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Technical Specification

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NR;

Radio Resource Control (RRC) protocol specification

(Release 15)

** 

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# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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x the first digit:

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document specifies the Radio Resource Control protocol for the radio interface between UE and NG-RAN.

The scope of the present document also includes:

- the radio related information transported in a transparent container between source gNB and target gNB upon inter gNB handover;

- the radio related information transported in a transparent container between a source or target gNB and another system upon inter RAT handover.

- the radio related information transported in a transparent container between a source eNB and target gNB during E-UTRA-NR Dual Connectivity.

# 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 38.300: "NR; Overall description; Stage 2".

[3] 3GPP TS 38.321: "NR; Medium Access Control (MAC); Protocol specification".

[4] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".

[5] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) protocol specification".

[6] ITU-T Recommendation X.680 (08/2015) "Information Technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation" (Same as the ISO/IEC International Standard 8824-1).

[7] ITU-T Recommendation X.681 (08/2015) "Information Technology - Abstract Syntax Notation One (ASN.1): Information object specification" (Same as the ISO/IEC International Standard 8824-2).

[8] ITU-T Recommendation X.691 (08/2015) "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)" (Same as the ISO/IEC International Standard 8825-2).

[9] 3GPP TS 38.215: "NR; Physical layer measurements".

[10] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA) Radio Resource Control (RRC); Protocol Specification".

[11] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".

[12] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

[13] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[14] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[15] 3GPP TS 38.101: "NR; User Equipment (UE) radio transmission and reception".

[16] 3GPP TS 38.211: "NR; Physical channels and modulation".

[17] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[18] ITU-T Recommendation X.683 (08/2015) "Information Technology - Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications" (Same as the ISO/IEC International Standard 8824-4).

[19] 3GPP TS 38.214: "NR; Physical layer procedures for data".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Field:** The individual contents of an information element are referred as fields.

**Floor:** Mathematical function used to 'round down' i.e. to the nearest integer having a lower or equal value.

**Information element:** A structural element containing a single or multiple fields is referred as information element.

**Primary Cell**: The MCG cell, operating on the primary frequency, in which the UE either performs the initial connection establishment procedure or initiates the connection re-establishment procedure.

**Primary SCG Cell**: For dual connectivity operation, the SCG cell in which the UE performs random access when performing the Reconfiguration with Sync procedure.

**RLC bearer configuration:** The lower layer part of the radio bearer configuration comprising the RLC and logical channel configurations.

**Secondary Cell**: For a UE configured with CA, a cell providing additional radio resources on top of Special Cell.

**Secondary Cell Group**: For a UE configured with dual connectivity, the subset of serving cells comprising of the PSCell and zero or more secondary cells.

**Serving Cell**: For a UE in RRC\_CONNECTED not configured with CA/DC there is only one serving cell comprising of the primary cell. For a UE in RRC\_CONNECTED configured with CA/ DC the term 'serving cells' is used to denote the set of cells comprising of the Special Cell(s) and all secondary cells.

**Special Cell:** For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG, otherwise the term Special Cell refers to the PCell.

**SRB1S:** The SCG part of MCG split SRB1 for EN-DC.

**SRB2S:** The SCG part of MCG split SRB2 for EN-DC.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

5GC 5G Core Network

ACK Acknowledgement

AM Acknowledged Mode

ARQ Automatic Repeat Request

AS Access Stratum

ASN.1 Abstract Syntax Notation One

BLER Block Error Rate

BWP Bandwidth Part

CA Carrier Aggregation

CCCH Common Control Channel

CG Cell Group

CMAS Commercial Mobile Alert Service

CP Control Plane

C-RNTI Cell RNTI

CSI Channel State Information

DC Dual Connectivity

DCCH Dedicated Control Channel

DCI Downlink Control Information

DL Downlink

DL-SCH Downlink Shared Channel

DRB (user) Data Radio Bearer

DRX Discontinuous Reception

DTCH Dedicated Traffic Channel

EPC Evolved Packet Core

EPS Evolved Packet System

ETWS Earthquake and Tsunami Warning System

E-UTRA Evolved Universal Terrestrial Radio Access

E-UTRAN Evolved Universal Terrestrial Radio Access Network

FDD Frequency Division Duplex

FFS For Further Study

GERAN GSM/EDGE Radio Access Network

GNSS Global Navigation Satellite System

GSM Global System for Mobile Communications

HARQ Hybrid Automatic Repeat Request

IE Information element

IMSI International Mobile Subscriber Identity

kB Kilobyte (1000 bytes)

L1 Layer 1

L2 Layer 2

L3 Layer 3

MAC Medium Access Control

MCG Master Cell Group

MIB Master Information Block

N/A Not Applicable

PCell Primary Cell

PDCP Packet Data Convergence Protocol

PDU Protocol Data Unit

PLMN Public Land Mobile Network

PSCell Primary Secondary Cell

QoS Quality of Service

RAN Radio Access Network

RAT Radio Access Technology

RLC Radio Link Control

RNTI Radio Network Temporary Identifier

ROHC RObust Header Compression

RRC Radio Resource Control

RS Reference Signal

SCell Secondary Cell

SCG Secondary Cell Group

SFN System Frame Number

SFTD SFN and Frame Timing Difference

SI System Information

SIB System Information Block

SpCell Special Cell

SRB Signalling Radio Bearer

SSB Synchronization Signal Block

TAG Timing Advance Group

TDD Time Division Duplex

TM Transparent Mode

UE User Equipment

UL Uplink

UM Unacknowledged Mode

UP User Plane

In the ASN.1, lower case may be used for some (parts) of the above abbreviations e.g. c-RNTI.

# 4 General

## 4.1 Introduction

This specification is organised as follows:

- sub-clause 4.2 describes the RRC protocol model;

- sub-clause 4.3 specifies the services provided to upper layers as well as the services expected from lower layers;

- sub-clause 4.4 lists the RRC functions;

- clause 5 specifies RRC procedures, including UE state transitions;

- clause 6 specifies the RRC messages in ASN.1 and description;

- clause 7 specifies the variables (including protocol timers and constants) and counters to be used by the UE;

- clause 8 specifies the encoding of the RRC messages;

- clause 9 specifies the specified and default radio configurations;

- clause 10 specifies generic error handling;

- clause 11 specifies the RRC messages transferred across network nodes;

- clause 12 specifies the UE capability related constraints and performance requirements.

## 4.2 Architecture

Editor's note The state model is still a subject for discussion.FFS

### 4.2.1 UE states and state transitions including inter RAT

Editor’s Note: For EN\_DC, only RRC\_CONNECTED is applicable.

A UE is either in RRC\_CONNECTED state or in RRC\_INACTIVE state when an RRC connection has been established. If this is not the case, i.e. no RRC connection is established, the UE is in RRC\_IDLE state. The RRC states can further be characterised as follows:

**- RRC\_IDLE**:

- A UE specific DRX may be configured by upper layers;

- UE controlled mobility based on network configuration;

- The UE:

- Monitors a Paging channel;

- Performs neighbouring cell measurements and cell (re-)selection;

- Acquires system information.

**- RRC\_INACTIVE**:

- A UE specific DRX may be configured by upper layers or by RRC layer;

- UE controlled mobility based on network configuration;

- The UE stores the AS context;

- The UE:

- Monitors a Paging channel;

- Performs neighbouring cell measurements and cell (re-)selection;

- Performs RAN-based notification area updates when moving outside the RAN-based notification area;

Editor’s Note: FFS Whether a RAN-based notification area is always configured or not.

Editor’s Note: FFS UE behavior if it is decided that a RAN-based notification area is not always configured.

- Acquires system information.

**- RRC\_CONNECTED:**

- The UE stores the AS context;

- Transfer of unicast data to/from UE;

- At lower layers, the UE may be configured with a UE specific DRX;

- For UEs supporting CA, use of one or more SCells, aggregated with the SpCell, for increased bandwidth;

- For UEs supporting DC, use of one SCG, aggregated with the MCG, for increased bandwidth;

- Network controlled mobility within NR and to/from E-UTRAN;

- The UE:

- Monitors a Paging channel;

- Monitors control channels associated with the shared data channel to determine if data is scheduled for it;

- Provides channel quality and feedback information;

- Performs neighbouring cell measurements and measurement reporting;

- Acquires system information.

Figure 4.2.1-1 illustrates an overview of UE RRC state machine and state transitions in NR. A UE has only one RRC state in NR at one time.



Figure 4.2.1-1: UE state machine and state transitions in NR

Figure 4.2.1-2 illustrates an overview of UE state machine and state transitions in NR as well as the mobility procedures supported between NR/NGC and E-UTRAN/EPC.



Figure 4.2.1-2: UE state machine and state transitions between NR/NGC and E-UTRAN/EPC

The UE state machine, state transition and mobility procedures between NR/NGC and E-UTRA/NGC is FFS.

### 4.2.2 Signalling radio bearers

## 4.3 Services

### 4.3.1 Services provided to upper layers

The RRC protocol offers the following services to upper layers:

- Broadcast of common control information;

- Notification of UEs in RRC\_IDLE, e.g. about a terminating call [FFS, for ETWS, for CMAS];

- Transfer of dedicated control information, i.e. information for one specific UE.

### 4.3.2 Services expected from lower layers

In brief, the following are the main services that RRC expects from lower layers:

- PDCP: integrity protection, ciphering and in-sequence delivery of information without duplication [FFS if duplication need to be listed];

- RLC: reliable transfer of information, without introducing duplicates and with support for segmentation.

## 4.4 Functions

The RRC protocol includes the following main functions:

- Broadcast of system information:

- Including NAS common information;

- Information applicable for UEs in RRC\_IDLE and RRC\_INACTIVE, e.g. cell (re-)selection parameters, neighbouring cell information and information (also) applicable for UEs in RRC\_CONNECTED, e.g. common channel configuration information;

- [FFS Including ETWS notification, CMAS notification].

- RRC connection control:

- Paging;

- Establishment/modification/suspension/resumption/release of RRC connection, including e.g. assignment/modification of UE identity (C-RNTI), establishment/modification/release of SRBs, access class barring;

Editor’s note: The terminology for establishment/modification/suspension/resumption is FFS.

- Initial security activation, i.e. initial configuration of AS integrity protection (SRBs) and AS ciphering (SRBs, DRBs);

- RRC connection mobility including e.g. intra-frequency and inter-frequency handover, associated security handling, i.e. key/algorithm change, specification of RRC context information transferred between network nodes;

- Establishment/modification/release of RBs carrying user data (DRBs);

- Radio configuration control including e.g. assignment/modification of ARQ configuration, HARQ configuration, DRX configuration;

- In case of DC, cell management including e.g. change of PSCell, addition/modification/release of SCG cell(s);

- In case of CA, cell management including e.g. addition/modification/release of SCell(s);

- Recovery from radio link failure.

- Inter-RAT mobility including e.g. security activation, transfer of RRC context information;

- Measurement configuration and reporting:

- Establishment/modification/release of measurements (e.g. intra-frequency, inter-frequency and inter- RAT measurements);

- Setup and release of measurement gaps;

- Measurement reporting.

- Other functions including e.g. transfer of dedicated NAS information, transfer of UE radio access capability information [FFS support for RAN sharing (multiple PLMN identities)].

# 5 Procedures

## 5.1 General

### 5.1.1 Introduction

This section covers the general requirements.

### 5.1.2 General requirements

The UE shall:

1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;

NOTE: Network may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.

1> within a sub-clause execute the steps according to the order specified in the procedural description;

1> consider the term 'radio bearer' (RB) to cover SRBs and DRBs unless explicitly stated otherwise;

1> set the *rrc-TransactionIdentifier* in the response message, if included, to the same value as included in the message received from NR that triggered the response message;

1> upon receiving a choice value set to *setup*:

2> apply the corresponding received configuration and start using the associated resources, unless explicitly specified otherwise;

1> upon receiving a choice value set to *release*:

2> clear the corresponding configuration and stop using the associated resources;

1> in case the size of a list is extended, upon receiving an extension field comprising the entries in addition to the ones carried by the original field (regardless of whether NR signals more entries in total); apply the following generic behaviour unless explicitly stated otherwise:

2> create a combined list by concatenating the additional entries included in the extension field to the original field while maintaining the order among both the original and the additional entries;

2> for the combined list, created according to the previous, apply the same behaviour as defined for the original field.

## 5.2 System information

Editor’s Note: Targeted for completion in June 2018. For EN\_DC, only parts related to MIB acquisition, in sub-clauses 5.2.2.3.1 and 5.2.2.4.1, are applicable.

### 5.2.1 Introduction

System Information (SI) is divided into the *MasterInformationBlock* (MIB) and a number of *SystemInformationBlocks* (SIBs) where:

- the *MasterInformationBlock* (MIB) is always transmitted on the BCH with a periodicity of 80 ms and repetitions made within 80 ms [38.212, Section 7.1] and it includes parameters that are needed to acquire *SystemInformationBlockType1* (SIB1) from the cell;

- the *SystemInformationBlockType1* (SIB1) is transmitted on the DL-SCH with a periodicity of [X] and repetitions made within [X]. SIB1 includes information regarding the availability and scheduling (e.g. periodicity, SI-window size) of other SIBs. It also indicates whether they (i.e. other SIBs) are provided via periodic broadcast basis or only on-demand basis (refer Figure 5.2.2.X.X FFS\_Ref). If other SIBs are provided on-demand then SIB1 includes information for the UE to perform SI request;

- SIBs other than *SystemInformationBlockType1* are carried in *SystemInformation* (SI) messages, which are transmitted on the DL-SCH. Each SI message is transmitted within periodically occurring time domain windows (referred to as SI-windows);

- For PSCell and SCells, RAN provides the required SI by dedicated signalling. 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.

Editor’s Note: Reference to RAN1 specification may be used for the MIB/SIB1 periodicities [X].FFS

### 5.2.2 System information acquisition

#### 5.2.2.1 General UE requirements



Figure 5.2.2.1-1: System information acquisition

The UE applies the SI acquisition procedure to acquire the AS- and NAS information. The procedure applies to UEs in RRC\_IDLE, in RRC\_INACTIVE and in RRC\_CONNECTED.

The UE in RRC\_IDLE and RRC\_INACTIVE shall ensure having a valid version of (at least) the *MasterInformationBlock*, *SystemInformationBlockType1* as well as *SystemInformationBlockTypeX* through *SystemInformationBlockTypeY* (depending on support of the concerned RATs for UE controlled mobility).

The UE in RRC\_CONNECTED shall ensure having a valid version of (at least) the *MasterInformationBlock*, *SystemInformationBlockType1* as well as *SystemInformationBlockTypeX* (depending on support of mobility towards the concerned RATs).

The UE shall store relevant SI acquired from the currently camped/serving cell. A version of the SI that the UE acquires and stores remains valid only for a certain time. The UE may use such a stored version of the SI e.g. after cell re-selection, upon return from out of coverage or after SI change indication.

Editor’s Note: [FFS\_Standalone if the UE is required to store SI other than for the currently camped/serving cell].

Editor’s Note: [FFS\_Standalone if different versions of SIBs are provided].

Editor’s Note: [FFS\_Standalone UE may or shall store several versions of SI].

Editor’s Note: FFS\_Standalone To be updated when above is resolved. Another sub-clause under 5.2.2.2 can be considered depending on the resolution of above.

#### 5.2.2.2 SI validity and need to (re)-acquire SI

The UE shall apply the SI acquisition procedure as defined in clause 5.2.2.3 upon cell selection (e.g. upon power on), cell-reselection, return from out of coverage, after reconfiguration with sync completion, after entering RAN from another RAT; whenever the UE does not have a valid version in the stored SI.

Editor’s Note: [FFS\_Standalone if upon receiving HO command the SI acquisition depend on stored SI]

When the UE acquires a *MasterInformationBlock* or a *SystemInformationBlockType1* or a SI message in a currently camped/serving cell as described in clause 5.2.2.3, the UE shall store the acquired SI.

##### 5.2.2.2.1 SI validity

The UE shall:

1> delete any stored version of SI after [FFS] hours from the moment it was successfully confirmed as valid;

1> if the UE does not have in the stored SI a valid version for the required SI corresponding to the *systemInfoAreaIdentifier* and *systemInfoValueTag*/*systemInfoConfigurationIndex* of that SI in the currently camped/serving cell:

2> (re)acquire the SI as specified in clause 5.2.2.3.

NOTE: At the SI acquisition procedure, the UE may assume the acquired SI in the currently camped/serving cell to be valid in other cells than the currently camped/serving cell based on *systemInfoAreaIdentifier* and *systemInfoValueTag*/*systemInfoConfigurationIndex*.

Editor’s Note: [FFS\_Standalone terminology to be used is systemInfoValueTag or systemInfoConfigurationIndex]

Editor’s Note: [FFS\_Standalone terminology to be used for area ID is systemInfoAreaIdentifier]

Editor’s Note: [FFS\_Standalone whether the area ID and valuetag is separately signalled or as a single identifier]

Editor’s Note: [FFS\_Standalone whether the area ID is associated to each SIB/SI message or associated to a group of SIBs/SI messages or all SIBs/SI messages]

##### 5.2.2.2.2 SI change indication and PWS notification

A modification period is used, i.e. updated SI is provided in the modification period following the one where SI change indication is transmitted. RAN transmits SI change indication and PWS notification through paging. Repetitions of SI change indication may occur within preceding modification period.

Editor’s Note : The above descriptive text can remain in this sub-clause or moved under 5.2.1. FFS\_Standalone

If the UE is in RRC\_CONNECTED or is configured to use a DRX cycle smaller than the modification period in RRC\_IDLE or in RRC\_INACTIVE and receives a Paging message:

1> if the received Paging message includes the *etws*/*cmasNotification*;

2> the UE shall immediately re-acquire the SIB1 and apply the SI acquisition procedure as defined in sub-clause [X.X.X.X FFS\_Ref];

1> else, if the received Paging message includes the *systemInfoModification*;

2> the UE shall apply the SI acquisition procedure as defined in sub-clause [X.X.X.X FFS\_Ref] from the start of the next modification period.

NOTE For PWS notification the SIB1 is re-acquired to know the scheduling information for the PWS messages.

Editor’s Note: [FFS\_Standalone if upon receiving a SI change indication the SI acquisition depend on stored SI]

Editor’s Note: [FFS\_Standalone if value tags and area identifier included in paging message to reacquire SIB1]

Editor’s Note: [FFS\_Standalone the update mechanism for access control notifications and other non-access control configuration updates]

#### 5.2.2.3 Acquisition of System Information

##### 5.2.2.3.1 Acquisition of MIB and SIB1

The UE shall:

1> if the cell is a PSCell:

2> acquire the *MIB*, which is scheduled as specified in TS 38.213 [13];

2> perform the actions specified in section 5.2.2.4.1;

1> else:

2> acquire the *MIB,* which is scheduled as specified in TS 38.213 [13];

2> if the UE is unable to acquire the *MIB*;

3> follow the actions as specified in clause 5.2.2.5;

2> else:

3> perform the actions specified in section 5.2.2.4.1.

2> acquire the SystemInformationBlockType1 as specified in [X];

2> if the UE is unable to acquire the SystemInformationBlockType1:

3> follow the actions as specified in clause 5.2.2.5;

2> else:

3>perform the actions specified in section 5.2.2.4.2.

Editor’s Note: Reference to RAN1 [X] specification may be used for the scheduling of SIB1.FFS\_Standalone

##### 5.2.2.3.2 Acquisition of an SI message

When acquiring an SI message, the UE shall:

1> determine the start of the SI-window for the concerned SI message as follows:

Editor’s Note: [FFS\_Standalone the details of the mapping to subframes/slots where the SI messages are scheduled]

Editor’s Note: [FFS\_Standalone if there are any exceptions on e.g. subframes where SI messages cannot be transmitted]

Editor’s Note: [FFS\_Standalone if the SI-windows of different SI messages do not overlap].

Editor’s Note: [FFS\_Standalone if multiple SI messages can be mapped to same SI window]

Editor’s Note: [FFS\_Standalone if the length of SI-window is common for all SI messages or if it is configured per SI message]

Editor’s Note: [FFS\_Standalone if the UE may accumulate the SI-Message transmissions across several SI-Windows within the Modification Period]

1> if SI message acquisition not triggered due to UE request:

2> receive DL-SCH using the SI-RNTI from the start of the SI-window and continue until the end of the SI-window whose absolute length in time is given by *si-WindowLength*, or until the SI message was received;

2> if the SI message was not received by the end of the SI-window, repeat reception at the next SI-window occasion for the concerned SI message;

1> if SI message acquisition triggered due to UE request:

2> [FFS\_Standalone receive DL-SCH using the SI-RNTI from the start of the SI-window and continue until the end of the SI-window whose absolute length in time is given by si-WindowLength, or until the SI message was received];

2> [FFS\_Standalone if the SI message was not received by the end of the SI-window, repeat reception at the next SI-window occasion for the concerned SI message];

Editor’s Note: [FFS\_Standalone on the details of from which SI-window the UE shall receive the DL-SCH upon triggering the SI request.

Editor’s Note: [FFS\_Standalone on the details of how many SI-windows the UE should monitor for SI message reception if transmission triggered by UE request]

Editor’s Note: [FFS\_Standalone if UE need to monitor all the TTIs in SI window for receiving SI message]

1> store the acquired SI message as specified in clause 5.2.2.2.

Editor’s Note: FFS\_Standalone The procedural text for SI message acquisition triggered by UE request will be updated upon finalizing the details.

##### 5.2.2.3.3 Request for on demand system information

When acquiring an SI message, which according to the SystemInformationBlockType1 is indicated to be provided upon UE request, the UE shall:

1> if in RRC\_IDLE or in RRC\_INACTIVE:

2> if the [FFS\_Standalone] field is received in *SIB1*:

3> the UE shall trigger the lower layer to initiate the preamble transmission procedure in accordance with TS 38.321 [3] using the [indicated PRACH preamble] and [indicated PRACH resource];

3> if acknowledgement for SI request is received from lower layer;

4> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2;

Editor’s Note: To be updated with details of the Msg1 request procedure.FFS\_Standalone

2> else

3> the UE shall trigger the lower layer to initiate the random access procedure in accordance with TS 38.321 [3];

3> if acknowledgement for SI request is received;

4> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2;

Editor’s Note: To be updated with details of the Msg3 request procedure. FFS\_Standalone

1> else (in RRC\_CONNECTED):

2> [details FFS\_Standalone].

Editor’s Note: To be updated with details of the on-demand request procedure in RRC\_CONNECTED. FFS\_Standalone

Editor’s Note: [FFS\_Standalone if there is a need for a separate sub-clause to describe case where on demand SI is not successfully received by the UE and where it should initiate a new request]

#### 5.2.2.4 Actions upon receipt of SI message

##### 5.2.2.4.1 Actions upon reception of the *MIB*

Upon receiving the *MIB* the UE shall:

1> store the acquired *MIB*;

1> if the UE is in RRC\_IDLE or if the UE is in RRC\_INACTIVE or if the UE is in RRC\_CONNECTED while *T311* is running: [FFS]

2> if the *cellBarred* in the acquired MIB is set to *barred*;

3> consider the cell as barred in accordance with TS 38.304 [FFS];

2> else,

3> apply the received parameter(s) [FFS] to acquire *SIB1*.

##### 5.2.2.4.2 Actions upon reception of the SystemInformationBlockType1

Upon receiving the SystemInformationBlockType1 the UE shall:

1> store the acquired *SIB1*;

1> if the UE has a stored valid version of the required SIB(s) associated with the *systemInfoAreaIdentifier* and *systemInfoValueTag*/*systemInfoConfigurationIndex* in the acquired *SIB1*:

2> use that stored version of the SIB;

1> else if the *SIB1* message indicates that the SI message(s) is only provided on request:

2> trigger a request to acquire the SI message(s) (if needed) as defined in sub-clause 5.2.2.3;

1> else:

2> acquire the SI message(s) (if needed) as defined in sub-clause 5.2.2.3.2, which are provided according to the schedulingInfoList in the SystemInformationBlockType1.

Editor’s Note: [FFS\_Standalone Whether there is an additional indication that an on-demand SI is actually being broadcast at this instant in time]

Editor’s Note: To be updated when content of the SystemInformationBlockType1 has been agreed. FFS\_Standalone.

Editor’s Note: To be updated how to capture the UE behaviour when some required SIBs are from broadcast and other required SIBs through SI request.

##### 5.2.2.4.3 Actions upon reception of SystemInformationBlockTypeX

Editor’s Note: To be extended with further sub-clauses as more SIBs are defined. FFS\_Standalone

#### 5.2.2.5 Essential system information missing

The UE shall:

1> if in RRC\_IDLE or in RRC\_INACTIVE:

2> if the UE is unable to acquire the *MIB*; or

2> if the UE is unable to acquire the *SIB1* and UE does not have a stored valid version of SIB1; or

2> [FFS\_Standalone if the UE is unable to acquire the [FFS essential SystemInformationBlockTypeX] and UE does not have a stored valid version of SystemInformationBlockTypeX];

3> consider the cell as barred in accordance with TS 38.304 [X]; and

3> perform barring as if *intraFreqReselection* is set to *allowed.*

Editor’s Note: [FFS\_Standalone on details of RRC connection re-establishment procedure and corresponding reading of SI in RRC\_CONNECTED].

Editor’s Note: [FFS\_Standalone whether all the information needed to access the cell is included in SIB1 or if both SIB1 and SIB2 are essential in NR].

## 5.3 Connection control

Editor's note: FFS The structure and content of this subclause is a subject for discussion, e.g. potential merging of connection establishment and re-establishment messages, mobility aspects etc.

### 5.3.1 Introduction

### 5.3.2 Paging

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

### 5.3.3 RRC connection establishment

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

### 5.3.4 Initial security activation

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

### 5.3.5 RRC reconfiguration

#### 5.3.5.1 General



Figure 5.3.5.1-1: RRC reconfiguration, successful



Figure 5.3.5.1-2: RRC reconfiguration, failure

The purpose of this procedure is to modify an RRC connection, e.g. to establish/modify/release RBs, to perform reconfiguration with sync, to setup/modify/release measurements, to add/modify/release SCells and cell groups. As part of the procedure, NAS dedicated information may be transferred from the Network to the UE.

In EN-DC, SRB3 can be used to configure measurements, MAC, RLC, PDCP, physical layer and RLF timers and constants.

#### 5.3.5.2 Initiation

The Network may initiate the RRC reconfiguration procedure to a UE in RRC\_CONNECTED. The Network applies the procedure as follows:

- the establishment of RBs (other than SRB1, that is established during RRC connection establishment) is performed only when AS security has been activated;

- the addition of Secondary Cell Group and SCells is performed only when AS security has been activated;

- the *reconfigurationWithSync* is included in *secondaryCellGroup* only when at least one DRB is setup in SCG.

#### 5.3.5.3 Reception of an *RRCReconfiguration* by the UE

The UE shall perform the following actions upon reception of the *RRCReconfiguration*:

1> if the RRCReconfiguration includes the secondaryCellGroup:

2> perform the cell group configuration for the SCG according to 5.3.5.5;

1> if the RRCReconfiguration message contains the radioBearerConfig:

2> perform the radio bearer configuration according to 5.3.5.6;

1> if the *RRCReconfiguration* message includes the *measConfig*:

2> perform the measurement configuration procedure as specified in 5.5.2;

1> if the UE is configured with E-UTRA *nr-SecondaryCellGroupConfig* (MCG is E-UTRA):

2> if *RRCReconfiguration* was received via SRB1:

3> construct *RRCReconfigurationComplete* message and submit it 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];

2> else (*RRCReconfiguration* was received via SRB3):

3> submit the *RRCReconfigurationComplete* message via SRB3 to lower layers for transmission using the new configuration;

NOTE: In the case of SRB1, the random access is triggered by RRC layer itself as there is not necessarily other UL transmission. In the case of SRB3, the random access is triggered by the MAC layer due to arrival of *RRCReconfigurationComplete*.

1> if MAC of an NR cell group successfully completes a random access procedure triggered above;

2> stop timer T304 for that cell group;

2> apply the parts of the CQI reporting configuration, the scheduling request configuration and the sounding RS configuration that do not require the UE to know the SFN of the respective target SpCell, if any;

2> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the respective target SpCell (e.g. measurement gaps, periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of that target SpCell;

2> the procedure ends.

#### 5.3.5.4 Secondary cell group release

The UE shall:

1> as a result of SCG release triggered by E-UTRA:

2> reset SCG MAC, if configured;

2> for each RLC bearer that is part of the SCG configuration:

3> perform RLC bearer release procedure as specified in 5.3.5.5.3;

2> release the SCG configuration;

2> stop timer T310 for the corresponding SpCell, if running;

2> stop timer T304 for the corresponding SpCell, if running.

NOTE: Release of cell group means only release of the lower layer configuration of the cell group but the *RadioBearerConfig* may not be released.

#### 5.3.5.5 Cell Group configuration

##### 5.3.5.5.1 General

The network configures the UE with one Secondary Cell Group (SCG). For EN-DC, the MCG is configured as specified in TS 36.331 [10]. The network provides the configuration parameters for a cell group in the *CellGroupConfig* IE.

The UE performs the following actions based on a received *CellGroupConfig* IE:

1> if the CellGroupConfig contains the spCellConfig with reconfigurationWithSync:

2> perform Reconfiguration with sync according to 5.3.5.5.2;

2> resume all suspended radio bearers and resume SCG transmission for all radio bearers, if suspended;

1> if the CellGroupConfig contains the rlc-BearerToReleaseList:

2> perform RLC bearer release as specified in 5.3.5.5.3;

1> if the CellGroupConfig contains the rlc-BearerToAddModList:

2> perform the RLC bearer addition/modification as specified in 5.3.5.5.4;

1> if the CellGroupConfig contains the mac-CellGroupConfig:

2> configure the MAC entity of this cell group as specified in 5.3.5.5.5;

1> if the CellGroupConfig contains the sCellToReleaseList:

2> perform SCell release as specified in 5.3.5.5.8;

1> if the *CellGroupConfig* contains the spCellConfig:

2> configure the SpCell as specified in 5.3.5.5.7;

1> if the CellGroupConfig contains the sCellToAddModList:

2> perform SCell addition/modification as specified in 5.3.5.5.9.

