing is performed in the transmitting PDCP entity.

A PDCP entity associated with DRB can be configured by upper layers TS 38.331 [3] to use header compression. In this version of the specification, the robust header compression protocol (ROHC) and the Ethernet header compression protocol (EHC) are supported. Each header compression protocol is independently configured for a DRB.



Figure 4.2.2-1: PDCP layer, functional view

Figure 4.2.2-2 represents the functional view of the PDCP entity associated with the DAPS bearer for the PDCP sublayer; it should not restrict implementation. The figure is based on the radio interface protocol architecture defined in TS 38.300 [2].

For DAPS bearers, the PDCP entity is configured with two sets of security functions and keys and two sets of header compression protocols.



Figure 4.2.2-2: PDCP layer associated with DAPS bearer, functional view

[TS 38.323, clause 5.4.1]

For AM DRBs configured by upper layers to send a PDCP status report in the uplink (*statusReportRequired* in TS 38.331 [3]), the receiving PDCP entity shall trigger a PDCP status report when:

- upper layer requests a PDCP entity re-establishment;

- upper layer requests a PDCP data recovery;

- upper layer requests a uplink data switching;

- upper layer reconfigures the PDCP entity to release DAPS and *daps-SourceRelease* is configured in TS 38.331 [3].

For UM DRBs configured by upper layers to send a PDCP status report in the uplink (*statusReportRequired* in TS 38.331 [3]), the receiving PDCP entity shall trigger a PDCP status report when:

- upper layer requests a uplink data switching.

[TS 38.323, clause 5.8]

The ciphering function includes both ciphering and deciphering and is performed in PDCP, if configured. The data unit that is ciphered is the MAC-I (see clause 6.3.4) and the data part of the PDCP Data PDU (see clause 6.3.3) except the SDAP header and the SDAP Control PDU if included in the PDCP SDU. The ciphering is not applicable to PDCP Control PDUs.

For downlink and uplink, the ciphering algorithm and key to be used by the PDCP entity are configured by upper layers TS 38.331 [3] and the ciphering method shall be applied as specified in TS 33.501 [6].

The ciphering function is activated/suspended/resumed by upper layers TS 38.331 [3]. When security is activated and not suspended, the ciphering function shall be applied to all PDCP Data PDUs indicated by upper layers TS 38.331 [3] for the downlink and the uplink, respectively.

For DAPS bearers, the PDCP entity shall perform the ciphering or deciphering for the PDCP SDU using the ciphering algorithm and key either configured for the source cell or configured for the target cell, based on to/from which cell the PDCP SDU is transmitted/received.

For downlink and uplink ciphering and deciphering, the parameters that are required by PDCP for ciphering are defined in TS 33.501 [6] and are input to the ciphering algorithm. The required inputs to the ciphering function include the COUNT value, and DIRECTION (direction of the transmission: set as specified in TS 33.501 [6]). The parameters required by PDCP which are provided by upper layers TS 38.331 [3] are listed below:

- BEARER (defined as the radio bearer identifier in TS 33.501 [6]. It will use the value RB identity –1 as in TS 38.331 [3]);

- KEY (the ciphering keys for the control plane and for the user plane are KRRCenc and KUPenc, respectively).

[TS 38.323, clause 5.9]

The integrity protection function includes both integrity protection and integrity verification and is performed in PDCP, if configured. The data unit that is integrity protected is the PDU header and the data part of the PDU before ciphering. The integrity protection is always applied to PDCP Data PDUs of SRBs. The integrity protection is applied to sidelink SRB1, SRB2 and SRB3. The integrity protection is applied to PDCP Data PDUs of DRBs (including sidelink DRBs for unicast) for which integrity protection is configured. The integrity protection is not applicable to PDCP Control PDUs.

For downlink and uplink, the integrity protection algorithm and key to be used by the PDCP entity are configured by upper layers TS 38.331 [3] and the integrity protection method shall be applied as specified in TS 33.501 [6].

The integrity protection function is activated/suspended/resumed by upper layers TS 38.331 [3]. When security is activated and not suspended, the integrity protection function shall be applied to all PDUs including and subsequent to the PDU indicated by upper layers TS 38.331 [3] for the downlink and the uplink, respectively.

NOTE 1: As the RRC message which activates the integrity protection function is itself integrity protected with the configuration included in this RRC message, this message needs first be decoded by RRC before the integrity protection verification could be performed for the PDU in which the message was received.

NOTE 2: As the PC5-S message which activates the integrity protection function is itself integrity protected with the configuration included in this PC5-S message, this message needs first be decoded by upper layer before the integrity protection verification could be performed for the PDU in which the message was received.

For DAPS bearers, the PDCP entity shall perform the integrity protection or verification for the PDCP SDU using the integrity protection algorithm and key either configured for the source cell or configured for the target cell, based on to/from which cell the PDCP SDU is transmitted/received.

For downlink and uplink integrity protection and verification, the parameters that are required by PDCP for integrity protection are defined in TS 33.501 [6] and are input to the integrity protection algorithm. The required inputs to the integrity protection function include the COUNT value, and DIRECTION (direction of the transmission: set as specified in TS 33.501 [6]). The parameters required by PDCP which are provided by upper layers TS 38.331 [3] are listed below:

- BEARER (defined as the radio bearer identifier in TS 33.501 [6]. It will use the value RB identity –1 as in TS 38.331 [3]);

- KEY (the integrity protection keys for the control plane and for the user plane are KRRCint and KUPint, respectively).

[TS 38.323, clause 5.13]

For DAPS bearers, when upper layers request uplink data switching, the transmitting PDCP entity shall:

- for AM DRBs, from the first PDCP SDU for which the successful delivery of the corresponding PDCP Data PDU has not been confirmed by the RLC entity associated with the source cell, perform retransmission or transmission of all the PDCP SDUs already associated with PDCP SNs in ascending order of the COUNT values associated to the PDCP SDU prior to uplink data switching to the RLC entity associated with the target cell as specified below:

- perform header compression of the PDCP SDU using ROHC as specified in the clause 5.7.4;

- perform integrity protection and ciphering of the PDCP SDU using the COUNT value associated with this PDCP SDU as specified in the clause 5.9 and 5.8;

- submit the resulting PDCP Data PDU to lower layer, as specified in clause 5.2.1.

- for UM DRBs, for all PDCP SDUs which have been processed by PDCP but which have not yet been submitted to lower layers, perform transmission of the PDCP SDUs in ascending order of the COUNT values to the RLC entity associated with the target cell as specified below:

- perform header compression of the PDCP SDU using ROHC as specified in the clause 5.7.4;

- perform integrity protection and ciphering of the PDCP SDU using the COUNT value associated with this PDCP SDU as specified in the clause 5.9 and 5.8;

- submit the resulting PDCP Data PDU to lower layer, as specified in clause 5.2.1.

7.1.3.4.3.3 Test description

7.1.3.4.3.3.1 Pre-test conditions

System Simulator:

Same Pre-test conditions as in clause 7.1.3.0 except the following:

- NR Cell 1 is the Serving cell and the power level is configured to ''Serving Cell” defined in TS 38.508-1 [4] Table 6.2.2.1-3.

- NR Cell 2 is the Suitable neighbour intra-frequency cell and the power level is configured to '' Suitable neighbour intra-frequency cell” defined in TS 38.508-1 [4] Table 6.2.2.1-3.

- System information combination NR-2 as defined in TS 38.508-1 [4] clause 4.4.3.1.3 is used for both NR Cells.

- Test Loop Function (On) with UE test loop mode B activated according to TS 38.508-1 [4], table 4.5.4.2-3.

UE:

- None.

Preamble:

- The UE is in 3N-A state configured with DRB#1 in RLC AM mode according to TS 38.508-1 [4], Table 4.4A.2-3.

7.1.3.4.3.3.2 Test procedure sequence

Table 7.1.3.4.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an *RRCReconfiguration* message containing *reconfigurationWithSync* to order UE to perform DAPS handover to NR Cell 2. DRB#n of the first PDU session is configured as DAPS bearer. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| - | EXCEPTION: In parallel with step 2-3, parallel behaviour defined in table 7.1.3.4.3.3.2-2 is executed repeatedly. | - | - | - | - |
| 2 | The SS sends one IP Packet to the UE via DRB#n of the first PDU session in NR Cell 1 and | <-- | PDCP PDU DATA #0 | - | - |
| 2A | The SS stops sending RLC acknowledgements. | - | - | - | - |
| 3 | Check: Does the UE loop back the IP packet received at step 2 in NR Cell 1? | --> | PDCP PDU DATA #0 | 1 | P |
| 4 | The SS transmits Random Access Response to respond to the latest preamble in NR Cell 2. | <- | Random Access Response | - | - |
| - | EXCEPTION: Steps 5-7 can occur in any order. | - | - | - | - |
| 5 | The UE transmits an *RRCReconfigurationComplete* message in NR Cell 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 6 | Check: Does the UE retransmit the IP packet received at step 2 in NR Cell 2? | --> | PDCP PDU DATA #0 | 2 | P |
| 7 | Check: Does the UE send PDCP status report in NR Cell 2? (Note 1) | --> | PDCP STATUS REPORT | 3 | P |
| 8 | The SS transmits an *RRCReconfiguration* message with condition DAPS\_HO\_ReleaseSource in NR Cell 2. | <-- | NR RRC: *RRCReconfiguration* | - | - |
| - | EXCEPTION: Steps 9-10 can occur in any order. | - | - | - | - |
| 9 | The UE transmits an RRCReconfigurationComplete message in NR Cell 2. | --> | NR RRC: *RRCReconfigurationComplete* | - | - |
| 10 | Check: Does the UE send PDCP status report in NR Cell 2? (Note 1) | --> | PDCP STATUS REPORT | 4 | P |
| Note 1: D/C field = 0 (PDCP control PDU) and PDU Type =000 (PDCP status report), FMC field = 1. | | | | | |

Table 7.1.3.4.3.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The UE transmits preamble to NR Cell 2. | -> | (PRACH Preamble) | - | - |

7.1.3.4.3.3.3 Specific message contents

Table 7.1.3.4.3.3.3-1: *RRCReconfiguration* (step 1, Table 7.1.3.4.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.8.1-1A with Condition RBConfig\_NoKeyChange | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig with conditions DRBn and DAPS\_PDCP |  |  |
| nonCriticalExtension SEQUENCE{ |  |  |  |
| masterCellGroup | CellGroupConfig | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.3.3.3-2: *CellGroupConfig* (Table 7.1.3.4.3.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 1 entry |  |  |
| RLC-BearerConfig[1] | RLC-BearerConfig with conditions AM, DRBn | entry1 |  |
| } |  |  |  |
| spCellConfig SEQUENCE { |  |  |  |
| reconfigurationWithSync SEQUENCE { |  |  |  |
| spCellConfigCommon SEQUENCE { |  |  |  |
| physCellId | Physical Cell Identity of NR Cell 2 |  |  |
| } |  |  |  |
| rach-ConfigDedicated CHOICE { |  |  |  |
| uplink | RACH-ConfigDedicated | OCTET STRING (CONTAINING RACH-ConfigDedicated) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.3.3.3-3: *RACH-ConfigDedicated* (Table 7.1.3.4.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-129 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigDedicated ::= SEQUENCE { |  |  |  |
| cfra SEQUENCE { |  |  |  |
| occasions SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric | OCTET STRING (CONTAINING RACH-ConfigGeneric) |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.4.3.3.3-4: *RACH-ConfigGeneric* (Table 7.1.3.4.3.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| preambleTransMax | n200 |  |  |
| } |  |  |  |

Table 7.1.3.4.3.3.3-5: *RRCReconfiguration* (step 8, Table 7.1.3.4.3.3.2-1)

|  |
| --- |
| Derivation Path: TS 38.508-1 [4], Table 4.8.1-1A with Condition DAPS\_HO\_ReleaseSource |

##### 7.1.3.4.4 PDCP handover / DAPS handover / Status reporting / Inter-frequency

7.1.3.4.4.1 Test Purpose (TP)

(1)

**with** { UE in NR RRC\_CONNECTED state and supporting Inter-frequency DAPS handover }

**ensure that** {

**when** { UE receives an RRCReconfiguration message including a reconfigurationWithSync for Inter-frequency DAPS handover }

**then** { PDCP entity associated with a DAPS bearer shall keep DL/UL reception/transmission with the source gNB }

}

(2)

**with** { UE in NR RRC\_CONNECTED state and supporting Inter-frequency DAPS handover and receiving an RRCReconfiguration message including a reconfigurationWithSync for Inter-frequency DAPS handover }

**ensure that** {

**when** { UE has performed random access procedure to the target cell successfully }

**then** { UE shall perform uplink data switching }

}

(3)

**with** { UE in NR RRC\_CONNECTED state and supporting Inter-frequency DAPS handover and receiving an RRCReconfiguration message including a reconfigurationWithSync for Inter-frequency DAPS handover }

**ensure that** {

**when** { upper layer requests a uplink data switching }

**then** { UE shall send a PDCP status report for the DAPS bearer }

}

(4)

**with** { UE in NR RRC\_CONNECTED state and supporting Inter-frequency DAPS handover and receiving an RRCReconfiguration message including a reconfigurationWithSync for Inter-frequency DAPS handover }

**ensure that** {

**when** { upper layer requests a PDCP entity reconfiguration and the associated RLC entity is released for a radio bearer }

**then** { UE shall send a PDCP status report for the DAPS bearer }

}

7.1.3.4.4.2 Conformance requirements

Same as test case 7.1.3.4.3.2.

7.1.3.4.4.3 Test description

7.1.3.4.4.3.1 Pre-test conditions

Same as test case 7.1.3.4.3 with the following differences:

- Cells configuration: NR Cell 3 replaces NR Cell 2.

- System information combination: NR-4 replaces NR-2.

7.1.3.4.4.3.2 Test procedure sequence

Same as test case 7.1.3.4.3 with the following differences:

- Cells configuration: NR Cell 3 replaces NR Cell 2.

7.1.3.4.4.3.3 Specific message contents

Same as test case 7.1.3.4.3 with the following differences:

- Cells configuration: NR Cell 3 replaces NR Cell 2.

#### 7.1.3.5 PDCP other

##### 7.1.3.5.1 PDCP Discard

7.1.3.5.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { the Discard Timer for a PDCP SDU expires }

**then** { UE discards the corresponding PDCP SDU }

}

7.1.3.5.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clause 5.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.3]

When the *discardTimer* expires for a PDCP SDU, or the successful delivery of a PDCP SDU is confirmed by PDCP status report, the transmitting PDCP entity shall discard the PDCP SDU along with the corresponding PDCP Data PDU. If the corresponding PDCP Data PDU has already been submitted to lower layers, the discard is indicated to lower layers.

