**3GPP TSG-RAN WG2 NR Ad-Hoc meeting *R2-18xxxxx***

**Vancouver, Canada, 22nd - 26th January 2018**

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| *CR-Form-v11.2* |
| **CHANGE REQUEST** |
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|  | **38.306** | **CR** |  | **rev** |  | **Current version:** | **15.0.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:***  | Updates on UE capabilities |
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| ***Source to WG:*** | Intel Corporation |
| ***Source to TSG:*** | R2 |
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| ***Work item code:*** | NR\_newRAT-Core |  | ***Date:*** | 2018-02-02 |
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| ***Category:*** | **F** |  | ***Release:*** | Rel-15 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | New agreements made at RAN2 NR Ad-Hoc: 1. Linking MR-DC BCs to BPCs (R2-1800909)
2. BC structure with UL and DL decoupling (R2-181620)
3. BPC capability coordination in MR-DC (R2-1800740)
4. Clarifications on BPC capabilities (R2-1801532)
5. L2 buffer size calculation (R2-1800946)
6. UE capabilities on dynamic power sharing (R2-1801520)
7. L2/3 capabilities (R2-1801608)
8. RAN1 LS (R2-1801608)
9. UE capability parameters with the table format (R2-1801608)
10. Correction on the field description of singleTransmission (R2-1801653)
11. Removal of *volteOverNR-PDCP* (R2-1800955)
12. Small corrections
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| ***Summary of change:*** | 1. Add clarification that the UE is allowed to include the fallback BPCs with a higher capability and multiple BPCs for the same band combination.
2. Add clarification how UL and DL decoupling works for SUL.
3. Add clarification of BPC coordination into clause 8 (Capability coordination).
4. Update the field descriptions of physical layer parameters.
5. Update 4.1.4 with the table showing RLC RTT per SCS.
6. Add the field descriptions of *dynamicPowerSharing* and *eutra-BasedTDM*.
7. Update L2/3 capabilities as follow:
* Add the field descriptions of *splitSRB-WithOneUL-Path, directSN-Addition, intraAndInterF-MeasAndReport*, and *eventA-MeasAndReport*.
* Add the field descriptions of *fdd-UE-MRDC-Capability, tdd-UE-MRDC-Capabilty, fdd-UE-NR-Capability* and *tdd-UE-NR-Capability* in 4.2.1
* Update the field description of *multipleTimingAdvances*.
* Fill in FDD-TDD difference column according to the agreements.
1. Update 4.1.2 according to RAN1 LS.
2. Update UE capability parameters with the table format.
3. Update the field description of *singleTransmission*.
4. Remove *volteOverNR-DPCP* field description.
5. Update with the following small corrections:
* Correct reference for channel BW in 4.1.2
* Remove clause 7 (Mandatory features).
* Add some references in 2 and corresponding field descriptions.
* Remove obvious and repeated editor’s notes
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| ***Consequences if not approved:*** | Specification is incomplete.  |
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| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |

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| The First Change |

Contents

Foreword 4

1 Scope 5

2 References 5

3 Definitions, symbols and abbreviations 5

3.1 Definitions 5

3.2 Symbols 5

3.3 Abbreviations 5

4 UE radio access capability parameters 6

4.1 Supported max data rate 6

4.1.1 General X

4.1.2 Max data rate without *ue-CategoryDL* and *ue-CategoryUL* X

4.1.3 Max data rate with *ue-CategoryDL* and *ue-CategoryUL* X

4.1.4 Total layer 2 buffer size X

4.2 UE Capability Parameters X

4.2.1 Introduction X

4.2.2 General parameters X

4.2.3 SDAP Parameters X

4.2.4 PDCP Parameters X

4.2.5 RLC parameters X

4.2.6 MAC parameters X

4.2.7 Physical layer parameters X

4.2.8 RF parameters X

4.2.9 Measurement parameters X

4.2.10 Inter-RAT parameters X

4.2.10.1 *eutraFDD* X

4.2.10.2 *eutraTDD* X

5 Optional features without UE radio access capability parameters X

6 Conditional mandatory features X

7. Capability coordination in MR-DC operation X

**Annex <A> (normative): <Normative annex title> X**

**Annex <B> (informative): <Informative annex title> X**

**Annex <X> (informative): Change history X**

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| The Next Change |

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-1: “NR User Equipment (UE) radio transmission and reception Part 1: Range 1 Standalone”.