##### 5.3.5.5.2 Reconfiguration with sync

The UE shall perform the following actions to execute a reconfiguration with sync.

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 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 frequency of the source SpCell with a physical cell identity indicated by the *physCellId*;

1> start synchronising to the DL of the target SpCell and acquire the *MIB* of the target SpCell as specified in 5.2.2.3.1;

NOTE: 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.

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;

Editor’s Note: Verify that this does not configure some common parameters which are later discarded due to e.g. SCell release or due to LCH release.

1> configure lower layers in accordance with the received s*pCellConfigCommon*;

1> consider the initial bandwidth part to be the active bandwidth part where random access is performed;

1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *reconfigurationWithSync.*

##### 5.3.5.5.3 RLC bearer release

The UE shall:

1> for each *logicalChannelIdentity* value included in the *rlc-BearerToReleaseList* that is part of the current UE configuration (LCH release); or

1> for each *logicalChannelIdentity* value that is to be released as the result of an SCG release according to 5.3.5.4:

2> release the RLC entity or entities (includes discarding all pending RLC PDUs and RLC SDUs);

2> release the corresponding logical channel.

##### 5.3.5.5.4 RLC bearer addition/modification

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.

1> else (a logical channel with the given *logicalChannelIdentity* was not configured before):

2> if the *logicalChannelIdentity* corresponds to an SRB and *rlc-Config* is not included:

3> establish an RLC entity in accordance with the default configuration defined in 9.2 for the corresponding SRB;

2> else:

3> establish an RLC entity in accordance with the received *rlc-Config*;

2> if the *logicalChannelIdentity* corresponds to an SRB and if *mac-LogicalChannelConfig* is not included:

3> configure this MAC entity with a logical channel in accordance to the default configuration defined in 9.2 for the corresponding SRB;

2> else:

3> configure this MAC entity with a logical channel in accordance to the received *mac-LogicalChannelConfig*;

2> associate this logical channel with the PDCP entity identified by *servedRadioBearer*.

##### 5.3.5.5.5 MAC entity configuration

The UE shall:

1> if SCG MAC is not part of the current UE configuration (i.e. SCG establishment):

2> create an SCG MAC entity;

1> reconfigure the MAC main configuration of the cell group in accordance with the received *mac-CellGroupConfig* other than *tag-ToReleaseList* and *tag-ToAddModList*;

1> if the received mac-CellGroupConfig includes the tag-ToReleaseList:

2> for each *TAG-Id* value included in the *tag-ToReleaseList* that is part of the current UE configuration:

3> release the TAG indicated by *TAG-Id*;

1> if the received mac-CellGroupConfig includes the tag-ToAddModList:

2> for each *tag-Id* value included in *tag-ToAddModList* that is not part of the current UE configuration (TAG addition):

3> add the TAG, corresponding to the *tag-Id*, in accordance with the received *timeAlignmentTimer*;

2> for each *tag-Id* value included in *tag-ToAddModList* that is part of the current UE configuration (TAG modification):

3> reconfigure the TAG, corresponding to the *tag-Id*, in accordance with the received *timeAlignmentTimer*.

##### 5.3.5.5.6 RLF Timers & Constants configuration

The UE shall:

1> if the received *rlf-TimersAndConstants* is set to release:

NOTE: In EN-DC, *rlf-TimersAndConstants* cannot be released.

Editor’s Note: Standalone part to be complete by June 2018.

2> stop timer T310 for this cell group, if running, and

2> release the value of timer *t310* as well as constants *n310* and *n310* for this cell group;

1> else:

2> reconfigure the value of timers and constants in accordance with received *rlf-TimersAndConstants*.

##### 5.3.5.5.7 SPCell Configuration

The UE shall:

1> if the SpCellConfig contains the rlf-TimersAndConstants:

2> configure the RLF timers and constants for this cell group as specified in 5.3.5.5.6.

1> if the SpCellConfig contains spCellConfigDedicated:

2> configure the SpCell in accordance with the *spCellConfigDedicated*.

##### 5.3.5.5.8 SCell Release

The UE shall:

1> if the release is triggered by reception of the *sCellToReleaseList*:

2> for each *sCellIndex* value included in the *sCellToReleaseList*:

3> if the current UE configuration includes an SCell with value *sCellIndex*:

4> release the SCell.

##### 5.3.5.5.9 SCell Addition/Modification

The UE shall:

1> for each *sCellIndex* value included in the *sCellToAddModList* that is not part of the current UE configuration (SCell addition):

2> add the SCell, corresponding to the *sCellIndex*, in accordance with the *sCellConfigCommon* and *sCellConfigDedicated*;

2> configure lower layers to consider the SCell to be in deactivated state;

Editor’s Note: FFS Check automatic measurement handling for SCells.

2> for each *measId* included in the *measIdList* within *VarMeasConfig*:

3> if SCells are not applicable for the associated measurement; and

3> if the concerned SCell is included in *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*:

4> remove the concerned SCell from *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

1> for each *sCellIndex* value included in the *sCellToAddModList* that is part of the current UE configuration (SCell modification):

2> modify the SCell configuration in accordance with the *sCellConfigDedicated*.

#### 5.3.5.6 Radio Bearer configuration

##### 5.3.5.6.1 General

The UE shall perform the following actions based on a received *RadioBearerConfig* IE:

1> if the *RadioBearerConfig* includes the *srb3-ToRelease* and set to true:

2> perform the SRB release as specified in 5.3.5.6.2;

1> if the RadioBearerConfig includes the srb-ToAddModList:

2> perform the SRB addition or reconfiguration as specified in 5.3.5.6.3;

1> if the RadioBearerConfig includes the drb-ToReleaseList:

2> perform DRB release as specified in 5.3.5.6.4;

1> if the RadioBearerConfig includes the drb-ToAddModList:

2> perform DRB addition or reconfiguration as specified in 5.3.5.6.5.

##### 5.3.5.6.2 SRB release

Editor’s note: FFS / TODO: check handling during full configuration

The UE shall:

1> release the PDCP entity of the SRB3.

##### 5.3.5.6.3 SRB addition/modification

The UE shall:

1> for each *srb-Identity* value included in the *srb-ToAddModList* that is not part of the current UE configuration (SRB establishment or reconfiguration from E-UTRA PDCP to NR PDCP):

2> establish a PDCP entity and configure it with the security algorithms according to *securityConfig* and apply the keys (KRRCenc and KRRCint) associated with the KeNB/S-KgNB as indicated in *keyToUse*, if applicable;

2> if the current UE configuration as configured by E-UTRA in TS 36.331 includes an SRB identified with the same *srb-Identity* value:

3> associate the E-UTRA RLC entity and DCCH of this SRB with the NR PDCP entity;

3> release the E-UTRA PDCP entity of this SRB;

2> if the *pdcp-Config* is included:

3> configure the PDCP entity in accordance with the received *pdcp-Config*;

2> else:

3> configure the PDCP entity in accordance with the default configuration defined in 9.2.1 for the corresponding SRB;

1> for each *srb-Identity* value included in the *srb-ToAddModList* that is part of the current UE configuration:

2> if reestablishPDCP is set:

3> configure the PDCP entity to apply the integrity protection algorithm and KRRCint key associated with the KeNB/S-KgNB as indicated in *keyToUse* , i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

3> configure the PDCP entity to apply the ciphering algorithm and KRRCenc key associated with the KeNB/S-KgNB as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

3> re-establish the PDCP entity of this SRB as specified in 38.323 [5];

2> else, if *discardOnPDCP* is set:

3> trigger the PDCP entity to perform SDU discard as specified in TS 38.323 [5];

2> if the *pdcp-Config* is included:

3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*.

##### 5.3.5.6.4 DRB release

Editor’s Note: FFS / TODO: Add handling for the new QoS concept (mapping of flows; configuration of QFI-to-DRB mapping; reflective QoS...) but keep also EPS-Bearer handling for the EN-DC case

The UE shall:

1> for each *drb-Identity* value included in the *drb-ToReleaseList* that is part of the current UE configuration (DRB release), or

1> for each *drb-identity* value that is to be released as the result of full configuration option according to 5.3.5.7:

2> release the PDCP entity;

1> if a new bearer is not added either with NR or E-UTRA with same *eps-BearerIdentity*:

2> if the procedure was triggered due to reconfiguration with sync:

3> indicate the release of the DRB and the *eps-BearerIdentity* of the released DRB to upper layers after successful reconfiguration with sync;

2> else:

3> indicate the release of the DRB and the *eps-BearerIdentity* of the released DRB to upper layers immediately.

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*.

##### 5.3.5.6.5 DRB addition/modification

The UE shall:

1> for each *drb-Identity* value included in the *drb-ToAddModList* that is not part of the current UE configuration (DRB establishment including the case when full configuration option is used):

2> establish a PDCP entity and configure it in accordance with the received *pdcp-Config*;

2> configure the PDCP entity with the security algorithms according to *securityConfig* and apply the keys (KUPenc) associated with the KeNB/S-KgNB as indicated in *keyToUse*;

2> if the DRB was configured with the same *eps-BearerIdentity* either by NR or E-UTRA prior to receiving this reconfiguration:

3> associate the established DRB with the corresponding *eps-BearerIdentity;*

2> else:

3> indicate the establishment of the DRB(s) and the *eps-BearerIdentity* of the established DRB(s) to upper layers;

1> for each *drb-Identity* value included in the *drb-ToAddModList* that is part of the current UE configuration:

2> if reestablishPDCP is set:

3> configure the PDCP entity of this *RadioBearerConfig* to apply the ciphering algorithm and KUPenc key associated with the KeNB/S-KgNB as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;

3> re-establish the PDCP entity of this DRB as specified in 38.323 [5], section 5.1.2;

2> else, if *recoverPDCP* is set:

3> trigger the PDCP entity of this DRB to perform data recovery as specified in 38.323;

2> if the *pdcp-Config* is included:

3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*.

NOTE 1: Removal and addition of the same *drb-Identity* in a single *radioResourceConfig* is not supported. In case *drb-Identity* is removed and added due to reconfiguration with sync or re-establishment with the full configuration option, the network can use the same value of *drb-Identity*.

NOTE 2: When determining whether a drb-Identity value is part of the current UE configuration, the UE does not distinguish which *RadioBearerConfig* and *DRB-ToAddModList* that DRB was originally configured in. To re-associate a DRB with a different key (KeNB to S-KeNB or vice versa), the network provides the *drb-Identity* value in the (target) *drb-ToAddModList* and sets the *reestablishPDCP* flag. The network does not list the *drb-Identity* in the (source) *drb-ToReleaseList*.

NOTE 3: When setting the *reestablishPDCP* flag for a radio bearer, the network ensures that the RLC receiver entities do not deliver old PDCP PDUs to the re-established PDCP entity. It does that e.g. by triggering a reconfiguration with sync of the cell group hosting the old RLC entity or by releasing the old RLC entity.

NOTE 4: In this specification, UE configuration refers to the parameters configured by NR RRC unless otherwise stated.

#### 5.3.5.7 Security key update

Upon reception of *sk-Counter* as specified in TS 36.331 [10] the UE shall:

1> update the S-KgNB key based on the KeNB key and using the received *sk-Counter* value, as specified in TS 33.501 [11];

1> derive KRRCenc and KUPenc key as specified in TS 33.501 [11];

1> derive the KRRCint and KUPint key as specified in TS 33.501 [11].

#### 5.3.5.8 Reconfiguration failure

##### 5.3.5.8.1 Integrity check failure

Editor’s Note: Removed "SIB3" from heading so that this sub-section can easily be expanded to stand-alone case (if considered necessary). FFS\_Standalone

The UE shall:

1> upon integrity check failure indication from NR lower layers for SRB3:

2> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SRB3 integrity check failure.

##### 5.3.5.8.2 Inability to comply with RRCReconfiguration

The UE shall:

1> if the UE is operating in EN-DC:

2> if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB3;

3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;

3> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG reconfiguration error, upon which the connection reconfiguration procedure ends;

2> else, if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over MCG SRB1;

3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;

3> initiate the connection re-establishment procedure as specified in TS 36.331 [10, 5.3.7], upon which the connection reconfiguration procedure ends.

NOTE 1: The UE may apply above failure handling also in case the *RRCReconfiguration* message causes a protocol error for which the generic error handling as defined in 10 specifies that the UE shall ignore the message.

NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/failure.

##### 5.3.5.8.3 T304 expiry (Reconfiguration with sync Failure)

The UE shall:

1> if T304 of a secondary cell group expires:

2> release rach-ConfigDedicated;

2> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG reconfiguration with sync failure.

#### 5.3.5.9 Other configuration

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

#### 5.3.5.10 EN-DC release

The UE shall:

1> as a result of EN-DC release triggered by E-UTRA:

2> release SRB3 (configured according to *radioBearerConfig*), if present;

2> release *measConfig*;

2> release the SCG configuration as specified in section 5.3.5.4.

### 5.3.6 Counter check

FFS

### 5.3.7 RRC connection re-establishment

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

### 5.3.8 RRC connection release

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

### 5.3.9 RRC connection release requested by upper layers

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

### 5.3.10 Radio link failure related actions

#### 5.3.10.1 Detection of physical layer problems in RRC\_CONNECTED

The UE shall:

1> upon receiving N310 consecutive "out-of-sync" indications for the SpCell from lower layers while T311 is not running:

2> start timer T310 for the corresponding SpCell.

Editor’s Note: FFS: Under which condition physical layer problems detection is performed, e.g. neither T300, T301, T304 nor T311 is running. It’s subject to the harmonization of the RRC procedures for RRC Connection establishment/resume/re-establishment and RRC connection reconfiguration.

#### 5.3.10.2 Recovery of physical layer problems

Upon receiving N311 consecutive "in-sync" indications for the SpCell from lower layers while T310 is running, the UE shall:

1> stop timer T310 for the corresponding SpCell.

NOTE 1: In this case, the UE maintains the RRC connection without explicit signalling, i.e. the UE maintains the entire radio resource configuration.

NOTE 2: Periods in time where neither "in-sync" nor "out-of-sync" is reported by layer 1 do not affect the evaluation of the number of consecutive "in-sync" or "out-of-sync" indications.

#### 5.3.10.3 Detection of radio link failure

The UE shall:

1> upon T310 expiry in PCell; or

1> upon random access problem indication from MCG MAC while T311 is not running; or

Editor’s Note: FFS: Under which condition physical layer problems detection is performed, e.g. neither T300, T301, T304 nor T311 is running. It’s subject to the harmonization of the RRC procedures for RRC Connection establishment/resume/re-establishment and RRC connection reconfiguration.

1> upon indication from MCG RLC that the maximum number of retransmissions has been reached:

Editor’s Note: FFS whether maximum ARQ retransmission is only criteria for RLC failure.

2> consider radio link failure to be detected for the MCG i.e. RLF;

Editor’s Note: FFS Whether indications related to beam failure recovery may affect the declaration of RLF.

Editor’s Note: FFS: How to handle RLC failure in CA duplication for MCG DRB and SRB.

Editor’s Note: FFS: RLF related measurement reports e.g. *VarRLF-Report* is supported in NR.

2> if AS security has not been activated:

3> perform the actions upon leaving RRC\_CONNECTED as specified in x.x.x FFS\_Ref, with release cause 'other';

2> else:

3> initiate the connection re-establishment procedure as specified in x.x.x FFS\_Ref.

The UE shall:

1> upon T310 expiry in PSCell; or

1> upon random access problem indication from SCG MAC; or

1> upon indication from SCG RLC that the maximum number of retransmissions has been reached:

2> consider radio link failure to be detected for the SCG i.e. SCG-RLF;

Editor’s Note: FFS: How to handle RLC failure in CA duplication for SCG DRB and SRB.

2> initiate the SCG failure information procedure as specified in 5.7.3 to report SCG radio link failure.

### 5.3.11 UE actions upon leaving RRC\_CONNECTED

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

### 5.3.12 UE actions upon PUCCH/SRS release request

Upon receiving a PUCCH release request from lower layers, for all bandwidth parts of an indicated serving cell the UE shall:

1> release PUCCH-CSI-Resources c1onfigured in CSI-ReportConfig;

1> release SchedulingRequestResourceConfig instances configured in PUCCH-Config.

Upon receiving an SRS release request from lower layers, for all bandwidth parts of an indicated serving cell the UE shall:

1> release *SRS-Resource* instances configured in *SRS-Config*.

## 5.4 Inter-RAT mobility

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

## 5.5 Measurements

### 5.5.1 Introduction

The network may configure an RRC\_CONNECTED UE to perform measurements and report them in accordance with the measurement configuration. The measurement configuration is provided by means of dedicated signalling i.e. using the *RRCReconfiguration.*

The network may configure the UE to perform the following types of measurements:

- NR measurements;

- Inter-RAT measurements of E-UTRA frequencies.

The network may configure the UE to report the following measurement information based on SS/PBCH block(s):

- Measurement results per SS/PBCH block;

- Measurement results per cell based on SS/PBCH block(s);

- SS/PBCH block(s) indexes.

The network may configure the UE to report the following measurement information based on CSI-RS resources:

- Measurement results per CSI-RS resource;

- Measurement results per cell based on CSI-RS resource(s);

- CSI-RS resource measurement identifiers.

The measurement configuration includes the following parameters:

**1. Measurement objects:** A list of objects on which the UE shall perform the measurements.

- For intra-frequency and inter-frequency measurements a measurement object is associated to an NR carrier frequency. Associated with this NR carrier frequency, the network may configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.

- The UE determines which MO corresponds to each serving cell frequency from the *frequencyInfoDL* in *ServingCellConfigCommon* within the serving cell configuration.

- For inter-RAT E-UTRA measurements a measurement object is a single EUTRA carrier frequency. Associated with this E-UTRA carrier frequency, the network can configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.

**2. Reporting configurations:** A list of reporting configurations where there can be one or multiple reporting configurations per measurement object. Each reporting configuration consists of the following:

- Reporting criterion: The criterion that triggers the UE to send a measurement report. This can either be periodical or a single event description;.

- RS type: The RS that the UE uses for beam and cell measurement results (SS/PBCH block or CSI-RS).

- Reporting format: The quantities per cell and per beam that the UE includes in the measurement report (e.g. RSRP) and other associated information such as the maximum number of cells and the maximum number beams per cell to report.

**3. Measurement identities:** A list of measurement identities where each measurement identity links one measurement object with one reporting configuration. By configuring multiple measurement identities, it is possible to link more than one measurement object to the same reporting configuration, as well as to link more than one reporting configuration to the same measurement object. The measurement identity is also included in the measurement report that triggered the reporting, serving as a reference to the network.

**4. Quantity configurations:** The quantity configuration defines the measurement filtering configuration used for all event evaluation and related reporting of that measurement type. For NR measurements, the network may configure up to 2 quantity configurations with a reference in the NR measurement object to the configuration that is to be used. In each configuration, different filter coefficients can be configured for different measurement quantities, for different RS types, and for measurements per cell and per beam.

**5. Measurement gaps:** Periods that the UE may use to perform measurements, i.e. no (UL, DL) transmissions are scheduled.

A UE in RRC\_CONNECTED maintains a measurement object list, a reporting configuration list, and a measurement identities list according to signalling and procedures in this specification. The measurement object list possibly includes NR intra-frequency object(s), NR inter-frequency object(s) and inter-RAT objects. Similarly, the reporting configuration list includes NR and inter-RAT reporting configurations. Any measurement object can be linked to any reporting configuration of the same RAT type. Some reporting configurations may not be linked to a measurement object. Likewise, some measurement objects may not be linked to a reporting configuration.

The measurement procedures distinguish the following types of cells:

1. The NR serving cell(s) - these are the SpCell and one or more SCells.

2. Listed cells - these are cells listed within the measurement object(s).

3. Detected cells - these are cells that are not listed within the measurement object(s) but are detected by the UE on the carrier frequency(ies) indicated by the measurement object(s).

For NR measurement object(s), the UE measures and reports on the serving cell(s), listed cells and/or detected cells.

Whenever the procedural specification, other than contained in sub-clause 5.5.2, refers to a field it concerns a field included in the *VarMeasConfig* unless explicitly stated otherwise i.e. only the measurement configuration procedure covers the direct UE action related to the received *measConfig*.

### 5.5.2 Measurement configuration

#### 5.5.2.1 General

The network applies the procedure as follows:

- to ensure that, whenever the UE has a *measConfig*, it includes a *measObject* for each NR serving frequency.

Editor’s Note: FFS How the procedure is used for CGI reporting.

The UE shall:

1> if the received *measConfig* includes the *measObjectToRemoveList*:

2> perform the measurement object removal procedure as specified in 5.5.2.4;

1> if the received *measConfig* includes the *measObjectToAddModList*:

2> perform the measurement object addition/modification procedure as specified in 5.5.2.5;

1> if the received *measConfig* includes the *reportConfigToRemoveList*:

2> perform the reporting configuration removal procedure as specified in 5.5.2.6;

1> if the received *measConfig* includes the *reportConfigToAddModList*:

2> perform the reporting configuration addition/modification procedure as specified in 5.5.2.7;

1> if the received *measConfig* includes the *measIdToRemoveList*:

2> perform the measurement identity removal procedure as specified in 5.5.2.2;

1> if the received *measConfig* includes the *measIdToAddModList*:

2> perform the measurement identity addition/modification procedure as specified in 5.5.2.3;

1> if the received *measConfig* includes the *measGapConfig*:

2> perform the measurement gap configuration procedure as specified in 5.5.2.9;

1> if the received *measConfig* includes the *s-MeasureConfig*:

2> if *s-MeasureConfig* is set to *ssb-RSRP*, set parameter *ssb-RSRP*of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig;*

2> else, set parameter *csi-RSRP* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig*.

#### 5.5.2.2 Measurement identity removal

The UE shall:

1> for each *measId* included in the received *measIdToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:

2> remove the entry with the matching *measId* from the *measIdList* within the *VarMeasConfig*;

2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

2> stop the periodical reporting timer if running and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *measIdToRemoveList* includes any *measId* value that is not part of the current UE configuration.

#### 5.5.2.3 Measurement identity addition/modification

The network applies the procedure as follows:

- configure a *measId* only if the corresponding measurement object, the corresponding reporting configuration and the corresponding quantity configuration, are configured.

The UE shall:

1> for each *measId* included in the received *measIdToAddModList*:

2> if an entry with the matching *measId* exists in the *measIdList* within the *VarMeasConfig*:

3> replace the entry with the value received for this *measId*;

2> else:

3> add a new entry for this *measId* within the *VarMeasConfig*;

2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

2> stop the periodical reporting timer and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

#### 5.5.2.4 Measurement object removal

The UE shall:

1> for each measObjectId included in the received measObjectToRemoveList that is part of measObjectList in VarMeasConfig:

2> remove the entry with the matching *measObjectId* from the *measObjectList* within the *VarMeasConfig*;

2> remove all *measId* associated with this *measObjectId* from the *measIdList* within the *VarMeasConfig*, if any;

2> if a *measId* is removed from the *measIdList*:

3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

3> stop the periodical reporting timer and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *measObjectToRemoveList* includes any *measObjectId* value that is not part of the current UE configuration.

#### 5.5.2.5 Measurement object addition/modification

The UE shall:

1> for each *measObjectId* included in the received *measObjectToAddModList*:

2> if an entry with the matching *measObjectId* exists in the *measObjectList* within the *VarMeasConfig*, for this entry:

3> reconfigure the entry with the value received for this measObject, except for the fields cellsToAddModList, blackCellsToAddModList, whiteCellsToAddModList, cellsToRemoveList,blackCellsToRemoveList, whiteCellsToRemoveList, absThreshSS-BlocksConsolidation,absThreshCSI-RS-Consolidation, nrofSS-BlocksToAverage,nroCSI-RS-ResourcesToAverage;

3> if the received *measObject* includes the *cellsToRemoveList*:

4> for each *physCellId* included in the *cellsToRemoveList*:

5> remove the entry with the matching *physCellId* from the *cellsToAddModList*;

3> if the received *measObject* includes the *cellsToAddModList*:

4> for each *physCellId* value included in the *cellsToAddModList*:

5> if an entry with the matching *physCellId* exists in the *cellsToAddModList*:

6> replace the entry with the value received for this *physCellId*;

5> else:

6> add a new entry for the received *physCellId* to the *cellsToAddModList*;

3> if the received *measObject* includes the *blackCellsToRemoveList*:

4> for each pci-RangeIndex included in the blackCellsToRemoveList:

5> remove the entry with the matching *pci-RangeIndex* from the *blackCellsToAddModList*;

NOTE: For each *pci-RangeIndex* included in the *blackCellsToRemoveList* that concerns overlapping ranges of cells, a cell is removed from the black list of cells only if all cell indexes containing it are removed.

3> if the received *measObject* includes the *blackCellsToAddModList*:

4> for each pci-RangeIndex included in the blackCellsToAddModList:

5> if an entry with the matching *pci-RangeIndex* is included in the *blackCellsToAddModList*:

6> replace the entry with the value received for this *pci-RangeIndex*;

5> else:

6> add a new entry for the received *pci-RangeIndex* to the *blackCellsToAddModList*;

3> if the received *measObject* includes the *whiteCellsToRemoveList*:

4> for each pci-RangeIndex included in the whiteCellsToRemoveList:

5> remove the entry with the matching *pci-RangeIndex* from the *whiteCellsToAddModList*;

3> if the received *measObject* includes the *whiteCellsToAddModList*:

4> for each pci-RangeIndex included in the whiteCellsToAddModList:

5> if an entry with the matching *pci-RangeIndex* is included in the *whiteCellsToAddModList*:

6> replace the entry with the value received for this *pci-RangeIndex*;

5> else:

6> add a new entry for the received *pci-RangeIndex* to the *whiteCellsToAddModList*;

3> for each *measId* associated with this *measObjectId* in the *measIdList* within the *VarMeasConfig*, if any:

4> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

4> stop the periodical reporting timer and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> else:

3> add a new entry for the received *measObject* to the *measObjectList* within *VarMeasConfig*.

#### 5.5.2.6 Reporting configuration removal

The UE shall:

1> for each *reportConfigId* included in the received *reportConfigToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:

2> remove the entry with the matching *reportConfigId* from the *reportConfigList* within the *VarMeasConfig*;

2> remove all *measId* associated with the *reportConfigId* from the *measIdList* within the *VarMeasConfig*, if any;

2> if a measId is removed from the *measIdList*:

3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

3> stop the periodical reporting timer and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *reportConfigToRemoveList* includes any *reportConfigId* value that is not part of the current UE configuration.

#### 5.5.2.7 Reporting configuration addition/modification

The UE shall:

1> for each *reportConfigId* included in the received *reportConfigToAddModList*:

2> if an entry with the matching *reportConfigId* exists in the *reportConfigList* within the *VarMeasConfig*, for this entry:

3> reconfigure the entry with the value received for this *reportConfig*;

3> for each *measId* associated with this *reportConfigId* included in the *measIdList* within the *VarMeasConfig*, if any:

4> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

4> stop the periodical reporting timer and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> else:

3> add a new entry for the received reportConfig to the *reportConfigList* within the *VarMeasConfig*.

#### 5.5.2.8 Quantity configuration

The UE shall:

1> for each RAT for which the received *quantityConfig* includes parameter(s):

2> set the corresponding parameter(s) in *quantityConfig* within *VarMeasConfig* to the value of the received *quantityConfig* parameter(s);

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

2> stop the periodical reporting timer and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

#### 5.5.2.9 Measurement gap configuration

The UE shall:

1> if the UE is operating in EN-DC;

2> if *gapFR2* is set to setup:

3> if an FR2 measurement gap configuration is already setup, release the FR2 measurement gap configuration;

3> setup the FR2 measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition (SFN and subframe of SCG cells on FR2):

SFN mod *T* = FLOOR(*gapOffset*/10);

subframe = *gapOffset* mod 10;

with *T* = MGRP/10 as defined in TS 38.133 [x];

3> if *mgta* is configured, apply the specified timing advance to the gap occurences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurences);

2> else if *gapFR2* is set to release:

3> release the FR2 measurement gap configuration.

#### 5.5.2.10 Reference signal measurement timing configuration

The UE shall setup the first SS/PBCH block measurement timing configuration (SMTC) in accordance with the received *periodicityAndOffset* parameter (providing *Periodicity* and *Offset* value for the following condition) in the *smtc1* configuration. The first subframe of each SMTC occasion occurs at an SFN and subframe of the NR SpCell meeting the following condition:

SFN mod *T* = FLOOR (*Offset*/10);

subframe = *Offset* mod 10;

with *T* = *Periodicity*/10.

If *smtc2* is present, for cells indicated in the *pci-List* parameter in *smtc2* in the same frequency, the UE shall setup an additional SS/PBCH block measurement timing configuration (SMTC) in accordance with the received *periodicity* parameter in the *smtc2* configuration and use the *Offset* (derived from parameter *periodicityAndOffset*) and *duration* parameter from the *smtc1* configuration. The first subframe of each SMTC occasion occurs at an SFN and subframe of the NR SpCell meeting the above condition:

On the concerned frequency, the UE shall not consider SS/PBCH block transmission in subframes outside the SMTC occasion for measurements including RRM measurements.

### 5.5.3 Performing measurements

#### 5.5.3.1 General

An RRC\_CONNECTED UE shall derive cell measurement results by measuring one or multiple beams associated per cell as configured by the network, as described in 5.5.3.3. For all cell measurement results in RRC\_CONNECTED the UE applies the layer 3 filtering as specified in 5.5.3.2, before using the measured results for evaluation of reporting criteria and measurement reporting. For cell measurements, the network can configure RSRP, RSRQ or SINR as trigger quantity. Reporting quantities can be the same as trigger quantity or combinations of quantities (i.e. RSRP and RSRQ; RSRP and SINR; RSRQ and SINR; RSRP, RSRQ and SINR).