For SRBs, when upper layers request a PDCP SDU discard, the PDCP entity shall discard all stored PDCP SDUs and PDCP PDUs.

NOTE: Discarding a PDCP SDU already associated with a PDCP SN causes a SN gap in the transmitted PDCP Data PDUs, which increases PDCP reordering delay in the receiving PDCP entity. It is up to UE implementation how to minimize SN gap after SDU discard.

[TS 38.323, clause 7.1]

This sub clause describes the state variables used in PDCP entities in order to specify the PDCP protocol. The state variables defined in this subclause are normative.

All state variables are non-negative integers, and take values from 0 to [232 – 1].

PDCP Data PDUs are numbered integer sequence numbers (SN) cycling through the field: 0 to [2[*pdcp-SN-Size*] – 1].

The transmitting PDCP entity shall maintain the following state variables:

a) TX\_NEXT

This state variable indicates the COUNT value of the next PDCP SDU to be transmitted. The initial value is 0.

The receiving PDCP entity shall maintain the following state variables:

a) RX\_NEXT

This state variable indicates the COUNT value of the next PDCP SDU expected to be received. The initial value is 0.

b) RX\_DELIV

This state variable indicates the COUNT value of the first PDCP SDU not delivered to the upper layers, but still waited for. The initial value is 0.

c) RX\_REORD

This state variable indicates the COUNT value following the COUNT value associated with the PDCP Data PDU which triggered *t-Reordering*.

[TS 38.323, clause 6.3.5]

Length: 32 bits

The COUNT value is composed of a HFN and the PDCP SN. The size of the HFN part in bits is equal to 32 minus the length of the PDCP SN.



Figure 6.3.5-1: Format of COUNT

NOTE: COUNT does not wrap around.

7.1.3.5.1.3 Test description

7.1.3.5.1.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 with exceptions listed in Table 7.1.3.5.1.3.1-1 applicable for the configured UM DRB and Table 7.1.3.5.1.3.3-1 for SR configuration except that PDCP is configured for 18 bit SN.

Table 7.1.3.5.1.3.1-1: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| Discard\_Timer | 500 ms |

7.1.3.5.1.3.2 Test procedure sequence

Table 7.1.3.5.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| - | EXCEPTION: The SS does not allocate UL grants unless when explicitly stated so in the procedure. | - | - | - | - |
| 1 | The SS creates 5 PDCP Data PDUs and the PDCP SN = "0" within TX\_NEXT. |  | - | - | - |
| 2 | Void |  |  |  |  |
| - | EXCEPTION: Step 3 shall be repeated for k=0 to 2 (increment=1) with the below specified PDU size sent to the UE:  Data PDU#1 = 46 bytes for k=0  Data PDU#2 = 62 bytes for k=1  Data PDU#3 = 78 bytes for k=2 | - | - | - | - |
| 3 | The SS sends a PDCP Data PDU via RLC-UM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k  After having sent a PDU, the SS sets PDCP SN is set to k+1 within TX\_NEXT. | <-- | PDCP DATA PDU (SN=k) | - | - |
| 4 | Wait for Discard\_Timer to expire.  Note: According to TS38.508-1, timer tolerance should be 10% of Discard\_Timer. | - | - | - | - |
| - | EXCEPTION: Step 5 shall be repeated for k=3 to 4 (increment=1) with the below specified PDU size sent to the UE:  Data PDU#4 = 94 bytes for k=3  Data PDU#5 = 110 bytes for k=4 | - | - | - | - |
| 5 | The SS sends a PDCP Data PDU via RLC-UM RB with the following content to the UE:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k  After having sent a PDU, the SS sets PDCP SN is set to k+1 within TX\_NEXT. | <-- | PDCP DATA PDU (SN=k) | - | - |
| 6 | The SS resumes normal UL grant allocation. | - | - | - | - |
| 7 | Check: Does UE transmit a PDCP Data PDU # 4 of size 94 bytes? (Note1) (Note 2) | --> | PDCP Data PDU # 4 | 1 | P |
| 8 | Check: Does UE transmit a PDCP Data PDU # 5 of size 110 bytes? (Note1) (Note 2) | --> | PDCP Data PDU # 5 | 1 | P |
| Note 1 PDCP Data PDU contents are checked to verify that the UL PDU is same as the DL PDU. According to the Note in TS 38.323 [19] clause 5.3 in case of PDCP SDUs being discarded it is up to the UE implementation which SN to be used and therefore the SN cannot be checked.  Note 2 PDCP PDUs at steps 7 and 8 may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot). | | | | | |

7.1.3.5.1.3.3 Specific message contents

Table 7.1.3.5.1.3.3-1: SchedulingRequest-Config (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-155 | | | |
| Information Element | Value/remark | Comment | Condition |
| sr-TransMax | n64 |  |  |

##### 7.1.3.5.2 PDCP Uplink Routing / Split DRB

7.1.3.5.2.1 Test Purpose

(1)

**with** { UE in RRC\_CONNECTED state with SCG activated with a Split DRB established and total amount of PDCP data volume is less than *ul-DataSplitThreshold* and not yet transmitted RLC data volume in the two associated RLC entities }

**ensure that** {

**when** { UE has PDCP SDUs available for transmission }

**then** { the UE transmits the PDCP SDUs on the Primary RLC entity }

}

(2)

**with** { UE in RRC\_CONNECTED state with SCG activated with a Split DRB established and total amount of PDCP data volume is not less than *ul-DataSplitThreshold* and not yet transmitted RLC data volume in the two associated RLC entities }

**ensure that** {

**when** { UE has PDCP SDUs available for transmission }

**then** { the UE transmits the PDCP SDUs on the primary or secondary RLC entity }

}

7.1.3.5.2.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clause 5.2.1. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.2.1]

At reception of a PDCP SDU from upper layers, the transmitting PDCP entity shall:

- start the *discardTimer* associated with this PDCP SDU (if configured).

For a PDCP SDU received from upper layers, the transmitting PDCP entity shall:

- associate the COUNT value corresponding to TX\_NEXT to this PDCP SDU;

NOTE 1: Associating more than half of the PDCP SN space of contiguous PDCP SDUs with PDCP SNs, when e.g., the PDCP SDUs are discarded or transmitted without acknowledgement, may cause HFN desynchronization problem. How to prevent HFN desynchronization problem is left up to UE implementation.

- perform header compression of the PDCP SDU as specified in the subclause 5.7.4;

- perform integrity protection, and ciphering using the TX\_NEXT as specified in the subclause 5.9 and 5.8, respectively;

- set the PDCP SN of the PDCP Data PDU to TX\_NEXT modulo 2[*pdcp-SN-Size*];

- increment TX\_NEXT by one;

- submit the resulting PDCP Data PDU to lower layer as specified below.

When submitting a PDCP Data PDU to lower layer, the transmitting PDCP entity shall:

- if the transmitting PDCP entity is associated with one RLC entity:

- submit the PDCP Data PDU to the associated RLC entity.

- else, if the transmitting PDCP entity is associated with two RLC entities:

- if the PDCP duplication is activated:

- if the PDCP PDU is a PDCP Data PDU:

- duplicate the PDCP Data PDU and submit the PDCP Data PDU to both associated RLC entities.

- else:

- if the two associated RLC entities belong to the different Cell Groups; and

- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 36.322 [5]) in the two associated RLC entities is equal to or larger than *ul-DataSplitThreshold*:

- submit the PDCP Data PDU to either the primary RLC entity or the secondary RLC entity;.

- else:

- submit the PDCP Data PDU to the primary RLC entity.

NOTE 2: If the transmitting PDCP entity is associated with two RLC entities, the UE should minimize the amount of PDCP PDUs submitted to lower layers before receiving request from lower layers and minimize the PDCP SN gap between PDCP PDUs submitted to two associated RLC entities to minimize PDCP reordering delay in the receiving PDCP entity.

7.1.3.5.2.3 Test description

7.1.3.5.2.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 with exceptions listed in Table 7.1.3.5.2.3.1-1 and Generic procedure parameter DC bearer(*MCG and split*).

For NR/5GC, NR Cell 1 is the PCell and NR Cell 10 is the PSCell and same Pre-test conditions as in clause 7.1.3.0 using generic procedure parameter Connectivity (NR-DC) with DC bearer(*MCG and split)*.

Table 7.1.3.5.2.3.1-1: PDCP Settings

|  |  |
| --- | --- |
| Parameter | Value |
| Discard\_Timer | 500 ms |
| ul-DataSplitThreshold | b100 |

7.1.3.5.2.3.2 Test procedure sequence

Table 7.1.3.5.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 0A | SS transmits NR *RRCReconfiguration* message to configure the primary path on the MCG Cell. | <-- | *RRCReconfiguration* | - | - |
| 0B | UE transmits *RRCReconfigurationComplete* (Note 2). | --> | *RRCReconfigurationComplete* | - | - |
| 1 | The SS sends a PDCP Data PDU on the split DRB on AM RLC entity configured for SCG on PSCell.  Data PDU = 64 bytes. | <-- | PDCP DATA PDU | - | - |
| - | EXCEPTION: In parallel with step 2, UE may execute parallel behaviour defined in table 7.1.3.5.2.3.2-2. | - | - | - | - |
| 2 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 1 | P |
| 2A | SS transmits NR *RRCReconfiguration* message to configure the primary path on the SCG Cell. | <-- | *RRCReconfiguration* | - | - |
| 2B | UE transmits *RRCReconfigurationComplete* (Note 2). | --> | *RRCReconfigurationComplete* | - | - |
| 2C | The SS sends a PDCP Data PDU on the split DRB on AM RLC entity configured for SCG on PSCell.  Data PDU = 64 bytes. | <-- | PDCP DATA PDU | - | - |
| - | EXCEPTION: In parallel with step 2D, UE may execute parallel behaviour defined in table 7.1.3.5.2.3.2-2. | - | - | - | - |
| 2D | Check: Does UE transmit a PDCP Data PDU on the primary AM RLC entity? | --> | PDCP DATA PDU | 1 | P |
| 3 | The SS sends a PDCP Data PDU on the split DRB on AM RLC entity configured for SCG on PSCell.  Data PDU = 164 bytes. | <-- | PDCP DATA PDU | - | - |
| - | EXCEPTION: Steps 4a1 to 4b2 describe optional behaviour that depends on the UE uplink path | - | - | - | - |
| 4a1 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 2 | P |
| 4a2 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity | --> | PDCP DATA PDU | 2 | F |
| 4b1 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity? | --> | PDCP DATA PDU | 2 | P |
| 4b2 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 2 | F |
| 5 | SS transmits NR *RRCReconfiguration* message to configure new split DRB parameters, where the ul-DataSplitThreshold is equal to 0 bytes (Note 1). | <-- | *RRCReconfiguration* | - | - |
| 6 | UE transmits *RRCReconfigurationComplete* (Note 2). | --> | *RRCReconfigurationComplete* | - | - |
| 7 | The SS sends a PDCP Data PDU on the split DRB on AM RLC entity configured for SCG on PSCell.  Data PDU = 64 bytes | <-- | PDCP Data PDU | - | - |
| - | EXCEPTION: Steps 8a1 to 8b2 describe optional behaviour that depends on the UE uplink path | - | - | - | - |
| 8a1 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 2 | P |
| 8a2 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity? | --> | PDCP DATA PDU | 2 | F |
| 8b1 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary? | --> | PDCP DATA PDU | 2 | P |
| 8b2 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary? | --> | PDCP DATA PDU | 2 | F |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR *RRCReconfigurationComplete* message is contained in *RRCConnectionReconfigurationComplete*. | | | | | |

Table 7.1.3.5.2.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity in next 2 seconds?  NOTE: 2 seconds is sufficient time to discard PDCP PDU. | --> | PDCP DATA PDU | 1 | F |

7.1.3.5.2.3.3 Specific message contents

Table 7.1.3.5.2.3.3-0A: *RRCConnectionReconfiguration* (step 0A, step 2A, step 5, Table 7.1.3.5.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.1-8 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| c1 CHOICE{ |  |  |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.2.3.3-0B: *RRCReconfiguration* (step 0A, step 2C, step 5, Table 7.1.3.5.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| radioBearerConfig2 | OCTET STRING including RadioBearerConfig |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.2.3.3-1: *RadioBearerConfig* (Table 7.1.3.5.2.3.3-0A and Table 7.1.3.5.2.3.3-0B)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-132 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| pdcp-Config SEQUENCE { |  |  |  |
| moreThanOneRLC SEQUENCE { |  |  |  |
| primaryPath SEQUENCE { |  |  |  |
| cellGroup | 0 |  | Step 0A |
| 1 |  | Step 2A |
| logicalChannel | LogicalChannelIdentity |  |  |
| } |  |  |  |
| ul-DataSplitThreshold | b0 |  | Step 5 |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.3.5.3 PDCP Data Recovery

7.1.3.5.3.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with a DRB established using RLC-AM }

**ensure that** {

**when** { network requests reconfiguration and recovery of the DRB (without handover) }

**then** { UE reconfigures the DRB and performs retransmission of all the PDCP PDUs previously submitted to re-established AM RLC entity in ascending order of the associated COUNT values from the first PDCP PDU for which the successful delivery has not been confirmed by lower layers }

}

7.1.3.5.3.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clauses 5.2.1, 5.4.1 and 5.5; TS 38.331, clause 5.3.5.4.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.2.1]

At reception of a PDCP SDU from upper layers, the transmitting PDCP entity shall:

- start the *discardTimer* associated with this PDCP SDU (if configured).

For a PDCP SDU received from upper layers, the transmitting PDCP entity shall:

- associate the COUNT value corresponding to TX\_NEXT to this PDCP SDU;

NOTE 1: Associating more than half of the PDCP SN space of contiguous PDCP SDUs with PDCP SNs, when e.g., the PDCP SDUs are discarded or transmitted without acknowledgement, may cause HFN desynchronization problem. How to prevent HFN desynchronization problem is left up to UE implementation.

- perform header compression of the PDCP SDU as specified in the subclause 5.7.4;

- perform integrity protection, and ciphering using the TX\_NEXT as specified in the subclause 5.9 and 5.8, respectively;

- set the PDCP SN of the PDCP Data PDU to TX\_NEXT modulo 2[*pdcp-SN-Size*];

- increment TX\_NEXT by one;

- submit the resulting PDCP Data PDU to lower layer as specified below.

When submitting a PDCP PDU to lower layer, the transmitting PDCP entity shall:

- if the transmitting PDCP entity is associated with one RLC entity:

- submit the PDCP PDU to the associated RLC entity;

- else, if the transmitting PDCP entity is associated with two RLC entities:

- if *pdcp-Duplication* is configured and activated:

- duplicate the PDCP Data PDU and submit the PDCP Data PDU to both associated RLC entities;

- else, if *pdcp-Duplication* is configured but not activated:

- submit the PDCP Data PDU to the primary RLC entity;

- else:

- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the two associated RLC entities is less than *ul-DataSplitThreshold*:

- submit the PDCP PDU to the primary RLC entity;

- else:

- submit the PDCP PDU to either the primary RLC entity or the secondary RLC entity.