[3] 3GPP TS 38.101-2: “NR User Equipment (UE) radio transmission and reception Part 2: Range 2 Standalone”.

[4] 3GPP TS 38.101-3: “NR User Equipment (UE) radio transmission and reception Part 3: Range 1 and Range 2 Interworking operation with other radios”.

[5] 3GPP TS 38.133: “NR Requirements for support of radio resource management”.

[6] 3GPP TS 38.211: “NR Physical channels and modulation”.

[7] 3GPP TS 37.340: “Evolved Universal Terrestrial Radio Access (E-UTRA) and NR Multi-connectivity”.

[8] 3GPP TS 38.321: “NR Medium Access Control (MAC) protocol specificiation”.

[9] 3GPP TS 38.331: “NR Radio Resource Control (RRC) protocol specification”.

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| The Next Change |

4.1.2 Max data rate without *ue-CategoryDL* and *ue-CategoryUL*

The approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.



wherein

J is the number of aggregated component carriers in a band or band combination

Rmax = 948/1024

For the j-th CC,

 is the maximum number of layers

 is the maximum modulation order

is the scaling factor

The scaling factor can at least take the values 1 and 0.75.

is signalled per band and per band per band combination

 is the numerology (as defined in TS 38.211 [6])

 is the average OFDM symbol duration in a subframe for numerology , i.e. . Note that normal cyclic prefix is assumed.

 is the maximum RB allocation in bandwidth  with numerology , as defined in 5.3 TS 38.101-1 [2] and 5.3 TS 38.101-2 [3], where  is the UE supported maximum bandwidth in the given band or band combination

is the overhead and takes the following values

[0.14], for frequency range FR1 for DL

[0.18], for frequency range FR2 for DL

[0.08], for frequency range FR1 for UL

[0.10], for frequency range FR2 for UL

Note: Only one of the UL or SUL carriers (the one with the higher data rate) is counted for a cell operating SUL

The approximate maximum data rate can be computed as the maximum of the approximate data rates computed using the above formula for each of the supported band or band combinations.

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| The Next Change |

4.1.4 Total layer 2 buffer size

The total layer 2 buffer size is defined as the sum of the number of bytes that the UE is capable of storing in the RLC transmission windows and RLC reception and reordering windows for all radio bearers, and for UEs capable of split bearers, also in PDCP reordering windows for all split radio bearers.

The required total layer 2 buffer size for split bearer operation in MR-DC is calculated by *MaxULDataRate \* RTT + MaxDLDataRate\_SN \* RTT + MaxDLDataRate\_MN \* (RTT + Xn delay + Queuing in SN)*. Otherwise it is calculated by *MaxDLDataRate \* RTT + MaxULDataRate \* RTT*. The required total layer 2 buffer size is determined as the maximum total layer 2 buffer size of all the calculated ones for each band combination in the supported MR-DC or NR band combinations.

wherein

Xn delay + Queuing in SN = 25ms

| RLC RTT (ms) | SCS (kHz) |
| --- | --- |
| TBD | TBD |
| TBD | TBD |
| TBD | TBD |
| TBD | TBD |

Editor’s Note: RTT value will be added once decided.