The network may also configure the UE to report measurement information per beam (which can either be measurement results per beam with respective beam identifier(s) or only beam identifier(s)), derived as described in 5.5.3.3a. If beam measurement information is configured to be included in measurement reports, the UE applies the layer 3 beam filtering as specified in 5.5.3.2. On the other hand, the exact layer 1 filtering of beam measurements used to derive cell measurement results is implementation dependent.

The UE shall:

1> whenever the UE has a *measConfig*, perform RSRP and RSRQ measurements for each serving cell as follows:

2> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *ssb*:

3> if at least one measId included in the measIdList within VarMeasConfig contains a reportQuantityRsIndexes and maxNrofRSIndexesToReport:

4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;

3> derive serving cell measurement results based on SS/PBCH block, as described in 5.5.3.3;

2> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *csi-rs*:

3> if at least one measId included in the measIdList within VarMeasConfig contains a reportQuantityRsIndexes and maxNrofRSIndexesToReport:

4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;

3> derive serving cell measurement results based on CSI-RS, as described in 5.5.3.3;

1> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains SINR as trigger quantity and/or reporting quantity:

2> if the associated *reportConfig* contains *rsType* set to *ssb*:

3> if the measId contains a reportQuantityRsIndexes and maxNrofRSIndexesToReport:

4> derive layer 3 filtered SINR per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;

3> derive serving cell SINR based on SS/PBCH block, as described in 5.5.3.3;

2> if the associated *reportConfig* contains *rsType* set to *csi-rs*:

3> if the measId contains a reportQuantityRsIndexes and maxNrofRSIndexesToReport:

4> derive layer 3 filtered SINR per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;

3> derive serving cell SINR based on CSI-RS, as described in 5.5.3.3;

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the reportType for the associated reportConfig is periodical or eventTriggered:

3> if a measurement gap configuration is setup, or

3> if the UE does not require measurement gaps to perform the concerned measurements:

4> if *s-MeasureConfig* is not configured, or

4> if *s-MeasureConfig* is set to *ssb-RSRP* and the NR SpCell RSRP based on SS/PBCH block, after layer 3 filtering, is lower than *ssb-RSRP,*or

4> if *s-MeasureConfig* is set to *csi-RSRP* and the NR SpCell RSRP based on CSI-RS, after layer 3 filtering, is lower than *csi-RSRP*:

5> if the *measObject* is associated to NR and the *rsType* is set to *csi-rs*:

6> if reportQuantityRsIndexes and maxNrofRSIndexesToReport for the associated reportConfig are configured:

7> derive layer 3 filtered beam measurements only based on CSI-RS for each measurement quantity indicated in *reportQuantityRsIndexes*, as described in 5.5.3.3a;

6> derive cell measurement results based on CSI-RS for each trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;

5> if the *measObject* is associated to NR and the *rsType* is set to *ssb*:

6> if reportQuantityRsIndexes and maxNrofRSIndexesToReport for the associated reportConfig are configured:

7> derive layer 3 beam measurements only based on SS/PBCH block for each measurement quantity indicated in *reportQuantityRsIndexes*, as described in 5.5.3.3a;

6> derive cell measurement results based on SS/PBCH block for each trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;

5> if the *measObject* is associated to E-UTRA:

6> perform the corresponding measurements associated to neighbouring cells on the frequencies indicated in the concerned *measObject*;

2> perform the evaluation of reporting criteria as specified in 5.5.4.

#### 5.5.3.2 Layer 3 filtering

The UE shall:

1> for each cell measurement quantity and for each beam measurement quantity that the UE performs measurements according to 5.5.3.1:

2> filter the measured result, before using for evaluation of reporting criteria or for measurement reporting, by the following formula:



where

***Mn*** is the latest received measurement result from the physical layer;

***Fn*** is the updated filtered measurement result, that is used for evaluation of reporting criteria or for measurement reporting;

***Fn-1***is the old filtered measurement result, where ***F0***is set to ***M1*** when the first measurement result from the physical layer is received; and

***a*** = 1/2(***k***/4), where ***k*** is the *filterCoefficient* for the corresponding measurement quantity received by the *quantityConfig*;

2> adapt the filter such that the time characteristics of the filter are preserved at different input rates, observing that the *filterCoefficient k* assumes a sample rate equal to X ms; The value of X is equivalent to one intra-frequency L1 measurement period as defined in 38.331 [14] assuming non-DRX operation, and depends on frequency range.

NOTE 1: If ***k*** is set to 0, no layer 3 filtering is applicable.

NOTE 2: The filtering is performed in the same domain as used for evaluation of reporting criteria or for measurement reporting, i.e., logarithmic filtering for logarithmic measurements.

NOTE 3: The filter input rate is implementation dependent, to fulfil the performance requirements set in TS 38.133[14]. For further details about the physical layer measurements, see TS 38.133 [14].

#### 5.5.3.3 Derivation of cell measurement results

The network may configure the UE to derive RSRP, RSRQ and SINR measurement results per cell associated to NR carrier frequencies based on parameters configured in the *measObject* (e.g. maximum number of beams to be averaged and beam consolidation thresholds) and in the *reportConfig* (*rsType* to be measured, SS/PBCH block or CSI-RS).

The UE shall:

1> for each cell measurement quantity to be derived based on SS/PBCH block:

2> if *nrofSS-BlocksToAverage* in the associated *measObject* is not configured; or

2> if *absThreshSS-BlocksConsolidation* in the associated *measObject* is not configured; or

2> if the highest beam measurement quantity value is below *absThreshSS-BlocksConsolidation*:

3> derive each cell measurement quantity based on SS/PBCH block as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];

2> else:

3> derive each cell measurement quantity based on SS/PBCH block as the linear average of the power values of the highest beam measurement quantity values above *absThreshSS-BlocksConsolidation* where the total number of averaged beams shall not exceed *nrofSS-BlocksToAverage*;

2> apply layer 3 cell filtering as described in 5.5.3.2;

1> for each cell measurement quantity to be derived based on CSI-RS:

2> consider a CSI-RS resource on the associated frequency to be applicable for deriving cell measurements when the concerned CSI-RS resource is included in the *csi-rs-ResourceConfigMobility* with the corresponding *physCellId* and *CSI-RS-CellMobility* in the associated *measObject*;

2> if *nrofCSI-RS-ResourcesToAverage* in the associated *measObject* is not configured; or

2> if *absThreshCSI-RS-Consolidation* in the associated *measObject* is not configured; or

2> if the highest beam measurement quantity value is below *absThreshCSI-RS-Consolidation*:

3> derive each cell measurement quantity based on CSI-RS as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];

2> else:

3> derive each cell measurement quantity based on CSI-RS as the linear average of the power values of the highest beam measurement quantity values above *absThreshCSI-RS-Consolidation* where the total number of averaged beams shall not exceed *nroCSI-RS-ResourcesToAverage*;

2> apply layer 3 cell filtering as described in 5.5.3.2.

#### 5.5.3.3a Derivation of layer 3 beam filtered measurement

The UE shall:

1> for each layer 3 beam filtered measurement quantity to be derived based on SS/PBCH block;

2> derive each configured beam measurement quantity based on SS/PBCH block as described in TS 38.215[9], and apply layer 3 beam filtering as described in 5.5.3.2;

1> for each layer 3 beam filtered measurement quantity to be derived based on CSI-RS;

2> derive each configured beam measurement quantity based on CSI-RS as described in TS 38.215 [9], and apply layer 3 beam filtering as described in 5.5.3.2.

### 5.5.4 Measurement report triggering

#### 5.5.4.1 General

If security has been activated successfully, the UE shall:

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the corresponding *reportConfig*includes a *reportType* set to *eventTriggered* or *periodical*;

3> if the corresponding *measObject* concerns NR;

4> if the *eventA1* or *eventA2* is configured in the corresponding *reportConfig*:

5> consider only the serving cell to be applicable;

4> else:

5> for events involving a serving cell on one frequency and neighbours on another frequency, consider any serving cell on the other frequency to be a neighbouring cell as well;

5> if *useWhiteCellList* is set to TRUE:

6> consider any neighbouring cell detected on the associated frequency to be applicable when the concerned cell is included in the *whiteCellsToAddModList* defined within the *VarMeasConfig* for this measId;

5> else:

6> consider any neighbouring cell detected on the associated frequency to be applicable when the concerned cell is not included in the *blackCellsToAddModList* defined within the *VarMeasConfig* for this measId;

2> if the *reportType* is set to *eventTriggered* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig*, while the *VarMeasReportList* does not include a measurement reporting entry for this *measId* (a first cell triggers the event):

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *reportType* is set to *eventTriggered* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells not included in the *cellsTriggeredList* for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig* (a subsequent cell triggers the event):

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *reportType* is set to *eventTriggered* and if the leaving condition applicable for this event is fulfilled for one or more of the cells included in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* for all measurements after layer 3 filtering taken during *timeToTrigger* defined within the *VarMeasConfig* for this event:

3> remove the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> if *reportOnLeave* is set to *TRUE* for the corresponding reporting configuration:

4> initiate the measurement reporting procedure, as specified in 5.5.5;

3> if the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* is empty:

4> remove the measurement reporting entry within the *VarMeasReportList* for this *measId*;

4> stop the periodical reporting timer for this *measId*, if running;

2> if *reportType* is set to *periodical* and if a (first) measurement result is available:

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

4> if the *reportAmount* exceeds 1:

5> initiate the measurement reporting procedure,as specified in 5.5.5, immediately after the quantity to be reported becomes available for the NR SpCell;

4> else (i.e. the *reportAmount* is equal to 1):

5> initiate the measurement reportingprocedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the NR SpCelland for the strongest cell among the applicable cells;

2> upon expiry of the periodical reporting timer for this *measId*:

3> initiate the measurement reporting procedure, as specified in 5.5.5.

#### 5.5.4.2 Event A1 (Serving becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A1-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A1-2, as specified below, is fulfilled;

1> for this measurement, consider the serving cell to be the NR SpCell or the NR SCell that isconfigured on the frequency indicated in the associated *measObjectNR*.

Inequality A1-1 (Entering condition)



Inequality A1-2 (Leaving condition)



The variables in the formula are defined as follows:

***Ms*** is the measurement result of the serving cell, not taking into account any offsets.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis*as defined within*reportConfigNR*for this event).

***Thresh*** is the threshold parameter for this event (i.e. *a1-Threshold* as defined within*reportConfigNR*for this event).

***Ms*** is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Hys*** is expressed in dB.

***Thresh*** is expressed in the same unit as ***Ms***.

#### 5.5.4.3 Event A2 (Serving becomes worse than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A2-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A2-2, as specified below, is fulfilled;

1> for this measurement, consider the serving cell to be the NR SpCellor the NR SCell that is configured on the frequency indicated in the associated *measObjectNR*.

Inequality A2-1 (Entering condition)



Inequality A2-2 (Leaving condition)



The variables in the formula are defined as follows:

***Ms*** is the measurement result of the serving cell, not taking into account any offsets.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

***Thresh*** is the threshold parameter for this event (i.e. *a2-Threshold* as defined within *reportConfigNR* for this event).

***Ms*** is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Hys*** is expressed in dB.

***Thresh*** is expressed in the same unit as ***Ms***.

#### 5.5.4.4 Event A3 (Neighbour becomes offset better than SpCell)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A3-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A3-2, as specified below, is fulfilled;

1> use the PSCell for *Mp*, *Ofp and Ocp*.

NOTE The cell(s) that triggers the event is on the frequency indicated in the associated *measObjectNR* which may be different from the frequency used by the NR SpCell.

Inequality A3-1 (Entering condition)



Inequality A3-2 (Leaving condition)



The variables in the formula are defined as follows:

***Mn*** is the measurement result of the neighbouring cell, not taking into account any offsets.

***Ofn*** is the frequency specific offset of the frequency of the neighbour cell (i.e. *offsetFreq* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell).

***Ocn*** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

***Mp*** is the measurement result of the SpCell, not taking into account any offsets.

***Ofp*** is the frequency specific offset of the frequency of the SpCell (i.e. *offsetFreq* as defined within *measObjectNR* corresponding to the frequency of the SpCell).

***Ocp*** is the cell specific offset of the SpCell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the SpCell), and is set to zero if not configured for the SpCell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within*reportConfigNR* for this event).

***Off*** is the offset parameter for this event (i.e. *a3-Offset* as defined within*reportConfigNR* for this event).

***Mn, Mp*** are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Ofn***, ***Ocn***, ***Ofp***, ***Ocp***, ***Hys***, ***Off*** are expressed in dB.

#### 5.5.4.5 Event A4 (Neighbour becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A4-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A4-2, as specified below, is fulfilled.

Inequality A4-1 (Entering condition)



Inequality A4-2 (Leaving condition)



The variables in the formula are defined as follows:

***Mn*** is the measurement result of the neighbouring cell, not taking into account any offsets.

***Ofn*** is the frequency specific offset of the frequency of the neighbour cell (i.e. *offsetFreq* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell).

***Ocn*** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR*for this event).

***Thresh*** is the threshold parameter for this event (i.e. *a4-Threshold* as defined within *reportConfigNR*for this event).

***Mn*** is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Ofn, Ocn, Hys*** are expressed in dB.

***Thresh*** is expressed in the same unit as ***Mn***.

#### 5.5.4.6 Event A5 (SpCell becomes worse than threshold1 and neighbour becomes better than threshold2)

The UE shall:

1> consider the entering condition for this event to be satisfied when both condition A5-1 and condition A5-2, as specified below, are fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A5-3 or condition A5-4, i.e. at least one of the two, as specified below, is fulfilled;

1> use the PSCell for *Mp*.

NOTE: The cell(s) that triggers the event is on the frequency indicated in the associated *measObjectNR* which may be different from the frequency used by the NR SpCell.

Inequality A5-1 (Entering condition 1)



Inequality A5-2 (Entering condition 2)



Inequality A5-3 (Leaving condition 1)



Inequality A5-4 (Leaving condition 2)



The variables in the formula are defined as follows:

***Mp*** is the measurement result of the NR SpCell, not taking into account any offsets.

***Mn***is the measurement result of the neighbouring cell, not taking into account any offsets.

***Ofn*** is the frequency specific offset of the frequency of the neighbour cell (i.e. *offsetFreq* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell).

***Ocn*** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR*for this event).

***Thresh1*** is the threshold parameter for this event (i.e. *a5-Threshold1* as defined within *reportConfigNR* for this event).

***Thresh2*** is the threshold parameter for this event (i.e. *a5-Threshold2* as defined within *reportConfigNR* for this event).

***Mn, Mp*** are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Ofn, Ocn, Hys*** are expressed in dB.

***Thresh1***is expressed in the same unit as ***Mp***.

***Thresh2*** is expressed in the same unit as ***Mn***.

#### 5.5.4.7 Event A6 (Neighbour becomes offset better than SCell)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A6-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A6-2, as specified below, is fulfilled;

1> for this measurement, consider the (secondary) cell that is configured on the frequency indicated in the associated *measObjectNR* to be the serving cell.

NOTE: The neighbour(s) is on the same frequency as the SCell i.e. both are on the frequency indicated in the associated *measObjectNR*.

Inequality A6-1 (Entering condition)



Inequality A6-2 (Leaving condition)



The variables in the formula are defined as follows:

***Mn***is the measurement result of the neighbouring cell, not taking into account any offsets.

***Ocn*** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

***Ms***is the measurement result of the serving cell, not taking into account any offsets.

***Ocs*** is the cell specific offset of the serving cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the serving frequency), and is set to zero if not configured for the serving cell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within*reportConfigNR* for this event).

***Off*** is the offset parameter for this event (i.e. *a6-Offset* as defined within*reportConfigNR* for this event).

***Mn, Ms*** are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Ocn, Ocs, Hys, Off*** are expressed in dB.

### 5.5.5 Measurement reporting

#### 5.5.5.1 General



Figure 5.5.5.1-1: Measurement reporting

The purpose of this procedure is to transfer measurement results from the UE to the network. The UE shall initiate this procedure only after successful security activation.

For the *measId* for which the measurement reporting procedure was triggered, the UE shall set the *measResults* within the *MeasurementReport* message as follows:

1> set the *measId* to the measurement identity that triggered the measurement reporting;

1> set the *measResultServingCell* within *measResultServingFreqList* to include RSRP, RSRQ and the available SINR for each configured serving cell derived based on the *rsType* indicated in the associated *reportConfig*;

1> set the *measResultServingCell* within *measResultServingFreqList* to include for each NR serving cell that is configured, if any, the *servFreqId*;

1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRsIndexes* and *maxNrofRSIndexesToReport*:

2> for each configured serving cell, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2;

1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:

2>for each serving frequency for which *measObjectId* is referenced in the *measIdList*, other than the frequency corresponding with the *measId* that triggered the measurement reporting:

3> set the *measResultBestNeighCell* within *measResultServingFreqList* to include the *physCellId* and the available measurement quantities based on the *reportQuantityCell* and *rsType* indicated in *reportConfig* of the non-serving cell on the concerned serving frequency with the highest measured RSRP if RSRP measurement results are available for cells on this frequency, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells on this frequency, otherwise with the highest measured SINR;

3> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRsIndexes* and *maxNrofRSIndexesToReport:*

4> for each best non-serving cell included in the measurement report:

5>include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2;

1> if there is at least one applicable neighbouring cell to report:

2> set the *measResultNeighCells* to include the best neighbouring cells up to *maxReportCells* in accordance with the following:

3> if the reportType is set to eventTriggered:

4> include the cells included in the *cellsTriggeredList* as defined within the *VarMeasReportList* for this *measId*;

3> else:

4> include the applicable cells for which the new measurement results became available since the last periodical reporting or since the measurement was initiated or reset;

4> if *reportQuantityRsIndexes* and *maxNrofRSIndexesToReport* areconfigured, include beam measurement information as described in 5.5.5.2;

3> for each cell that is included in the *measResultNeighCells*, include the *physCellId*;

3> if the reportType is set to eventTriggered:

4> for each included cell, include the layer 3 filtered measured results in accordance with the *reportConfig* for this *measId*, ordered as follows:

5> if the *measObject* associated with this *measId* concerns NR:

6> if *rsType* in the associated *reportConfig* is set to *ssb*:

7> set *resultsSSB-Cell* within the *measResult* to include the SS/PBCH block based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in order of decreasing trigger quantity, i.e. the best cell is included first:

8> if *reportQuantityRsIndexes* and *maxNrofRSIndexesToReport* areconfigured, include beam measurement information as described in 5.5.5.2;

6> else if *rsType* in the associated *reportConfig* is set to *csi-rs*:

7> set *resultsCSI-RS-Cell* within the *measResult* to include the CSI-RS based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in order of decreasing trigger quantity, i.e. the best cell is included first:

8> if *reportQuantityRsIndexes* and *maxNrofRSIndexesToReport* are, include beam measurement information as described in 5.5.5.2;

1> increment the *numberOfReportsSent* as defined within the *VarMeasReportList* for this measId by 1;

1> stop the periodical reporting timer, if running;

1> if the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* is less than the *reportAmount* as defined within the corresponding *reportConfig* for this *measId*:

2> start the periodical reporting timer with the value of *reportInterval* as defined within the corresponding *reportConfig* for this *measId*;

1> else:

2> if the *reportType* is set to *periodical*:

3> remove the entry within the *VarMeasReportList* for this *measId*;

3> remove this *measId* from the *measIdList* within *VarMeasConfig*;

1> if the UE is configured with EN-DC:

2> if SRB3 is configured:

3> submit the *MeasurementReport* message via SRB3 to lower layers for transmission, upon which the procedure ends;

2>else:

3> submit the *MeasurementReport* message via the EUTRA MCG embedded in E-UTRA RRC message *ULInformationTransferMRDC* as specified in TS 36.331 [10].

1> else:

2>submit the *MeasurementReport* message to lower layers for transmission, upon which the procedure ends.

#### 5.5.5.2 Reporting of beam measurement information

For beam measurement information to be included in a measurement report the UE shall:

1> if reportType is set to eventTriggered:

2> consider the trigger quantity as the sorting quantity;

1> if reportType is set to periodical:

2> if a single reporting quantity is set to TRUE in *reportQuantityRsIndexes*;

3> consider the configured single quantity as the sorting quantity;

2> else:

3> if *rsrp* is set to TRUE;

4> consider RSRP as the sorting quantity;

3> else:

4> consider RSRQ as the sorting quantity;

1> set *rsIndexResults* to include up to *maxNrofRsIndexesToReport*SS/PBCH block indexes or CSI-RS indexes in order of decreasing sorting quantity as follows:

2> if the measurement information to be included is based on SS/PBCH block:

3> include within *resultsSSB-Indexes* the index associated to the best beam for that SS/PBCH block sorting quantity and the remaining beams whose sorting quantity is above *absThreshSS-BlocksConsolidation* defined in the *VarMeasConfig* for the corresponding *measObject*;

3> if *includeBeamMeasurements* is configured, include the SS/PBCH based measurement results for the quantities in *reportQuantityRsIndexes* set to TRUE for each SS/PBCH blockindex;2> else if the beam measurement information to be included is based on CSI-RS:

3> include within *resultsCSI-RS-Indexes* the index associated to the best beam for that CSI-RS sorting quantity and the remaining beams whose sorting quantity is above *absThreshCSI-RS-Consolidation* defined in the *VarMeasConfig* for the corresponding *measObject*;

3> if *includeBeamMeasurements*is configured, include the CSI-RS based measurement results for the quantities in *reportQuantityRsIndexes* set to TRUE for each CSI-RS index.

## 5.6 UE capabilities

### 5.6.1 UE capability transfer

#### 5.6.1.1 General

Editor’s Note: Targeted for completion in June 2018

#### 5.6.1.2 Initiation

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

#### 5.6.1.3 Reception of the *UECapabilityEnquiry* by the UE

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

#### 5.6.1.4 Compilation of band combinations supported by the UE

The UE shall:

1> if includes *FreqBandList* is received:

2> compile a list of band combinations, candidate for inclusion in the *UECapabilityInformation* message, only consisting of bands included in *FreqBandList*, and prioritized in the order of *FreqBandList*, (i.e. first include remaining band combinations containing the first-listed band, then include remaining band combinations containing the second-listed band, and so on);

2> for each band combination included in the candidate list:

3> if it is regarded as a fallback band combination with the same capabilities of another band combination included in the list of candidates as specified in TS 38.306 [xx]:

4> remove the band combination from the list of candidates;

2> include all band combinations in the candidate list into *supportedBandCombination*;

1> else:

2> include all band combinations supported by the UE into *supportedBandCombination,* excluding fallback band combinations with the same capabilities of another band combination included in the list of band combinations supported by the UE.

#### 5.6.1.5 Compilation of feature sets supported by the UE

The UE shall:

1> for each band in a band combination included in *supportedBandCombination*:

2> if the frequency band indicator conveys *FreqBandIndicatorNR*:

3> include the list of downlink and uplink feature set identifiers supported for the band combination into *featureSetListDownlink* and *featureSetListUplink.*

2> if the frequency band indicator conveys *FreqBandIndicatorEUTRA*:

3> include the list of downlink and uplink feature set identifiers supported for the band combination into *featureSetEUTRA-DownlinkList* and *featureSetEUTRA-UplinkList.*

## 5.7 Other

### 5.7.1 DL information transfer

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

### 5.7.2 UL information transfer

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

### 5.7.3 SCG failure information

#### 5.7.3.1 General



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.

Editor’s Note: SCG failure considers the case of exceeding the maximum uplink transmission timing difference if RAN1 decides that EN-DC supports the synchronised operation case. FFS how to capture

Editor’s Note: FFS whether to include the handling of SCell Failure in CA duplication case in SCGfailureinformation procedure and whether to rename SCGfailureinformation.

#### 5.7.3.2 Initiation

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].

Editor’s Note: The section for transmission of SCGFailureInformation in NR RRC entity for SA is FFS\_Standalone.

#### 5.7.3.3 Failure type determination

Editor’s Note: FFS / TODO: Either use this section also for NR-DC or change section title (add "for EN-DC").

The UE shall set the SCG failure type as follows:

1> if the UE initiates transmission of the *SCGFailureInformationNR* message to provide SCG radio link failure information:

2> set the failureType as scg-RadioLinkFailure;

1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide reconfiguration with sync failure information for an SCG:

2> set the failureType as scg-ChangeFailure;

Editor’s Note: FFS whether to change scg-ChangeFailure to synchronousReconfigurationFailure-SCG.

1> else, if the UE initiates transmission of the *SCGFailureInformationNR* message due to SRB3 IP check failure:

2> set the failureType as srb3-IntegrityFailure;

1> else, if the UE initiates transmission of the *SCGFailureInformationNR* message due to Reconfiguration failure of NR RRC reconfiguration message:

2> set the failureType as scg-reconfigFailure.

Editor’s Note: FFS: whether to include *rrc-TransactionIdentifier* information.

#### 5.7.3.4 Setting the contents of *MeasResultSCG-Failure*

The UE shall set the contents of the *MeasResultSCG-Failure* as follows:

1> set the *measResultServFreqList* to include for each SCG cell that is configured by the SN to be measured, if any, within *measResultServingCell* the quantities of the concerned SCell based on both SS/PBCH block and CSI-RS, if available, according to performance requirements in [FFS\_Ref];

1> for each SCG serving frequency included in *measResultServFreqList* include within *measResultBestNeighCell* the *physCellId* and the quantities (including both available cell level and beam level measurement results) of the best non-serving cell on the concerned serving frequency, sorting based on SS/PBCH block if available and otherwise CSI-RS, with the highest measured RSRP if RSRP measurement results are available for cells on this frequency, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells on this frequency, otherwise with the highest measured SINR;

1> set the *measResultNeighCells* to include the best measured cells on non-serving NR frequencies, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected the failure, sorting based on SS/PBCH block if available and otherwise CSI-RS, with the highest measured RSRP if RSRP measurement results are available for cells on this frequency, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells on this frequency, otherwise with the highest measured SINR, and set its fields as follows;

2> if the UE was configured to perform measurements by the SN for one or more non-serving NR frequencies and measurement results are available, include the *measResultListNR*;

2> for each neighbour cell included:

3> include the optional fields that are available.

NOTE: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.

# 6 Protocol data units, formats and parameters (ASN.1)

## 6.1 General

### 6.1.1 Introduction

The contents of each RRC message is specified in sub-clause 6.2 using ASN.1 to specify the message syntax and using tables when needed to provide further detailed information about the fields specified in the message syntax. The syntax of the information elements that are defined as stand-alone abstract types is further specified in a similar manner in sub-clause 6.3.

### 6.1.2 Need codes and conditions for optional downlink fields

The need for fields to be present in a message or an abstract type, i.e., the ASN.1 fields that are specified as OPTIONAL in the abstract notation (ASN.1), is specified by means of comment text tags attached to the OPTIONAL statement in the abstract syntax. All comment text tags are available for use in the downlink direction only. The meaning of each tag is specified in table 6.1.2-1.

If conditions are used, a conditional presence table is provided for the message or information element specifying the need of the field for each condition case. The table also specifies whether UE maintains or releases the value in case the field is not present. The conditions clarify what the UE may expect regarding the setting of the message by the network. Violation of conditions is regarded as invalid network behaviour, which the UE is not required to cope with. Hence the general error handling defined in 10.4 does not apply in case a field is absent although it is mandatory according to the CondC or CondM condition.

For guidelines on the use of need codes and conditions, see Annex A.6 and A.7.

Table 6.1.2-1: Meaning of abbreviations used to specify the need for fields to be present

| Abbreviation | Meaning |
| --- | --- |
| CondC conditionTag | Configuration condition  Presence of the field is conditional to other configuration settings. |
| CondM conditionTag | Message condition  Presence of the field is conditional to other fields included in the message. |
| Need S | *Specified*  Used for (configuration) fields, whose field description or procedure **specifies** the UE behavior performed upon receiving a message with the field absent (and not if field description or procedure specifies the UE behavior when field is not configured). |
| Need M | *Maintain*  Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE maintains the current value. |
| Need N | *No action* (one-shot configuration that is not maintained)  Used for (configuration) fields that are not stored and whose presence causes a one-time action by the UE. Upon receiving message with the field absent, the UE takes no action. |
| Need R | *Release*  Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE releases the current value. |

## 6.2 RRC messages

### 6.2.1 General message structure

#### *– NR-RRC-Definitions*

This ASN.1 segment is the start of the NR RRC PDU definitions.

-- ASN1START

-- TAG-NR-RRC-DEFINITIONS-START

NR-RRC-Definitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- TAG-NR-RRC-DEFINITIONS-STOP

-- ASN1STOP

#### *– BCCH-BCH-Message*

The *BCCH-BCH-Message* class is the set of RRC messages that may be sent from the network to the UE via BCH on the BCCH logical channel.

-- ASN1START

-- TAG-BCCH-BCH-MESSAGE-START

BCCH-BCH-Message ::= SEQUENCE {

message BCCH-BCH-MessageType

}

BCCH-BCH-MessageType ::= CHOICE {

mib MIB,

messageClassExtension SEQUENCE {}

}

-- TAG-BCCH-BCH-MESSAGE-STOP

-- ASN1STOP

#### *– DL-DCCH-Message*

The *DL-DCCH-Message* class is the set of RRC messages that may be sent from the network to the UE on the downlink DCCH logical channel.

-- ASN1START

-- TAG-DL-DCCH-MESSAGE-START

DL-DCCH-Message ::= SEQUENCE {

message DL-DCCH-MessageType

}

DL-DCCH-MessageType ::= CHOICE {

c1 CHOICE {

rrcReconfiguration RRCReconfiguration,

spare15 NULL, spare14 NULL, spare13 NULL,

spare12 NULL, spare11 NULL, spare10 NULL,

spare9 NULL, spare8 NULL, spare7 NULL,

spare6 NULL, spare5 NULL, spare4 NULL,

spare3 NULL, spare2 NULL, spare1 NULL

},

messageClassExtension SEQUENCE {}

}

-- TAG-DL-DCCH-MESSAGE-STOP

-- ASN1STOP

#### *– UL-DCCH-Message*

The *UL-DCCH-Message* class is the set of RRC messages that may be sent from the UE to the network on the uplink DCCH logical channel.