NOTE 2: If the transmitting PDCP entity is associated with two RLC entities, the UE should minimize the amount of PDCP PDUs submitted to lower layers before receiving request from lower layers and minimize the PDCP SN gap between PDCP PDUs submitted to two associated RLC entities to minimize PDCP reordering delay in the receiving PDCP entity.

[TS 38.323, clause 5.4.1]

For AM DRBs configured by upper layers to send a PDCP status report in the uplink (*statusReportRequired* in TS 38.331 [3]), the receiving PDCP entity shall trigger a PDCP status report when:

- upper layer requests a PDCP entity re-establishment;

- upper layer requests a PDCP data recovery.

If a PDCP status report is triggered, the receiving PDCP entity shall:

- compile a PDCP status report as indicated below by:

- setting the FMC field to RX\_DELIV;

- if RX\_DELIV < RX\_NEXT:

- allocating a Bitmap field of length in bits equal to the number of COUNTs from and not including the first missing PDCP SDU up to and including the last out-of-sequence PDCP SDUs, rounded up to the next multiple of 8, or up to and including a PDCP SDU for which the resulting PDCP Control PDU size is equal to 9000 bytes, whichever comes first;

- setting in the bitmap field as '0' for all PDCP SDUs that have not been received, and optionally PDCP SDUs for which decompression have failed;

- setting in the bitmap field as '1' for all PDCP SDUs that have been received;

- submit the PDCP status report to lower layers as the first PDCP PDU for transmission.

[TS 38.323, clause 5.4.2]

For AM DRBs, when a PDCP status report is received in the downlink, the transmitting PDCP entity shall:

- consider for each PDCP SDU, if any, with the bit in the bitmap set to '1', or with the associated COUNT value less than the value of FMC field as successfully delivered, and discard the PDCP SDU as specified in the subclause 5.3.

[TS 38.323, clause 5.5]

For AM DRBs, when upper layers request a PDCP data recovery for a radio bearer, the transmitting PDCP entity shall:

- perform retransmission of all the PDCP Data PDUs previously submitted to re-established or released AM RLC entity in ascending order of the associated COUNT values for which the successful delivery has not been confirmed by lower layers.

After performing the above procedures, the transmitting PDCP entity shall follow the procedures in subclause 5.2.1.

7.1.3.5.3.3 Test description

7.1.3.5.3.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 except that DRB is configured in RLC AM mode according to Table 7.1.3.5.3.3.1-1.

For NR 5GC, NRCell 1 is the PCell and NR Cell 10 is the PSCell and same Pre-test conditions as in clause 7.1.3.0 using generic procedure parameter Connectivity (*NR-DC*).

Table 7.1.3.5.3.3.1-1: RLC parameters

|  |  |
| --- | --- |
| *t-PollRetransmit* | ms150 |

7.1.3.5.3.3.2 Test procedure sequence

Table 7.1.3.5.3.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Void | - | - | - | - |
| 2 | The SS creates 3 PDCP Data PDUs and the Next\_PDCP\_TX\_SN is set to "0". | - | - | - | - |
| - | EXCEPTION: Steps 2A and 4 shall be repeated for k=0 to 2 (increment=1). | - | - | - | - |
| 2A | The SS is configured on PSCell to not send RLC acknowledgement (RLC ACK) to the UE | - | - | - | - |
| 3 | The SS sends the PDCP Data PDU #k on SCG DRB on (PSCell):  D/C field = 1 (PDCP Data PDU) and PDCP SN = k.  After having sent a PDU, the SS sets Next\_PDCP\_TX\_SN= k+1. | <-- | PDCP PDU DATA #k | - | - |
| 4 | The UE sends the PDCP Data PDU #k on the AM RLC entity configured for PSCell:  D/C field = 1 (PDCP Data PDU) and PDCP SN = k.  Data is previously received data from PDU #k. | --> | PDCP PDU DATA #k | - | - |
| 4A | The SS does not allocate any UL grant. | - | - | - | - |
| 5 | The SS transmits a NR *RRCReconfiguration*. (Note 1). | <-- | *RRCReconfiguration* | - | - |
| 6 | The UE transmits a NR *RRCReconfigurationComplete*. (Note 2). | --> | *RRCReconfigurationComplete* | - | - |
| 7 | The SS assigns 1 UL grant of sufficient size to allow the UE to send only PDCP status report. | - | - | - | - |
| 8 | The UE sends PDCP Control PDUs on PSCell via RLC-AM RB with the following content to the SS:  D/C field = 0 (PDCP control PDU) and PDU Type =000, FMC field = 3. | --> | PDCP STATUS REPORT | - | - |
| 8A | After 100 ms the SS allocates 3 UL grants every 20ms of sufficient size to enable the UE to return each received PDCP PDU in one looped back PDCP PDU on PSCell. | - | - | - | - |
| - | EXCEPTION: Step 9 shall be repeated for k=0 to 2 (increment=1). | - | - | - | - |
| 9 | Check: Does the UE send the PDCP Data PDU #k via the AM RLC entity configured for PSCell for Connectivity ENDC and PCell for Connectivity (NR-DC).  D/C field = 1 (PDCP Data PDU) and PDCP SN = k.  Data is previously received data from PDU #k ? | --> | PDCP DATA PDU #k | 1 | P |
| Note 1: For EN-DC the NR *RRCReconfiguration* message is contained in *RRCConnectionReconfiguration.*  Note 2: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete. | | | | | |

7.1.3.5.3.3.3 Specific message contents

Table 7.1.3.5.3.3.3-1: *RRCConnectionReconfiguration* (step 5, Table 7.1.3.5.3.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.1-8 with condition MCG\_and\_SCG | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| c1 CHOICE{ |  |  |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nr-Config-r15 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| nr-SecondaryCellGroupConfig-r15 | OCTET STRING including the *RRCReconfiguration-PDCP* message and the IE secondaryCellGroup |  |  |
| } |  |  |  |
| } |  |  |  |
| nr-RadioBearerConfig1-r15 | OCTET STRING including RadioBearerConfig-PDCP-ENDC |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.3.3.3-2: RRCReconfiguration-PDCP(Step 5, Table 7.1.3.5.3.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| radioBearerConfig | Not present |  | NR-DC |
| secondaryCellGroup | CellGroupConfig-PDCP-ENDC |  | EN-DC |
| Not present |  | NR-DC |
| nonCriticalExtension SEQUENCE { |  |  | NR-DC |
| masterCellGroup | CellGroupConfig with condition DRBn as per 38.508-1[4] Table 4.6.3-19 | SCG DRBn added in master cell group |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| mrdc-SecondaryCellGroupConfig CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| mrdc-SecondaryCellGroup CHOICE { |  |  |  |
| nr-SCG | RRCReconfiguration-SCGRLCreEst | OCTET STRING (CONTAINING RRCReconfiguration) |  |
| radioBearerConfig2 | RadioBearerConfig-PDCPsplit |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.3.3.3-2A: RRCReconfiguration-SCGRLCreEst(Table 7.1.3.5.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 with condition NR-DC\_SCG | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| secondaryCellGroup | | CellGroupConfig-SCG-RLC | OCTET STRING (CONTAINING CellGroupConfig) |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.3.5.3.3.3-2B: *CellGroupConfig-PDCP-ENDC*(Table 7.1.3.5.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 1 entry |  |  |
| RLC-BearerConfig[1] | RLC-BearerConfig with conditions AM and DRB2 and Re-establish\_RLC | entry 1 |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.3.3.3-2C: *CellGroupConfig-SCG-RLC* (Table 7.1.3.5.3.3.3-2A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-19 with condition NR-DC\_SCG | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLCH)) OF RLC-BearerConfig { | 1 entry |  |  |
|  | RLC-BearerConfig with conditions AM and DRBn and Re-establish\_RLC |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.3.3.3-3: *RadioBearerConfig-PDCP-ENDC* (Table 4.1.3.5.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [7], Table 4.6.3-132 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| srb3-ToRelease | Not present |  |  |
| drb-ToAddModList | Not present |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| cnAssociation CHOICE { |  |  |  |
| eps-BearerIdentity | 6 |  |  |
| sdap-Config | Not present |  |  |
| } |  |  |  |
| drb-Identity | 2 |  |  |
|  |  |  |
| reestablishPDCP | Not present |  |  |
| recoverPDCP | true |  |  |
| pdcp-Config | PDCP-Config-Split |  |  |
|  |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-ToReleaseList | Not present |  |  |
| } |  |  |  |

Table 7.1.3.5.3.3.3-3A: RadioBearerConfig-PDCPsplit (Table 7.1.3.5.3.3.3-2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-132 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  |  |  |
| cnAssociation | Not present |  |  |
| drb-Identity | DRB-Identity with condition DRBn | SGC DRBn |  |
| reestablishPDCP | Not present |  |  |
| recoverPDCP | true |  |  |
| pdcp-Config | PDCP-Config-Split |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.3.3.3-4: PDCP-Config-Split (Table 7.1.3.5.3.3.3-3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-99 condition EN-DC | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| moreThanOneRLC SEQUENCE { |  |  |  |
| primaryPath SEQUENCE { |  |  |  |
| cellGroup | 1 |  | EN-DC |
|  | 0 | MCG Path | NR-DC |
| } |  |  |  |
| ul-DataSplitThreshold | infinity |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.3.5.4 PDCP reordering / Maximum re-ordering delay below t-Reordering / t-Reordering timer operations

7.1.3.5.4.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state using RLC-AM }

**ensure that** {

**when** { a PDCP PDU is received from the lower layers and the COUNT value of the received PDCP Data PDU is out of the re-ordering window }

**then** { UE discards the PDCP PDU }

}

(2)

**with** { UE in RRC\_CONNECTED state using RLC-AM }

**ensure that** {

**when** { a PDCP PDU is received from the lower layers **and** the COUNT value of the received PDCP Data PDU is within the re-ordering window }

**then** { UE stores the resulting PDCP SDU }

}

(3)

**with** { UE in RRC\_CONNECTED state using RLC-AM, **and** the RX\_DELIV is not equal to the COUNT value of the RX\_NEXT (there is missing PDCP PDUs) }

**ensure that** {

**when** { a PDCP PDU is received from the lower layers **and** the RCVD\_COUNT = RX\_DELIV }

**then** { UE delivers the resulting PDCP SDU and all stored PDCP SDUs with consecutive COUNT value to upper layer, in ascending order }

}

(4)

**with** { UE in RRC\_CONNECTED state using RLC-AM **and** the associated PDCP *t-Reordering* timer is running }

**ensure that** {

**when** { RX\_DELIV >= RX\_REORD }

**then** { UE stops and resets *t-Reordering* timer }

}

(5)

**with** { UE in RRC\_CONNECTED state using RLC-AM **and** the associated PDCP *t-Reordering* timer is running }

**ensure that** {

**when** { the *t-Reordering* timer expires }

**then** { UE delivers all stored PDCP SDUs to upper layer }

}

(6)

**with** { UE in RRC\_CONNECTED state using RLC-AM **and** the associated PDCP *t-Reordering* timer is running }

**ensure that** {

**when** { the *t-Reordering* is reconfigured by upper layers }

**then** { UE stops and resets *t-Reordering* timer }

}

7.1.3.5.4.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 38.323, clause 5.2.2.1, 5.2.2.2 and 5.2.2.3. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.2.2.1]

In this section, following definitions are used:

- HFN(State Variable): the HFN part (i.e. the number of most significant bits equal to HFN length) of the State Variable;

- SN(State Variable): the SN part (i.e. the number of least significant bits equal to PDCP SN length) of the State Variable;

- RCVD\_SN: the PDCP SN of the received PDCP Data PDU, included in the PDU header;

- RCVD\_HFN: the HFN of the received PDCP Data PDU, calculated by the receiving PDCP entity;

- RCVD\_COUNT: the COUNT of the received PDCP Data PDU = [RCVD\_HFN, RCVD\_SN].

At reception of a PDCP Data PDU from lower layers, the receiving PDCP entity shall determine the COUNT value of the received PDCP Data PDU, i.e. RCVD\_COUNT, as follows:

- if RCVD\_SN < SN(RX\_DELIV) – Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) + 1.

- else if RCVD\_SN >= SN(RX\_DELIV) + Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) – 1.

- else:

- RCVD\_HFN = HFN(RX\_DELIV);

- RCVD\_COUNT = [RCVD\_HFN, RCVD\_SN].

After determining the COUNT value of the received PDCP Data PDU = RCVD\_COUNT, the receiving PDCP entity shall:

- perform deciphering and integrity verification of the PDCP Data PDU using COUNT = RCVD\_COUNT;

- if integrity verification fails:

- indicate the integrity verification failure to upper layer;

- discard the PDCP Data PDU;

- if RCVD\_COUNT < RX\_DELIV; or

- if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:

- discard the PDCP Data PDU;

If the received PDCP Data PDU with COUNT value = RCVD\_COUNT is not discarded above, the receiving PDCP entity shall:

- store the resulting PDCP SDU in the reception buffer;

- if RCVD\_COUNT >= RX\_NEXT:

- update RX\_NEXT to RCVD\_COUNT + 1.

- if *outOfOrderDelivery* is configured:

- deliver the resulting PDCP SDU to upper layers.

- if RCVD\_COUNT = RX\_DELIV:

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before;

- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from COUNT = RX\_DELIV;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers, with COUNT value > RX\_DELIV;

- if *t-Reordering* is running, and if RX\_DELIV >= RX\_REORD:

- stop and reset *t-Reordering*.

- if *t-Reordering* is not running (includes the case when *t-Reordering* is stopped due to actions above), and RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

[TS 38.323, clause 5.2.2.2]

When *t-Reordering* expires, the receiving PDCP entity shall:

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before:

- all stored PDCP SDU(s) with associated COUNT value(s) < RX\_REORD;

- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from RX\_REORD;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers, with COUNT value >= RX\_REORD;

- if RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

[TS 38.323, clause 5.2.2.3]

When the value of the *t-Reordering* is reconfigured by upper layers while the *t-Reordering* is running, the receiving PDCP entity shall:

- update RX\_REORD to RX\_NEXT;

- stop and restart *t-Reordering*.

7.1.3.5.4.3 Test description

7.1.3.5.4.3.1 Pre-test conditions

Same Pre-test conditions as in clause 7.1.3.0 exception of PDCP parameters according to Table 7.1.3.5.4.3.1-1.