4.2 UE Capability Parameters

4.2.1 Introduction

If the UE supports both FDD and TDD, set all fields in UE-MRDC-Capability and/or UE-NR-Capability, except fdd-UE-MRDC-Capability, tdd-UE-MRDC-Capability, fdd-UE-NR-Capability, and tdd-UE-NR-Capability, to include the values applicable for both FDD and TDD (i.e. functionality supported by both modes). If (some of) the UE capability fields have a different value for FDD and TDD, the UE includes supported FDD/TDD dedicated additional functionality by the field in fdd-UE-MRDC-Capability/tdd-UE-MRDC-Capability and/or fdd-UE-NR-Capability/tdd-UE-NR-Capability. If the UE supports either FDD or TDD only, set all fields in UE-MRDC-Capability and/or UE-NR-Capability, except fdd-UE-MRDC-Capability, tdd-UE-MRDC-Capability, fdd-UE-NR-Capability and tdd-UE-NR-Capability, to include the values applicable for the FDD/TDD supported by the UE.

4.2.2 General parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***splitSRB-WithOneUL-Path***This field indicates whether the UE supports UL transmission via either MCG path or SCG path for the split SRB as specified in TS 37.340 [7]. | UE | TBD | Yes |
| ***directSN-Addition***This field indicates whether the UE supports direct SN addition and SCG DRB setup at the first RRC reconfiguration after RRC Connection Setup.  | UE | TBD | Yes |

Editor’s Note: Parameters may be added later.

4.2.3 SDAP Parameters

Editor’s Note: Targeted for completion in June 2018.

4.2.4 PDCP Parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***continueROHC-Context***This field defines whether the UE supports ROHC context continuation operation where the UE does not reset the current ROHC context upon handover. | UE | TBD | No |
| ***dataRateDRB-IP***This field defines the upper bound of the aggregated data rate of user plane integrity protected data in either UL or DL DRBs. Value 64kbps corresponds to the aggregated data rate of user plane integrity protected data in either UL or DL cannot exceed 64kbps and so on. It is not supported in this version and is targeted for completion in June 2018.  | UE | TBD | No |
| ***maxNumberROHC-ContextSessions***This field defines the maximum number of header compression context sessions supported by the UE, excluding context sessions that leave all headers uncompressed. | UE | TBD | No |
| ***outOfOrderDelivery***This field indicates whether UE supports Out of order delivery of data to upper layers by PDCP. | UE | TBD | No |
| ***shortSN***This field indicates whether the UE supports 12 bit length of PDCP sequence number. | UE | TBD | No |
| ***supportedROHC-Profiles***This field defines which ROHC profiles from the list below are supported by the UE: - 0x0000 ROHC No compression (RFC 5795)- 0x0001 ROHC RTP/UDP/IP (RFC 3095, RFC 4815)- 0x0002 ROHC UDP/IP (RFC 3095, RFC 4815)- 0x0003 ROHC ESP/IP (RFC 3095, RFC 4815)- 0x0004 ROHC IP (RFC 3843, RFC 4815)- 0x0006 ROHC TCP/IP (RFC 6846)- 0x0101 ROHC RTP/UDP/IP (RFC 5225)- 0x0102 ROHC UDP/IP (RFC 5225)- 0x0103 ROHC ESP/IP (RFC 5225)- 0x0104 ROHC IP (RFC 5225)A UE that supports one or more of the listed ROHC profiles shall support ROHC profile 0x0000 ROHC uncompressed (RFC 5795). | UE | TBD | No |
| ***uplinkOnlyROHC-Profiles***This field defines which ROHC profile(s) from the list below are supported in uplink-only ROHC operation by the UE. - 0x0006 ROHC TCP (RFC [6846])A UE that supports uplink-only ROHC profile(s) shall support ROHC profile 0x0000 ROHC uncompressed (RFC 5795). | UE | TBD | No |

4.2.5 RLC parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***amWithShortSN***This field indicates whether the UE supports RLC AM with 12 bit length of RLC sequence number. | UE | TBD | No |
| ***umWIthLongSN***This field indicates whether the UE supports RLC UM with 12 bit length of RLC sequence number.  | UE | TBD | No |
| ***umWithShortSN***This field indicates whether the UE supports RLC UM with 6 bit length of RLC sequence number. | UE | TBD | No |