-- ASN1START

-- TAG-UL-DCCH-MESSAGE-START

UL-DCCH-Message ::= SEQUENCE {

message UL-DCCH-MessageType

}

UL-DCCH-MessageType ::= CHOICE {

c1 CHOICE {

measurementReport MeasurementReport,

rrcReconfigurationComplete RRCReconfigurationComplete,

spare14 NULL, spare13 NULL, spare12 NULL,

spare11 NULL, spare10 NULL, spare9 NULL,

spare8 NULL, spare7 NULL, spare6 NULL,

spare5 NULL, spare4 NULL, spare3 NULL,

spare2 NULL, spare1 NULL

},

messageClassExtension SEQUENCE {}

}

-- TAG-UL-DCCH-MESSAGE-STOP

-- ASN1STOP

### 6.2.2 Message definitions

#### – *MIB*

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

*MIB*

-- ASN1START

-- TAG-MIB-START

MIB ::= SEQUENCE {

-- The 6 most significant bit (MSB) of the 10 bit System Frame Number. The 4 LSB of the SFN are conveyed in the PBCH transport block

-- as well but outside the MIB.

systemFrameNumber BIT STRING (SIZE (6)),

-- Subcarrier spacing for SIB1, Msg.2/4 for initial access and broadcast SI-messages.

-- If the UE acquires this MIB on a carrier frequency <6GHz, the values 15 and 30 kHz are applicable.

-- If the UE acquires this MIB on a carrier frequency >6GHz, the values 60 and 120 kHz are applicable.

subCarrierSpacingCommon ENUMERATED {scs15or60, scs30or120},

-- The frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See 38.211, section 7.4.3.1)

-- Note: For frequencies <6 GHz a fith, this field may comprise only the 4 least significant bits of the ssb-SubcarrierOffset.

-- The codepoint "FFS\_RAN1" indicates that this cell does not provide SIB1 and that there is hence no common CORESET.

ssb-SubcarrierOffset INTEGER (0..15),

-- Position of (first) DL DM-RS. Corresponds to L1 parameter 'DL-DMRS-typeA-pos' (see 38.211, section 7.4.1.1.1)

dmrs-TypeA-Position ENUMERATED {pos2, pos3},

-- Determines a bandwidth for PDCCH/SIB, a common ControlResourceSet (CORESET) a common search space and necessary PDCCH parameters.

-- Corresponds to L1 parameter 'RMSI-PDCCH-Config' (see FFS\_Specification, section FFS\_Section)

pdcch-ConfigSIB1 INTEGER (0..255),

-- Indicates that UE shall not camp on this cell

cellBarred ENUMERATED {barred, notBarred},

-- Controls cell reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE,

-- as specified in TS 38.304.

intraFreqReselection ENUMERATED {allowed, notAllowed},

spare BIT STRING (SIZE (1))

}

-- TAG-MIB-STOP

-- ASN1STOP

#### – *MeasurementReport*

The *MeasurementReport* message is used for the indication of measurement results.

Signalling radio bearer: SRB1, SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

*MeasurementReport message*

-- ASN1START

-- TAG-MEASUREMENTREPORT-START

MeasurementReport ::= SEQUENCE {

criticalExtensions CHOICE {

measurementReport MeasurementReport-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

MeasurementReport-IEs ::= SEQUENCE {

measResults MeasResults,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE{} OPTIONAL

}

-- TAG-MEASUREMENTREPORT-STOP

-- ASN1STOP

#### – *RRCReconfiguration*

The *RRCReconfiguration* message is the command to modify an RRC connection. It may convey information for measurement configuration, mobility control, radio resource configuration (including RBs, MAC main configuration and physical channel configuration) including and security configuration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

*RRCReconfiguration message*

-- ASN1START

-- TAG-RRCRECONFIGURATION-START

RRCReconfiguration ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

rrcReconfiguration RRCReconfiguration-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

RRCReconfiguration-IEs ::= SEQUENCE {

-- Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP.

-- In EN-DC this field may only be present if the RRCReconfiguration

-- is transmitted over SRB3.

radioBearerConfig RadioBearerConfig OPTIONAL, -- Need M

-- Configuration of secondary cell group (EN-DC):

secondaryCellGroup OCTET STRING (CONTAINING CellGroupConfig) OPTIONAL, -- Need M

measConfig MeasConfig OPTIONAL, -- Need M

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-RRCRECONFIGURATION-STOP

-- ASN1STOP

#### *– RRCReconfigurationComplete*

The *RRCReconfigurationComplete* message is used to confirm the successful completion of an RRC connection reconfiguration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

*RRCReconfigurationComplete message*

-- ASN1START

-- TAG-RRCRECONFIGURATIONCOMPLETE-START

RRCReconfigurationComplete ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

rrcReconfigurationComplete RRCReconfigurationComplete-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

RRCReconfigurationComplete-IEs ::= SEQUENCE {

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-RRCRECONFIGURATIONCOMPLETE-STOP

-- ASN1STOP

#### – *SIB1*

Editor’s Note: Targeted for completion in June 2018. Not used in EN-DC.

*SIB1* contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information.It also contains radio resource configuration information that is common for all UEs.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channels: BCCH and BR-BCCH

Direction: Network to UE

*SIB1 message*

-- ASN1START

-- TAG-SIB1-START

SIB1 ::= SEQUENCE {

-- FFS / TODO: Add other parameters.

-- Frequency offset for the SSB of -5kHz (M=-1) or +5kHz (M=1). When the field is absent, the UE applies no offset (M=0).

-- The offset is only applicable for the frequency range 0-2.65GHz. Corresponds to parameter 'M' (see 38.101, section FFS\_Section)

frequencyOffsetSSB ENUMERATED {khz-5, khz5} OPTIONAL, -- Need R

-- Time domain positions of the transmitted SS-blocks in an SS-Burst-Set (see 38.213, section 4.1)

ssb-PositionsInBurst SEQUENCE {

-- Indicates the presence of the up to 8 SSBs in one group

inOneGroup BIT STRING (SIZE (8)),

-- For above 6 GHz: indicates which groups of SSBs is present

groupPresence BIT STRING (SIZE (8)) OPTIONAL -- Cond above6GHzOnly

},

-- The SSB periodicity in msec for the rate matching purpose (see 38.211, section [7.4.3.1])

ssb-PeriodicityServingCell ENUMERATED {ms5, ms10, ms20, ms40, ms80, ms160, spare1, spare2},

-- TX power that the NW used for SSB transmission. The UE uses it to estimate the RA preamble TX power.

-- (see 38.213, section 7.4)

ss-PBCH-BlockPower INTEGER (-60..50),

uplinkConfigCommon UplinkConfigCommon OPTIONAL,

-- FFS: How to indicate the FrequencyInfoUL for the SUL

supplementaryUplink SEQUENCE {

uplinkConfigCommon UplinkConfigCommon OPTIONAL

-- FFS: Add additional (selection) criteria determining when/whether the UE shall use the SUL frequency

} OPTIONAL, -- Cond SUL

tdd-UL-DL-Configuration TDD-UL-DL-ConfigCommon OPTIONAL, -- Cond TDD

tdd-UL-DL-configurationCommon2 TDD-UL-DL-ConfigCommon OPTIONAL, -- Cond TDD

pdcch-ConfigCommon PDCCH-ConfigCommon OPTIONAL,

pucch-ConfigCommon PUCCH-ConfigCommon OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE{} OPTIONAL

}

-- TAG-SIB1-STOP

-- ASN1STOP

## 6.3 RRC information elements

### 6.3.0 Parameterized types

#### – *SetupRelease*

*SetupRelease* allows the *ElementTypeParam* to be used as the referenced data type for the setup and release entries. See A.3.8 for guidelines.

-- ASN1START

-- TAG-SETUP-RELEASE-START

SetupRelease { ElementTypeParam } ::= CHOICE {

release NULL,

setup ElementTypeParam

}

-- TAG-SETUP-RELEASE-STOP

-- ASN1STOP

### 6.3.1 System information blocks

### 6.3.2 Radio resource control information elements

#### – *AdditionalSpectrumEmission*

The IE *AdditionalSpectrumEmission* is used to indicate emission requirements to be fulfilled by the UE (see 38.101, section FFS\_Section)

*AdditionalSpectrumEmission* information element

-- ASN1START

-- TAG-ADDITIONALSPECTRUMEMISSION-START

AdditionalSpectrumEmission ::= INTEGER (0..7)

-- TAG-ADDITIONALSPECTRUMEMISSION-STOP

-- ASN1STOP

#### – *Alpha*

The IE Alpha defines possible values for uplink power control.

-- ASN1START

-- TAG-ALPHA-START

Alpha ::= ENUMERATED {alpha0, alpha04, alpha05, alpha06, alpha07, alpha08, alpha09, alpha1}

-- TAG-ALPHA-STOP

-- ASN1STOP

#### – *ARFCN-ValueNR*

The IE *ARFCN-ValueNR* is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) NR global frequency raster, as defined in TS 38.101-2 [15].

-- ASN1START

-- TAG-ARFCN-VALUE-NR-START

ARFCN-ValueNR ::= INTEGER (0..3279165)

-- TAG-ARFCN-VALUE-NR-STOP

-- ASN1STOP

#### – *BWP*

The *BWP* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2.

For each serving cell the network configures at least an initial bandwidth part comprising of at least a downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The bandwidth part configuration is split into uplink and downlink parameters and into common and dedicated parameters. Common parameters (in BWP-UplinkCommon and BWP-DownlinkCommon) are ”cell specific” and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

*BWP* information element

-- ASN1START

-- TAG-BANDWIDTH-PART-START

-- Generic parameters used in Uplink- and Downlink bandwidth parts

BWP ::= SEQUENCE {

-- Frequency domain location and bandwidth of this bandwidth part defined commonly in a table (FFS\_Section). The location is given as

-- distance (in number of PRBs) to point A (absoluteFrequencyPointA in FrequencyInfoDL).

-- Corresponds to L1 parameter 'DL-BWP-loc'. (see 38.211, section FFS\_Section).

-- In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bwp-Id) must have the same location (see 38.211, section REF)

locationAndBandwidth INTEGER (0..37949),

-- Subcarrier spacing to be used in this BWP for all channels and

-- reference signals unless explicitly configured elsewhere.

-- Corresponds to subcarrier spacing according to 38.211, Table 4.2-1.

-- The value kHz15 corresponds to µ=0, kHz30 to µ=1, and so on. Only the values 15 or 30 kHz (<6GHz), 60 or 120 kHz (>6GHz) are

-- applicable.

subcarrierSpacing SubcarrierSpacing,

-- Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix.

-- Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing.

-- (see 38.211, section 4.2.2)

cyclicPrefix ENUMERATED { extended } OPTIONAL -- Need R

}

BWP-Uplink ::= SEQUENCE {

-- An identifier for this bandwidth part. Other parts of the RRC configuration use the BWP-Id to associate themselves with a particular

-- bandwidth part. The BWP ID=0 is always associated with the initial BWP and may hence not be used here (in other bandwidth parts).

-- The NW may trigger the UE to swtich UL or DL BWP using a DCI field. The four code points in that DCI field map to the RRC-configured

-- BWP-ID as follows: For up to 3 configured BWPs (in addition to the initial BWP) the DCI code point is equivalent to the BWP ID

-- (initial = 0, first dedicated = 1, ...). If the NW configures 4 dedicated bandwidth parts, they are identified by DCI code

-- points 0 to 3. In this case it is not possible to switch to the initial BWP using the DCI field.

-- Corresponds to L1 parameter 'UL-BWP-index'. (see 38.211, 38.213, section 12)

bwp-Id BWP-Id,

bwp-Common BWP-UplinkCommon OPTIONAL, -- Need M

bwp-Dedicated BWP-UplinkDedicated OPTIONAL, -- Need M

...

}

BWP-UplinkCommon ::= SEQUENCE {

genericParameters BWP,

-- Configuration of cell specific random access parameters which the UE uses for contention based and contention free random access

-- as well as for contention based beam failure recovery.

rach-ConfigCommon SetupRelease { RACH-ConfigCommon } OPTIONAL, -- Need M

-- Cell specific parameters for the PUSCH

pusch-ConfigCommon SetupRelease { PUSCH-ConfigCommon } OPTIONAL, -- Need M

-- Cell specific parameters for the PUCCH

pucch-ConfigCommon SetupRelease { PUCCH-ConfigCommon } OPTIONAL, -- Need M

...

}

BWP-UplinkDedicated ::= SEQUENCE {

-- PUCCH configuration for one BWP of the regular UL or SUL of a serving cell. If the UE is configured with SUL, the network

-- configures PUCCH only on the BWPs of one of the uplinks (UL or SUL).

pucch-Config SetupRelease { PUCCH-Config } OPTIONAL, -- Need M

-- PUSCH configuration for one BWP of the regular UL or SUL of a serving cell. If the UE is configured with SUL and

-- if it has a PUSCH-Config for both UL and SUL, a carrier indicator field in DCI indicates for which of the two to use an UL grant.

-- See also L1 parameter 'dynamicPUSCHSUL' (see 38.213, section FFS\_Section)

pusch-Config SetupRelease { PUSCH-Config } OPTIONAL, -- Need M

-- A Configured-Grant of typ1 or type2. It may be configured for Ul or SUL but in case of type1 [FFS also type2] not for both at a time.

configuredGrantConfig SetupRelease { ConfiguredGrantConfig } OPTIONAL, -- Need M

-- Uplink sounding reference signal configuration

srs-Config SetupRelease { SRS-Config } OPTIONAL, -- Need M

-- Determines how the UE performs Beam Failure Recovery upon detection of a Beam Failure (see RadioLinkMonitoringConfig)

beamFailureRecoveryConfig SetupRelease { BeamFailureRecoveryConfig } OPTIONAL, -- Need M

...

}

BWP-Downlink ::= SEQUENCE {

-- An identifier for this bandwidth part. Other parts of the RRC configuration use the BWP-Id to associate themselves with a particular

-- bandwidth part. The BWP ID=0 is always associated with the initial BWP and may hence not be used here. (in other bandwidth parts).

-- The NW may trigger the UE to swtich UL or DL BWP using a DCI field. The four code points in that DCI field map to the RRC-configured

-- BWP-ID as follows: For up to 3 configured BWPs (in addition to the initial BWP) the DCI code point is equivalent to the BWP ID

-- (initial = 0, first dedicated = 1, ...). If the NW configures 4 dedicated bandwidth parts, they are identified by DCI code

-- points 0 to 3. In this case it is not possible to switch to the initial BWP using the DCI field.

-- Corresponds to L1 parameter 'DL-BWP-index'. (see 38.211, 38.213, section 12)

bwp-Id BWP-Id,

bwp-Common BWP-DownlinkCommon OPTIONAL, -- Need M

bwp-Dedicated BWP-DownlinkDedicated OPTIONAL, -- Need M

...

}

BWP-DownlinkCommon ::= SEQUENCE {

genericParameters BWP,

pdcch-ConfigCommon SetupRelease { PDCCH-ConfigCommon } OPTIONAL, -- Need M

pdsch-ConfigCommon SetupRelease { PDSCH-ConfigCommon } OPTIONAL, -- Need M

...

}

BWP-DownlinkDedicated ::= SEQUENCE {

pdcch-Config SetupRelease { PDCCH-Config } OPTIONAL, -- Need M

pdsch-Config SetupRelease { PDSCH-Config } OPTIONAL, -- Need M

sps-Config SetupRelease { SPS-Config } OPTIONAL, -- Need M

radioLinkMonitoringConfig SetupRelease { RadioLinkMonitoringConfig } OPTIONAL, -- Need M

...

}

-- TAG-BANDWIDTH-PART-STOP

-- ASN1STOP

#### – *BWP-Id*

The IE *BWP-Id* is used to refer to Bandwidth Parts (BWP). The initial BWP is referred to by BWP-Id 0. The other BWPs are referred to by BWP-Id 1 to *maxNrofBWPs*.

*BWP-Id* information element

-- ASN1START

-- TAG-BWP-ID-START

BWP-Id ::= INTEGER (0..maxNrofBWPs)

-- TAG-BWP-ID-STOP

-- ASN1STOP

#### *– BeamFailureRecoveryConfig*

The BeamFailureRecoveryConfig IE is used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection. See also 38.321, section 5.1.1.

*BeamFailureRecoveryConfig* information element

-- ASN1START

-- TAG-BEAM-FAILURE-RECOVERY-CONFIG-START

BeamFailureRecoveryConfig ::= SEQUENCE {

rootSequenceIndex-BFR INTEGER (0..137) OPTIONAL, -- Need M

-- Configuration of contention free random access occasions for BFR

rach-ConfigBFR RACH-ConfigGeneric OPTIONAL, -- Need M

-- L1-RSRP threshold used for determining whether a candidate beam may be used by the UE to attempt contention free

-- Random Access to recover from beam failure. The signalled threshold is applied directly for SSB, a threshold for

-- CSI-RS is determined by linearly scaling singalled value based on Pc\_ss corresponding to the CSI-RS resource.

-- (see FFS\_Specification, FFS\_Section)

candidateBeamThreshold RSRP-Range OPTIONAL, -- Need M

-- A list of reference signals (CSI-RS and/or SSB) identifying the candidate beams for recover and the associated RA parameters

candidateBeamRSList SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR OPTIONAL, -- Need M

-- Explicitly signalled PRACH Mask Index for RA Resource selection in TS 36.321. The mask is valid for all SSB resources

ra-ssb-OccasionMaskIndex INTEGER (0..15) OPTIONAL, -- Need M

-- Control Resource Set that the UE uses to receive the random access response for beam failure recovery.

-- If the field is absent the UE uses the initial CORESET (ControlResourceSetId = 0)

recoveryControlResourceSetId ControlResourceSetId OPTIONAL , -- Need S

-- Search space to use for BFR RAR. If the field is absent, the UE uses the initial Serach Space (SearchSpaceId = 0).

recoverySearchSpaceId SearchSpaceId OPTIONAL, -- Need S

...

}

PRACH-ResourceDedicatedBFR ::= CHOICE {

ssb BFR-SSB-Resource,

csi-RS BFR-CSIRS-Resource

}

BFR-SSB-Resource ::= SEQUENCE {

-- The ID of an SSB transmitted by this serving cell. It determines a candidate beam for beam failure recovery (BFR)

ssb SSB-Index,

-- The preamble index that the UE shall use when performing BFR upon selecting the candidate beams identified by this SSB.

ra-PreambleIndex INTEGER (0..63),

...

}

BFR-CSIRS-Resource ::= SEQUENCE {

-- The ID of a NZP-CSI-RS-Resource configured in the CSI-MeasConfig of this serving cell. This reference signal determines a candidate beam

-- for beam failure recovery (BFR).

csi-RS NZP-CSI-RS-ResourceId,

-- RA occasions that the UE shall use when performing BFR upon selecting the candidate beam identified by this CSI-RS. If the field is absent

-- the UE uses the RA occasion associated with the SSB that is QCLed with this CSI-RS.

-- The RA preamble index to use in the RA occasions associated with this CSI-RS. If the field is absent, the UE uses the preamble index

-- associated with the SSB that is QCLed with this CSI-RS.

ra-PreambleIndex INTEGER (0..63) OPTIONAL, -- Need R

...

}

-- TAG-BEAM-FAILURE-RECOVERY-CONFIG-STOP

-- ASN1STOP

#### – *CellGroupConfig*

The *CellGroupConfig* IE is used to configure a master cell group (MCG) or secondary cell group (SCG). A cell group comprises of one MAC entity, a set of logical channels with associated RLC entities and of a primary cell (SpCell) and one or more secondary cells (SCells).

*CellGroupConfig* information element

-- ASN1START

-- TAG-CELL-GROUP-CONFIG-START

-- Configuration of one Cell-Group:

CellGroupConfig ::= SEQUENCE {

cellGroupId CellGroupId,

-- Logical Channel configuration and association with radio bearers:

rlc-BearerToAddModList SEQUENCE (SIZE(1..maxLC-ID)) OF RLC-Bearer-Config OPTIONAL, -- Need N

rlc-BearerToReleaseList SEQUENCE (SIZE(1..maxLC-ID)) OF LogicalChannelIdentity OPTIONAL, -- Need N

-- Parameters applicable for the entire cell group:

mac-CellGroupConfig MAC-CellGroupConfig OPTIONAL, -- Need M

physicalCellGroupConfig PhysicalCellGroupConfig OPTIONAL, -- Need M

-- Serving Cell specific parameters (SpCell and SCells)

spCellConfig SpCellConfig OPTIONAL, -- Need M

sCellToAddModList SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellConfig OPTIONAL, -- Need N

-- List of seconary serving cells to be released (not applicable for SpCells)

sCellToReleaseList SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellIndex OPTIONAL, -- Need N

...

}

-- The ID of a cell group. 0 identifies the master cell group. Other values identify secondary cell groups.

-- In this version of the specification only values 0 and 1 are supported.

-- FFS: This should be moved to be own IE section

CellGroupId ::= INTEGER (0.. maxSecondaryCellGroups)

RLC-Bearer-Config ::= SEQUENCE {

-- ID used commonly for the MAC logical channel and for the RLC bearer.

logicalChannelIdentity LogicalChannelIdentity,

-- Associates the RLC Bearer with an SRB or a DRB. The UE shall deliver DL RLC SDUs received via the RLC entity of this

-- RLC bearer to the PDCP entity of the servedRadioBearer. Furthermore, the UE shall advertise and deliver uplink PDCP PDUs of the

-- uplink PDCP entity of the servedRadioBearer to the uplink RLC entity of this RLC bearer unless the uplink scheduling

-- restrictions ('moreThanOneRLC' in PDCP-Config and the restrictions in LogicalChannelConfig) forbid it to do so.

servedRadioBearer CHOICE {

srb-Identity SRB-Identity,

drb-Identity DRB-Identity

} OPTIONAL, -- Cond LCH-SetupOnly

reestablishRLC ENUMERATED {true} OPTIONAL, -- Need N

rlc-Config RLC-Config OPTIONAL, -- Cond LCH-Setup

mac-LogicalChannelConfig LogicalChannelConfig OPTIONAL, -- Cond LCH-Setup

...

}

LogicalChannelIdentity ::= INTEGER (1..maxLC-ID)

-- Cell-Group specific L1 parameters

PhysicalCellGroupConfig ::= SEQUENCE {

-- Enables spatial bundling of HARQ ACKs. It is configured per cell group (i.e. for all the cells within the cell group) for PUCCH

-- reporting of HARQ-ACK. It is only applicable when more than 4 layers are possible to schedule.

-- Corresponds to L1 parameter 'HARQ-ACK-spatial-bundling' (see 38.213, section FFS\_Section)

-- Absence indicates that spatial bundling is disabled.

harq-ACK-SpatialBundlingPUCCH ENUMERATED {true} OPTIONAL, -- Need R

-- Enables spatial bundling of HARQ ACKs. It is configured per cell group (i.e. for all the cells within the cell group) for PUSCH

-- reporting of HARQ-ACK. It is only applicable when more than 4 layers are possible to schedule.

-- Corresponds to L1 parameter 'HARQ-ACK-spatial-bundling' (see 38.213, section FFS\_Section)

-- Absence indicates that spatial bundling is disabled.

harq-ACK-SpatialBundlingPUSCH ENUMERATED {true} OPTIONAL, -- Need R

-- The maximum transmit power to be used by the UE in this NR cell group.

p-NR P-Max OPTIONAL, -- Need R

-- The PDSCH HARQ-ACK codebook is either semi-static of dynamic. This is applicable to both CA and none CA operation.

-- Corresponds to L1 parameter 'HARQ-ACK-codebook' (see 38.213, section FFS\_Section)

pdsch-HARQ-ACK-Codebook ENUMERATED {semiStatic, dynamic},

-- RNTI used for SRS TPC commands on DCI. Corresponds to L1 parameter 'TPC-SRS-RNTI' (see 38.213, section 10)

tpc-SRS-RNTI RNTI-Value OPTIONAL, -- Need R

-- RNTI used for PUCCH TPC commands on DCI. Corresponds to L1 parameter 'TPC-PUCCH-RNTI' (see 38.213, section 10).

tpc-PUCCH-RNTI RNTI-Value OPTIONAL, -- Need R

-- RNTI used for PUSCH TPC commands on DCI. Corresponds to L1 parameter 'TPC-PUSCH-RNTI' (see 38.213, section 10)

tpc-PUSCH-RNTI RNTI-Value OPTIONAL,-- Need R

...

}

-- Serving cell specific MAC and PHY parameters for a SpCell:

SpCellConfig ::= SEQUENCE {

-- Serving cell ID of a PSCell (the PCell of the Master Cell Group uses ID = 0)

servCellIndex ServCellIndex OPTIONAL, -- Cond SCG

-- Parameters for the synchronous reconfiguration to the target SpCell:

reconfigurationWithSync ReconfigurationWithSync OPTIONAL, -- Cond ReconfWithSync

rlf-TimersAndConstants SetupRelease { RLF-TimersAndConstants } OPTIONAL, -- Need M

rlmInSyncOutOfSyncThreshold INTEGER (0..1) OPTIONAL, -- Need M

spCellConfigDedicated ServingCellConfig OPTIONAL, -- Need M

...

}

ReconfigurationWithSync ::= SEQUENCE {

spCellConfigCommon ServingCellConfigCommon OPTIONAL, -- Need M

newUE-Identity RNTI-Value,

t304 ENUMERATED {ms50, ms100, ms150, ms200, ms500, ms1000, ms2000, ms10000},

rach-ConfigDedicated CHOICE {

uplink RACH-ConfigDedicated,

supplementaryUplink RACH-ConfigDedicated

} OPTIONAL, -- Need N

...

}

SCellConfig ::= SEQUENCE {

sCellIndex SCellIndex,

sCellConfigCommon ServingCellConfigCommon OPTIONAL, -- Cond SCellAdd

sCellConfigDedicated ServingCellConfig OPTIONAL, -- Cond SCellAddMod

...