Table 7.1.3.5.4.3.1-1: PDCP parameters

|  |  |
| --- | --- |
| t-Reordering | ms300 |

7.1.3.5.4.3.2 Test procedure sequence

Table 7.1.3.5.4.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS sends the PDCP SDU #131072  D/C field = 1 (PDCP Data PDU) and PDCP SN = 131072. (Note 1) | <-- | (PDCP SDU #131072) | - | - |
| 2 | Check: Does the UE transmit a PDCP SDU via the AM RLC entity in the next 1s? | --> | (PDCP SDU) | 1 | F |
| 3 | The SS sends the PDCP SDU #1  D/C field = 1 (PDCP Data PDU) and PDCP SN = 1.  The UE starts *t-Reordering*. | <-- | (PDCP SDU #1) | - | - |
| 4 | The SS sends the PDCP SDU #2  D/C field = 1 (PDCP Data PDU) and PDCP SN =2. | <-- | (PDCP SDU #2) | - | - |
| 5 | Wait for 100ms (< configured *t-Reordering*). | - | - | - | - |
| 6 | The SS sends the PDCP SDU #0  D/C field = 1 (PDCP Data PDU) and PDCP SN = 0. | <-- | (PDCP SDU #0) | - | - |
| 7 | Check: Does the UE transmit the PDCP SDU #0 via the AM RLC entity  D/C field = 1 (PDCP Data PDU) and PDCP SN = 0?  (Note 4) | --> | (PDCP SDU #0) | 2, 3 | P |
| 8 | Check: Does the UE transmit the PDCP SDU #1 via the AM RLC entity  D/C field = 1 (PDCP Data PDU) and PDCP SN = 1?  (Note 4) | --> | (PDCP SDU #1) | 2, 3 | P |
| 9 | Check: Does the UE transmit the PDCP SDU #2 via the AM RLC entity  D/C field = 1 (PDCP Data PDU) and PDCP SN = 2?  (Note 4) | --> | (PDCP SDU #2) | 2, 3 | P |
| 10 | The SS sends the PDCP SDU #4  D/C field = 1 (PDCP Data PDU) and PDCP SN = 4.  The UE starts *t-Reordering*. | <-- | (PDCP SDU #4) | - | - |
| 11 | Wait for 100ms (< configured *t-Reordering*) | - | - | - | - |
| 12 | The SS sends the PDCP SDU #7  D/C field = 1 (PDCP Data PDU) and PDCP SN = 7. | <-- | (PDCP SDU #7) | - | - |
| 13 | The SS sends the PDCP SDU #3  D/C field = 1 (PDCP Data PDU) and PDCP SN = 3.  The UE restarts *t-Reordering* timer.  Note T1 | <-- | (PDCP SDU #3) | - | - |
| 14 | Check: Does the UE transmit the PDCP SDU #3 via the AM RLC entity?  (Note 5) | --> | (PDCP SDU #3) | 3 | P |
| 15 | Check: Does the UE transmit the PDCP SDU #4 via the AM RLC entity?  (Note 5) | --> | (PDCP SDU #4) | 3 | P |
| 16 | Check 1: Does the UE transmit the PDCP SDU #7 with PDCP SN=5 via the AM RLC entity after *t-Reordering* expiry?  Note T2  Check 2: Is (T2 – T1) > *t-Reordering*? | --> | (PDCP SDU #7) | 4,5 | P |
| 17 | The SS sends the PDCP SDU #9  D/C field = 1 (PDCP Data PDU) and PDCP SN = 9.  The UE starts *t-Reordering*. | <-- | (PDCP SDU #9) | - | - |
| 18 | Wait for 100ms (< configured *t-Reordering*) | - | - | - | - |
| 19 | The SS reconfigures the *t-Reordering* by sending a NR *RRCReconfiguration* message.  The UE restarts *t-Reordering* timer. (Note 2)  Note T3 | <-- | *RRCReconfiguration* | - | - |
| 20 | The UE transmits a NR *RRCReconfigurationComplete* message.  (Note 3) | --> | *RRCReconfigurationComplete* | - | - |
| 21 | Check 1: Does the UE transmit the PDCP SDU #9 with PDCP SN=6 via the AM RLC entity after *t-Reordering* expiry?  Note T4  Check 2: Is (T4 – T3) > *t-Reordering*? | --> | (PDCP SDU #9) | 6 | P |
| Note 1: The Reordering Window size is 131072 when 18 bit SN length is used.  Note 2: For EN-DC the NR RRCReconfiguration message is contained in RRCConnectionReconfiguration 36.508 [7], Table 4.6.1-8 using condition EN-DC\_Embed\_RBConfig.  Note 3: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 4: PDCP SDUs at steps 7, 8 and 9 may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot)  Note 5: PDCP SDUs at steps 14 and 15 may be received by the SS in the same slot or in multiple slots (max one MAC PDU in a slot). | | | | | |

7.1.3.5.4.3.3 Specific message contents

Table 7.1.3.5.4.3.3-1: *RRCReconfiguration* (step 19, Table 7.1.3.5.4.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table: 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration ::= SEQUENCE { |  |  |  |
| radioBearerConfig | RadioBearerConfig |  | Not EN-DC |
| secondaryCellGroup | CellGroupConfig |  | EN-DC |
| } |  |  |  |
| RRCReconfiguration-v1530-IEs::= SEQUENCE { |  |  |  |
| masterCellGroup | CellGroupConfig |  | Not-EN-DC |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.4.3.3-2: *RadioBearerConfig* (Table 7.1.3.5.4.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation path: 38.508-1 [4], Table 4.6.3-132 | | | |
| Information Element | Value/Remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList ::= SEQUENCE (SIZE 1..2)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| pdcp-Config SEQUENCE { |  |  |  |
| drb SEQUENCE { |  |  |  |
| outOfOrderDelivery | False |  |  |
| } |  |  |  |
| t-Reordering | ms750 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.3.5.5 PDCP Duplication

7.1.3.5.5.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and pdcpDuplication is configured and activated}

**ensure that** {

**when** { UE has PDCP SDUs available for transmission}

**then** { the UE transmits the PDCP SDUs on both the associated RLC entities }

}

(2)

**with** { UE in RRC\_CONNECTED state and pdcpDuplication is configured and not activated }

**ensure that** {

**when** { UE receives MAC Control Element to Activate PDCP Duplication on a DRB configured with PDCP duplication }

**then** { the UE activates PDCP Duplication on the PDCP associated with the DRB }

}

(3)

**with** { UE in RRC\_CONNECTED state and pdcpDuplication is configured }

**ensure that** {

**when** { UE has PDCP SDUs available for transmission }

**then** { the UE transmits the PDCP SDUs on the primary RLC entity}

}

(4)

**with** { UE in RRC\_CONNECTED state and pdcpDuplication is configured and activated}

**ensure that** {

**when** { the UE had transmited the PDCP SDUs on both the associated RLC entities and successful delivery of a PDCP Data PDU is confirmed by one of the two associated AM RLC entities}

**then** { the other AM RLC entity discards the duplicated PDCP Data PDU}

}

7.1.3.5.5.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321:5.10, 6.1.3.10 and TS 38.323:5.2.1, 5.11.1, 5.11.2 and TS 38.331: 5.3.5.6.4. Unless otherwise stated these are Rel-15 requirements.

[TS 38.323, clause 5.2.1]

When submitting a PDCP PDU to lower layer, the transmitting PDCP entity shall:

- if the transmitting PDCP entity is associated with one RLC entity:

- submit the PDCP PDU to the associated RLC entity;

- else, if the transmitting PDCP entity is associated with two RLC entities:

- if the PDCP duplication is activated:

- if the PDCP PDU is a PDCP Data PDU:

- duplicate the PDCP Data PDU and submit the PDCP Data PDU to both associated RLC entities;

- else:

- submit the PDCP Control PDU to the primary RLC entity;

- else:

- if the two associated RLC entities belong to the different Cell Groups; and

- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the two associated RLC entities is equal to or larger than *ul-DataSplitThreshold*:

- submit the PDCP PDU to either the primary RLC entity or the secondary RLC entity;

- else:

- submit the PDCP PDU to the primary RLC entity.

[TS 38.331, clause 5.3.5.6.4]

The UE shall:

1> for each *drb-Identity* value included in the *drb-ToReleaseList* that is part of the current UE configuration; or

1> for each *drb-Identity* value that is to be released as the result of full configuration according to 5.3.5.11:

2> release the PDCP entity and the *drb-Identity*;

2> if SDAP entity associated with this DRB is configured:

3> indicate the release of the DRB to SDAP entity associated with this DRB (TS 37.324 [24], clause 5.3.3);

2> if the UE is operating in EN-DC:

3> if a new bearer is not added either with NR or E-UTRA with same *eps-BearerIdentity*:

4> indicate the release of the DRB and the *eps-BearerIdentity* of the released DRB to upper layers.

NOTE 1: The UE does not consider the message as erroneous if the *drb-ToReleaseList* includes any *drb-Identity* value that is not part of the current UE configuration.

NOTE 2: Whether or not the RLC and MAC entities associated with this PDCP entity are reset or released is determined by the *CellGroupConfig*.

[TS 38.323, clause 5.11.1]

For the PDCP entity configured with *pdcp-Duplication*, the transmitting PDCP entity shall:

- for SRBs:

- activate the PDCP duplication;

- for DRBs:

- if the activation of PDCP duplication is indicated:

- activate the PDCP duplication;

- if the deactivation of PDCP duplication is indicated:

- deactivate the PDCP duplication.

[TS 38.323, clause 5.11.2]

For the PDCP entity configured with *pdcp-Duplication*, the transmitting PDCP entity shall:

- if the successful delivery of a PDCP Data PDU is confirmed by one of the two associated AM RLC entities:

- indicate to the other AM RLC entity to discard the duplicated PDCP Data PDU;

- if the deactivation of PDCP duplication is indicated:

- indicate to the secondary RLC entity to discard all duplicated PDCP Data PDUs.

[TS 38.321, clause 5.10]

If one or more DRBs are configured with PDCP duplication, the network may activate and deactivate the PDCP duplication for the configured DRB(s).

The PDCP duplication for the configured DRB(s) is activated and deactivated by:

- receiving the Duplication Activation/Deactivation MAC CE described in subclause 6.1.3.11;

- indication by RRC.

The MAC entity shall for each DRB configured with PDCP duplication:

1> if a Duplication Activation/Deactivation MAC CE is received activating the PDCP duplication of the DRB:

2> indicate the activation of PDCP duplication of the DRB to upper layers.

1> if a Duplication Activation/Deactivation MAC CE is received deactivating the PDCP duplication of the DRB:

2> indicate the deactivation of PDCP duplication of the DRB to upper layers.

7.1.3.5.5.3 Test description

7.1.3.5.5.3.1 Pre-test conditions

System Simulator:

- For NR 5GC NR Cell 1 and NR Cell 10

UE:

- None

Preamble:

- Same Pre-test conditions as in clause 7.1.3.0 and Generic procedure parameter DC bearer (MCG and split).

- For NR 5GC, Same Pre-test conditions as in clause 7.1.3.0 using generic procedure parameter Connectivity (*NR-DC*), Bearers(MCG(s) and Split),

7.1.3.5.5.3.2 Test procedure sequence

Table 7.1.3.5.5.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Void | - | - | - | - |
| 2 | SS transmits a Duplication Activation MAC CE to activate PDCP Duplication for split DRB. | <-- | MAC PDU (Duplication Activation MAC Control Element) | - | - |
| 2A | The SS is configured not to send RLC ACK for the next PDU on split DRB. (Note 6) | - | - | - | - |
| 3 | The SS sends a PDCP Data PDU on the split DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| - | EXCEPTION: Steps 4-4A below occur in any sequence | - | - | - | - |
| 4 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 3 | P |
| 4A | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity? | --> | PDCP DATA PDU | 2 | P |
| 4B-4C | Void | - | - | - | - |
| 5 | SS transmits a Duplication Deactivation MAC CE to deactivate PDCP Duplication for split DRB. | <-- | MAC PDU (Duplication Deactivation MAC Control Element) | - | - |
| 6 | The SS sends a PDCP Data PDU on the split DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| 7 | Check: Does UE transmit a PDCP Data PDU on the AM RLC entity configured on the AM RLC primary entity? | --> | PDCP DATA PDU | 3 | P |
| 8 | The SS transmits an NR *RRCReconfiguration* message to activate parameters for PdcpDuplication(Note 2) | <-- | *RRCReconfiguration* | - | - |
| 8A | UE responses NR *RRCReconfigurationComplete* message.(Note 3) | --> | *RRCReconfigurationComplete* | - | - |
| 8AA | The SS is configured not to send RLC ACK for the next PDU on split DRB. (Note 6) | - | - | - | - |
| 8B | The SS sends a PDCP Data PDU on the split DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| - | EXCEPTION: Steps 8C-8D below occur in any sequence | - | - | - | - |
| 8C | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 1 | P |
| 8D | Check: Does UE transmit a PDCP Data PDU on the AM RLC secondary entity? | --> | PDCP DATA PDU | 1 | P |
| 8E-8F | Void | - | - | - | - |
| 9 | The SS stops allocating any UL grant for the AM RLC secondary entity(Note 1) | - | - | - | - |
| 10 | The SS sends a PDCP Data PDU on the split DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| 11 | UE transmits a PDCP Data PDU on the AM RLC primary entity | --> | PDCP DATA PDU | - | - |
| 12 | The SS resumes normal UL grant allocation for the AM RLC secondary entity. | - | - | - | - |
| 13 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary or secondary entity in next five seconds? | --> | PDCP DATA PDU | 4 | F |
| Note 1: Discard of RLC SDU is not possible if submitted to lower layers. Therefore, Grant is not provided so that RLC SDU is not submitted to lower layers.  Note 2: For EN-DC the NR RRCReconfiguration is contained in *RRCConnectionReconfiguration* Table 7.1.3.5.5.3.3-4.  Note 3: For EN-DC the NR RRCReconfigurationComplete message is contained in RRCConnectionReconfigurationComplete.  Note 4: Void  Note 5: Void  Note 6: SS is configured not to send RLC ACK for the next PDU on split DRB to ensure that UE side primary or secondary entities do not discard the PDU before PDSCH transmission upon receipt of RLC ACK on one of the entities. This may cause UE side entities to retransmit the PDU but it shall be ignored by SS side RLC entity as it has already been received though not acknowledged due to SS side RLC being configured in test mode. | | | | | |