4.2.6 MAC parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***lcp-Restriction***This field indicates whether UE supports the selection of logical channels for each UL grant based on RRC configured restriction. | UE | TBD | No |
| ***logicalChannelSR-DelayTimer***This field indicates whether the UE supports the logicalChannelSR-DelayTimer as specified in TS 38.321 [8]  | UE | TBD | Yes |
| ***longDRX-Cycle***This field indicates whether UE supports long DRX cycle as specified in TS 38.321 [8]. | UE | TBD | Yes |
| ***numberOfConfiguredGrantConfigurations***This field indicates the maximum number of grant configurations supported per cell group. | UE | TBD | Yes |
| ***numberOfSR-Configurations***This field indicates the maximum number of SR configurations supported per cell group. | UE | TBD | Yes |
| ***shortDRX-Cycle***This field indicates whether UE supports short DRX cycle as specified in TS 38.321 [8]. | UE | TBD | Yes |
| ***skipUplinkTxDynamic***This field indicates whether the UE supports skipping of UL transmission for an uplink grant indicated on PDCCH if no data is available for transmission as specified in TS 38.321 [8]. | UE | TBD | Yes |

4.2.7 Physical layer parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***bandwidthPerCC-DL, bandwidthPerCC-UL***This field defines the supported bandwidth per CC, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. | CC per BPC | TBD | No |
| ***ca-BandwidthClassDL and ca-BandwidthClassUL***This field defines for DL and UL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. | Band per BPC | TBD | No |
| ***supportedBasebandProcessingCombination***This field defines the supported CA baseband processing combinations by the UE. The baseband processing combinations associated to *supportedBandCombination* are only included. For a given band combination, multiple baseband processing combinations and fallback baseband processing combination with a higher capability can be included. A baseband combination is applicable to the band combination which consist of bands with equal *ca-BandwidthClassDL, ca-BandwidthClassUL,* and equal or higher *supportedMIMO-CapabilityDL* and *supportedMIMO-Capability*. | UE | TBD | No |
| ***supportedBasebandProcessingCombination-MRDC***This field defines the supported MN and SN baseband processing combinations for MR-DC by the UE. The *basebandProcesingCombinationIndexMN* defines the supported baseband processing combinations in MN side and *basebandProcessingCombinationLinkedIndexSN* defines the supported baseband processing combinations in SN side, which is associated with each MN supported baseband processing combination.  | UE | TBD | No |
| ***supportedMIMO-CapabilityDL, supportedMIMO-CapabilityUL***This field defines the supported number of MIMO layers by the UE.  | (Band& CC) per BPC | TBD | No |
| ***supportedModulationOrderDL, supportedModulationOrderUL***This field defines the supported modulation scheme by the UE. | CC per BPC | TBD | No |
| ***supportedSubCarrierSpacingList***This field defines the supported sub-carrier spacing by the UE. | TBD | TBD | No |