}

-- TAG-CELL-GROUP-CONFIG-STOP

-- ASN1STOP

|  |
| --- |
| *CellGroupConfig* field descriptions |
| ***logicalChannelIdentity***  The logical channel identity for both UL and DL. |
| ***rlmInSyncOutOfSyncThreshold***  BLER threshold pair index for IS/OOS indication generation (TS 38.133). Whenever this is reconfigured, UE resets on-going RLF timers and counter. |

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *LCH-SetupOnly* | The field is mandatory present if the corresponding LCH is being set up; otherwise it is not present. |
| *LCH-Setup* | The field is mandatory present if the corresponding LCH is being set up for DRB; otherwise it is optionally present, need M. |
| *ReconfWithSync* | The field is mandatory present in case of SpCell change and security key change; otherwise it is optionally present, need M. |
| *SCellAdd* | The field is optionally present, need M, upon SCell addition; otherwise it is not present |
| *SCellAddMod* | The field is mandatory present upon SCell addition; otherwise it is optionally present, need M. |

#### – *CodebookConfig*

The IE *CodebookConfig* is used to configure codebooks of Type-I and Type-II (see 38.214, section 5.2.2.2)

*CodebookConfig* information element

-- ASN1START

-- TAG-CODEBOOKCONFIG-START

CodebookConfig ::= SEQUENCE {

-- CodebookType including possibly sub-types and the corresponding parameters for each. Corresponds to L1 parameter 'CodebookType'

-- (see 38.214, section 5.2.2.2)

codebookType CHOICE {

type1 SEQUENCE {

subType CHOICE {

typeI-SinglePanel SEQUENCE {

nrOfAntennaPorts CHOICE {

two SEQUENCE {

-- Codebook subset restriction for 2TX codebook

-- Corresponds to L1 parameter ' TypeI-SinglePanel-2Tx-CodebookSubsetRestriction' (see 38.214 section 5.2.2.2.1)

twoTX-CodebookSubsetRestriction BIT STRING (SIZE (6))

},

moreThanTwo SEQUENCE {

-- Number of antenna ports in first (n1) and second (n2) dimension and codebook subset restriction

-- Corresponds to L1 parameters 'CodebookConfig-N1', 'CodebookConfig-N2'

-- 'TypeI-SinglePanel-CodebookSubsetRestriction ' (see 38.214 section 5.2.2.2.1)

n1-n2 CHOICE {

two-one-TypeI-SinglePanel-Restriction BIT STRING (SIZE (8)),

two-two-TypeI-SinglePanel-Restriction BIT STRING (SIZE (64)),

four-one-TypeI-SinglePanel-Restriction BIT STRING (SIZE (16)),

three-two-TypeI-SinglePanel-Restriction BIT STRING (SIZE (96)),

six-one-TypeI-SinglePanel-Restriction BIT STRING (SIZE (24)),

four-two-TypeI-SinglePanel-Restriction BIT STRING (SIZE (128)),

eight-one-TypeI-SinglePanel-Restriction BIT STRING (SIZE (32)),

four-three-TypeI-SinglePanel-Restriction BIT STRING (SIZE (192)),

six-two-TypeI-SinglePanel-Restriction BIT STRING (SIZE (192)),

twelve-one-TypeI-SinglePanel-Restriction BIT STRING (SIZE (48)),

four-four-TypeI-SinglePanel-Restriction BIT STRING (SIZE (256)),

eight-two-TypeI-SinglePanel-Restriction BIT STRING (SIZE (256)),

sixteen-one-TypeI-SinglePanel-Restriction BIT STRING (SIZE (64))

},

-- i2 codebook subset restriction for Type I Single-panel codebook used when reportQuantity is CRI/Ri/i1/CQI

-- Corresponds to L1 parameter 'TypeI-SinglePanel-CodebookSubsetRestriction-i2' (see 38.214 section 5.2.2.2.1)

typeI-SinglePanel-codebookSubsetRestriction-i2 BIT STRING (SIZE (16)) OPTIONAL

}

},

-- Restriction for RI for TypeI-SinglePanel-RI-Restriction

-- Corresponds to L1 parameter 'TypeI-SinglePanel-RI-Restriction' (see 38.214, section 5.2.2.2.1)

typeI-SinglePanel-ri-Restriction BIT STRING (SIZE (8))

},

typeI-MultiPanel SEQUENCE {

-- Codebook subset restriction for Type I Multi-panel codebook

-- Corresponds to L1 parameter 'TypeI-MultiPanel-CodebookSubsetRestriction' (see 38.214, section 5.2.2.2.2)

ng-n1-n2 CHOICE {

two-two-one-TypeI-MultiPanel-Restriction BIT STRING (SIZE (8)),

two-four-one-TypeI-MultiPanel-Restriction BIT STRING (SIZE (32)),

four-two-one-TypeI-MultiPanel-Restriction BIT STRING (SIZE (32)),

two-two-two-TypeI-MultiPanel-Restriction BIT STRING (SIZE (128)),

two-eight-one-TypeI-MultiPanel-Restriction BIT STRING (SIZE (64)),

four-four-one-TypeI-MultiPanel-Restriction BIT STRING (SIZE (64)),

two-four-two-TypeI-MultiPanel-Restriction BIT STRING (SIZE (256)),

four-two-two-TypeI-MultiPanel-Restriction BIT STRING (SIZE (256))

},

-- Restriction for RI for TypeI-MultiPanel-RI-Restriction

-- Corresponds to L1 parameter 'TypeI-MultiPanel-RI-Restriction' (see 38.214, section 5.2.2.2.2)

ri-Restriction BIT STRING (SIZE (4))

}

},

-- CodebookMode as specified in 38.214 section 5.2.2.2.2

codebookMode INTEGER (1..2)

},

type2 SEQUENCE {

subType CHOICE {

typeII SEQUENCE {

-- Number of antenna ports in first (n1) and second (n2) dimension and codebook subset restriction

-- Corresponds to L1 parameters 'CodebookConfig-N1', 'CodebookConfig-N2'

-- The CHOICE name indicates the value of n1 and n2, the CHOICE contents is the codebook subset restriction bitmap

-- Corresponds to L1 parameter ' TypeII-CodebookSubsetRestriction' (see 38.214 section 5.2.2.2.3)

-- Number of bits for codebook subset restriction is ceil(log2(nchoosek(O1\*O2,4)))+8\*n1\*n2 where nchoosek(a,b) = a!/(b!(a-b)!)

n1-n2-codebookSubsetRestriction CHOICE {

two-one BIT STRING (SIZE (16)),

two-two BIT STRING (SIZE (139)),

four-one BIT STRING (SIZE (32)),

three-two BIT STRING (SIZE (59)),

six-one BIT STRING (SIZE (49)),

four-two BIT STRING (SIZE (75)),

eight-one BIT STRING (SIZE (65)),

four-three BIT STRING (SIZE (107)),

six-two BIT STRING (SIZE (107)),

twelve-one BIT STRING (SIZE (129)),

four-four BIT STRING (SIZE (139)),

eight-two BIT STRING (SIZE (139)),

sixteen-one BIT STRING (SIZE (129))

},

-- Restriction for RI for TypeII-RI-Restriction

-- Corresponds to L1 parameter 'TypeII-RI-Restriction' (see 38.214, section 5.2.2.2.3)

typeII-RI-Restriction BIT STRING (SIZE (2))

},

typeII-PortSelection SEQUENCE {

-- The size of the port selection codebook (parameter d)

portSelectionSamplingSize ENUMERATED {n1, n2, n3, n4} OPTIONAL, -- Cond TypeII-PortSelection

-- Restriction for RI for TypeII-PortSelection-RI-Restriction

-- Corresponds to L1 parameter 'TypeII-PortSelection-RI-Restriction' (see 38.214, section 5.2.2.4)

typeII-PortSelectionRI-Restriction BIT STRING (SIZE (2))

}

},

-- The size of the PSK alphabet, QPSK or 8-PSK

phaseAlphabetSize ENUMERATED {n4, n8},

-- If subband amplitude reporting is activated (true)

subbandAmplitude BOOLEAN,

-- Number of beams, L, used for linear combination

numberOfBeams ENUMERATED {two, three, four}

}

}

}

-- TAG-CODEBOOKCONFIG-STOP

-- ASN1STOP

#### – *ConfiguredGrantConfig*

The IE *ConfiguredGrantConfig* is used to configure uplink transmission without dynamic grant according to two possible schemes. The actual uplink grant may either be configured via RRC (type1) or provided via the PDCCH (addressed to CS-RNTI) (type2).

*ConfiguredGrantConfig* information element

-- ASN1START

-- TAG-CONFIGUREDGRANTCONFIG-START

ConfiguredGrantConfig ::= SEQUENCE {

-- Frequency hopping as agreed in RAN1-AH18776

frequencyHopping ENUMERATED {mode1, mode2},

-- DMRS configuration, as agreed in RAN1-AH18776

cg-DMRS-Configuration DMRS-UplinkConfig,

-- Indicates the MCS table the UE shall use for PUSCH without transform precoding, as agreed in RAN1-AH18776

mcs-Table ENUMERATED {qam64, qam256},

-- Indicates the MCS table the UE shall use for PUSCH with transform precoding, as agreed in RAN1-AH18776

-- When the field is absent the UE applies the value 64QAM

mcs-TableTransformPrecoder ENUMERATED {qam256} OPTIONAL, -- Need S

-- Selection between and configuration of dynamic and semi-static beta-offset, as agreed in RAN1-AH18776

-- Note: For Type 1 UL data transmission without grant, "uci-on-PUSCH" should be set to semiStatic

uci-OnPUSCH SetupRelease { CG-UCI-OnPUSCH },

-- Configuration of resource allocation type 0 and resource allocation type 1, as agreed in RAN1-AH18776

-- Note: For Type 1 UL data transmission without grant, "resourceAllocation" should be resourceAllocationType0 or resourceAllocationType1

resourceAllocation ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch },

-- Selection between config 1 and config 2 for RBG size for PUSCH. When the field is absent the UE applies the value config1.

-- Note: rbg-Size is used when the transformPrecoder parameter is disabled.

rbg-Size ENUMERATED {config2} OPTIONAL, -- Need S

-- Closed control loop to apply. Corresponds to L1 parameter 'PUSCH-closed-loop-index' (see 38.213, section FFS\_Section)

powerControlLoopToUse ENUMERATED {n0, n1},

-- Index of the P0-PUSCH-AlphaSet to be used for this configuration

p0-PUSCH-Alpha P0-PUSCH-AlphaSetId,

-- Enable transformer precoder for type1 and type2. Absence indicates that it is disabled.

-- Corresponds to L1 parameter 'UL-TWG-tp' (see 38.214, section 6.1.3)

transformPrecoder ENUMERATED {enabled} OPTIONAL, -- Need R

-- The number of HARQ processes configured. It applies for both Type 1 and Type 2

-- Corresponds to L1 parameter 'UL-TWG-numbHARQproc' (see 38.321, section 5.8.2)

nrofHARQ-Processes INTEGER(1..16),

-- The number or repetitions of K:

repK ENUMERATED {n1, n2, n4, n8},

-- If repetitions is used, this field indicates the redundancy version (RV) sequence to use.

-- Corresponds to L1 parameter 'UL-TWG-RV-rep' (see 38.321, section 5.8.2)

repK-RV ENUMERATED {s1-0231, s2-0303, s3-0000} OPTIONAL, -- Cond RepK

-- Periodicity for UL transmission without UL grant for type 1 and type 2

-- Corresponds to L1 parameter 'UL-TWG-periodicity' (see 38.321, section 5.8.2)

-- The following periodicities are supported depending on the configured subcarrier spacing [symbols]:

-- 15kHz: 2, 7, n\*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 320, 640}

-- 30kHz: 2, 7, n\*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 640, 1280}

-- 60kHz with normal CP: 2, 7, n\*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1280, 2560}

-- 60kHz with ECP: 2, 6, n\*12, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1280, 2560}

-- 120kHz: 2, 7, n\*14, where n={1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1024, 1280, 2560, 5120}

-- (see 38.214, Table 6.1.2.3-1)

periodicity ENUMERATED {

sym2, sym7, sym1x14, sym2x14, sym4x14, sym5x14, sym8x14, sym10x14, sym16x14, sym20x14,

sym32x14, sym40x14, sym64x14, sym80x14, sym128x14, sym160x14, sym256x14, sym320x14, sym512x14,

sym640x14, sym1024x14, sym1280x14, sym2560x14, sym5120x14,

sym6, sym1x12, sym2x12, sym4x12, sym5x12, sym8x12, sym10x12, sym16x12, sym20x12, sym32x12,

sym40x12, sym64x12, sym80x12, sym128x12, sym160x12, sym256x12, sym320x12, sym512x12, sym640x12,

sym1280x12, sym2560x12

},

-- If configured, the UE uses the configured grant timer (see 38.321, section 5.8.2) with this initial timer value.

-- Supported values are as follows in units of symbols:

-- For normal CP: 2, 7, {1, 2, 4, 5, 8, 10, 20, 32, 40, 64, 80, 128, 160, 256, 512, 640 } x 14

-- For extended CP: 2, 6, {1, 2, 4, 8, 20, 40, 80, 128, 160, 256, 320, 512, 640 } x 12

configuredGrantTimer ENUMERATED {

sym2, sym7, sym1x14, sym2x14, sym4x14, sym5x14, sym8x14, sym10x14, sym16x14, sym20x14, sym32x14,

sym40x14, sym64x14, sym80x14, sym128x14, sym160x14, sym256x14, sym512x14, sym640x14,

sym6, sym1x12, sym2x12, sym4x12, sym5x12, sym8x12, sym10x12, sym16x12, sym20x12, sym32x12,

sym40x12, sym64x12, sym80x12, sym128x12, sym256x12, sym320x12, sym512x12, sym640x12

} OPTIONAL, -- Need R

-- Selection between "configured grant" transmission with fully RRC-configured UL grant (Type1)

-- or with UL grant configured by DCI addressed to CS-RNTI (Type2).

rrc-ConfiguredUplinkGrant SEQUENCE {

-- Offset related to SFN=0

timeDomainOffset INTEGER (0..5119),

-- Corresponding to the DCI field of time domain resource assignment, and the maximum bit width is 4.

--(see 38.214, section 6.1.2 and 38.212, section 7.3.1)

timeDomainAllocation INTEGER (0..15), -- RAN1 indicated just "Mapping-type,Index-start-len"

-- Corresponding to the DCI field of freq domain resource assignment.

-- (see 38.214, section 6.1.2, and 38.212, section 7.3.1)

frequencyDomainAllocation BIT STRING (SIZE(18)),

-- UE-specific DMRS configuration: corresponding to the DCI field of antenna ports, and the maximum bitwidth is 5.

-- (see 38.214, section 6.1.2, and 38.212, section 7.3.1)

antennaPort INTEGER (0..31),

dmrs-SeqInitialization INTEGER (0..1) OPTIONAL, -- Cond NoTransformPrecoder

precodingAndNumberOfLayers INTEGER (0..63),

srs-ResourceIndicator INTEGER (0..15),

-- The modulation order, target code rate and TB size (see 38.214, section 6.1.2)

mcsAndTBS INTEGER (0..31),

-- Enables intra-slot frequency hopping with the given frequency hopping offset

-- Corresponds to L1 parameter 'UL-TWG-hopping' (see 38.214, section FFS\_Section)

frequencyHoppingOffset INTEGER (1.. maxNrofPhysicalResourceBlocks-1),

pathlossReferenceIndex INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1),

...

} OPTIONAL -- Cond Type1

}

CG-UCI-OnPUSCH ::= CHOICE {

dynamic SEQUENCE (SIZE (1..4)) OF BetaOffsets,

semiStatic BetaOffsets

}

-- TAG-CONFIGUREDGRANTCONFIG-STOP

-- ASN1STOP

| *ConfiguredGrantConfig*field descriptions |
| --- |
| ***configuredGrantTimer***  If configured, the UE uses the configured grant timer (see 38.321, section 5.8.2) with this initial timer value. |
| ***frequencyHopping***  Controls frequency hopping for transmission with configured grant. |
| ***nrofHARQ-Processes***  The number of HARQ processes configured. It applies for both Type 1 and Type 2 |
| ***p0-PUSCH-Alpha***  Index of the P0-PUSCH-AlphaSet to be used for this configuration |
| ***periodicity***  Periodicity for UL transmission without UL grant for type 1 and type 2 |
| ***powerControlLoopToUse***  Closed control loop to apply. Corresponds to L1 parameter 'PUSCH-closed-loop-index' (see 38.213, section FFS\_Section) |
| ***rbg-Size***  Selection between config 1 and config 2 for RBG size for PUSCH. When the field is absent the UE applies the value config1. |
| ***repK***  The number or repetitions of K. |
| ***repK-RV***  If repetitions is used, this field indicates the redundancy version (RV) sequence to use. |
| ***resourceAllocation***  Configuration of resource allocation type 0 and resource allocation type 1. For Type 1 UL data transmission without grant, “resourceAllocation” should be resourceAllocationType0 or resourceAllocationType1. |
| ***rrc-ConfiguredUplinkGrant***  Configuration for "configured grant" transmission with fully RRC-configured UL grant (Type1).  NOTE: Type 1 confgured grant may be configured for UL or SUL, but not for both simultaneously. |
| ***transformPrecoder***  Enable transformer precoder for type1 and type2. Absence indicates that it is disabled. |

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| RepK | The field is mandatory present if *repK* is set to *n2, n4,*or *n8*. It is not present if *repK* is set to *n1*. |

#### – *ControlResourceSet*

The IE *ControlResourceSet* is used to configure a time/frequency control resource set (CORESET) in which to search for downlink control information (see 38.213, section FFS\_Section).

*ControlResourceSet* information element

-- ASN1START

-- TAG-CONTROLRESOURCESET-START

ControlResourceSet ::= SEQUENCE {

-- Corresponds to L1 parameter 'CORESET-ID'

-- Value 0 identifies the common CORESET configured in MIB and in ServingCellConfigCommon

-- Values 1..maxNrofControlResourceSets-1 identify CORESETs configured by dedicated signalling

-- The controlResourceSetId is unique among the BWPs of a ServingCell.

controlResourceSetId ControlResourceSetId,

-- Frequency domain resources for the CORESET. Each bit corresponds a group of 6 RBs, with grouping starting from PRB 0, which is fully

-- contained in the bandwidth part within which the CORESET is configured.

-- The most significant bit corresponds to the group of lowest frequency which is fully contained in the bandwidth part within which the

-- CORESET is configured, each next subsequent lower significance bit corresponds to the next lowest frequency group fully contained within

-- the bandwidth part within which the CORESET is configured, if any.

-- Bits corresponding to a group not fully contained within the bandwidth part within which the CORESET is configured are set to zero.

-- Corresponds to L1 parameter 'CORESET-freq-dom'(see 38.211, section 7.3.2.2)

frequencyDomainResources BIT STRING (SIZE (45)),

-- Contiguous time duration of the CORESET in number of symbols

-- Corresponds to L1 parameter 'CORESET-time-duration' (see 38.211, section 7.3.2.2FFS\_Section)

duration INTEGER (1..maxCoReSetDuration),

-- Mapping of Control Channel Elements (CCE) to Resource Element Groups (REG).

-- Corresponds to L1 parameter 'CORESET-CCE-REG-mapping-type' (see 38.211Section sections 7.3.2.2 and 7.4.1.3.2)

cce-REG-MappingType CHOICE {

interleaved SEQUENCE {

-- Resource Element Groups (REGs) can be bundled to create REG bundles. This parameter defines the size of such bundles.

-- Corresponds to L1 parameter 'CORESET-REG-bundle-size' (see 38.211, section FFS\_Section)

reg-BundleSize ENUMERATED {n2, n3, n6},

-- Corresponds to L1 parameter 'CORESET-interleaver-size' (see 38.211, 38.213, section FFS\_Section)

interleaverSize ENUMERATED {n2, n3, n6},

-- Corresponds to L1 parameter 'CORESET-shift-index' (see 38.211, section 7.3.2.2)

shiftIndex INTEGER(0..maxNrofPhysicalResourceBlocks-1)

},

nonInterleaved NULL

},

-- Precoder granularity in frequency domain.

-- Corresponds to L1 parameter 'CORESET-precoder-granuality' (see 38.211, sections 7.3.2.2 and 7.4.1.3.2)

precoderGranularity ENUMERATED {sameAsREG-bundle, allContiguousRBs},

-- A subset of the TCI states defined in TCI-States used for providing QCL relationships between the DL RS(s) in one RS Set

-- (TCI-State) and the PDCCH DMRS ports. Corresponds to L1 parameter 'TCI-StatesPDCCH' (see 38.214, section FFS\_Section)

tci-StatesPDCCH SEQUENCE(SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId OPTIONAL, -- Need R

-- If at least spatial QCL is configured/indicated, this field indicates if TCI field is present or not present in DL-related DCI.

-- When the field is absent the UE considers the TCI to be absent/disabled.

-- Corresponds to L1 parameter 'TCI-PresentInDCI' (see 38,213, section 5.1.5)

tci-PresentInDCI ENUMERATED {enabled} OPTIONAL, -- Need S

-- PDCCH DMRS scrambling initalization. Corresponds to L1 parameter 'PDCCH-DMRS-Scrambling-ID' (see 38.214, section 5.1)

-- When the field is absent the UE applies the value '0'.

pdcch-DMRS-ScramblingID BIT STRING (SIZE (16)) OPTIONAL -- Need S

}

-- TAG-CONTROLRESOURCESET-STOP

-- ASN1STOP

#### – *ControlResourceSetId*

The *ControlResourceSetId* IE concerns a short identity, used to identify a control resource set within a serving cell. The *ControlResourceSetId* = 0 identifies the ControlResourceSet configured via PBCH (MIB) and in ServingCellConfigCommon. The ID space is used across the BWPs of a Serving Cell. The number of CORESETs per BWP is limited to 3 (including the initial CORESET).

*ControlResourceSetId* information element

-- ASN1START

-- TAG-CONTROL-RESOURCE-SET-ID-START

ControlResourceSetId ::= INTEGER (0..maxNrofControlResourceSets-1)

-- TAG-CONTROL-RESOURCE-SET-ID-STOP

-- ASN1STOP

#### – *CrossCarrierSchedulingConfig*

The IE *CrossCarrierSchedulingConfig* is used to specify the configuration when the cross-carrier scheduling is used in a cell.

*CrossCarrierSchedulingConfig* information elements

-- ASN1START

CrossCarrierSchedulingConfig ::= SEQUENCE {

schedulingCellInfo CHOICE {

own SEQUENCE { -- No cross carrier scheduling

cif-Presence BOOLEAN

},

other SEQUENCE { -- Cross carrier scheduling

schedulingCellId ServCellIndex,

cif-InSchedulingCell INTEGER (1..7)

} -- Cond SCellOnly

},

...

}

-- ASN1STOP

| *CrossCarrierSchedulingConfig* field descriptions |
| --- |
| ***cif-Presence***  The field is used to indicate whether carrier indicator field is present (value TRUE) or not (value FALSE) in PDCCH/EPDCCH DCI formats, see TS 38.213 [REF, SECTION]. |
| ***cif-InSchedulingCell***  The field indicates the CIF value used in the scheduling cell to indicate a grant or assignment applicable for this cell, see TS 38.213 [REF, SECTION]. If *cif-Presence* is set to true, the CIF value indicating a grant or assignment for this cell is 0. |
| ***pdsch-Start***  The starting OFDM symbol of PDSCH for the concerned SCell, see TS [REF]. Values 1, 2, 3 are applicable when *dl-Bandwidth* for the concerned SCell is greater than 10 resource blocks, values 2, 3, 4 are applicable when *dl-Bandwidth* for the concerned SCell is less than or equal to 10 resource blocks, see TS [REF]. |
| ***schedulingCellId***  Indicates which cell signals the downlink allocations and uplink grants, if applicable, for the concerned SCell. In case the UE is configured with DC, the scheduling cell is part of the same cell group (i.e. MCG or SCG) as the scheduled cell. |

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *SCellOnly* | This field is optionally present, Need M, for SCells. It is absent otherwise |

#### – *CSI-AperiodicTriggerStateList*

The *CSI-AperiodicTriggerStateList* IE is used to configure the UE with a list of aperiodic trigger states. Each value from 1 to 2^*reportTriggerSize* of the DCI field "CSI request" field is associated with one trigger state. Upon reception of the value associated with a trigger state, the UE will perform measurement of aperiodic CSI-RS (reference signals) and aperiodic reporting on L1 according to all entries in the *associatedReportConfigInfoList* for that trigger state.

*CSI-AperiodicTriggerStateList* information element

-- ASN1START

-- TAG-CSI-APERIODICTRIGGERSTATELIST-START

CSI-AperiodicTriggerStateList ::= SEQUENCE (SIZE (1..maxNrOfCSI-AperiodicTriggers)) OF CSI-AperiodicTriggerState

CSI-AperiodicTriggerState ::= SEQUENCE {

associatedReportConfigInfoList SEQUENCE (SIZE(1..maxNrofReportConfigPerAperiodicTrigger)) OF CSI-AssociatedReportConfigInfo,

...

}

CSI-AssociatedReportConfigInfo ::= SEQUENCE {

-- The reportConfigId of one of the CSI-ReportConfigToAddMod configured in CSI-MeasConfig

reportConfigId CSI-ReportConfigId,

resourcesForChannel CHOICE {

nzp-CSI-RS SEQUENCE {

-- NZP-CSI-RS-ResourceSet for channel measurements. Entry number in nzp-CSI-RS-ResourceSetList in the CSI-ResourceConfig

-- indicated by resourcesForChannelMeasurement in the CSI-ReportConfig indicated by reportConfigId above

-- (1 corresponds to the first entry, 2 to thesecond entry, and so on).

resourceSet INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig),

-- List of references to TCI-States for providing the QCL source and QCL type for for each NZP-CSI-RS-Resource

-- listed in nzp-CSI-RS-Resources of the NZP-CSI-RS-ResourceSet indicated by nzp-CSI-RS-ResourcesforChannel.

-- First entry in qcl-info-forChannel corresponds to first entry in nzp-CSI-RS-Resources of that NZP-CSI-RS-ResourceSet,

-- second entry in qcl-info-forChannel corresponds to second entry in nzp-CSI-RS-Resources,

-- and so on. Corresponds to L1 parameter 'QCL-Info-aPeriodicReportingTrigger' (see 38.214, section 5.2.1.5.1)

qcl-info SEQUENCE (SIZE(1..maxNrofAP-CSI-RS-ResourcesPerSet)) OF TCI-StateId

},

-- CSI-SSB-ResourceSet for channel measurements. Entry number in csi-SSB-ResourceSetList in the CSI-ResourceConfig indicated by

-- resourcesForChannelMeasurement in the CSI-ReportConfig indicated by reportConfigId above (1 corresponds to the first entry, 2 to

-- the second entry, and so on).

csi-SSB-ResourceSet INTEGER (1..maxNrofCSI-SSB-ResourceSetsPerConfig)

},

-- CSI-IM-ResourceSet for interference measurement. Entry number in csi-IM-ResourceSetList in the CSI-ResourceConfig indicated by

-- csi-IM-ResourcesForInterference in the CSI-ReportConfig indicated by reportConfigId above (1 corresponds to the first entry, 2 to the second

-- entry, and so on).

-- The indicated CSI-IM-ResourceSet should have exactly the same number of resources like the NZP-CSI-RS-ResourceSet indicated in

-- nzp-CSI-RS-ResourcesforChannel.

-- This field can only be present if the CSI-ReportConfig identified by reportConfigId includes csi-IM-ResourcesForInterference.

csi-IM-ResourcesforInteference INTEGER(1..maxNrofCSI-IM-ResourceSetsPerConfig) OPTIONAL, --Cond CSI-IM-forInterference

-- NZP-CSI-RS-ResourceSet for interference measurement. Entry number in nzp-CSI-RS-ResourceSetList in the CSI-ResourceConfig indicated by

-- nzp-CSI-RS-ResourcesForInterference in the CSI-ReportConfig indicated by reportConfigId above (1 corresponds to the first entry,

-- 2 to the second entry, and so on).

-- The indicated NZP-CSI-RS-ResourceSet should have exactly the same number of resources like the NZP-CSI-RS-ResourceSet indicated in

-- nzp-CSI-RS-ResourcesforChannel.

-- This field can only be present if the CSI-ReportConfig identified by reportConfigId includes nzp-CSI-RS-ResourcesForInterference.

nzp-CSI-RS-ResourcesforInterference INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig) OPTIONAL, --Cond LinkedNZP-CSI-RS-forInterference

...

}

-- TAG-CSI-APERIODICTRIGGERSTATELIST-STOP

-- ASN1STOP

#### – *CSI-FrequencyOccupation*

The IE *CSI-FrequencyOccupation* is used to configure the frequency domain occupation of a channel state information measurement resource (e.g. *NZP-CSI-RS-Resource*, *CSI-IM-Resource*).

*CSI-FrequencyOccupation* information element

-- ASN1START

-- TAG-CSI-FREQUENCYOCCUPATION-START

CSI-FrequencyOccupation ::= SEQUENCE {

-- PRB where this CSI resource starts in relation to PRB 0 of the associated BWP.

-- Only multiples of 4 are allowed (0, 4, ...)

startingRB INTEGER (0..maxNrofPhysicalResourceBlocks-1),

-- Number of PRBs across which this CSI resource spans. Only multiples of 4 are allowed. The smallest configurable

-- number is the minimum of 24 and the width of the associated BWP.

nrofRBs INTEGER (24..maxNrofPhysicalResourceBlocks),

...

}

-- TAG-CSI-FREQUENCYOCCUPATION-STOP

-- ASN1STOP

#### – *CSI-IM-Resource*

The IE *CSI-IM-Resource* is used to configure one CSI Interference Management (IM) resource.

*CSI-IM-Resource* information element

-- ASN1START

-- TAG-CSI-IM-RESOURCE-START

CSI-IM-Resource ::= SEQUENCE {

csi-IM-ResourceId CSI-IM-ResourceId,

-- The resource element pattern (Pattern0 (2,2) or Pattern1 (4,1)) with corresponding parameters.

-- Corresponds to L1 parameter 'CSI-IM-RE-pattern' (see 38.214, section 5.2.2.3.4)

csi-IM-ResourceElementPattern CHOICE {

pattern0 SEQUENCE {

-- OFDM subcarrier occupancy of the CSI-IM resource for Pattern0

-- Corresponds to L1 parameter 'CSI-IM-ResourceMapping' (see 38.214, section 5.2.2.3.4)

subcarrierLocation-p0 ENUMERATED { s0, s2, s4, s6, s8, s10 },

-- OFDM symbol location of the CSI-IM resource for Pattern0

-- Corresponds to L1 parameter 'CSI-IM-ResourceMapping' (see 38.214, section 5.2.2.3.4)

symbolLocation-p0 INTEGER (0..12)

},

pattern1 SEQUENCE {

-- OFDM subcarrier occupancy of the CSI-IM resource for Pattern1

-- Corresponds to L1 parameter 'CSI-IM-ResourceMapping' (see 38.214, section 5.2.2.3.4)

subcarrierLocation-p1 ENUMERATED { s0, s4, s8 },

-- OFDM symbol location of the CSI-IM resource for Pattern1

-- Corresponds to L1 parameter 'CSI-IM-ResourceMapping' (see 38.214, section 5.2.2.3.4)

symbolLocation-p1 INTEGER (0..13)

}

} OPTIONAL, --Need M

-- Frequency-occupancy of CSI-IM. Corresponds to L1 parameter 'CSI-IM-FreqBand' (see 38.214, section 5.2.2.3.2)

freqBand CSI-FrequencyOccupation OPTIONAL, -- Need M

-- Periodicity and slot offset for periodic/semi-persistent CSI-IM. Corresponds to L1 parameter 'CSI-IM-timeConfig'

periodicityAndOffset CSI-ResourcePeriodicityAndOffset OPTIONAL, --Cond PeriodicOrSemiPersistent

...

}

-- TAG-CSI-IM-RESOURCE-STOP

-- ASN1STOP

#### – *CSI-IM-ResourceId*

The IE *CSI-IM-ResourceId* is used to identify one *CSI-IM-Resource*.

*CSI-IM-ResourceId* information element

-- ASN1START

-- TAG-CSI-IM-RESOURCEID-START

CSI-IM-ResourceId ::= INTEGER (0..maxNrofCSI-IM-Resources-1)

-- TAG-CSI-IM-RESOURCEID-STOP

-- ASN1STOP

#### – *CSI-IM-ResourceSet*

The IE *CSI-IM-ResourceSet* is used to configure a set of one or more CSI Interference Management (IM) resources (their IDs) and set-specific parameters.

*CSI-IM-ResourceSet* information element

-- ASN1START

-- TAG-CSI-IM-RESOURCESET-START

CSI-IM-ResourceSet ::= SEQUENCE {

csi-IM-ResourceSetId CSI-IM-ResourceSetId,

-- CSI-IM-Resources associated with this CSI-IM-ResourceSet

-- Corresponds to L1 parameter 'CSI-IM-ResourceConfigList' (see 38.214, section 5.2)

csi-IM-Resources SEQUENCE (SIZE(1..maxNrofCSI-IM-ResourcesPerSet)) OF CSI-IM-ResourceId,

...

}

-- TAG-CSI-IM-RESOURCESET-STOP

-- ASN1STOP

#### – *CSI-IM-ResourceSetId*

The IE *CSI-IM-ResourceSetId* is used to identify *CSI-IM-ResourceSet*s.