7.1.3.5.5.3.3 Specific message contents

Table 7.1.3.5.5.3.3-0A: *RRCConnectionReconfiguration* (step 8, Table 7.1.3.5.5.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 36.508 [7], Table 4.6.1-8 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCConnectionReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| c1 CHOICE{ |  |  |  |
| rrcConnectionReconfiguration-r8 ::= SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nr-RadioBearerConfig1-r15 | OCTET STRING including *RadioBearerConfig-PDCP* |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.5.3.3-0B: *RRCReconfiguration* (step 8, Table 7.1.3.5.5.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.1-13 | | | |
| Information Element | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { |  |  |  |
| criticalExtensions CHOICE { |  |  |  |
| rrcReconfiguration SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| nonCriticalExtension SEQUENCE { |  |  |  |
| radioBearerConfig2 | OCTET STRING including *RadioBearerConfig-PDCP* |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.5.3.3-1: *RadioBearerConfig-PDCP* (Table 7.1.3.5.5.3.3-0A and Table 7.1.3.5.5.3.3-0B , Step 8)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [7], Table 4.6.3-132 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| srb3-ToRelease | Not present |  |  |
| drb-ToAddModList | Not present |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| drb-Identity | 2 |  | EN-DC |
|  | SCG DRBn |  | NR |
| pdcp-Config | PDCP-Config-Split |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-ToReleaseList | Not present |  |  |
| } |  |  |  |

Table 7.1.3.5.5.3.3-2: PDCP-Config-Split (Table 7.1.3.5.5.3.3-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-99 condition Split | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| moreThanOneRLC SEQUENCE { |  |  |  |
| primaryPath SEQUENCE { |  |  |  |
| cellGroup | 1 |  | EN-DC |
|  | 0 |  | NR |
| } |  |  |  |
| ul-DataSplitThreshold | infinity |  |  |
| pdcp-Duplication | true |  |  |
| } |  |  |  |
| } |  |  |  |
|  |  |  |  |

##### 7.1.3.5.6 PDCP Duplication / 3 RLC entities

##### 7.1.3.5.6.1 PDCP Duplication / 3 RLC entities / Intra-band Contiguous CA

7.1.3.5.6.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state and PDCP CA duplication is configured and activated}

**ensure that** {

**when** { UE has a PDCP SDU available for transmission }

**then** { the UE transmits the PDCP SDU on all the associated RLC entities }

}

(2)

**Void**

(3)

**with** { UE in RRC\_CONNECTED state and PDCP CA duplication is configured }

**ensure that** {

**when** { UE has a PDCP SDU available for transmission }

**then** { the UE transmits the PDCP SDU on the primary RLC entity }

}

(4)

**with** { UE in RRC\_CONNECTED state and PDCP CA duplication is configured and activated }

**ensure that** {

**when** { the UE had transmitted the PDCP SDU on all the associated RLC entities and successful delivery of a PDCP Data PDU is confirmed by one of the associated AM RLC entities }

**then** { the other AM RLC entities discard the duplicated PDCP Data PDU }

}

(5)

**with** { UE in RRC\_CONNECTED state and PDCP CA duplication is configured and activated }

**ensure that** {

**when** { UE receives MAC Control Element to deactivate PDCP Duplication on one of the associated RLC entity configured with PDCP duplication }

**then** { the UE deactivates the PDCP duplication for the indicated associated RLC entity }

7.1.3.5.6.1.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.321:5.10, 6.1.3.11, 6.1.3.32, TS 38.323:5.2.1, 5.11.1, 5.11.2 and TS 38.331: 5.3.5.6.4. Unless otherwise stated these are Rel-16 requirements.

[TS 38.323, clause 5.2.1]

When submitting a PDCP PDU to lower layer, the transmitting PDCP entity shall:

- if the transmitting PDCP entity is associated with one RLC entity:

- submit the PDCP PDU to the associated RLC entity;

- else, if the transmitting PDCP entity is associated with at least two RLC entities:

- if the PDCP duplication is activated for the RB:

- if the PDCP PDU is a PDCP Data PDU:

- duplicate the PDCP Data PDU and submit the PDCP Data PDU to the associated RLC entities activated for PDCP duplication;

- else:

- submit the PDCP Control PDU to the primary RLC entity;

- else (i.e. the PDCP duplication is deactivated for the RB):

- if the split secondary RLC entity is configured; and

- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the primary RLC entity and the split secondary RLC entity is equal to or larger than *ul-DataSplitThreshold*:

- submit the PDCP PDU to either the primary RLC entity or the split secondary RLC entity;

- else, if the transmitting PDCP entity is associated with the DAPS bearer:

- if the uplink data switching has not been requested:

- submit the PDCP PDU to the RLC entity associated with the source cell;

- else:

- if the PDCP PDU is a PDCP Data PDU:

- submit the PDCP Data PDU to the RLC entity associated with the target cell;

- else:

- if the PDCP Control PDU is associated with source cell:

- submit the PDCP Control PDU to the RLC entity associated with the source cell;

- else:

- submit the PDCP Control PDU to the RLC entity associated with the target cell;

- else:

- submit the PDCP PDU to the primary RLC entity.

[TS 38.323, clause 5.11.1]

For the PDCP entity configured with *pdcp-Duplication*, the transmitting PDCP entity shall:

- for SRBs:

- activate the PDCP duplication;

- for DRBs:

- if the activation of PDCP duplication is indicated for the DRB:

- activate the PDCP duplication for the DRB;

- if the activation of PDCP duplication is indicated for at least one associated RLC entities:

- activate the PDCP duplication for the indicated associated RLC entities;

- activate the PDCP duplication for the DRB;

- if the deactivation of PDCP duplication is indicated for the DRB:

- deactivate the PDCP duplication for the DRB;

- if the deactivation of PDCP duplication is indicated for at least one associated RLC entities:

- deactivate the PDCP duplication for the indicated associated RLC entities;

- if all associated RLC entities other than the primary RLC entity are deactivated for PDCP duplication:

- deactivate the PDCP duplication for the DRB.

[TS 38.323, clause 5.11.2]

For the PDCP entity configured with *pdcp-Duplication*, the transmitting PDCP entity shall:

- if the successful delivery of a PDCP Data PDU is confirmed by one of the associated AM RLC entities:

- indicate to the other AM RLC entities to discard the duplicated PDCP Data PDU;

- if the deactivation of PDCP duplication is indicated for the DRB:

- indicate to the RLC entities other than the primary RLC entity to discard all duplicated PDCP Data PDUs;

- if the deactivation of PDCP duplication is indicated for at least one associated RLC entities:

- indicate to the RLC entities deactivated for PDCP duplication to discard all duplicated PDCP Data PDUs.

[TS 38.321, clause 5.10]

If one or more DRBs are configured with PDCP duplication, the network may activate and deactivate the PDCP duplication for all or a subset of associated RLC entities for the configured DRB(s).

The PDCP duplication for the configured DRB(s) is activated and deactivated by:

- receiving the Duplication Activation/Deactivation MAC CE described in clause 6.1.3.11;

- receiving the Duplication RLC Activation/Deactivation MAC CE described in clause 6.1.3.32;

- indication by RRC.

The PDCP duplication for all or a subset of associated RLC entities for the configured DRB(s) is activated and deactivated by:

- receiving the Duplication RLC Activation/Deactivation MAC CE described in clause 6.1.3.32;

- indication by RRC.

The MAC entity shall for each DRB configured with PDCP duplication:

1> if a Duplication Activation/Deactivation MAC CE is received activating the PDCP duplication of the DRB:

2> indicate the activation of PDCP duplication of the DRB to upper layers.

1> if a Duplication Activation/Deactivation MAC CE is received deactivating the PDCP duplication of the DRB:

2> indicate the deactivation of PDCP duplication of the DRB to upper layers.

1> if a Duplication RLC Activation/Deactivation MAC CE is received activating PDCP duplication for associated RLC entities of a DRB configured with PDCP duplication:

2> indicate the activation of PDCP duplication for the indicated secondary RLC entity(ies) of the DRB to upper layers.

1> if a Duplication RLC Activation/Deactivation MAC CE is received deactivating PDCP duplication for associated RLC entities of a DRB configured with PDCP duplication:

2> indicate the deactivation of PDCP duplication for the indicated secondary RLC entity(ies) of the DRB to upper layers.

[TS 38.331, clause 5.3.5.6.4]

The UE shall:

1> for each *drb-Identity* value included in the *drb-ToReleaseList* that is part of the current UE configuration; or

1> for each *drb-Identity* value that is to be released as the result of full configuration according to 5.3.5.11:

2> release the PDCP entity and the *drb-Identity*;

2> if SDAP entity associated with this DRB is configured:

3> indicate the release of the DRB to SDAP entity associated with this DRB (TS 37.324 [24], clause 5.3.3);

2> if the UE is operating in EN-DC:

3> if a new bearer is not added either with NR or E-UTRA with same *eps-BearerIdentity*:

4> indicate the release of the DRB and the *eps-BearerIdentity* of the released DRB to upper layers.

NOTE 1: The UE does not consider the message as erroneous if the *drb-ToReleaseList* includes any *drb-Identity* value that is not part of the current UE configuration.

NOTE 2: Whether or not the RLC and MAC entities associated with this PDCP entity are reset or released is determined by the *CellGroupConfig*.

7.1.3.5.6.1.3 Test description

7.1.3.5.6.1.3.1 Pre-test conditions

System Simulator:

- NR Cell 1 is the PCell, NR Cell 3 and NR Cell 6 are the SCells.

UE:

- None

Preamble:

- Same Pre-test conditions as in clause 7.1.3.0.

7.1.3.5.6.1.3.2 Test procedure sequence

Table 7.1.3.5.6.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS transmits an NR *RRCReconfiguration* message to add 2 SCells and to configure parameters for PDCP CA duplication | <-- | *RRCReconfiguration* | - | - |
| 1A | UE transmits NR *RRCReconfigurationComplete* message. | --> | *RRCReconfigurationComplete* | - | - |
| 1B | The SS transmits a SCell Activation MAC-CE on PCell (NR Cell 1) to activate NR SCells (NR Cell 3 and NR Cell 6). | <-- | MAC PDU (SCell Activation/Deactivation MAC CE of one octet (C1=1)) | - | - |
| 2 | The SS sends a PDCP Data PDU on the DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| 3 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 3 | P |
| 3A | SS transmits a MAC CE to activate PDCP Duplication for all AM RLC entities associated to the DRB. | <-- | MAC PDU (Duplication RLC Activation MAC Control Element) | - | - |
| 3B | The SS is configured not to send RLC ACK on all 3 RLC entities. (Note 2) | - | - | - | - |
| 3C | The SS sends a PDCP Data PDU on the DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
|  | EXCEPTION: Steps 3D, 4 & 4A below can occur in any order. | - | - | - | - |
| 3D | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary entity? | --> | PDCP DATA PDU | 1 | P |
| 4 | Check: Does UE transmit a PDCP Data PDU on the associated AM RLC entity on the SCell (NR Cell3)? | --> | PDCP DATA PDU | 1 | P |
| 4A | Check: Does UE transmit a PDCP Data PDU on the associated AM RLC entity on the SCell (NR Cell6)? | --> | PDCP DATA PDU | 1 | P |
| 5 | The SS transmits a MAC CE to deactivate PDCP Duplication for the AM RLC entity associated with theDRB on SCell (NR Cell 6). | <-- | MAC PDU (Duplication RLC Deactivation MAC Control Element) | - | - |
| 5A | The SS is configured not to send RLC ACK on all 3 RLC entities. | - | - | - | - |
| 6 | The SS sends a PDCP Data PDU on the DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| - | EXCEPTION: Steps 6A-6B below can occur in any order. | - | - | - | - |
| 6A | The UE transmits a PDCP Data PDU on the activated primary AM RLC entity. | --> | PDCP DATA PDU | - | - |
| 6B | The UE transmits a PDCP Data PDU on the activated secondary AM RLC entity. | --> | PDCP DATA PDU | - | - |
| 7 | Check: Does UE transmit a PDCP Data PDU on the deactivated AM RLC entity by step 5? | --> | PDCP DATA PDU | 5 | F |
| 8-14 | Void | - | - | - | - |
| 15 | The SS stops allocating any UL grant on the SCells.(Note 1) | - | - | - | - |
| 16 | The SS sends a PDCP Data PDU on the DRB on the AM RLC primary entity. | <-- | PDCP DATA PDU | - | - |
| 17 | UE transmits a PDCP Data PDU on the AM RLC primary entity | --> | PDCP DATA PDU | - | - |
| 18 | The SS resumes normal UL grant allocation on the SCells. | - | - | - | - |
| - | EXCEPTION: Steps 19-21 below can occur in any order in the next five seconds. | - | - | - | - |
| 19 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary? | --> | PDCP DATA PDU | 4 | F |
| 20 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary or the associated AM RLC entity on the SCell (NR Cell 3)? | --> | PDCP DATA PDU | 4 | F |
| 21 | Check: Does UE transmit a PDCP Data PDU on the AM RLC primary or the associated AM RLC entity on the SCell (NR Cell 6)? | --> | PDCP DATA PDU |  | F |
| Note 1: Discard of RLC SDU is not possible if submitted to lower layers. Therefore, Grant is not provided so that RLC SDU is not submitted to lower layers.  Note2: SS is configured not to send RLC ACK for the next PDU on all RLC entities to ensure that UE side primary or secondary entities do not discard the PDU before PDSCH transmission upon receipt of RLC ACK on one of the entities. This may cause UE side entities to retransmit the PDU but it shall be ignored by SS side RLC entity as it has already been received though not acknowledged due to SS side RLC being configured in test mode. | | | | | |