4.2.8 RF parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***ca-BandwidthClassDL and ca-BandwidthClassUL***This field defines for NR DL and UL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE, as specified in TS 38.101-1 [2] and TS 38.101-2 [3] | Band per BC | TBD | No |
| ***dynamicPowerSharing***This field indicates whether the UE supports dynamic EN-DC power sharing or not. If the UE supports this capability it will dynamically share the power between NR and LTE if P\_LTE + P\_NR > Pcmax.  | UE | TBD | No |
| ***eutra-BasedTDM***This field indicates whether the UE shall not perform the NR UL transmission if P\_LTE + P\_NR > Pcmax in case the subframe is LTE UL in the reference TDD configuration configured for the LTE PCell. It is mandatory for the UE that does not support dynamicPowerSharing and the UE that indicates single UL for any band combination, and optional otherwise.  | UE | TBD | No |
| ***intraBandAsyncFDD***This field indicates whether the UE supports asynchronous FDD-FDD intra-band LTE-NR DC with MRTD and MTTD as specified in [X]. If it is not supported for FDD-FDD intra-band LTE-NR DC, the UE supports only synchronous FDD-FDD intra-band LTE-NR DC.  | TBD | TBD | No |
| ***intraBandSimultaneousTxRx***This field indicates whether the UE supports simultaneous transmission and reception in TDD-TDD and TDD-FDD inter-band LTE-NR DC operation. | TBD | TBD | No |
| ***multipleTimingAdvances***This field indicates whether multiple timing advances are supported by the UE. For NR CA band combination, if the band combination comprised of more than one band entry (i.e., inter-band or intra-band non-contiguous band combination), the field indicates that different timing advances on different band entries are supported. For EN-DC band combination, this field is not presented and it is mandatory for the UE supporting EN-DC band combination. In this release, up to two timing advances are supported for EN-DC band combination or NR CA band combination.  | BC | TBD | No |
| ***scalingFactor0dot75***This field indicates the scaling factor 0.75 is applied to the band in the max data rate calculation as defined in 4.1.2. If absent, the scaling factor 1 is applied to the band in the max data rate calculation.  | Band per BC | TBD | No |
| ***singleTransmission***This field indicates that the UE does not support simultaneous UL transmissions as defined in TS 38.101-3 [4]. The UE may only set this bit for certain band combinations defined in TS 38.101-3 [4]. If set for a particular band combination, the bit applies to all fallback band combinations of this band combination that are defined in TS 38.101-3 [4] as being allowed to set the bit and does not apply to any other fallback band combinations defined in TS 38.101-3 [4]. | BC | TBD | No |
| ***supportedBandCombination***This field defines the supported CA and/or MR-DC band combinations by the UE. For each band in a band combination the UE provides the supported CA bandwidth classes for DL and/or UL. For SUL, frequeny band indicator is included in *BandDL-Info* and *bandParametersDL* is absent.  | UE | TBD | No |
| ***supportedBandListNR***This field includes the supported NR bands as defined in TS 38.101-1 [2] and TS 38.101-2 [3]. | UE | TBD | No |

4.2.9 Measurement parameters

| Definitions for parameters | Per | M | FDD-TDD diff |
| --- | --- | --- | --- |
| ***independentGapConfig***This field indicates whether the UE supports two independent measurement gap configurations for FR1 and FR2 specified in TS 38.133 [5]. | UE | TBD | Yes |
| ***intraCarrierConcurrentMeas***This field indicates whether the UE supports concurrent intra-frequency measurement on serving cell or neighbouring cell and PDCCH or PDSCH reception from the serving cell with a different numerology.  | UE | TBD | Yes |
| ***sstd-MeasType1***This field indicates whether the UE supports SSTD measurements between the PCell and a configured PSCell. | UE | TBD | Yes |
| ***intraAndInterF-MeasAndReport***This field indicates whether the UE supports NR intra-frequency and inter-frequency measurements and at least periodical reporting.  | UE | TBD | Yes |
| ***eventA-MeasAndReport***This field indicates whether the UE supports NR measurements and events A triggered reporting as specified in TS 38.331 [9] | UE | TBD | Yes |

4.2.10 Inter-RAT parameters

4.2.10.1 *eutraFDD*

This parameter defines whether the UE supports EUTRA FDD.

4.2.10.2 *eutraTDD*

This parameter defines whether the UE supports EUTRA TDD.

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| The Last Change |

7 Capability coordination in MR-DC operation

In MR-DC operation, only two nodes (one EUTRA eNB and one NR gNB) need to be considered in the EUTRA/NR capability coordination. For capabilities for which coordination is needed, it is up to the MN to make the decision on how to resolve the dependency between MN and SN configurations. The MN provides the resulting UE capabilities usable for SCG configuration to the SN. The SN is allowed to initiate the re-negotiation of capability. For capabilities for which no coordination is needed, the SN specific capabilities are just forwarded by the MN to the SN. For baseband processing combination, MN determines its own baseband processing combination to be used in MN side based on *supportedBandCombination* in MRDC container and *supportedBasebandProcessingCombination-MRDC* then determines the allowed baseband processing combination list in SN side and indicates them to SN via *SCG-ConfigInfo*. SN may request to MN different baseband processing combination to be used in SN side via *SCG-Config*.Editor’s Note: Whether to include the list of capabilities which need the coordination or to refer the other specification needs to be discussed.