*CSI-IM-ResourceSetId* information element

-- ASN1START

-- TAG-CSI-IM-RESOURCESETID-START

CSI-IM-ResourceSetId ::= INTEGER (0..maxNrofCSI-IM-ResourceSets-1)

-- TAG-CSI-IM-RESOURCESETID-STOP

-- ASN1STOP

#### – *CSI-MeasConfig*

The *CSI-MeasConfig* IE is used to configure CSI-RS (reference signals) belonging to the serving cell in which *CSI-MeasConfig* is included and channel state information reports to be transmitted on L1 (PUCCH, PUSCH) on the serving cell in which *CSI-MeasConfig* is included. See also 38.214, section 5.2.

*CSI-MeasConfig* information element

-- ASN1START

-- TAG-CSI-MEAS-CONFIG-START

CSI-MeasConfig ::= SEQUENCE {

-- Pool of NZP-CSI-RS-Resource which can be referred to from NZP-CSI-RS-ResourceSet

nzp-CSI-RS-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-Resource OPTIONAL, -- Need N

nzp-CSI-RS-ResourceToReleaseList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-ResourceId OPTIONAL, -- Need N

-- Pool of NZP-CSI-RS-ResourceSet which can be referred to from CSI-ResourceConfig or from MAC CEs

nzp-CSI-RS-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSet OPTIONAL, -- Need N

nzp-CSI-RS-ResourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSetId OPTIONAL, -- Need N

-- Pool of CSI-IM-Resource which can be referred to from CSI-IM-ResourceSet

csi-IM-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-Resource OPTIONAL, -- Need N

csi-IM-ResourceToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-ResourceId OPTIONAL, -- Need N

-- Pool of CSI-IM-ResourceSet which can be referred to from CSI-ResourceConfig or from MAC CEs

csi-IM-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSet OPTIONAL, -- Need N

csi-IM-ResourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSetId OPTIONAL, -- Need N

-- Pool of CSI-SSB-ResourceSet which can be referred to from CSI-ResourceConfig

csi-SSB-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSet OPTIONAL, -- Need N

csi-SSB-ResourceSetToAddReleaseList SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSetId OPTIONAL, -- Need N

-- Configured CSI resource settings as specified in TS 38.214 section 5.2.1.2

csi-ResourceConfigToAddModList SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfig OPTIONAL, -- Need N

csi-ResourceConfigToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfigId OPTIONAL, -- Need N

-- Configured CSI report settings as specified in TS 38.214 section 5.2.1.1

csi-ReportConfigToAddModList SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfig OPTIONAL, -- Need N

csi-ReportConfigToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfigId OPTIONAL, -- Need N

-- Size of CSI request field in DCI (bits). Corresponds to L1 parameter 'ReportTriggerSize' (see 38.214, section 5.2)

reportTriggerSize INTEGER (0..6) OPTIONAL,

-- Contains trigger states for dynamically selecting one or more aperiodic and semi-persistent reporting configurations

-- and/or triggering one or more aperiodic CSI-RS resource sets for channel and/or interference measurement.

-- FFS: How to address the MAC-CE configuration

aperiodicTriggerStateList SetupRelease { CSI-AperiodicTriggerStateList } OPTIONAL, -- Need M

semiPersistentOnPUSCH-TriggerStateList SetupRelease { CSI-SemiPersistentOnPUSCH-TriggerStateList } OPTIONAL, -- Need M

...

}

maxNrofNZP-CSI-RS-ResourceSets INTEGER ::= 64

maxNrofNZP-CSI-RS-ResourceSets-1 INTEGER ::= 63

maxNrofCSI-SSB-ResourceSets INTEGER ::= 64

maxNrofCSI-SSB-ResourceSets-1 INTEGER ::= 63

maxNrofCSI-IM-ResourceSets INTEGER ::= 64

maxNrofCSI-IM-ResourceSets-1 INTEGER ::= 63

-- TAG-CSI-MEAS-CONFIG-STOP

-- ASN1STOP

#### – *CSI-ReportConfig*

The IE *CSI-ReportConfig* is used to configure reports sent on L1 (e.g. PUCCH) on the cell in which the *CSI-ReportConfig* is included.

*CSI-ReportConfig* information element

-- ASN1START

-- TAG-CSI-REPORTCONFIG-START

-- Configuration of a CSI-Report sent on L1 (e.g. PUCCH) (see 38.214, section 5.2.1)

CSI-ReportConfig ::= SEQUENCE {

reportConfigId CSI-ReportConfigId,

-- Indicates in which serving cell the CSI-ResourceConfigToAddMod(s) below are to be found.

-- If the field is absent, the resources are on the same serving cell as this report configuration.

carrier ServCellIndex OPTIONAL, -- Need S

-- Resources for channel measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell

-- indicated with the field "carrier" above. This CSI-ReportConfig is associated with the DL BWP indicated by bwp-Id in that CSI-ResourceConfig.

resourcesForChannelMeasurement CSI-ResourceConfigId,

-- CSI IM resources for interference measurement. csi-ResourceConfigId of a CSI-ResourceConfig included in the configuration of the serving cell

-- indicated with the field "carrier" above. The bwp-Id in that CSI-ResourceConfigToAddMod is the same value like the bwp-Id in the

-- CSI-ResourceConfig indicated by resourcesForChannelMeasurement.

csi-IM-ResourcesForInterference CSI-ResourceConfigId OPTIONAL, -- Need R

-- NZP CSI RS resources for interference measurement. csi-ResourceConfigId of a CSI-ResourceConfigToAddMod included in the configuration of the

-- serving cell indicated with the field "carrier" above. The bwp-Id in that CSI-ResourceConfigToAddMod is the same value like the bwp-Id in the

-- CSI-ResourceConfigToAddMod indicated by resourcesForChannelMeasurement.

nzp-CSI-RS-ResourcesForInterference CSI-ResourceConfigId OPTIONAL, -- Need R

-- Time domain behavior of reporting configuration

reportConfigType CHOICE {

periodic SEQUENCE {

-- Periodicity and slot offset. Corresponds to L1 parameter 'ReportPeriodicity'and 'ReportSlotOffset'

-- (see 38.214, section section 5.2.1.4).

reportSlotConfig CSI-ReportPeriodicityAndOffset,

-- Indicates which PUCCH resource to use for reporting on PUCCH.

pucch-CSI-ResourceList SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource

},

semiPersistentOnPUCCH SEQUENCE {

-- Periodicity and slot offset. Corresponds to L1 parameter 'ReportPeriodicity' and 'ReportSlotOffset'

-- (see 38.214, section section 5.2.1.4).

reportSlotConfig CSI-ReportPeriodicityAndOffset,

-- Indicates which PUCCH resource to use for reporting on PUCCH.

pucch-CSI-ResourceList SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource

},

semiPersistentOnPUSCH SEQUENCE {

-- Periodicity. Corresponds to L1 parameter 'Reportperiodicity-spCSI'. (see 38.214, section 5.2.1.1?FFS\_Section)

reportSlotConfig ENUMERATED {sl5, sl10, sl20, sl40, sl80, sl160, sl320},

-- Timing offset Y for aperiodic reporting using PUSCH. This field lists the allowed offset values.

-- A particular value is indicated in DCI. The first report is transmitted in slot n+Y, second report in n+Y+P,

-- where P is the configured periodicity.

reportSlotOffsetList SEQUENCE (SIZE (1..4)) OF INTEGER (0..7),

-- RNTI for SP CSI-RNTI, Corresponds to L1 parameter 'SPCSI-RNTI' (see 38.214, section 5.2.1.5.2)

-- FFS: RAN1 models different RNTIs as different Search Spaces with independent configurations. Align the configuration

-- of this one (e.g. group with monitoring periodicity, PDCCH candidate configuration, DCI-Payload size...)?

csi-RNTI RNTI-Value,

-- Index of the p0-alpha set determining the power control for this CSI report transmission.

-- Corresponds to L1 parameter 'SPCSI-p0alpha' (see 38.214, section FFS\_Section)

p0alpha P0-PUSCH-AlphaSetId

},

aperiodic SEQUENCE {

-- Timing offset Y for aperiodic reporting using PUSCH. This field lists the allowed offset values. A particular value is indicated in DCI.

-- (see 38.214, section 5.2.3)

-- FFS\_Value: Range wasn’t final in RAN1 table.

-- FFS\_FIXME: How are the DCI codepoints mapped to the allowed offsets?

reportSlotOffsetList SEQUENCE (SIZE (1..16)) OF INTEGER (0..7)

}

},

-- The CSI related quanities to report. Corresponds to L1 parameter 'ReportQuantity' (see 38.214, section REF)

reportQuantity CHOICE {

none NULL,

cri-RI-PMI-CQI NULL,

cri-RI-i1 NULL,

cri-RI-i1-CQI SEQUENCE {

-- PRB bundling size to assume for CQI calcuation when reportQuantity is CRI/RI/i1/CQI

-- Corresponds to L1 parameter 'PDSCH-bundle-size-for-CSI' (see 38.214, section 5.2.1.4)

pdsch-BundleSizeForCSI ENUMERATED {n2, n4} OPTIONAL

},

cri-RI-CQI NULL,

cri-RSRP NULL,

ssb-Index-RSRP NULL,

cri-RI-LI-PMI-CQI NULL

},

-- Reporting configuration in the frequency domain. (see 38.214, section 5.2.1.4)

reportFreqConfiguration SEQUENCE {

-- Indicates whether the UE shall report a single (wideband) or multiple (subband) CQI. (see 38.214, section 5.2.1.4)

cqi-FormatIndicator ENUMERATED { widebandCQI, subbandCQI },

-- Indicates whether the UE shall report a single (wideband) or multiple (subband) PMI. (see 38.214, section 5.2.1.4)

pmi-FormatIndicator ENUMERATED { widebandPMI, subbandPMI },

-- Indicates a contiguous or non-contigous subset of subbands in the bandwidth part which CSI shall be reported

-- for. Each bit in the bit-string represents one subband. The right-most bit in the bit string represents the

-- lowest subband in the BWP. (see 38.214, section 5.2.1.4)

-- The number of subbands is determined according to 38.214 section 5.2.1.4. It is absent if there are less than 24 PRBs (no sub band)

-- and present otherwise, the number of sub bands can be from 3 (24 PRBs, sub band size 8) to 18 (72 PRBs, sub band size 4).

csi-ReportingBand CHOICE {

subbands3 BIT STRING(SIZE(3)),

subbands4 BIT STRING(SIZE(4)),

subbands5 BIT STRING(SIZE(5)),

subbands6 BIT STRING(SIZE(6)),

subbands7 BIT STRING(SIZE(7)),

subbands8 BIT STRING(SIZE(8)),

subbands9 BIT STRING(SIZE(9)),

subbands10 BIT STRING(SIZE(10)),

subbands11 BIT STRING(SIZE(11)),

subbands12 BIT STRING(SIZE(12)),

subbands13 BIT STRING(SIZE(13)),

subbands14 BIT STRING(SIZE(14)),

subbands15 BIT STRING(SIZE(15)),

subbands16 BIT STRING(SIZE(16)),

subbands17 BIT STRING(SIZE(17)),

subbands18 BIT STRING(SIZE(18)),

...

} OPTIONAL -- Need S

},

-- Time domain measurement restriction for the channel (signal) measurements.

-- Corresponds to L1 parameter 'MeasRestrictionConfig-time-channel' (see 38.214, section 5.2.1.1)

timeRestrictionForChannelMeasurements ENUMERATED {configured, notConfigured},

-- Time domain measurement restriction for interference measurements.

-- Corresponds to L1 parameter 'MeasRestrictionConfig-time-interference' (see 38.214, section 5.2.1.1)

timeRestrictionForInterferenceMeasurements ENUMERATED {configured, notConfigured},

-- Codebook configuration for Type-1 or Type-II including codebook subset restriction

codebookConfig CodebookConfig,

-- Maximum number of CQIs per CSI report (cf. 1 for 1-CW, 2 for 2-CW)

nrofCQIsPerReport ENUMERATED {n1, n2},

-- Turning on/off group beam based reporting (see 38.214, section 5.2.1.4)

groupBasedBeamReporting CHOICE {

enabled NULL,

disabled SEQUENCE {

-- The number (N) of measured RS resources to be reported per report setting in a non-group-based report.

-- N <= N\_max, where N\_max is either 2 or 4 depending on UE capability.

-- FFS: The signaling mechanism for the gNB to select a subset of N beams for the UE to measure and report.

-- FFS: Note: this parameter may not be needed for certain resource and/or report settings

-- FFS\_ASN1: Change groupBasedBeamReporting into a CHOICE and include this field into the "no" option?

-- (see 38.214, section FFS\_Section)

-- When the field is absent the UE applies the value 1

nrofReportedRS ENUMERATED {n1, n2, n3, n4} OPTIONAL -- Need S

}

},

-- Which CQI table to use for CQI calculation. Corresponds to L1 parameter 'CQI-table' (see 38.214, section 5.2.2.1)

cqi-Table ENUMERATED {table1, table2, spare2, spare1} OPTIONAL,

-- Indicates one out of two possible BWP-dependent values for the subband size as indicated in 38.214 table 5.2.1.4-2

-- Corresponds to L1 parameter 'SubbandSize' (see 38.214, section 5.2.1.4)

subbandSize ENUMERATED {value1, value2},

-- BLER target that the UE shall be assume in its CQI calculation.

-- Corresponds to L1 parameter 'BLER-Target' (see 38.214, section 5.2.2.1)

-- FFS\_Values (now filled with spares)

bler-Target ENUMERATED {zerodot1, spare3, space2, spare1} OPTIONAL,

-- Port indication for RI/CQI calculation. For each CSI-RS resource in the linked ResourceConfig for channel measurement,

-- a port indication for each rank R, indicating which R ports to use. Applicable only for non-PMI feedback.

-- Corresponds to L1 parameter 'Non-PMI-PortIndication' (see 38.214, section FFS\_Section)

-- The first entry in non-PMI-PortIndication corresponds to the NZP-CSI-RS-Resource indicated by the first entry in

-- nzp-CSI-RS-Resources in the NZP-CSI-RS-ResourceSet indicated in the first entry of nzp-CSI-RS-ResourceSetList of the

-- CSI-ResourceConfig whose CSI-ResourceConfigId is indicated in a CSI-MeasId together with the above CSI-ReportConfigId,

-- the second entry in non-PMI-PortIndication corresponds to the NZP-CSI-RS-Resource indicated by the second entry in

-- nzp-CSI-RS-Resources in the NZP-CSI-RS-ResourceSet indicated in the first entry of nzp-CSI-RS-ResourceSetList of the

-- same CSI-ResourceConfig, and so on until the NZP-CSI-RS-Resource indicated by the last entry in nzp-CSI-RS-Resources

-- in the in the NZP-CSI-RS-ResourceSet indicated in the first entry of nzp-CSI-RS-ResourceSetList of the

-- same CSI-ResourceConfig, then the next entry corresponds to the NZP-CSI-RS-Resource indicated by the first entry

-- in nzp-CSI-RS-Resources in the NZP-CSI-RS-ResourceSet indicated in the second entry of nzp-CSI-RS-ResourceSetList of the

-- same CSI-ResourceConfig and so on.

non-PMI-PortIndication SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerConfig)) OF PortIndexFor8Ranks OPTIONAL, ...

}

CSI-ReportPeriodicityAndOffset ::= CHOICE {

slots4 INTEGER(0..3),

slots5 INTEGER(0..4),

slots8 INTEGER(0..7),

slots10 INTEGER(0..9),

slots16 INTEGER(0..15),

slots20 INTEGER(0..19),

slots40 INTEGER(0..39),

slots80 INTEGER(0..79),

slots160 INTEGER(0..159),

slots320 INTEGER(0..319)

}

PUCCH-CSI-Resource ::= CHOICE {

uplinkBandwidthPartId BWP-Id,

-- PUCCH resource for the associated uplink BWP. Only PUCCH-Resource of format 2, 3 and 4 is supported.

pucch-Resource PUCCH-Resource

}

-- The PortIndexFor8Ranks allows to indicate port indexes for 1 to 8 ranks using a port index ranges from 0 to 31, or from 0 to 15, or from 0

-- to 7, or from 0 to 3, or from 0 to 1, or with 0 only.

PortIndexFor8Ranks ::= CHOICE {

portIndex8 SEQUENCE{

rank1-8 PortIndex8,

rank2-8 SEQUENCE(SIZE(1..2)) OF PortIndex8,

rank3-8 SEQUENCE(SIZE(1..3)) OF PortIndex8,

rank4-8 SEQUENCE(SIZE(1..4)) OF PortIndex8,

rank5-8 SEQUENCE(SIZE(1..5)) OF PortIndex8,

rank6-8 SEQUENCE(SIZE(1..6)) OF PortIndex8,

rank7-8 SEQUENCE(SIZE(1..7)) OF PortIndex8,

rank8-8 SEQUENCE(SIZE(1..8)) OF PortIndex8

},

portIndex4 SEQUENCE{

rank1-4 PortIndex4,

rank2-4 SEQUENCE(SIZE(1..2)) OF PortIndex4,

rank3-4 SEQUENCE(SIZE(1..3)) OF PortIndex4,

rank4-4 SEQUENCE(SIZE(1..4)) OF PortIndex4

},

portIndex2 SEQUENCE{

rank1-2 PortIndex2,

rank2-2 SEQUENCE(SIZE(1..2)) OF PortIndex2

},

portIndex1 NULL

}

PortIndex8::= INTEGER (0..7)

PortIndex4::= INTEGER (0..3)

PortIndex2::= INTEGER (0..1)

maxNrofNZP-CSI-RS-ResourcesPerConfig INTEGER ::= 128

-- TAG-CSI-REPORTCONFIG-STOP

-- ASN1STOP

#### – *CSI-ReportConfigId*

The IE *CSI-ReportConfigId* is used to identify one *CSI-ReportConfig*.

*CSI-ReportConfigId* information element

-- ASN1START

-- TAG-CSI-REPORTCONFIGID-START

CSI-ReportConfigId ::= INTEGER (0..maxNrofCSI-ReportConfigurations-1)

-- TAG-CSI-REPORTCONFIGID-STOP

-- ASN1STOP

#### – *CSI-ResourceConfig*

The IE *CSI-ResourceConfig* refers to one or more *NZP-CSI-RS-ResourceSet*, *CSI-IM-ResourceSet* and/or *CSI-SSB-ResourceSet*.

*CSI-ResourceConfig* information element

-- ASN1START

-- TAG-CSI-RESOURCECONFIG-START

-- One CSI resource configuration comprising of one or more resource sets

CSI-ResourceConfig ::= SEQUENCE {

-- Used in CSI-ReportConfig to refer to an instance of CSI-ResourceConfig

csi-ResourceConfigId CSI-ResourceConfigId,

-- Contains up to maxNrofNZP-CSI-RS-ResourceSetsPerConfig resource sets if ResourceConfigType is 'aperiodic' and 1 otherwise.

-- Corresponds to L1 parameter 'ResourceSetConfigList' (see 38.214, section 5.2.1.3.1)

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 OPTIONAL,

-- List of SSB resources used for beam measurement and reporting in a resource set

-- Corresponds to L1 parameter 'resource-config-SS-list' (see 38,214, section FFS\_Section)

csi-SSB-ResourceSetList SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSetsPerConfig)) OF CSI-SSB-ResourceSetId OPTIONAL

},

csi-IM-ResourceSetList SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSetsPerConfig)) OF CSI-IM-ResourceSetId

},

-- The DL BWP which the CSI-RS associated with this CSI-ResourceConfig are located in.

-- Corresponds to L1 parameter 'BWP-Info' (see 38.214, section 5.2.1.2

bwp-Id BWP-Id,

-- Time domain behavior of resource configuration. Corresponds to L1 parameter 'ResourceConfigType' (see 38.214, section 5.2.2.3.5)

resourceType ENUMERATED { aperiodic, semiPersistent, periodic },

...

}

-- TAG-CSI-RESOURCECONFIGTOADDMOD-STOP

-- ASN1STOP

#### – *CSI-ResourceConfigId*

The IE *CSI-ResourceConfigId* is used to identify a CSI-ResourceConfig.

*CSI-ResourceConfigId* information element

-- ASN1START

-- TAG-CSI-RESOURCECONFIGID-START

CSI-ResourceConfigId ::= INTEGER (0..maxNrofCSI-ResourceConfigurations-1)

-- TAG-CSI-RESOURCECONFIGID-STOP

-- ASN1STOP

#### – *CSI-ResourcePeriodicityAndOffset*

The IE *CSI-ResourcePeriodicityAndOffset* is used to configure a periodicity and a corresponding offset for periodic and semi-persistent CSI resources, and for periodic and semi-persistent reporting on PUCCH. both, the periodicity and the offset are given in number of slots. The periodicity value slots4 corresponds to 4 slots, slots5 corresponds to 5 slots, and so on.

*CSI-ResourcePeriodicityAndOffset* information element

-- ASN1START

-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-START

CSI-ResourcePeriodicityAndOffset ::= CHOICE {

slots4 INTEGER (0..3),

slots5 INTEGER (0..4),

slots8 INTEGER (0..7),

slots10 INTEGER (0..9),

slots16 INTEGER (0..15),

slots20 INTEGER (0..19),

slots32 INTEGER (0..31),

slots40 INTEGER (0..39),

slots64 INTEGER (0..63),

slots80 INTEGER (0..79),

slots160 INTEGER (0..159),

slots320 INTEGER (0..319),

slots640 INTEGER (0..639)

}

-- TAG-CSI-RESIYRCEPERIODICITYANDOFFSET-STOP

-- ASN1STOP

#### – *CSI-RS-ResourceMapping*

The IE *CSI-RS-ResourceMapping* is used to configure the resource element mapping of a CSI-RS resource in time- and frequency domain.

*CSI-RS-ResourceMapping* information element

-- ASN1START

-- TAG-CSI-RS-RESOURCEMAPPING-START

CSI-RS-ResourceMapping ::= SEQUENCE {

-- Frequency domain allocation within a physical resource block in accordance with 38.211, section 7.4.1.5.3 including table 7.4.1.5.2-1.

-- The number of bits that may be set to one depend on the chosen row in that table. For the choice "other", the row can be determined from

-- the parmeters below and from the number of bits set to 1 in frequencyDomainAllocation.

frequencyDomainAllocation CHOICE {

row1 BIT STRING (SIZE (4)),

row2 BIT STRING (SIZE (12)),

row4 BIT STRING (SIZE (3)),

other BIT STRING (SIZE (6))

},

-- Number of ports (see 38.214, section 5.2.2.3.1)

nrofPorts ENUMERATED {p1,p2,p4,p8,p12,p16,p24,p32},

-- Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS.

-- Parameter l0 in 38.211, section 7.4.1.5.3. Value 2 is supported only when DL-DMRS-typeA-pos equals 3.

firstOFDMSymbolInTimeDomain INTEGER (0..13),

-- Time domain allocation within a physical resource block. Parameter l1 in 38.211, section 7.4.1.5.3.

firstOFDMSymbolInTimeDomain2 INTEGER (0..13) OPTIONAL, -- Need R

-- CDM type (see 38.214, section 5.2.2.3.1)

cdm-Type ENUMERATED {noCDM, fd-CDM2, cdm4-FD2-TD2, cdm8-FD2-TD4},

-- Density of CSI-RS resource measured in RE/port/PRB. Corresponds to L1 parameter 'CSI-RS-Density' (see 38.211, section 7.4.1.5.3)

-- Values 0.5 (dot5), 1 (one) and 3 (three) are allowed for X=1,

-- values 0.5 (dot5) and 1 (one) are allowed for X=2, 16, 24 and 32,

-- value 1 (one) is allowed for X=4, 8, 12.

-- For density = 1/2, includes 1 bit indication for RB level comb offset indicating whether odd or even RBs are occupied by CSI-RS

density CHOICE {

dot5 ENUMERATED {evenPRBs, oddPRBs},

one NULL,

three NULL,

spare NULL

},

-- Wideband or partial band CSI-RS. Corresponds to L1 parameter 'CSI-RS-FreqBand' (see 38.214, section 5.2.2.3.1)

freqBand CSI-FrequencyOccupation,

...

}

-- TAG-CSI-RS-RESOURCEMAPPING-STOP

-- ASN1STOP

#### – *CSI-SemiPersistentOnPUSCH-TriggerStateList*

The *CSI-SemiPersistentOnPUSCH-TriggerStateList* IE is used to configure the UE with list of trigger states for semi-persistent reporting of channel state information on L1. . See also 38.214, section 5.2.

*CSI-SemiPersistentOnPUSCH-TriggerStateList* information element

-- ASN1START

-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-START

CSI-SemiPersistentOnPUSCH-TriggerStateList ::= SEQUENCE(SIZE (1..maxNrOfSemiPersistentPUSCH-Triggers)) OF CSI-SemiPersistentOnPUSCH-TriggerState

CSI-SemiPersistentOnPUSCH-TriggerState ::= SEQUENCE {

associatedReportConfigInfo CSI-ReportConfigId,

...

}

maxNrOfSemiPersistentPUSCH-Triggers INTEGER ::= 64 -- Maximum number of triggers for semi persistent reporting on PUSCH

-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-STOP

-- ASN1STOP

#### – *CSI-SSB-ResourceSetId*

The IE *CSI-SSB-ResourceSetId* is used to identify one SS/PBCH block resource set.

*CSI-SSB-ResourceId* information element

-- ASN1START

-- TAG-CSI-SSB-RESOURCESETID-START

CSI-SSB-ResourceSetId ::= INTEGER (0..maxNrofCSI-SSB-ResourceSets-1)

-- TAG-CSI-SSB-RESOURCESETID-STOP

-- ASN1STOP

#### – *CSI-SSB-ResourceSet*

The IE *CSI-SSB-ResourceSet* is used to configure one SS/PBCH block resource set which refers to SS/PBCH as indicated in *ServingCellConfigCommon*.

*CSI-SSB-ResourceSet* information element

-- ASN1START

-- TAG-CSI-SSB-RESOURCESET-START

CSI-SSB-ResourceSet ::= SEQUENCE {

csi-SSB-ResourceSetId CSI-SSB-ResourceSetId,

csi-SSB-ResourceList SEQUENCE (SIZE(1..maxNrofCSI-SSB-ResourcePerSet)) OF SSB-Index,

...

}

-- TAG-CSI-SSB-RESOURCESET-STOP

-- ASN1STOP

#### – *DMRS-DownlinkConfig*

The IE *DMRS-DownlinkConfig* is used to configure downlink demodulation reference signals for PDSCH.

*DMRS-DownlinkConfig* information element

-- ASN1START

-- TAG-DMRS-DOWNLINKCONFIG-START

DMRS-DownlinkConfig ::= SEQUENCE {

-- Selection of the DMRS type to be used for DL (see 38.211, section 7.4.1.1.1).

-- If the field is absent, the UE uses DMRS type 1.

dmrs-Type ENUMERATED {type2} OPTIONAL, -- Need R

-- Position for additional DM-RS in DL, see Table 7.4.1.1.2-4 in 38.211.

-- The four values represent the cases of 1+0, 1+1, 1+1+1. 1+1+1+1 non-adjacent OFDM symbols for DL.

-- If the field is absent, the UE applies the value pos2.

dmrs-AdditionalPosition ENUMERATED {pos0, pos1, pos3} OPTIONAL, -- Need R

-- DM-RS groups that are QCL:ed, i.e. group 1 (see 38.214, section 5.1)

dmrs-group1 BIT STRING (SIZE (12)) OPTIONAL, -- Need R

-- DM-RS groups that are QCL:ed, i.e. group 2 (see 38.214, section 5.1)

dmrs-group2 BIT STRING (SIZE (12)) OPTIONAL, -- Need R

-- The maximum number of OFDM symbols for DL front loaded DMRS. 'len1' corresponds to value 1. 'len2 corresponds to value 2.

-- If the field is absent, the UE applies value len1.

-- Corresponds to L1 parameter 'DL-DMRS-max-len' (see 38.214, section 5.1)

maxLength ENUMERATED {len2} OPTIONAL, -- Need R

-- DL DMRS scrambling initalization

-- Corresponds to L1 parameter 'n\_SCID 0' (see 38.211, section 7.4.1)

-- When the field is absent the UE applies the value Physical cell ID (physCellId) configured for this serving cell."

scramblingID0 INTEGER (0..65535) OPTIONAL, -- Need S

-- DL DMRS scrambling initalization. Corresponds to L1 parameter 'n\_SCID 1' (see 38.211, section 7.4.1)

-- When the field is absent the UE applies the value (physCellId) configured for this serving cell.

scramblingID1 INTEGER (0..65535) OPTIONAL, -- Need S

-- Configures downlink PTRS. If absent of released, the UE assumes that downlink PTRS are not present. See 38.214 section 5.1.6.3

phaseTrackingRS SetupRelease { PTRS-DownlinkConfig } OPTIONAL, -- Need M

...

}

-- TAG-DMRS-DOWNLINKCONFIG-STOP

-- ASN1STOP

#### – *DMRS-UplinkConfig*

The IE *DMRS-UplinkConfig* is used to configure FFS

*DMRS-UplinkConfig* information element

-- ASN1START

-- TAG-DMRS-UPLINKCONFIG-START

DMRS-UplinkConfig ::= SEQUENCE {

-- Selection of the DMRS type to be used for UL (see section 38.211, section 6.4.1.1.3)

-- If the field is absent, the UE uses DMRS type 1.

dmrs-Type ENUMERATED {type2} OPTIONAL, -- Need R

-- Position for additional DM-RS in UL. Corresponds to L1 parameter 'UL-DMRS-add-pos' (see Table 7.4.1.1.2-4 in 38.211)

-- The four values represent the cases of 1+0, 1+1, 1+1+1. 1+1+1+1 non-adjacent OFDM symbols for UL.