7.1.3.5.6.1.3.3 Specific message contents

Table 7.1.3.5.6.1.3.3-1: *Void*

Table 7.1.3.5.6.1.3.3-1A: *RRCReconfiguration* (Step 1, Table 7.1.3.5.6.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.1-13 with condition SCell\_add | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| radioBearerConfig | | RadioBearerConfig-DRB |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| masterCellGroup | | CellGroupConfig-SCells |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| nonCriticalExtension SEQUENCE { | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.3.5.6.1.3.3-1B: *RadioBearerConfig-DRB* (Table 7.1.3.5.6.1.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [7], Table 4.6.3-132 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| srb3-ToRelease | Not present |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| drb-Identity | DRBi |  |  |
| pdcp-Config | PDCP-Config |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.6.1.3.3-1C: CellGroupConfig-SCells (Table 7.1.3.5.6.1.3.3-1A)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-19 with condition SCell\_add | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| rlc-BearerToAddModList SEQUENCE (SIZE(1..max LC-ID)) OF RLC-BearerConfig { | 3 entries |  |  |
| RLC-BearerConfig[1] | RLC-BearerConfig-1 | entry 1  Table 7.1.3.5.6.3.3-3  RLC entity 1 (primary) |  |
| RLC-BearerConfig[2] | RLC-BearerConfig-2 | entry 2  Table 7.1.3.5.6.3.3-4  RLC entity 2 (secondary) |  |
| RLC-BearerConfig[3] | RLC-BearerConfig-3 | entry 3  Table 7.1.3.5.6.3.3-5  RLC entity 3 (secondary) |  |
| } |  |  |  |
| mac-CellGroupConfig | Not present |  |  |
| physicalCellGroupConfig | Not present |  |  |
| spCellConfig | Not present |  |  |
| sCellToAddModList SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellConfig { | 2 entries |  |  |
| SCellConfig[1] SEQUENCE { |  | entry 1 |  |
| sCellIndex | SCellIndex for NR Cell 3 |  |  |
| sCellConfigCommon | ServingCellConfigCommon as per TS 38.508-1 [4] Table 4.6.3-168 |  |  |
| sCellConfigDedicated | ServingCellConfig as per TS 38.508-1 [4] Table 4.6.3-167 |  |  |
| } |  |  |  |
| SCellConfig[2] SEQUENCE { |  | entry 2 |  |
| sCellIndex | SCellIndex for NR Cell 6 |  |  |
| sCellConfigCommon | ServingCellConfigCommon as per TS 38.508-1 [4] Table 4.6.3-168 |  |  |
| sCellConfigDedicated | ServingCellConfig as per TS 38.508-1 [4] Table 4.6.3-167 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.6.1.3.3-2: PDCP-Config (Table 7.1.3.5.6.1.3.3-1B)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1 [4], Table 4.6.3-99 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { |  |  |  |
| t-Reordering | Not present |  |  |
| moreThanTwoRLC-DRB-r16 SEQUENCE { |  |  |  |
| duplicationState-r16 SEQUENCE (SIZE (3)) | 3 entries |  |  |
| duplicationState-r16[1] | true |  |  |
| duplicationState-r16[2] | true |  |  |
| duplicationState-r16[3] | false |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.6.1.3.3-3: *RLC-BearerConfig-1* (Table 7.1.3.5.6.1.3.3-1C)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-148 with Condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-BearerConfig ::= SEQUENCE { |  |  |  |
| logicalChannelIdentity | LogicalChannelIdentity with condition DRB j | ID of primary logical channel |  |
| servedRadioBearer CHOICE { |  |  |  |
| drb-Identity | DRB-Identity with condition DRB j | DRB |  |
| } |  |  |  |
| rlc-Config CHOICE { |  |  |  |
| am SEQUENCE { |  |  |  |
| ul-AM-RLC SEQUENCE { |  |  |  |
| maxRetxThreshold | t32 | To ensure RLC failure happens before RLF |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| mac-LogicalChannelConfig SEQUENCE { |  |  |  |
| ul-SpecificParameters SEQUENCE { |  |  |  |
| allowedServingCells SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex { | 1 entry |  |  |
| ServCellIndex[1] | ServCellIndex of NR Cell 1 | entry 1 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.6.1.3.3-4: *RLC-BearerConfig-2* (Table 7.1.3.5.6.1.3.3-1C)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-148 with Condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-BearerConfig ::= SEQUENCE { |  |  |  |
| logicalChannelIdentity | LogicalChannelIdentity with condition DRB j+1 | To ensure ID of secondary logical channel ID is different with existing logical channel and the primary logical channel |  |
| servedRadioBearer CHOICE { |  |  |  |
| drb-Identity | DRB-Identity with condition DRB j | DRB |  |
| } |  |  |  |
| rlc-Config CHOICE { |  |  |  |
| am SEQUENCE { |  |  |  |
| ul-AM-RLC SEQUENCE { |  |  |  |
| maxRetxThreshold | t1 | To ensure RLC failure happens before RLF |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| mac-LogicalChannelConfig SEQUENCE { |  |  |  |
| ul-SpecificParameters SEQUENCE { |  |  |  |
| allowedServingCells SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex { | 1 entry |  |  |
| ServCellIndex[1] | ServCellIndex of NR Cell 3 | entry 1 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.6.1.3.3-5: *RLC-BearerConfig-3* (Table 7.1.3.5.6.1.3.3-1C)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], Table 4.6.3-148 with Condition AM | | | |
| Information Element | Value/remark | Comment | Condition |
| RLC-BearerConfig ::= SEQUENCE { |  |  |  |
| logicalChannelIdentity | LogicalChannelIdentity with condition DRB j+2 | To ensure ID of secondary logical channel ID is different with existing logical channel and the primary logical channel |  |
| servedRadioBearer CHOICE { |  |  |  |
| drb-Identity | DRB-Identity with condition DRB j | DRB |  |
| } |  |  |  |
| rlc-Config CHOICE { |  |  |  |
| am SEQUENCE { |  |  |  |
| ul-AM-RLC SEQUENCE { |  |  |  |
| maxRetxThreshold | t1 | To ensure RLC failure happens before RLF |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| mac-LogicalChannelConfig SEQUENCE { |  |  |  |
| ul-SpecificParameters SEQUENCE { |  |  |  |
| allowedServingCells SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex { | 1 entry |  |  |
| ServCellIndex[1] | ServCellIndex of NR Cell 6 | entry 1 |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

##### 7.1.3.5.6.2 PDCP Duplication / 3 RLC entities / Intra-band non-Contiguous CA

The scope and description of the present TC is the same as test case 7.1.3.5.6.1 with the following differences:

- CA configuration: Intra-band non-Contiguous CA replaces Intra-band Contiguous CA.

##### 7.1.3.5.7 Ethernet header compression and decompression / Correct functionality of ethernet header compression and decompression

7.1.3.5.7.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS sends PDCP Data PDU containing EHC compressed ethernet packet with Context ID A and with full ethernet header A to UE }

**then** { UE sends PDCP Control PDU to SS containing EHC feedback packet with Context ID A }

}

(2)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS sends PDCP Data PDU containing EHC compressed ethernet packet with Context ID A and with full ethernet header A to UE }

**then** { UE sends PDCP Data PDU to SS containing EHC compressed ethernet packet with Context ID B and with full ethernet header A generated from the looped back ethernet packet }

}

(3)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS sends PDCP Data PDU containing EHC compressed ethernet packet with Context ID A and without ethernet header to UE }

**then** { UE sends PDCP Data PDU to SS containing EHC compressed ethernet packet with Context ID B and with full ethernet header A generated from the looped back ethernet packet with decompressed ethernet header }

}

(4)

**with** { UE in RRC\_CONNECTED state }

**ensure that** {

**when** { SS has sent PDCP Control PDU to UE containing EHC feedback packet with Context ID B and SS sends PDCP Data PDU to UE containing EHC compressed ethernet packet with Context ID A without ethernet header to UE }

**then** { UE sends PDCP Data PDU to SS containing EHC compressed ethernet packet with Context ID B and without ethernet header generated from the looped back ethernet packet with decompressed ethernet header }

}

7.1.3.5.7.2 Conformance requirements

References: The conformance requirements covered in the present TC are specified in: TS 38.323, clause 5.12. These are Rel-16 requirements.

[TS 38.323, clause 5.12.2]

PDCP entities associated with DRBs can be configured by upper layers TS 38.331 [3] to use EHC. Each PDCP entity carrying user plane data may be configured to use EHC. Every PDCP entity uses at most one EHC compressor instance and at most one EHC decompressor instance.

[TS 38.323, clause 5.12.3]

The usage and definition of the parameters shall be as specified below.

- MAX\_CID\_EHC\_UL: This is the maximum CID value that can be used for uplink. One CID value shall always be reserved for uncompressed flows. The parameter MAX\_CID\_EHC\_UL is configured by upper layers (*maxCID-EHC-UL* in TS 38.331 [3]);

[TS 38.323, clause 5.12.4]

If EHC is configured, the EHC protocol generates two types of output packets:

- EHC compressed packets (i.e. EHC full header packets and EHC compressed header packets), each associated with one PDCP SDU;

- standalone packets not associated with a PDCP SDU, i.e. EHC feedback.

An EHC compressed packet is associated with the same PDCP SN and COUNT value as the related PDCP SDU. The header compression is not applicable to the SDAP header and the SDAP Control PDU if included in the PDCP SDU.

EHC feedback are not associated with a PDCP SDU. They are not associated with a PDCP SN and are not ciphered.

[TS 38.323, clause 5.12.5]

If EHC is configured by upper layers for PDCP entities associated with user plane data, the PDCP Data PDUs are decompressed by the EHC protocol after performing deciphering as explained in clause 5.8. The header decompression is not applicable to the SDAP header and the SDAP Control PDU if included in the PDCP Data PDU.

[TS 38.323, clause 5.12.6.1]

When an EHC feedback is generated by the EHC protocol, the transmitting PDCP entity shall:

- submit to lower layers the corresponding PDCP Control PDU as specified in clause 6.2.3.3 i.e. without associating a PDCP SN, nor performing ciphering.

[TS 38.323, clause 5.12.6.2]

At reception of a PDCP Control PDU for EHC feedback from lower layers, the receiving PDCP entity shall:

- deliver the corresponding EHC feedback to the EHC protocol without performing deciphering.

7.1.3.5.7.3 Test description

7.1.3.5.7.3.1 Pre-test conditions

Pre-test conditions as in clause 7.1.3.0 with condition pc\_NG\_RAN\_NR, PDN/PDU session type Ethernet used in 4.5A.2 and message with condition UM used for step 7 in 4.5.4.2 according to [4] for primary DRB.

7.1.3.5.7.3.2 Test procedure sequence

Table 7.1.3.5.7.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | SS transmits an *RRCReconfiguration* message to configure DRB to use ethernet header compression. | <-- | *RRCReconfiguration* | - | - |
| 2 | UE transmits *RRCReconfigurationComplete* message to confirm that reconfiguration with ethernet header compression configuration is completed. | --> | *RRCReconfigurationComplete* | - | - |
| 3 | SS transmits PDCP Data PDU containing EHC compressed ethernet packet with Context ID A and with full ethernet header information A. | <-- | PDCP Data PDU #0 | - | - |
| 4 | CHECK: Does UE transmit PDCP Control PDU containing unciphered EHC feedback packet with Context ID A? | --> | PDCP Control PDU #0 | 1 | P |
| 5 | CHECK: Does UE transmit PDCP Data PDU containing EHC compressed ethernet packet with Context ID B and with full ethernet header information A? | --> | PDCP Data PDU #0 | 1 | P |
| 6 | SS transmits PDCP Data PDU containing EHC compressed ethernet packet with Context ID A and without ethernet header information. | <-- | PDCP Control PDU #0 | - | - |
| 7 | CHECK: Does UE transmit PDCP Data PDU containing EHC compressed ethernet packet with Context ID B and with full ethernet header information A? | --> | PDCP Data PDU #1 | - | - |
| 8 | SS transmits PDCP Control PDU containing unciphered EHC feedback packet with Context ID B. | <-- | PDCP Control PDU #1 | - | - |
| 9 | SS transmits PDCP Data PDU containing EHC compressed ethernet packet with Context ID A and without ethernet header information. | <-- | PDCP Data PDU #2 | - | - |
| 10 | CHECK: Does UE transmit PDCP Data PDU containing EHC compressed ethernet packet with Context ID B and without ethernet header information? | --> | PDCP Data PDU #2 | 4 | P |
| Note 1: PDCP PDUs will be checked before and after decompressor on the NW side for test steps 5, 7 and 10.  Note 2: The value of Context ID A and Context ID B can be any value. However, value of Context ID A and Context ID B should stay the same in all steps. | | | | | |

7.1.3.5.7.3.3 Specific message contents

Table 7.1.3.5.7.3.3-1: *RRCReconfiguration (step 1, Table 7.1.3.5.7.3.2-1)*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508 [4], clause 4.6.1, table 4.6.1-13 RRCReconfiguration | | | |
| Information Element | | Value/remark | Comment | Condition |
| RRCReconfiguration ::= SEQUENCE { | |  |  |  |
| criticalExtensions CHOICE { | |  |  |  |
| rrcReconfiguration SEQUENCE { | |  |  |  |
| radioBearerConfig | | RadioBearerConfig-EHC |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

Table 7.1.3.5.7.3.3-2: *RadioBearerConfig-EHC (Table 7.1.3.5.7.3.3-1)*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [12], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| drb-Identity | DRB-Identity for DRB created in pre-test conditions |  |  |
| pdcp-Config | PDCP-Config-EHC |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.3.5.7.3.3-3: *PDCP-Config-EHC*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS38.331 [12], clause 6.3.2 | | | |
| Information Element | | Value/remark | Comment | Condition |
| PDCP-Config ::= SEQUENCE { | |  |  |  |
| ethernetHeaderCompression-r16 SEQUENCE { | |  |  |  |
| ehc-Common-r16 SEQUENCE { | |  |  |  |
| ehc-CID-Length-r16 | | bits15 |  |  |
| } | |  |  |  |
| ehc-Downlink-r16 SEQUENCE { | |  |  |  |
| drb-ContinueEHC-DL-r16 | | true |  |  |
| } | |  |  |  |
| ehc-Uplink-r16 SEQUENCE { | |  |  |  |
| maxCID-EHC-UL-r16 | | 32767 |  |  |
| drb-ContinueEHC-UL-r16 | | true |  |  |
| } | |  |  |  |
| } | |  |  |  |
| } | |  |  |  |

### 7.1.4 SDAP

#### 7.1.4.1 SDAP Data Transfer and PDU Header Handling UL/DL

7.1.4.1.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with multiple DRB's established, each mapping more than one QoS flow }

**ensure** **that** {

**when** { UE receives an SDAP PDU with SDAP header }

**then** { UE SDAP entity retrieves the SDAP SDU from the SDAP PDU and delivers it to upper layer }

}

(2)

**with** { UE in RRC\_CONNECTED state with multiple DRB's established configured with UL SDAP header, each mapping more than one QoS flow configured by RRC }

**ensure** **that** {

**when** { UE has to transmit a SDAP PDU with header to be included }

**then** {UE builds an SDAP PDU from the SDAP SDU including the header, and maps it to the DRB as per stored DRB mapping rule for the QoS flow }

}

(3)

**with** { UE in RRC\_CONNECTED state with multiple DRB's and QoS flows established }

**ensure that** {

**when** { UE receives a SDAP PDU with SDAP header and RDI fields set to 1 }

**then** { UE stores the QoS flow to DRB mapping of the DL SDAP PDU as the QoS flow to DRB mapping rule for the UL and uses it for further UL SDAP PDU transmissions }

}

(4)

**with** { UE in RRC\_CONNECTED state with multiple DRB's and QoS flows established }

**ensure that** {

**when** { UE receives a SDAP PDU with SDAP header and RDI field set to 1 and the stored QoS flow to DRB mapping rule for the QoS flow is different from the QoS flow to DRB mapping of the DL SDAP data PDU }

**then** { UE stores the QoS flow to DRB mapping of the DL SDAP PDU as the QoS flow to DRB mapping rule for the UL, to be used for further UL SDAP PDU transmissions and transmits an end-marker control PDU for the QoS flow on the old DRB }

}

(5)

**with** { UE in RRC\_CONNECTED state with multiple DRB's and QoS flows established with QoS flow to DRB mapping }

**ensure that** {

**when** { UE receives a message which configures a new QoS flow to DRB mapping, different from the existing mapping }

**then** { UE stores the QoS flow to DRB mapping to be used for further UL SDAP PDU transmissions and transmits an end-marker control PDU for the QoS flow on the old DRB }

}

7.1.4.1.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 37.324, clauses 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.2.2.1, 6.2.2.2, 6.2.2.3, 6.2.3 and 6.3.4, TS 24.501 clause 6.2.5.1.3. Unless otherwise stated these are Rel-15 requirements.