-- If the field is absent, the UE applies the value pos2.

dmrs-AdditionalPosition ENUMERATED {pos0, pos1, pos3} OPTIONAL, -- Need R

-- Configures uplink PTRS (see 38.211, section x.x.x.x) FFS\_Ref

phaseTrackingRS SetupRelease { PTRS-UplinkConfig } OPTIONAL, -- Need M

-- The maximum number of OFDM symbols for UL front loaded DMRS. 'len1' corresponds to value 1. 'len2 corresponds to value 2.

-- If the field is absent, the UE applies value len1.

-- Corresponds to L1 parameter 'UL-DMRS-max-len' (see 38.214, section 6.4.1.1.2)

maxLength ENUMERATED {len2} OPTIONAL, -- Need R

transformPrecoding CHOICE {

-- DMRS related parameters for Cyclic Prefix OFDM

disabled SEQUENCE {

-- UL DMRS scrambling initalization for CP-OFDM

-- Corresponds to L1 parameter 'n\_SCID 0' (see 38.214, section 6.4.1.1.2)

-- When the field is absent the UE applies the value Physical cell ID (physCellId)

scramblingID0 INTEGER (0..65535) OPTIONAL, -- Need S

-- UL DMRS scrambling initalization for CP-OFDM.

-- Corresponds to L1 parameter 'n\_SCID 1' (see 38.214, section 6.4.1.1.2)

-- When the field is absent the UE applies the value Physical cell ID (physCellId)

scramblingID1 INTEGER (0..65535) OPTIONAL -- Need S

},

-- DMRS related parameters for DFT-s-OFDM (Transform Precoding)

enabled SEQUENCE {

-- Parameter: N\_ID^(PUSCH) for DFT-s-OFDM DMRS. If the value is absent or released, the UE uses the Physical cell ID.

-- Corresponds to L1 parameter 'nPUSCH-Identity-Transform precoding' (see 38.211, section FFS\_Section)

nPUSCH-Identity INTEGER(0..1007) OPTIONAL, -- Need S

-- Sequence-group hopping for PUSCH can be disabled for a certain UE despite being enabled on a cell basis. For DFT-s-OFDM DMRS

-- If the field is released, the UE considers group hopping to be enabled.

-- Corresponds to L1 parameter 'Disable-sequence-group-hopping-Transform-precoding' (see 38.211, section FFS\_Section)

disableSequenceGroupHopping ENUMERATED {disabled} OPTIONAL, -- Need S

-- Determines if sequence hopping is enabled or not. For DFT-s-OFDM DMRS.

-- If the field is released, the UE considers sequence hopping to be disabled.

-- Corresponds to L1 parameter 'Sequence-hopping-enabled-Transform-precoding' (see 38.211, section FFS\_Section)

sequenceHoppingEnabled ENUMERATED {enabled} OPTIONAL -- Need S

}

},

...

}

-- TAG-DMRS-UPLINKCONFIG-STOP

-- ASN1STOP

#### – *DownlinkPreemption*

The IE *DownlinkPreemption* is used to configure the UE to monitor PDCCH for the INT-RNTI (interruption).

*DownlinkPreemption* information element

-- ASN1START

-- TAG-DOWNLINKPREEMPTION-START

-- Configuration of downlink preemption indication on PDCCH.

DownlinkPreemption ::= SEQUENCE {

-- RNTI used for indication pre-emption in DL.

-- Corresponds to L1 parameter 'INT-RNTI', where ”INT” stands for ”interruption” (see 38.213, section 10)

int-RNTI RNTI-Value,

-- Set selection for DL-preemption indication. Corresponds to L1 parameter 'int-TF-unit' (see 38.213, section 10.1)

-- The set determines how the UE interprets the DL preemption DCI payload.

timeFrequencySet ENUMERATED {set0, set1},

-- Total length of the DCI payload scrambled with INT-RNTI. The value must be an integer multiple of 14 bit.

-- Corresponds to L1 parameter 'INT-DCI-payload-length' (see 38.213, section 11.2)

dci-PayloadSize INTEGER (0..maxINT-DCI-PayloadSize),

-- Indicates (per serving cell) the position of the 14 bit INT values inside the DCI payload.

-- Corresponds to L1 parameter 'INT-cell-to-INT' and 'cell-to-INT' (see 38.213, section 11.2)

int-ConfigurationPerServingCell SEQUENCE (SIZE (1..maxNrofServingCells)) OF INT-ConfigurationPerServingCell,

...

}

INT-ConfigurationPerServingCell ::= SEQUENCE {

servingCellId ServCellIndex,

-- Starting position (in number of bit) of the 14 bit INT value applicable for this serving cell (servingCellId) within the DCI

-- payload. Must be multiples of 14 (bit). Corresponds to L1 parameter 'INT-values' (see 38.213, section 11.2)

positionInDCI INTEGER (0..maxINT-DCI-PayloadSize-1)

}

-- TAG-DOWNLINKPREEMPTION-STOP

-- ASN1STOP

#### – *DRB-Identity*

The IE *DRB-Identity* is used to identify a DRB used by a UE.

*DRB-Identity* information elements

-- ASN1START

-- TAG-DRB-IDENTITY-START

DRB-Identity ::= INTEGER (1..32)

-- TAG-DRB-IDENTITY-STOP

-- ASN1STOP

#### – *EUTRA-MBSFN-SubframeConfigList*

The IE *EUTRA-MBSFN-SubframeConfigList* is used to define an E-UTRA MBSFN subframe pattern (for the purpose of NR rate matching).

*EUTRA-MBSFN-SubframeConfigList* information element

-- ASN1START

-- TAG-EUTRA-MBSFN-SUBFRAMECONFIGLIST-START

EUTRA-MBSFN-SubframeConfigList ::= SEQUENCE (SIZE (1..maxMBSFN-Allocations)) OF EUTRA-MBSFN-SubframeConfig

EUTRA-MBSFN-SubframeConfig ::= SEQUENCE {

-- Field as defined in MBSFN-SubframeConfig in 36.331

radioframeAllocationPeriod ENUMERATED {n1, n2, n4, n8, n16, n32},

-- Field as defined in MBSFN-SubframeConfig in 36.331

radioframeAllocationOffset INTEGER (0..7),

-- Field as defined in MBSFN-SubframeConfig in 36.331

subframeAllocation CHOICE {

-- Field as defined in MBSFN-SubframeConfig in 36.331

oneFrame BIT STRING (SIZE(6)),

-- Field as defined in MBSFN-SubframeConfig in 36.331

fourFrames BIT STRING (SIZE(24))

},

subframeAllocation-v1430 CHOICE {

-- Field as defined in MBSFN-SubframeConfig in 36.331

oneFrame-v1430 BIT STRING (SIZE(2)),

-- Field as defined in MBSFN-SubframeConfig in 36.331

fourFrames-v1430 BIT STRING (SIZE(8))

} OPTIONAL, -- Need R

...

}

-- TAG-EUTRA-MBSFN-SUBFRAMECONFIGLIST-STOP

-- ASN1STOP

#### – *FilterCoefficient*

The IE *FilterCoefficient* specifies the measurement filtering coefficient. Value *fc0* corresponds to k = 0, *fc1* corresponds to k = 1, and so on.

*FilterCoefficient* information element

-- ASN1START

FilterCoefficient ::= ENUMERATED {

fc0, fc1, fc2, fc3, fc4, fc5,

fc6, fc7, fc8, fc9, fc11, fc13,

fc15, fc17, fc19, spare1, ...}

-- ASN1STOP

Editor’s Note: Values should be checked.

#### – *FreqBandIndicatorNR*

The IE *FreqBandIndicatorNR* is used to convey an NR frequency band number as defined in 38.101.

*FreqBandIndicatorNR* information element

-- ASN1START

-- TAG-FREQBANDINDICATORNR-START

FreqBandIndicatorNR ::= INTEGER (1..1024)

-- TAG-FREQBANDINDICATORNR-STOP

-- ASN1STOP

#### – FrequencyInfoDL

The IE *FrequencyInfoDL* provides basic parameters of a downlink carrier and transmission thereon.

*FrequencyInfoDL* information element

-- ASN1START

-- TAG-FREQUENCY-INFO-DL-START

FrequencyInfoDL ::= SEQUENCE {

-- Frequency of the SSB to be used for this serving cell. The frequency provided in this field identifies the position of

-- resource element RE=#0 (subcarrier #0) of resource block RB#10 of the SS block. The cell-defining SSB of an SpCell is always on

-- the sync raster. Frequencies are considered to be on the sync raster if they are also identifiable with a GSCN value (see 38.101).

absoluteFrequencySSB ARFCN-ValueNR,

-- The frequency domain offset between SSB and the overall resource block grid in number of subcarriers.

-- Absence of the field indicates that no offset is applied (offset = 0). For FR2 only values up to 11 are applicable.

-- Corresponds to L1 parameter kssb (See 38.211, section 7.4.3.1)

ssb-SubcarrierOffset INTEGER (1..23) OPTIONAL, -- Need S

-- List of one or multiple frequency bands to which this carrier(s) belongs. Multiple values are only supported in

-- system information but not when the FrequencyInfoDL is provided in dedicated signalling (HO or S(p)Cell addition).

frequencyBandList MultiFrequencyBandListNR,

-- Absolute frequency position of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A.

-- Note that the lower edge of the actual carrier is not defined by this field but rather in the scs-SpecificCarrierList.

-- Corresponds to L1 parameter 'offset-ref-low-scs-ref-PRB' (see 38.211, section FFS\_Section)

absoluteFrequencyPointA ARFCN-ValueNR,

-- A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A.

-- Corresponds to L1 parameter 'offset-pointA-set' (see 38.211, section FFS\_Section)

scs-SpecificCarrierList SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,

...

}

-- TAG-FREQUENCY-INFO-UL-STOP

-- ASN1STOP

#### – *FrequencyInfoUL*

The IE *FrequencyInfoUL* provides basic parameters of an uplink carrier and transmission thereon.

*FrequencyInfoUL* information element

-- ASN1START

-- TAG-FREQUENCY-INFO-UL-START

FrequencyInfoUL ::= SEQUENCE {

-- List of one or multiple frequency bands to which this carrier(s) belongs. Multiple values are only supported in

-- system information but not when the FrequencyInfoDL is provided in dedicated signalling (HO or S(p)Cell addition).

frequencyBandList MultiFrequencyBandListNR OPTIONAL, -- Cond FDD-OrSUL

-- Absolute frequency of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A.

-- Corresponds to L1 parameter 'offset-ref-low-scs-ref-PRB' (see 38.211, section FFS\_Section)

absoluteFrequencyPointA ARFCN-ValueNR OPTIONAL, -- Cond FDD-OrSUL

-- A set of virtual carriers for different subcarrier spacings (numerologies). Defined in relation to Point A.

-- Note that the lower edge of the actual carrier is not defined by this field but rather in the scs-SpecificCarrierList.

-- Corresponds to L1 parameter 'offset-pointA-set' (see 38.211, section FFS\_Section)

scs-SpecificCarriers SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,

-- The additional spectrum emission requirements to be applied by the UE on this uplink.

-- If the field is absent, the UE applies the value FFS\_RAN4. (see FFS\_section, section FFS\_Section)

additionalSpectrumEmission AdditionalSpectrumEmission OPTIONAL, -- Need S

-- FFS\_Definition. Corresponds to parameter FFS\_RAN4. (see FFS\_Spec, section FFS\_Section)

-- If the field is absent, the UE applies the value FFS\_RAN4.

p-Max P-Max OPTIONAL, -- Need S

-- Enable the NR UL transmission with a 7.5KHz shift to the LTE raster. If the field is absent, the frequency shift is disabled.

frequencyShift7p5khz ENUMERATED {true} OPTIONAL, -- Cond FDD-OrSUL-Optional

...

}

-- TAG-FREQUENCY-INFO-UL-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *FDD-OrSUL* | The field is mandatory present if this FrequencyInfoUL is for the paired UL for a DL (defined in a FrequencyInfoDL) or if this FrequencyInfoUL is for a supplementary uplink (SUL). It is absent otherwise (if this FrequencyInfoUL is for an unpaired UL (TDD). |
| *FDD-OrSUL-Optional* | The field is optionally present, Need R, if this FrequencyInfoUL is for the paired UL for a DL (defined in a FrequencyInfoDL) or if this FrequencyInfoUL is for a supplementary uplink (SUL). It is absent otherwise. |

#### – *GSCN-ValueNR*

The IE *GSCN-ValueNR* is used to indicate the frequency positions of the SS/PBCH Blocks, as defined in TS 38.101 [15].

-- ASN1START

-- TAG-GSCN-VALUE-NR-START

GSCN-ValueNR ::= INTEGER (1..28557)

-- TAG-GSCN-VALUE-NR-STOP

-- ASN1STOP

#### – *Hysteresis*

The IE *Hysteresis* is a parameter used within the entry and leave condition of an event triggered reporting condition. The actual value is field value \* 0.5 dB.

*Hysteresis* information element

-- ASN1START

Hysteresis ::= INTEGER (0..30)

-- ASN1STOP

Editor’s Note: Values should be checked.

#### - *LogicalChannelConfig*

The IE *LogicalChannelConfig* is used to configure the logical channel parameters.

*LogicalChannelConfig* information element

-- ASN1START

-- TAG-LOGICAL-CHANNEL-CONFIG-START

LogicalChannelConfig ::= SEQUENCE {

ul-SpecificParameters SEQUENCE {

priority INTEGER (1..16),

prioritisedBitRate ENUMERATED {kBps0, kBps8, kBps16, kBps32, kBps64, kBps128, kBps256, kBps512,

kBps1024, kBps2048, kBps4096, kBps8192, kBps16384, kBps32768, kBps65536, infinity},

bucketSizeDuration ENUMERATED {ms50, ms100, ms150, ms300, ms500, ms1000, spare2, spare1},

allowedServingCells SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex OPTIONAL, -- Need R

allowedSCS-List SEQUENCE (SIZE (1..maxSCSs)) OF SubcarrierSpacing OPTIONAL, -- Need R

maxPUSCH-Duration ENUMERATED { ms0p02, ms0p04, ms0p0625, ms0p125, ms0p25, ms0p5, spare2, spare1 } OPTIONAL, -- Need R

configuredGrantType1Allowed ENUMERATED {true} OPTIONAL, -- Need R

logicalChannelGroup INTEGER (0..maxLCG-ID) OPTIONAL, -- Need R

schedulingRequestID SchedulingRequestId OPTIONAL, -- Need R

logicalChannelSR-Mask BOOLEAN,

logicalChannelSR-DelayTimerApplied BOOLEAN

} OPTIONAL, -- Cond UL

-- other parameters

...

}

-- TAG-LOGICAL-CHANNEL-CONFIG-STOP

-- ASN1STOP

|  |
| --- |
| *LogicalChannelConfig field descriptions* |
| ***allowedSCS-List***  If present, UL MAC SDUs from this logical channel can only be mapped to the indicated numerology. Otherwise, UL MAC SDUs from this logical channel can be mapped to any configured numerology. Corresponds to ‘allowedSCS-List’ as specified in TS 38.321 [3]. |
| ***allowedServingCells***  If present, UL MAC SDUs from this logical channel can only be mapped to the serving cells indicated in this list. Otherwise, UL MAC SDUs from this logical channel can be mapped to any configured serving cell of this cell group. Corresponds to 'allowedServingCells' in TS 38.321 [3]. |
| ***bucketSizeDuration***  Value in ms. ms50 corresponds to 50ms, ms100 corresponds to 100ms, and so on. |
| ***configuredGrantType1Allowed***  If present, UL MAC SDUs from this logical channel can be transmitted on a configured grant type 1. Corresponds to 'configuredGrantType1Allowed' in TS 38.321 [3]. |
| ***logicalChannelGroup***  ID of the logical channel group, as specified in TS 38.321 [3], which the logical channel belongs to. |
| ***logicalChannelSR-Mask***  Indicates whether SR masking is configured for this logical channel. |
| ***logicalChannelSR-DelayTimerApplied***  Indicates whether to apply the delay timer for SR transmission for this logical channel. Set to FALSE if *logicalChannelSR-DelayTimer* is not included in *BSR-Config*. |
| ***maxPUSCH-Duration***  If present, UL MAC SDUs from this logical channel can only be transmitted using uplink grants that result in a PUSCH duration shorter than or equal to the the duration indicated by this field. Otherwise, UL MAC SDUs from this logical channel can be transmitted using an uplink grant resulting in any PUSCH duration. Corresponds to "maxPUSCH-Duration' in TS 38.321 [3]. |
| ***priority***  Logical channel priority, as specified in TS 38.321 [3]. |
| ***prioritisedBitRate***  Value in kiloBytes/s. 0kBps corresponds to 0, 8kBps corresponds to 8 kiloBytes/s,16 kBps corresponds to 16 kiloBytes/s, and so on. For SRBs, the value can only be set to infinity. |
| **schedulingRequestId**  If present, it indicates the scheduling request configuration applicable for this logical channel, as specified in TS 38.321 [3]. |

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *UL* | The field is mandatory present for a logical channel with uplink if it serves DRB. It is optionally present for a logical channel with uplink if it serves an SRB. otherwise it is not present. |

#### – *MAC-CellGroupConfig*

The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX.

*MAC-CellGroupConfig* information element

-- ASN1START

-- TAG-MAC-CELL-GROUP-CONFIG-START

MAC-CellGroupConfig ::= SEQUENCE {

drx-Config SetupRelease { DRX-Config } OPTIONAL, -- Need M

schedulingRequestConfig SchedulingRequestConfig OPTIONAL, -- Need M

bsr-Config BSR-Config OPTIONAL, -- Need M

tag-Config TAG-Config OPTIONAL, -- Need M

phr-Config SetupRelease { PHR-Config } OPTIONAL, -- Need M

-- FFS : configurable per SCell?

skipUplinkTxDynamic BOOLEAN,

-- RNTI value for downlink SPS (see SPS-config) and uplink configured scheduling (see ConfiguredSchedulingConfig).

cs-RNTI SetupRelease { RNTI-Value } OPTIONAL -- Need M

}

DRX-Config ::= SEQUENCE {

drx-onDurationTimer CHOICE {

subMilliSeconds INTEGER (1..31),

milliSeconds ENUMERATED {

ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60,

ms80, ms100, ms200, ms300, ms400, ms500, ms600, ms800, ms1000, ms1200,

ms1600, spare9, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 }

},

drx-InactivityTimer ENUMERATED {

ms0, ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60, ms80,

ms100, ms200, ms300, ms500, ms750, ms1280, ms1920, ms2560, spare9, spare8,

spare7, spare6, spare5, spare4, spare3, spare2, spare1},

drx-HARQ-RTT-TimerDL INTEGER (0..56),

drx-HARQ-RTT-TimerUL INTEGER (0..56),

drx-RetransmissionTimerDL ENUMERATED {

sl0, sl1, sl2, sl4, sl6, sl8, sl16, sl24, sl33, sl40, sl64, sl80, sl96, sl112, sl128,

sl160, sl320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,

spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1},

drx-RetransmissionTimerUL ENUMERATED {

sl0, sl1, sl2, sl4, sl6, sl8, sl16, sl24, sl33, sl40, sl64, sl80, sl96, sl112, sl128,

sl160, sl320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,

spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },

drx-LongCycleStartOffset CHOICE {

ms10 INTEGER(0..9),

ms20 INTEGER(0..19),

ms32 INTEGER(0..31),

ms40 INTEGER(0..39),

ms60 INTEGER(0..59),

ms64 INTEGER(0..63),

ms70 INTEGER(0..69),

ms80 INTEGER(0..79),

ms128 INTEGER(0..127),

ms160 INTEGER(0..159),

ms256 INTEGER(0..255),

ms320 INTEGER(0..319),

ms512 INTEGER(0..511),

ms640 INTEGER(0..639),

ms1024 INTEGER(0..1023),

ms1280 INTEGER(0..1279),

ms2048 INTEGER(0..2047),

ms2560 INTEGER(0..2559),

ms5120 INTEGER(0..5119),

ms10240 INTEGER(0..10239)

},

-- FFS need for finer offset granulary

-- FFS need for shorter values for long and short cycles

shortDRX SEQUENCE {

drx-ShortCycle ENUMERATED {

ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,

ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,

spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },

drx-ShortCycleTimer INTEGER (1..16)

} OPTIONAL, -- Need R

drx-SlotOffset INTEGER (0..31)

}

PHR-Config ::= SEQUENCE {

phr-PeriodicTimer ENUMERATED {sf10, sf20, sf50, sf100, sf200,sf500, sf1000, infinity},

phr-ProhibitTimer ENUMERATED {sf0, sf10, sf20, sf50, sf100,sf200, sf500, sf1000},

phr-Tx-PowerFactorChange ENUMERATED {dB1, dB3, dB6, infinity},

multiplePHR BOOLEAN,

phr-Type2PCell BOOLEAN,

phr-Type2OtherCell BOOLEAN,

phr-ModeOtherCG ENUMERATED {real, virtual}

}

TAG-Config ::= SEQUENCE {

tag-ToReleaseList SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG-Id OPTIONAL, -- Need N

tag-ToAddModList SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG-ToAddMod OPTIONAL -- Need N

}

TAG-ToAddMod ::= SEQUENCE {

tag-Id TAG-Id,

timeAlignmentTimer TimeAlignmentTimer,

...

}

TAG-Id ::= INTEGER (0..maxNrofTAGs-1)

TimeAlignmentTimer ::= ENUMERATED {ms500, ms750, ms1280, ms1920, ms2560, ms5120, ms10240, infinity}

BSR-Config ::= SEQUENCE {

periodicBSR-Timer ENUMERATED {

sf1, sf5, sf10, sf16, sf20, sf32, sf40, sf64, sf80, sf128, sf160, sf320, sf640, sf1280, sf2560, infinity},

retxBSR-Timer ENUMERATED { sf10, sf20, sf40, sf80, sf160, sf320, sf640, sf1280, sf2560, sf5120, sf10240, spare5, spare4,

spare3, spare2, spare1},

logicalChannelSR-DelayTimer ENUMERATED { sf20, sf40, sf64, sf128, sf512, sf1024, sf2560, spare1} OPTIONAL -- Need R

}

-- TAG-MAC-CELL-GROUP-CONFIG-STOP

-- ASN1STOP

| *MAC-CellGroupConfig* field descriptions |
| --- |
| ***drx-Config***  Used to configure DRX as specified in TS 38.321 [3]. |
| ***drx-HARQ-RTT-TimerDL***  Value in number of symbols. |
| ***drx-HARQ-RTT-TimerUL***  Value in number of symbols. |
| ***drx-InactivityTimer***  Value in multiple integers of 1ms. ms0 corresponds to 0, ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on. |
| ***drx-onDurationTimer***  Value in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond). For the latter, ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on. |
| ***drx-LongCycleStartOffset***  *drx-LongCycle* in ms and *drx-StartOffset* in multiples of 1ms. |
| ***drx-RetransmissionTimerDL***  Value in number of slot lengths. sl1 corresponds to 1 slot, sl2 corresponds to 2 slots, and so on. |
| ***drx-RetransmissionTimerUL***  Value in number of slot lengths. sl1 corresponds to 1 slot, sl2 corresponds to 2 slots, and so on. |
| ***drx-ShortCycle***  Value in ms. ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on. |
| ***drx-ShortCycleTimer***  Value in multiples of *drx-ShortCycle*. A value of 1 corresponds to *drx-ShortCycle*, a value of 2 corresponds to 2 \* *drx-ShortCycle* and so on. |
| ***drx-SlotOffset***  Value in 1/32 ms. Value 0 corresponds to 0ms, value 1 corresponds to 1/32ms, value 2 corresponds to 2/32ms, and so on. |
| ***logicalChannelSR-DelayTimer***  Value in number of subframes. sf1 corresponds to one subframe, sf2 corresponds to 2 subframes, and so on. |
| ***multiplePHR***  Indicates if power headroom shall be reported using the Single Entry PHR MAC control element or Multiple Entry PHR MAC control element defined in TS 38.321 [3]. True means to use Multiple Entry PHR MAC control element and False means to use the Single Entry PHR MAC control element defined in TS 38.321 [3]. |
| ***periodicBSR-Timer***  Value in number of subframes. Value sf1 corresponds to 1 subframe, sf5 corresponds to 5 subframes and so on. |
| ***phr-Tx-PowerFactorChange***  Value in dB for PHR reporting as specified in TS 38.321 [3]. Value dB1 corresponds to 1 dB, dB3 corresponds to 3 dB and so on. The same value applies for each serving cell (although the associated functionality is performed independently for each cell). |
| ***phr-ModeOtherCG***  Indicates the mode (i.e. *real* or *virtual*) used for the PHR of the activated cells that are part of the other Cell Group (i.e. MCG or SCG), when DC is configured. |
| ***phr-PeriodicTimer***  Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. sf10 corresponds to 10 subframes, sf20 corresonds to 20 subframes, and so on. |
| ***phr-ProhibitTimer***  Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. sf0 corresponds to 0 subframe, sf10 corresponds to 10 subframes, sf20 corresponds to 20 subframes, and so on. |
| ***phr-Type2PCell***  Indicates whether or not PHR type 2 is reported for the PCell |
| ***phr-Type2OtherCell***  Indicates whether or not PHR type 2 is reported for the PSCell and PUCCH SCells. |
| ***retxBSR-Timer***  Value in number of subframes. Value sf10 corresponds to 10 subframes, sf20 corresponds to 20 subframes and so on. |
| ***skipUplinkTxDynamic***  If configured, indicates whether the UE skips UL transmissions for an uplink grant other than a configured uplink grant if no data is available for transmission in the UE buffer as described in TS 38.321 [3]. |
| ***tag-ID***  Indicates the TAG of an SCell, see TS 38.321 [3]. Uniquely identifies the TAG within the scope of a Cell Group (i.e. MCG or SCG). If the field is not configured for an SCell, the SCell is part of the PTAG. |
| ***timeAlignmentTimer***  Value in ms of the *timeAlignmentTimer* for TAG with ID *tag-Id*, as specified in TS 38.321 [3]. |

#### – *MeasConfig*

The IE *MeasConfig* specifies measurements to be performed by the UE, and covers intra-frequency, inter-frequency and inter-RAT mobility as well as configuration of measurement gaps.

*MeasConfig* information element

-- ASN1START

-- TAG-MEAS-CONFIG-START

MeasConfig ::= SEQUENCE {

-- Measurement objects

measObjectToRemoveList MeasObjectToRemoveList OPTIONAL, -- Need N

measObjectToAddModList MeasObjectToAddModList OPTIONAL, -- Need N

-- Reporting configurations

reportConfigToRemoveList ReportConfigToRemoveList OPTIONAL, -- Need N

reportConfigToAddModList ReportConfigToAddModList OPTIONAL, -- Need N

-- Measurement identities

measIdToRemoveList MeasIdToRemoveList OPTIONAL, -- Need N

measIdToAddModList MeasIdToAddModList OPTIONAL, -- Need N

-- Other parameters

--s-Measure config

s-MeasureConfig CHOICE {

ssb-RSRP RSRP-Range,

csi-RSRP RSRP-Range

} OPTIONAL, -- Need M

quantityConfig QuantityConfig OPTIONAL, -- Need M

--Placehold for measGapConfig

measGapConfig MeasGapConfig OPTIONAL, -- Need M

...

}

MeasObjectToRemoveList ::= SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectId

MeasIdToRemoveList ::= SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasId

ReportConfigToRemoveList ::= SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigId

-- TAG-MEAS-CONFIG-STOP

-- ASN1STOP

Editor’s Note: FFS Whether UE speed based TTT scaling (e.g. speedStatePars) is supported in Rel-15 (not applicable for EN-DC).

Editor’s Note: FFS Whether measScaleFactor (or equivalent) is supported in Rel-15 (not applicable for EN-DC).

Editor’s Note: FFS How to support allowInterruptions in NR (RAN4 input needed) in Rel-15.

| *MeasConfig* field descriptions |
| --- |
| ***measGapConfig***  Used to setup and release measurement gaps in NR. |
| ***measIdToAddModList***  List of measurement identities to add and/or modify. |
| ***measIdToRemoveList***  List of measurement identities to remove. |
| ***measObjectToAddModList***  List of measurement objects to add and/or modify. |
| ***measObjectToRemoveList***  List of measurement objects to remove. |
| ***reportConfigToAddModList***  List of measurement reporting configurations to add and/or modify |
| ***reportConfigToRemoveList***  List of measurement reporting configurations to remove. |
| ***s-MeasureConfig***  Threshold for NR SpCell RSRP measurement controlling when the UE is required to perform measurements on non-serving cells. Choice of *ssb-RSRP* corresponds to cell RSRP based on SS/PBCH block and choice of *csi-RSRP* corresponds to cell RSRP of CSI-RS. The UE is only required to perform measurements on non-serving cells when the SpCell RSRP is below that threshold. |

#### – *MeasGapConfig*

The IE *MeasGapConfig* specifies the measurement gap configuration and controls setup/ release of measurement gaps.

*MeasGapConfig* information element

-- ASN1START

--TAG-MEAS-GAP-CONFIG-START

MeasGapConfig ::= SEQUENCE {

gapFR2 SetupRelease { GapConfig } OPTIONAL,

...

}

GapConfig ::= SEQUENCE {

gapOffset INTEGER (0..159),

mgl ENUMERATED {ms1dot5, ms3, ms3dot5, ms4, ms5dot5, ms6},

mgrp ENUMERATED {ms20, ms40, ms80, ms160},

mgta ENUMERATED {ms0, ms0dot25, ms0dot5},

...