[TS 37.324 clause 5.2.1]

At the reception of an SDAP SDU from upper layer for a QoS flow, the transmitting SDAP entity shall:

- if there is no stored QoS flow to DRB mapping rule for the QoS flow as specified in the subclause 5.3:

- map the SDAP SDU to the default DRB;

- else:

- map the SDAP SDU to the DRB according to the stored QoS flow to DRB mapping rule;

- if the DRB to which the SDAP SDU is mapped is configured by RRC (3GPP TS 38.331 [3]) with the presence of SDAP header,

- construct the UL SDAP data PDU as specified in the subclause 6.2.2.3;

- else:

- construct the UL SDAP data PDU as specified in the subclause 6.2.2.1;

- submit the constructed UL SDAP data PDU to the lower layers.

NOTE 1: UE behaviour is not defined if there is neither a default DRB nor a stored QoS flow to DRB mapping rule for the QoS flow.

NOTE 2: Default DRB is always configured with UL SDAP header (3GPP TS 38.331 [3]).

[TS 37.324 clause 5.2.2]

At the reception of an SDAP data PDU from lower layers for a QoS flow, the receiving SDAP entity shall:

- if the DRB from which this SDAP data PDU is received is configured by RRC (3GPP TS 38.331 [3]) with the presence of SDAP header:

- perform reflective QoS flow to DRB mapping as specified in the subclause 5.3.2;

- perform RQI handling as specified in the subclause 5.4;

- retrieve the SDAP SDU from the DL SDAP data PDU as specified in the subclause 6.2.2.2.

- else:

- retrieve the SDAP SDU from the DL SDAP data PDU as specified in the subclause 6.2.2.1;

- deliver the retrieved SDAP SDU to the upper layer.

[TS 37.324 clause 5.3.1]

When RRC (3GPP TS 38.331 [3]) configures an UL QoS flow to DRB mapping rule for a QoS flow, the SDAP entity shall:

- if the SDAP entity has already been established and there is no stored QoS flow to DRB mapping rule for the QoS flow and a default DRB is configured:

- construct an end-marker control PDU, as specified in the subclause 6.2.3, for the QoS flow;

- map the end-marker control PDU to the default DRB;

- submit the end-marker control PDU to the lower layers.

- if the stored UL QoS flow to DRB mapping rule is different from the configured QoS flow to DRB mapping rule for the QoS flow and the DRB according to the stored QoS flow to DRB mapping rule is configured by RRC (3GPP TS 38.331 [3]) with the presence of UL SDAP header:

- construct an end-marker control PDU, as specified in the subclause 6.2.3, for the QoS flow;

- map the end-marker control PDU to the DRB according to the stored QoS flow to DRB mapping rule;

- submit the end-marker control PDU to the lower layers.

- store the configured UL QoS flow to DRB mapping rule for the QoS flow.

When RRC (3GPP TS 38.331 [3]) releases an UL QoS flow to DRB mapping rule for a QoS flow, the SDAP entity shall:

- remove the UL QoS flow to DRB mapping rule for the QoS flow.

[TS 37.324 clause 5.3.2]

For each received DL SDAP dataPDU with RDI set to 1, the SDAP entity shall:

- process the QFI field in the SDAP header and determine the QoS flow;

- if there is no stored QoS flow to DRB mapping rule for the QoS flow and a default DRB is configured:

- construct an end-marker control PDU, as specified in the subclause 6.2.3, for the QoS flow;

- map the end-marker control PDU to the default DRB;

- submit the end-marker control PDU to the lower layers;

- if the stored QoS flow to DRB mapping rule for the QoS flow is different from the QoS flow to DRB mapping of the DL SDAP data PDU and the DRB according to the stored QoS flow to DRB mapping rule is configured by RRC (3GPP TS 38.331 [3]) with the presence of UL SDAP header:

- construct an end-marker control PDU, as specified in the subclause 6.2.3, for the QoS flow;

- map the end-marker control PDU to the DRB according to the stored QoS flow to DRB mapping rule;

- submit the end-marker control PDU to the lower layers;

- store the QoS flow to DRB mapping of the DL SDAP data PDU as the QoS flow to DRB mapping rule for the UL.

[TS 37.324 clause 6.2.2.1]

An SDAP PDU consists only of a data field and does not consist of any SDAP header, as described in Figure 6.2.2.1-1.



Figure 6.2.2.1-1: SDAP Data PDU format without SDAP header

[TS 37.324 clause 6.2.2.2]

Figure 6.2.2.2 – 1 shows the format of SDAP Data PDU of DL with SDAP header being configured.



Figure 6.2.2.2-1: DL SDAP Data PDU format with SDAP header

[TS 37.324 clause 6.2.2.3]

Figure 6.2.2.3 – 1 shows the format of SDAP Data PDU of UL with SDAP header being configured.



Figure 6.2.2.3-1: UL SDAP Data PDU format with SDAP header

[TS 37.324 clause 6.2.3]

Figure 6.2.3 – 1 shows the format of End-Marker Control PDU.



Figure 6.2.2.3-1: UL SDAP Data PDU format with SDAP header

[TS 37.324 clause 6.3.4]

Length: 6 bits

The QFI field indicates the ID of the QoS flow (3GPP TS 23.501 [4]) to which the SDAP PDU belongs.

[TS 24.501 clause 6.2.5.1.3]

For PDU session of IPv4, IPv6, IPv4v6 or Ethernet PDU session type, upon receiving an UL user data packet from the upper layers for transmission via a PDU session, the UE shall attempt to associate the UL user data packet with:

a) the QFI of a signalled QoS rule associated with the PDU session which has a set of packet filters containing a packet filter for UL direction matching the UL user data packet or containing a packet filter for both UL and DL directions matching the UL user data packet; or

b) the QFI of a derived QoS rule associated with the PDU session which has the packet filter for UL direction matching the UL user data packet;

by evaluating the QoS rules in increasing order of their precedence values until the UL user data packet is associated with a QFI or all QoS rules are evaluated.

For PDU session of unstructured PDU session type, upon receiving an UL user data packet from the upper layers for transmission via a PDU session, the UE shall associate the UL user data packet with the QFI of the default QoS rule associated with the PDU session.

If the UL user data packet is associated with a QFI, the UE shall pass the QFI along the UL user data packet to the lower layers for transmission.

NOTE: Marking of the UL user data packet with the QFI is performed by the lower layers.

If all QoS rules are evaluated and the UL user data packet is not associated with a QFI, the UE shall discard the UL user data packet.

7.1.4.1.3 Test description

7.1.4.1.3.1 Pre-test conditions

System Simulator:

- NR Cell 1

UE:

- None.

Preamble:

- The UE is in 5GS state 3N-A with one PDU session active according to TS 38.508-1 [4], clause 4.4A.3, Table 4.4A.3-1 and using the message condition UE TEST LOOP MODE B active with IP PDU delay = 1 second, to return one SDAP SDU per DL SDAP SDU. 2 DRBs are configured where DRB j is defined as default DRB. The NAS QoS rules for the QoS flows with QFI=1, QFI=2, QFI=5 and QFI=6 are configured. QoS flows with QFI=5 and QFI=6 are mapped to DRB j, QoS flows with QFI=1 and QFI=2 are mapped to DRB k.

7.1.4.1.3.2 Test procedure sequence

Table 7.1.4.1.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The SS sends the SDAP Data PDU with SDAP header on DRB k and the following content to the UE: RDI=0. RQI=0, QFI=2. | <-- | SDAP DL Data PDU | - | - |
| 2 | Check: Does the UE re-transmit SDAP Data PDU on DRB k with SDAP header as per the stored DRB mapping flow with QFI=2? | --> | SDAP UL Data PDU | 1,2 | P |
| 2A | The SS transmits an OPEN UE TEST LOOP message. | <-- | OPEN UE TEST LOOP | - | - |
| 2B | The UE transmits an OPEN UE TEST LOOP COMPLETE message. | --> | OPEN UE TEST LOOP COMPLETE | - | - |
| 2C | The SS transmits a CLOSE UE TEST LOOP Message with IP PDU delay = 1 second. | <-- | CLOSE UE TEST LOOP | - | - |
| 2D | The UE transmits a CLOSE UE TEST LOOP COMPLETE message. | --> | CLOSE UE TEST LOOP COMPLETE | - | - |
| 3 | The SS sends the SDAP Data PDU with SDAP header on DRB k and the following content to the UE: RDI=1, RQI=0, QFI=5. | <-- | SDAP DL Data PDU | - | - |
| - | EXCEPTION: In parallel to the event described in step 4 the events specified in Table 7.1.4.1.3.2-2 shall take place. | - | - | - | - |
| 4 | Check: Does the UE re-transmit SDAP Data PDU on DRB k with SDAP header as per the stored DRB mapping Flow with QFI=5? | --> | SDAP UL Data PDU | 3 | P |
| 4A | The SS transmits an OPEN UE TEST LOOP message. | <-- | OPEN UE TEST LOOP | - | - |
| 4B | The UE transmits an OPEN UE TEST LOOP COMPLETE message. | --> | OPEN UE TEST LOOP COMPLETE | - | - |
| 4C | The SS transmits a CLOSE UE TEST LOOP Message with IP PDU delay = 1 second. | <-- | CLOSE UE TEST LOOP | - | - |
| 4D | The UE transmits a CLOSE UE TEST LOOP COMPLETE message. | --> | CLOSE UE TEST LOOP COMPLETE | - | - |
| 5 | The SS transmits an RRCReconfiguration message including a PDU SESSION MODIFICATION COMMAND | <-- | *RRCReconfiguration*  *(*PDU SESSION MODIFICATION COMMAND) | - | - |
| - | EXCEPTION: In parallel to the event described in step 6 the events specified in Tables 7.1.4.1.3.2-3 and 7.1.4.1.3.2-4 shall take place. | - | - | - | - |
| 6 | The UE transmits an RRCReconfigurationComplete message. | --> | *RRCReconfigurationComplete* | - | - |
| 7 | The SS sends the SDAP Data PDU with SDAP header on DRB k and the following content to the UE: RDI=0. RQI=0, QFI=4. | <-- | SDAP DL Data PDU | - | - |
| 8 | Check: Does the UE re-transmit SDAP Data PDU on DRB k with SDAP header as per the stored DRB mapping Flow with QFI=4? | --> | SDAP UL Data PDU | 5 | P |

Table 7.1.4.1.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit End-Marker Control PDU on DRB j for QFI=5? | --> | SDAP UL Control PDU | 4 | P |

Table 7.1.4.1.3.2-3: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | Check: Does the UE transmit End-Marker Control PDU on DRB j for QFI=4? | --> | SDAP UL Control PDU | 5 | P |

Table 7.1.4.1.3.2-4: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| St | Procedure | Message Sequence | | TP | Verdict |
|  |  | U - S | Message |  |  |
| 1 | The UE Transmits PDU SESSION MODIFICATION COMPLETE | --> | *ULInformationTransfer*  (PDU SESSION MODIFICATION COMPLETE) | - | - |

7.1.4.1.3.3 Specific message contents

Table 7.1.4.1.3.3-1: RadioBearerConfig-DRB(Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-132 and condition NR | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 2 entries |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | present |  |  |
| sdap-HeaderUL | present |  |  |
| defaultDRB | false |  |  |
| mappedQoS-FlowsToAdd SEQUENCE { |  |  |  |
| QFI | 1 |  |  |
| QFI | 2 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | k | k is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| DRB-ToAddMod[2] SEQUENCE { |  | entry 2 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | present |  |  |
| sdap-HeaderUL | present |  |  |
| defaultDRB | true |  |  |
| mappedQoS-FlowsToAdd SEQUENCE { |  |  |  |
| QFI | 5 |  |  |
| QFI | 6 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | j | j is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.4.1.3.3-2: RadioBearerConfig-DRB(step 5, Table 7.1.4.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-132 and condition NR | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { | - | - |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod { | 1 entry | BID is the total number of established DRBs in the UE, before applying the contents of this IE |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | present |  |  |
| sdap-HeaderUL | present |  |  |
| defaultDRB | false |  |  |
| mappedQoS-FlowsToAdd SEQUENCE { |  |  |  |
| QFI | 4 |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | k | k is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.4.1.3.3-3: PDU SESSION MODIFICATION COMMAND (step 5, Table 7.1.4.1.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.7.2-9 | | | |
| **Information Element** | **Value/remark** | **Comment** | **Condition** |
| PDU session ID | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| Authorized QoS rules | 1 entry |  |  |
| QoS rule [1] | Reference QoS rule #4a as defined in TS 38.508-1 [4], Table 4.8.2.1-4a. | QFI=4 |  |
| Authorized QoS flow descriptions | 1 entry |  |  |
| QoS flow [1] | Reference QoS flow #2a as defined in TS 38.508-1 [4], Table 4.8.2.3-2a. | QFI=4 |  |

Table 7.1.4.1.3.3-4: PDU SESSION ESTABLISHMENT ACCEPT (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.7.2-2 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDU session ID | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| Authorized QoS rules | 4 entries |  |  |
| QoS rule [1] | Reference QoS rule #1 as defined in TS 38.508-1 [4], Table 4.8.2.1-1 | QFI=1 |  |
| QoS rule [2] | Reference QoS rule #4 as defined in Table 7.1.4.1.3.3-7 | QFI=2 |  |
| QoS rule [3] | Reference QoS rule #5 as defined in TS 38.508-1 [4], Table 4.8.2.1-5 | QFI=5 |  |
| QoS rule [4] | Reference QoS rule #6 as defined in TS 38.508-1 [4], Table 4.8.2.1-6 | QFI=6 |  |
| Mapped EPS Bearer contexts | Not Present |  |  |
| Authorized QoS flow descriptions | 4 entries |  |  |
| QoS flow [1] | Reference QoS flow #1 as defined in Table 7.1.4.1.3.3-5 | QFI=1 |  |
| QoS flow [2] | Reference QoS flow #2 as defined in Table 7.1.4.1.3.3-6 | QFI=2 |  |
| QoS flow [3] | Reference QoS flow #3 as defined in TS 38.508-1 [4], Table 4.8.2.3-3 | QFI=5 |  |
| QoS flow [4] | Reference QoS flow #4 as defined in TS 38.508-1 [4], Table 4.8.2.3-4 | QFI=6 |  |

Table 7.1.4.1.3.3-5: Reference QoS flow #1 (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.8.2.3-1 | | | |
| Information Element | Value/remark | Comment | Condition |
| QoS flow descriptions |  |  |  |
| QoS flow description | 1 entry |  |  |
| QFI | ‘00 0001’B | QFI 1 |  |
| Operation code | ‘001’B | Create new QoS flow description |  |
| E bit | ‘1’B | Parameters list is included |  |
| Number of parameters | ’00 0001’B | 1 parameter |  |
| 5QI | ‘0000 1001’B | 5QI 9 |  |

Table 7.1.4.1.3.3-6: Reference QoS flow #2 (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.8.2.3-2 | | | |
| Information Element | Value/remark | Comment | Condition |
| QoS flow descriptions |  |  |  |
| QoS flow description | 1 entry |  |  |
| QFI | ‘00 0010’B | QFI 2 |  |
| Operation code | ‘001’B | Create new QoS flow description |  |
| E bit | ‘1’B | Parameters list is included |  |
| Number of parameters | ’00 0001’B | 1 parameter |  |
| 5QI | ‘0000 0101’B | 5QI 5 |  |

Table 7.1.4.1.3.3-7: Reference QoS rule #4

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[4], table 4.8.2.1-4 | | | |
| Information Element | Value/remark | Comment | Condition |
| QoS rules |  |  |  |
| QoS rule |  |  |  |
| DQR bit | ‘0’B |  |  |

#### 7.1.4.2 SDAP Data Transfer handling without Header UL/DL

7.1.4.2.1 Test Purpose (TP)

(1)

**with** { UE in RRC\_CONNECTED state with multiple DRB's established. SDAP configured without header and no stored QoS flow mapping }

**ensure** **that** {

**when** { UE receives a SDAP SDU from upper layers }

**then** { UE SDAP entity transmits the SDAP PDU with header on default DRB }

}

(2)

**with** { UE in RRC\_CONNECTED state with multiple DRB's established. SDAP configured without header and no stored QoS flow mapping }

**ensure** **that** {

**when** { UE SDAP recieves from RRC new Qos Flow mapping }

**then** { UE SDAP entity transmits an end-marker control PDU for the QoS flow on default DRB }

}

(3)

**with** { UE in RRC\_CONNECTED state with multiple DRB's established. SDAP configured without header and stored QoS flow mapping configured by RRC }

**ensure** **that** {

**when** { UE receives a SDAP SDU from upper layers }

**then** { UE SDAP entity transmits the SDAP PDU without header on non default DRB as per configured QoS flow mapping }

}

7.1.4.2.2 Conformance requirements

References: The conformance requirements covered in the present test case are specified in: TS 37.324, clauses 5.2.1, 5.2.2, 5.3.1, 6.2.2.1 and 6.2.3, TS 24.501 clause 6.2.5.1.3. Unless otherwise stated these are Rel-15 requirements.

[TS 37.324 clause 5.2.1]

At the reception of an SDAP SDU from upper layer for a QoS flow, the transmitting SDAP entity shall:

- if there is no stored QoS flow to DRB mapping rule for the QoS flow as specified in the subclause 5.3:

- map the SDAP SDU to the default DRB;

- else:

- map the SDAP SDU to the DRB according to the stored QoS flow to DRB mapping rule;

- if the DRB to which the SDAP SDU is mapped is configured by RRC (3GPP TS 38.331 [3]) with the presence of SDAP header,

- construct the UL SDAP data PDU as specified in the subclause 6.2.2.3;

- else:

- construct the UL SDAP data PDU as specified in the subclause 6.2.2.1;

- submit the constructed UL SDAP data PDU to the lower layers.

NOTE 1: UE behaviour is not defined if there is neither a default DRB nor a stored QoS flow to DRB mapping rule for the QoS flow.

NOTE 2: Default DRB is always configured with UL SDAP header (3GPP TS 38.331 [3]).

[TS 37.324 clause 5.2.2]

At the reception of an SDAP data PDU from lower layers for a QoS flow, the receiving SDAP entity shall:

- if the DRB from which this SDAP data PDU is received is configured by RRC (3GPP TS 38.331 [3]) with the presence of SDAP header:

- perform reflective QoS flow to DRB mapping as specified in the subclause 5.3.2;

- perform RQI handling as specified in the subclause 5.4;

- retrieve the SDAP SDU from the DL SDAP data PDU as specified in the subclause 6.2.2.2.

- else:

- retrieve the SDAP SDU from the DL SDAP data PDU as specified in the subclause 6.2.2.1;

- deliver the retrieved SDAP SDU to the upper layer.

[TS 37.324 clause 5.3.1]

When RRC (3GPP TS 38.331 [3]) configures an UL QoS flow to DRB mapping rule for a QoS flow, the SDAP entity shall:

- if the SDAP entity has already been established and there is no stored QoS flow to DRB mapping rule for the QoS flow and a default DRB is configured:

- construct an end-marker control PDU, as specified in the subclause 6.2.3, for the QoS flow;

- map the end-marker control PDU to the default DRB;

- submit the end-marker control PDU to the lower layers.

- if the stored UL QoS flow to DRB mapping rule is different from the configured QoS flow to DRB mapping rule for the QoS flow and the DRB according to the stored QoS flow to DRB mapping rule is configured by RRC (3GPP TS 38.331 [3]) with the presence of UL SDAP header:

- construct an end-marker control PDU, as specified in the subclause 6.2.3, for the QoS flow;

- map the end-marker control PDU to the DRB according to the stored QoS flow to DRB mapping rule;

- submit the end-marker control PDU to the lower layers.

- store the configured UL QoS flow to DRB mapping rule for the QoS flow.

When RRC (3GPP TS 38.331 [3]) releases an UL QoS flow to DRB mapping rule for a QoS flow, the SDAP entity shall:

- remove the UL QoS flow to DRB mapping rule for the QoS flow.

[TS 37.324 clause 6.2.2.1]

An SDAP PDU consists only of a data field and does not consist of any SDAP header, as described in Figure 6.2.2.1-1.



Figure 6.2.2.1-1: SDAP Data PDU format without SDAP header

[TS 37.324 clause 6.2.3]

Figure 6.2.3 – 1 shows the format of End-Marker Control PDU.



Figure 6.2.3-1: End-Marker Control PDU

[TS 24.501 clause 6.2.5.1.3]

For PDU session of IPv4, IPv6, IPv4v6 or Ethernet PDU session type, upon receiving an UL user data packet from the upper layers for transmission via a PDU session, the UE shall attempt to associate the UL user data packet with:

a) the QFI of a signalled QoS rule associated with the PDU session which has a set of packet filters containing a packet filter for UL direction matching the UL user data packet or containing a packet filter for both UL and DL directions matching the UL user data packet; or

b) the QFI of a derived QoS rule associated with the PDU session which has the packet filter for UL direction matching the UL user data packet;

by evaluating the QoS rules in increasing order of their precedence values until the UL user data packet is associated with a QFI or all QoS rules are evaluated.

For PDU session of unstructured PDU session type, upon receiving an UL user data packet from the upper layers for transmission via a PDU session, the UE shall associate the UL user data packet with the QFI of the default QoS rule associated with the PDU session.

If the UL user data packet is associated with a QFI, the UE shall pass the QFI along the UL user data packet to the lower layers for transmission.

NOTE: Marking of the UL user data packet with the QFI is performed by the lower layers.

If all QoS rules are evaluated and the UL user data packet is not associated with a QFI, the UE shall discard the UL user data packet.

7.1.4.2.3 Test description

7.1.4.2.3.1 Pre-test conditions

System Simulator:

- NR Cell 1

UE:

- None.

Preamble:

- The UE is in 5GS state 3N-A with one PDU session active according to TS 38.508-1 [4], clause 4.4A.3, Table 4.4A.3-1 and using the message condition UE TEST LOOP MODE B active to return one UL SDAP SDU per DL SDAP SDU. 2 DRBs are configured where DRBj is defined as default DRB. The NAS QoS rules for QoS flows QFI = 5 and QFI = 2 are configured. The 'mappedQoS-Flows' is empty for both DRB's for SDAP layer.

7.1.4.2.3.2 Test procedure sequence

Table 7.1.4.2.3.2-1: Main behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | The SS sends the SDAP Data PDU without SDAP header on DRB k for QFI =2. | <-- | SDAP DL Data PDU | - | - |
| 2 | Check: Does the UE transmit SDAP Data PDU on DRB j, which is default DRB, with SDAP header including QFI=2? | --> | SDAP UL Data PDU | 1 | P |
| 3 | The SS sends the SDAP Data PDU without SDAP header on DRB j for QFI 5. | <-- | SDAP DL Data PDU | - | - |
| 4 | Check: Does the UE transmit SDAP Data PDU on DRB j, which is default DRB, with SDAP header including QFI=5? | --> | SDAP UL Data PDU | 1 | P |
| 5 | The SS transmits an NR RRCReconfiguration message to configure QoS Flow rules | <-- | *(RRCReconfiguration)* | - | - |
| - | EXCEPTION: In parallel to the event described in step 6 the events specified in Table 7.1.4.2.3.2-2 shall take place. | - | *-* | - | - |
| 6 | The UE transmit an NR *RRCReconfigurationComplete* message. | --> | *(RRCReconfigurationComplete)* | - | - |
| 7 | The SS sends the SDAP Data PDU without SDAP header on DRB k for QFI =2. | <-- | SDAP DL Data PDU | - | - |
| 8 | Check: Does the UE transmit SDAP Data PDU on DRB k? | --> | SDAP UL Data PDU | 3 | P |
| 9 | The SS sends the SDAP Data PDU without SDAP header on DRB j for QFI 5. | <-- | SDAP DL Data PDU | - | - |
| 10 | Check: Does the UE transmit SDAP Data PDU on DRB j, with SDAP header including QFI=5? | --> | SDAP UL Data PDU | 3 | P |

Table 7.1.4.2.3.2-2: Parallel behaviour

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **St** | **Procedure** | **Message Sequence** | | **TP** | **Verdict** |
|  |  | **U - S** | **Message** |  |  |
| 1 | Check: Does the UE transmit End-Marker Control PDU on DRBj for QFI=2? | --> | SDAP UL Control PDU | 2 | P |

Table 7.1.4.2.3.2-3: Void

7.1.4.2.3.3 Specific message contents

Table 7.1.4.2.3.3-1: RadioBearerConfig-DRB(Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-132 and condition NR | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF SEQUENCE { | 2 entries |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | absent |  |  |
| sdap-HeaderUL | absent |  |  |
| defaultDRB | false |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | k | k is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| DRB-ToAddMod[2] SEQUENCE { |  | entry 2 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | absent |  |  |
| sdap-HeaderUL | present |  |  |
| defaultDRB | true |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | j | j is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.4.2.3.3-2: RadioBearerConfig-DRB(step 5, Table 7.1.4.2.3.2-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.6.3-132 and condition NR | | | |
| Information Element | Value/remark | Comment | Condition |
| RadioBearerConfig ::= SEQUENCE { |  |  |  |
| drb-ToAddModList SEQUENCE (SIZE (1..maxDRB)) OF SEQUENCE { | 2 entries |  |  |
| DRB-ToAddMod[1] SEQUENCE { |  | entry 1 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | absent |  |  |
| sdap-HeaderUL | absent |  |  |
| defaultDRB | false |  |  |
| mappedQoS-FlowsToAdd SEQUENCE { |  |  |  |
| QFI | 2 |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | k | k is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| DRB-ToAddMod[2] SEQUENCE { |  | entry 2 |  |
| cnAssociation CHOICE { |  |  |  |
| sdap-Config SEQUENCE { |  |  |  |
| pdu-Session | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| sdap-HeaderDL | absent |  |  |
| sdap-HeaderUL | present |  |  |
| defaultDRB | true |  |  |
| mappedQoS-FlowsToAdd | Not present | The 'mappedQoS-Flows' is empty for the DRB. |  |
| } |  |  |  |
| } |  |  |  |
| drb-Identity | j | j is allocated according to internal TTCN mapping |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

Table 7.1.4.2.3.3-3: PDU SESSION ESTABLISHMENT ACCEPT (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.7.2-2 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDU session ID | The same as the PDU session ID in PDU SESSION ESTABLISHMENT REQUEST |  |  |
| Authorized QoS rules | 3 entries |  |  |
| QoS rule [1] | Reference QoS rule #1 as defined in Table 4.8.2.1-1 | QFI=1 |  |
| QoS rule [2] | Reference QoS rule #4 as defined in Table 4.8.2.1-4 except DQR bit set to ‘0’ | QFI=2 |  |
| QoS rule [3] | Reference QoS rule #5 as defined in Table 4.8.2.1-5 | QFI=5 |  |
| Mapped EPS bearer contexts | Not Present |  |  |
| Authorized QoS flow descriptions | 3 entries |  |  |
| QoS flow [1] | Reference QoS flow #1 as defined in Table 7.1.4.2.3.3-4 | QFI=1 |  |
| QoS flow [2] | Reference QoS flow #2 as defined in Table 7.1.4.2.3.3-5 | QFI=2 |  |
| QoS flow [3] | Reference QoS flow #3 as defined in Table 4.8.2.3-3 | QFI=5 |  |

Table 7.1.4.2.3.3-4: Reference QoS flow #1 (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.8.2.3-1 | | | |
| Information Element | Value/remark | Comment | Condition |
| QoS flow descriptions |  |  |  |
| QoS flow description | 1 entry |  |  |
| QFI | ‘00 0001’B | QFI 1 |  |
| Operation code | ‘001’B | Create new QoS flow description |  |
| E bit | ‘1’B | Parameters list is included |  |
| Number of parameters | ’00 0001’B | 1 parameter |  |
| 5QI | ‘0000 1001’B | 5QI 9 |  |

Table 7.1.4.2.3.3-5: Reference QoS flow #2 (Preamble)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [4], table 4.8.2.3-2 | | | |
| Information Element | Value/remark | Comment | Condition |
| QoS flow descriptions |  |  |  |
| QoS flow description | 1 entry |  |  |
| QFI | ‘00 0010’B | QFI 2 |  |
| Operation code | ‘001’B | Create new QoS flow description |  |
| E bit | ‘1’B | Parameters list is included |  |
| Number of parameters | ’00 0001’B | 1 parameter |  |
| 5QI | ‘0000 0101’B | 5QI 5 |  |