}

-- TAG-MEAS-GAP-CONFIG-STOP

-- ASN1STOP

| *MeasGapConfig* field descriptions |
| --- |
| ***gapFR2***  Indicates measurement gap configuration applies to FR2 only. The applicability of the measurement gap is according to Table 9.1.2-2 in TS 38.133 [14]. |
| ***gapOffset***  Value *gapOffset* is the gap offset of the gap pattern with MGRP indicated in the field *mgrp*. The value range should be from 0 to *mgrp*-1. |
| ***mgl***  Value *mgl* is the measurement gap length in ms of the measurement gap. The applicability of the measurement gap is according to in Table 9.1.2-1 and Table 9.1.2-2 in TS 38.133 [14]. Value ms1dot5 corresponds to 1.5ms, ms3 corresponds to 3ms and so on. |
| ***mgrp***  Value *mgrp* is measurement gap repetition period in (ms) of the measurement gap. The applicability of the measurement gap is according to in Table 9.1.2-1 and Table 9.1.2-2 in TS 38.133 [14]. |
| ***mgta***  Value *mgta* is the measurement gap timing advance in ms. The applicability of the measurement gap timing advance is according to section9.1.2 of TS 38.133 [14]. Value ms0 corresponds to 0 ms, ms0dot25 corresponds to 0.25ms and ms0dot5 corresponds to 0.5ms.For FR2, the network only configures 0 and 0.25ms. |

#### – *MeasId*

The IE *MeasId* is used to identify a measurement configuration, i.e., linking of a measurement object and a reporting configuration.

*MeasId* information element

-- ASN1START

-- TAG-MEAS-ID-START

MeasId ::= INTEGER (1..maxNrofMeasId)

-- TAG-MEAS-ID-STOP

-- ASN1STOP

#### – *MeasIdToAddModList*

The IE *MeasIdToAddModList* concerns a list of measurement identities to add or modify, with for each entry the measId, the associated *measObjectId* and the associated *reportConfigId*.

*MeasIdToAddModList* information element

-- ASN1START

-- TAG-MEAS-ID-TO-ADD-MOD-LIST-START

MeasIdToAddModList ::= SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasIdToAddMod

MeasIdToAddMod ::= SEQUENCE {

measId MeasId,

measObjectId MeasObjectId,

reportConfigId ReportConfigId

}

-- TAG-MEAS-ID-TO-ADD-MOD-LIST-STOP

-- ASN1STOP

#### *– MeasObjectEUTRA*

The IE *MeasObjectEUTRA* specifies information applicable for E‑UTRA cells.

Editor’s Note: FFS Details of *measObjectEUTRA* that can be configured via NR (not applicable for EN-DC).

#### *– MeasObjectId*

The IE *MeasObjectId* used to identify a measurement object configuration.

*MeasObjectId* information element

-- ASN1START

-- TAG-MEAS-OBJECT-ID-START

MeasObjectId ::= INTEGER (1..maxNrofObjectId)

-- TAG-MEAS-OBJECT-ID-STOP

-- ASN1STOP

#### *– MeasObjectNR*

The IE *MeasObjectNR* specifies information applicable for SS/PBCH block(s) intra/inter-frequency measurements or CSI-RS intra/inter-frequency measurements.

*MeasObjectNR* information element

-- ASN1START

-- TAG-MEAS-OBJECT-NR-START

MeasObjectNR ::= SEQUENCE {

ssbFrequency ARFCN-ValueNR OPTIONAL,

refFreqCSI-RS ARFCN-ValueNR OPTIONAL,

--RS configuration (e.g. SMTC window, CSI-RS resource, etc.)

referenceSignalConfig ReferenceSignalConfig,

--Consolidation of L1 measurements per RS index

absThreshSS-BlocksConsolidation ThresholdNR OPTIONAL, -- Need R

absThreshCSI-RS-Consolidation ThresholdNR OPTIONAL, -- Need R

--Config for cell measurement derivation

nrofSS-BlocksToAverage INTEGER (2..maxNrofSS-BlocksToAverage) OPTIONAL, -- Need R

nrofCSI-RS-ResourcesToAverage INTEGER (2..maxNrofCSI-RS-ResourcesToAverage) OPTIONAL, -- Need R

-- Filter coefficients applicable to this measurement object

quantityConfigIndex INTEGER (1..maxNrofQuantityConfig),

--Frequency-specific offsets

offsetFreq Q-OffsetRangeList,

-- Cell list

cellsToRemoveList PCI-List OPTIONAL, -- Need N

cellsToAddModList CellsToAddModList OPTIONAL, -- Need N

-- Black list

blackCellsToRemoveList PCI-RangeIndexList OPTIONAL, -- Need N

blackCellsToAddModList BlackCellsToAddModList OPTIONAL, -- Need N

-- White list

whiteCellsToRemoveList PCI-RangeIndexList OPTIONAL, -- Need N

whiteCellsToAddModList WhiteCellsToAddModList OPTIONAL, -- Need N

...

}

ReferenceSignalConfig::= SEQUENCE {

-- SSB configuration for mobility (nominal SSBs, timing configuration)

ssb-ConfigMobility SSB-ConfigMobility OPTIONAL, -- Need M

-- CSI-RS resources to be used for CSI-RS based RRM measurements

csi-rs-ResourceConfigMobility SetupRelease { CSI-RS-ResourceConfigMobility } OPTIONAL-- Need M

}

-- A measurement timing configuration

SSB-ConfigMobility::= SEQUENCE {

--Only the values 15, 30 or 60 kHz (<6GHz), 60 or 120 kHz (>6GHz) are applicable

subcarrierSpacing SubcarrierSpacing,

-- The set of SS blocks to be measured within the SMTC measurement duration.

-- Corresponds to L1 parameter 'SSB-measured' (see FFS\_Spec, section FFS\_Section)

-- When the field is absent the UE measures on all SS-blocks

-- FFS\_CHECK: Is this IE placed correctly.

ssb-ToMeasure SetupRelease { SSB-ToMeasure } OPTIONAL, -- Need M

-- Indicates whether the UE can utilize serving cell timing to derive the index of SS block transmitted by neighbour cell:

useServingCellTimingForSync BOOLEAN,

-- Primary measurement timing configuration. Applicable for intra- and inter-frequency measurements.

smtc1 SEQUENCE {

-- Periodicity and offset of the measurement window in which to receive SS/PBCH blocks.

-- Periodicity and offset are given in number of subframes.

-- FFS\_FIXME: This does not match the L1 parameter table! They seem to intend an index to a hidden table in L1 specs.

-- (see 38.213, section REF):

periodicityAndOffset CHOICE {

sf5 INTEGER (0..4),

sf10 INTEGER (0..9),

sf20 INTEGER (0..19),

sf40 INTEGER (0..39),

sf80 INTEGER (0..79),

sf160 INTEGER (0..159)

},

-- Duration of the measurement window in which to receive SS/PBCH blocks. It is given in number of subframes

-- (see 38.213, section 4.1)

duration ENUMERATED { sf1, sf2, sf3, sf4, sf5 }

},

-- Secondary measurement timing confguration for explicitly signalled PCIs. It uses the offset and duration from smtc1.

-- It is supported only for intra-frequency measurements in RRC CONNECTED.

smtc2 SEQUENCE {

-- PCIs that are known to follow this SMTC.

pci-List SEQUENCE (SIZE (1..maxNrofPCIsPerSMTC)) OF PhysCellId OPTIONAL, -- Need M

-- Periodicity for the given PCIs. Timing offset and Duration as provided in smtc1.

periodicity ENUMERATED {sf5, sf10, sf20, sf40, sf80, sf160, spare2, spare1}

} OPTIONAL,-- Cond IntraFreqConnected

ss-RSSI-Measurement SEQUENCE {

measurementSlots CHOICE {

kHz15 BIT STRING (SIZE(1)),

kHz30 BIT STRING (SIZE(2)),

kHz60 BIT STRING (SIZE(4)),

kHz120 BIT STRING (SIZE(8))

},

endSymbol INTEGER(0..13)

} OPTIONAL

}

CSI-RS-ResourceConfigMobility ::= SEQUENCE {

-- MO specific values

isServingCellMO BOOLEAN,

-- Subcarrier spacing of CSI-RS.

-- Only the values 15, 30 or 60 kHz (<6GHz), 60 or 120 kHz (>6GHz) are applicable.

-- Corresponds to L1 parameter 'Numerology' (see 38.211, section FFS\_Section)

subcarrierSpacing SubcarrierSpacing,

-- List of cells

csi-RS-CellList-Mobility SEQUENCE (SIZE (1..maxNrofCSI-RS-CellsRRM)) OF CSI-RS-CellMobility

}

CSI-RS-CellMobility ::= SEQUENCE {

cellId PhysCellId,

csi-rs-MeasurementBW SEQUENCE {

-- Allowed size of the measurement BW in PRBs

-- Corresponds to L1 parameter 'CSI-RS-measurementBW-size' (see FFS\_Spec, section FFS\_Section)

nrofPRBs ENUMERATED { size24, size48, size96, size192, size264},

-- Starting PRB index of the measurement bandwidth

-- Corresponds to L1 parameter 'CSI-RS-measurement-BW-start' (see FFS\_Spec, section FFS\_Section)

-- FFS\_Value: Upper edge of value range unclear in RAN1

startPRB INTEGER(0..2169)

},

-- Frequency domain density for the 1-port CSI-RS for L3 mobility

-- Corresponds to L1 parameter 'Density' (see FFS\_Spec, section FFS\_Section)

density ENUMERATED {d1,d3} OPTIONAL,

-- List of resources

csi-rs-ResourceList-Mobility SEQUENCE (SIZE (1..maxNrofCSI-RS-ResourcesRRM)) OF CSI-RS-Resource-Mobility

}

CSI-RS-Resource-Mobility ::= SEQUENCE {

csi-RS-Index CSI-RS-Index,

-- Contains periodicity and slot offset for periodic/semi-persistent CSI-RS (see 38.211, section x.x.x.x)FFS\_Ref

slotConfig CHOICE {

ms4 INTEGER (0..31),

ms5 INTEGER (0..39),

ms10 INTEGER (0..79),

ms20 INTEGER (0..159),

ms40 INTEGER (0..319)

},

-- Each CSI-RS resource may be associated with one SSB. If such SSB is indicated, the NW also indicates whether the UE may assume

-- quasi-colocation of this SSB with this CSI-RS reosurce.

-- Corresponds to L1 parameter 'Associated-SSB' (see FFS\_Spec, section FFS\_Section)

associatedSSB SEQUENCE {

ssb-Index SSB-Index,

-- The CSI-RS resource is either QCL’ed not QCL’ed with the associated SSB in spatial parameters

-- Corresponds to L1 parameter 'QCLed-SSB' (see FFS\_Spec, section FFS\_Section)

isQuasiColocated BOOLEAN

} OPTIONAL, -- Cond AssociatedSSB

-- Frequency domain allocation within a physical resource block in accordance with 38.211, section 7.4.1.5.3 including table 7.4.1.5.2-1.

-- The number of bits that may be set to one depend on the chosen row in that table. For the choice "other", the row can be determined from

-- the parmeters below and from the number of bits set to 1 in frequencyDomainAllocation.

frequencyDomainAllocation CHOICE {

row1 BIT STRING (SIZE (4)),

row2 BIT STRING (SIZE (12))

},

-- Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS.

-- Parameter l0 in 38.211, section 7.4.1.5.3. Value 2 is supported only when DL-DMRS-typeA-pos equals 3.

firstOFDMSymbolInTimeDomain INTEGER (0..13),

-- Scrambling ID for CSI-RS(see 38.211, section 7.4.1.5.2)

sequenceGenerationConfig INTEGER (0..1023),

...

}

CSI-RS-Index ::= INTEGER (0..maxNrofCSI-RS-ResourcesRRM-1)

Q-OffsetRangeList ::= SEQUENCE {

rsrpOffsetSSB Q-OffsetRange DEFAULT dB0,

rsrqOffsetSSB Q-OffsetRange DEFAULT dB0,

sinrOffsetSSB Q-OffsetRange DEFAULT dB0,

rsrpOffsetCSI-RS Q-OffsetRange DEFAULT dB0,

rsrqOffsetCSI-RS Q-OffsetRange DEFAULT dB0,

sinrOffsetCSI-RS Q-OffsetRange DEFAULT dB0

}

SSB-ToMeasure ::= CHOICE {

-- bitmap for sub 3 GHz

shortBitmap BIT STRING (SIZE (4)),

-- bitmap for 3-6 GHz

mediumBitmap BIT STRING (SIZE (8)),

-- bitmap for above 6 GHz

longBitmap BIT STRING (SIZE (64))

}

ThresholdNR ::= SEQUENCE{

thresholdRSRP RSRP-Range OPTIONAL,

thresholdRSRQ RSRQ-Range OPTIONAL,

thresholdSINR SINR-Range OPTIONAL

}

CellsToAddModList ::= SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CellsToAddMod

CellsToAddMod ::= SEQUENCE {

physCellId PhysCellId,

cellIndividualOffset Q-OffsetRangeList

}

BlackCellsToAddModList ::= SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF BlackCellsToAddMod

BlackCellsToAddMod ::= SEQUENCE {

pci-RangeIndex PCI-RangeIndex,

pci-Range PCI-Range

}

WhiteCellsToAddModList ::= SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF WhiteCellsToAddMod

WhiteCellsToAddMod ::= SEQUENCE {

pci-RangeIndex PCI-RangeIndex,

pci-Range PCI-Range

}

-- TAG-MEAS-OBJECT-NR-STOP

-- ASN1STOP

Editor’s Note: FFS How to support CGI reporting and whether changes are required in MeasObjectNR (e.g. introduction of cellForWhichToReportCGI). Not applicable for EN-DC.

Editor’s Note: FFS Whether alternative TTT is supported in Rel-15 (not applicable for EN-DC).

Editor’s Note: FFS measCycleSCell. (not applicable for EN-DC)

Editor’s Note: FFS reducedMeasPerformance (not applicable for EN-DC).

| *MeasObjectNR* field descriptions |
| --- |
| ***absThreshCSI-RS-Consolidation***  Absolute threshold for the consolidation of measurement results per CSI-RS resource(s) from L1 filter(s). The values above the threshold are used as input to the derivation of cell measurement results as described in 5.5.3.3 and the L3 filter(s) per CSI-RS resource as described in 5.5.3.2. |
| ***absThreshSS-BlocksConsolidation***  Absolute threshold for the consolidation of measurement results per SS/PBCH block(s) from L1 filter(s). The values above the threshold are used as input to the derivation of cell measurement results as described in 5.5.3.3and the L3 filter(s) per SS/PBCH block index as described in 5.5.3.2. |
| ***associatedSSB***  If this field is present, the UE may base the timing of the CSI-RS resource indicated in *CSI-RS-Resource-Mobility*on the timing of the cell indicated by the *cellId*in the *CSI-RS-CellMobility*. In this case,the UE is not required to monitor that CSI-RS resourceif the UE can’t detect the SS/PBCH block indicated by this*associatedSSB*and*cellId*.If this field is absent, the UE shall base the timing of the CSI-RS resource indicated in *CSI-RS-Resource-Mobility*on the timing of the serving cell.In this case, the UE is required to measure the CSI-RS resource even if SS/PBCH block(s) with *cellId*in the *CSI-RS-CellMobility*are not detected. |
| ***blackCellsToAddModList***  List of cells to add/modify in the black list of cells. |
| ***blackCellsToRemoveList***  List of cells to remove from the black list of cells. |
| ***cellIndividualOffset***  Cell individual offsets applicable to a specific cell. |
| ***cellsToAddModList***  List of cells to add/modify in the cell list. |
| ***cellsToRemoveList***  List of cells to remove from the cell list. |
| ***csi-RS-Index***  CSI-RS resource index associated to the CSI-RS resource to be measured (and used for reporting). |
| ***endSymbol***  RSSI is measured from symbol 0 to symbol *endSymbol*. |
| ***nrofCSInrofCSI-RS-ResourcesToAverage***  Indicates the maximum number of measurement results per beam based on CSI-RS resources to be averaged. The same value applies for each detected cell associated with this MeasObjectNR. |
| ***nrofSS-BlocksToAverage***  Indicates the maximum number of measurement results per beam based on SS/PBCH blocks to be averaged. The same value applies for each detected cell associated with this MeasObject. |
| ***offsetFreq***  Offset values applicable to the carrier frequency. |
| ***physCellId***  Physical cell identity of a cell in the cell list. |
| ***quantityConfigIndex***  Indicates the n-*th* element of *quantityConfigNR-List*provided in *MeasConfig*. |
| ***pci-Range***  Physical cell identity or a range of physical cell identities. |
| ***measurementSlots***  Indicates the slots in which the UE can perform RSSI measurements. |
| ***slotConfig***  Indicates the CSI-RS periodicity (in milliseconds) and for each periodicity the offset (in number of slots).When *subcarrierSpacingCSI-RS* is set to 15kHZ, the maximum offset values for periodicities ms4/ms5/ms10/ms20/ms40 are 3/4/9/19/39 slots. When *subcarrierSpacingCSI-RS* is set to 30kHZ, the maximum offset values for periodicities ms4/ms5/ms10/ms20/ms40 are 7/9/19/39/79 slots. When *subcarrierSpacingCSI-RS* is set to 60kHZ, the maximum offset values for periodicities ms4/ms5/ms10/ms20/ms40 are 15/19/39/79/159 slots. When *subcarrierSpacingCSI-RS* is set 120kHZ, the maximum offset values for periodicities ms4/ms5/ms10/ms20/ms40 are 31/39/79/159/319 slots. |
| ***ssbFrequency*** Indicates the frequency of the SS associated to this MeasObjectNR. For cell defining SSB, it will be located on the sync raster. |
| ***whiteCellsToAddModList***  List of cells to add/modify in the white list of cells. |
| ***whiteCellsToRemoveList***  List of cells to remove from the white list of cells. |

| Conditional presence | Explanation |
| --- | --- |
| *AssociatedSSB* | If *useServingCellTimingForSync* is set to FALSE, this field is mandatory present, otherwise if *ssb-ConfigMobility* is present, it is optionally present, otherwise, it is absent. |

#### – *MeasObjectToAddModList*

The IE *MeasObjectToAddModList* concerns a list of measurement objects to add or modify.

*MeasObjectToAddModList* information element

-- ASN1START

-- TAG-MEAS-OBJECT-TO-ADD-MOD-LIST-START

MeasObjectToAddModList ::= SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectToAddMod

MeasObjectToAddMod ::= SEQUENCE {

measObjectId MeasObjectId,

measObject CHOICE {

measObjectNR MeasObjectNR,

...

}

}

-- TAG-MEAS-OBJECT-TO-ADD-MOD-LIST-STOP

-- ASN1STOP

#### – *MeasResults*

The IE *MeasResults* covers measured results for intra-frequency, inter-frequency, and inter-RAT mobility.

*MeasResults* information element

-- ASN1START

-- TAG-MEAS-RESULTS-START

MeasResults ::= SEQUENCE {

measId MeasId,

measResultServingFreqList MeasResultServFreqList,

measResultNeighCells CHOICE {

measResultListNR MeasResultListNR,

...

} OPTIONAL,

...

}

MeasResultServFreqList ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF MeasResultServFreq

MeasResultServFreq ::= SEQUENCE {

servFreqId ServCellIndex,

measResultServingCell MeasResultNR,

measResultBestNeighCell MeasResultNR,

...

}

MeasResultListNR ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultNR

MeasResultNR ::= SEQUENCE {

physCellId PhysCellId OPTIONAL,

--FFS: Details of cgi info

cgi-Info ENUMERATED {ffsTypeAndValue} OPTIONAL,

measResult SEQUENCE {

cellResults SEQUENCE{

resultsSSB-Cell MeasQuantityResults OPTIONAL,

resultsCSI-RS-Cell MeasQuantityResults OPTIONAL

},

rsIndexResults SEQUENCE{

resultsSSB-Indexes ResultsPerSSB-IndexList OPTIONAL,

resultsCSI-RS-Indexes ResultsPerCSI-RS-IndexList OPTIONAL

} OPTIONAL

},

...

}

MeasQuantityResults ::= SEQUENCE {

rsrp RSRP-Range OPTIONAL,

rsrq RSRQ-Range OPTIONAL,

sinr SINR-Range OPTIONAL

}

ResultsPerSSB-IndexList::= SEQUENCE (SIZE (1..maxNrofSSBs)) OF ResultsPerSSB-Index

ResultsPerSSB-Index ::= SEQUENCE {

ssb-Index SSB-Index,

ssb-Results MeasQuantityResults OPTIONAL

}

ResultsPerCSI-RS-IndexList::= SEQUENCE (SIZE (1..maxNrofCSI-RS)) OF ResultsPerCSI-RS-Index

ResultsPerCSI-RS-Index ::= SEQUENCE {

csi-RS-Index CSI-RS-Index,

csi-RS-Results MeasQuantityResults OPTIONAL

}

-- TAG-MEAS-RESULTS-STOP

-- ASN1STOP

Editor’s Note: FFS *locationInfo*.

| *MeasResults* field descriptions |
| --- |
| ***csi-rs-Index***  CSI-RS resource index associated to the measurement information to be reported. |
| ***measId***  Identifies the measurement identity for which the reporting is being performed. |
| ***measResult***  Measured results of an NR cell. |
| ***measResultListNR***  List of measured results for the maximum number of reported best cells for an NR measurement identity. |
| ***measResultServingFreqList***  Measured results of the serving frequencies including measurement results of SpCell, configured SCell(s) and best neighbouring cell on each serving frequency. |
| ***resultsCSI-RS-Indexes***  List of measurement information per CSI-RS resource index of an NR cell. |
| ***resultsSSB-Indexes***  List of measurement information per SS/PBCH index of an NR cell. |
| ***resultsCSI-RS-Cell***  Cell level measurement results (e.g. RSRP, RSRQ, SINR) to be reported derived from CSI-RS measurements. |
| ***resultsSSB-Cell***  Cell level measurement results (e.g. RSRP, RSRQ, SINR) to be reported derived on SS/PBCH block measurements. |
| ***rsrp***  Measured SS-RSRP or CSI-RSRP resultsas defined in TS 38.215 [9], either per NR cell from the L1 filter(s) or per (SS/PBCH)/(CSI-RS) index as specified in 5.5.3.3a. |
| ***rsrq***  Measured SS-RSRQ or CSI-RSRQ results as defined in TS 38.215 [9], either per NR cell from the L1 filter(s) or per (SS/PBCH)/(CSI-RS) index as specified in 5.5.3.3a. |
| ***sinr***  Measured SS-SINR or CSI-SINR results as defined in TS 38.215 [9], either per NR cell from the L1 filter(s) or per (SS/PBCH)/(CSI-RS) index as specified in 5.5.3.3a. |
| ***ssb-Index***  SS/PBCH block index associated to the measurement information to be reported. |

#### *–* *MeasResultSCG-Failure*

The IE *MeasResultSCG-Failure* is used to provide information regarding failures detected by the UE in case of EN-DC.

*MeasResultSCG-Failure* information element

-- ASN1START

-- TAG-MEAS-RESULT-SCG-FAILURE-START

MeasResultSCG-Failure ::= SEQUENCE {

measResultServFreqList MeasResultServFreqList2NR,

measResultNeighCells MeasResultList2NR,

...

}

MeasResultServFreqList2NR ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF MeasResultServFreq2NR

MeasResultServFreq2NR ::= SEQUENCE {

ssbFrequency ARFCN-ValueNR OPTIONAL,

refFreqCSI-RS ARFCN-ValueNR OPTIONAL,

measResultServingCell MeasResultNR,

measResultBestNeighCell MeasResultNR OPTIONAL

}

MeasResultList2NR ::= SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

MeasResult2NR ::= SEQUENCE {

ssbFrequency ARFCN-ValueNR OPTIONAL,

refFreqCSI-RS ARFCN-ValueNR OPTIONAL,

measResultListNR MeasResultListNR

}

-- TAG-MEAS-RESULT-SCG-FAILURE-STOP

-- ASN1STOP

#### – *MeasResult*CellList*SFTD*

The IE *MeasResultCellListSFTD* consists of SFN and radio frame boundary difference between the PCell and an NR cell as specified in TS 38.215 [9] and TS 38.133 [14].

MeasResultCellListSFTDinformation element

-- ASN1START

-- TAG-MEASRESULT-CELL-LIST-SFTD-START

MeasResultCellListSFTD ::= SEQUENCE (SIZE (1..maxCellSFTD)) OF MeasResultCellSFTD

MeasResultCellSFTD ::= SEQUENCE {

physCellId PhysCellId,

sfn-OffsetResult INTEGER (0..1023),

frameBoundaryOffsetResult INTEGER (-30720..30719),

rsrp-Result RSRP-Range OPTIONAL

}

-- TAG-MEASRESULT-CELL-LIST-SFTD-STOP

-- ASN1STOP

| *MeasResultSFTD* field descriptions |
| --- |
| ***sfn-OffsetResult***  Indicates the SFN difference between the PCell and the NR cell as an integer value according to TS 38.215 [9]. |
| ***frameBoundaryOffsetResult***  Indicates the frame boundary difference between the PCell and the NR cell as an integer value according to TS 38.215 [9]. |

#### – *MultiFrequencyBandListNR*

The IE *MultiFrequencyBandListNR* is used to configure a list of one or multiple NR frequency bands.

*MultiFrequencyBandListNR* information element

-- ASN1START

-- TAG-MULTIFREQUENCYBANDLISTNR-START

MultiFrequencyBandListNR ::= SEQUENCE (SIZE (1..maxNrofMultiBands)) OF FreqBandIndicatorNR

-- TAG-MULTIFREQUENCYBANDLISTNR-STOP

-- ASN1STOP

#### – *NZP-CSI-RS-ResourceSet*

The IE *NZP-CSI-RS-ResourceSet* is a set of Non-Zero-Power (NZP) CSI-RS resources (their IDs) and set-specific parameters.

*NZP-CSI-RS-ResourceSet* information element

-- ASN1START

-- TAG-NZP-CSI-RS-RESOURCESET-START

NZP-CSI-RS-ResourceSet ::= SEQUENCE {

nzp-CSI-ResourceSetId NZP-CSI-RS-ResourceSetId,

-- NZP-CSI-RS-Resources assocaited with this NZP-CSI-RS resource set.

-- Corresponds to L1 parameter 'CSI-RS-ResourceConfigList' (see 38.214, section 5.2)

-- For CSI, there are at most 8 NZP CSI RS resources per resource set

nzp-CSI-RS-Resources SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,

-- Indicates whether repetition is on/off. If set to set to 'OFF', the UE may not assume that the

-- NZP-CSI-RS resources within the resource set are transmitted with the same downlink spatial domain transmission filter

-- and with same NrofPorts in every symbol.

-- Corresponds to L1 parameter 'CSI-RS-ResourceRep' (see 38.214, sections 5.2.2.3.1 and 5.1.6.1.2)

-- Can only be configured for CSI-RS resource sets which are associated with CSI-ReportConfig with report of L1 RSRP or “no report”

repetition ENUMERATED { on, off } OPTIONAL,

-- Offset X between the slot containing the DCI that triggers a set of aperiodic NZP CSI-RS resources and the slot in which the

-- CSI-RS resource set is transmitted. When the field is absent the UE applies the value 0.

-- Corresponds to L1 parameter 'Aperiodic-NZP-CSI-RS-TriggeringOffset' (see 38,214, section FFS\_Section)

aperiodicTriggeringOffset INTEGER(0..4) OPTIONAL, -- Need S

-- Indicates that the antenna port for all NZP-CSI-RS resources in the CSI-RS resource set is same.

-- Corresponds to L1 parameter 'TRS-Info' (see 38.214, section 5.2.2.3.1)

trs-Info ENUMERATED {true} OPTIONAL,

...

}

-- TAG-NZP-CSI-RS-RESOURCESET-STOP

-- ASN1STOP

#### – *NZP-CSI-RS-ResourceSetId*

The IE *NZP-CSI-RS-ResourceSetId* is used to identify one *NZP-CSI-RS-ResourceSet*.

*NZP-CSI-RS-ResourceSetId* information element

-- ASN1START

-- TAG-NZP-CSI-RS-RESOURCESETID-START

NZP-CSI-RS-ResourceSetId ::= INTEGER (0..maxNrofNZP-CSI-RS-ResourceSets-1)

-- TAG-NZP-CSI-RS-RESOURCESETID-STOP

-- ASN1STOP

#### – *NZP-CSI-RS-Resource*

The IE *NZP-CSI-RS-Resource* is used to configure Non-Zero-Power (NZP) CSI-RStransmitted in the cell where the IE is included, which the UE may be configured to measure on (see 38.214, section 5.2.2.3.1).

*NZP-CSI-RS-Resource* information element

-- ASN1START

-- TAG-NZP-CSI-RS-RESOURCE-START

NZP-CSI-RS-Resource ::= SEQUENCE {

nzp-CSI-RS-ResourceId NZP-CSI-RS-ResourceId,

-- OFDM symbol location(s) in a slot and subcarrier occupancy in a PRB of the CSI-RS resource

resourceMapping CSI-RS-ResourceMapping,

-- Power offset of NZP CSI-RS RE to PDSCH RE. Value in dB. Corresponds to L1 parameter Pc (see 38.214, sections 5.2.2.3.1 and 4.1)

powerControlOffset INTEGER(-8..15),

-- Power offset of NZP CSI-RS RE to SS RE. Value in dB. Corresponds to L1 parameter 'Pc\_SS' (see 38.214, section 5.2.2.3.1)

powerControlOffsetSS ENUMERATED{db-3, db0, db3, db6} OPTIONAL,

-- Scrambling ID (see 38.214, section 5.2.2.3.1)

scramblingID ScramblingId,

-- Periodicity and slot offset sl1 corresponds to a periodicity of 1 slot, sl2 to a periodicity of two slots, and so on.

-- The corresponding offset is also given in number of slots. Corresponds to L1 parameter 'CSI-RS-timeConfig' (see 38.214, section 5.2.2.3.1)

periodicityAndOffset CSI-ResourcePeriodicityAndOffset OPTIONAL, --Cond PeriodicOrSemiPersistent

-- For a target periodic CSI-RS, contains a reference to one TCI-State in TCI-States for providing the QCL source and

-- QCL type. For periodic CSI-RS, the source can be SSB or another periodic-CSI-RS.

-- Corresponds to L1 parameter 'QCL-Info-PeriodicCSI-RS' (see 38.214, section 5.2.2.3.1)

qcl-InfoPeriodicCSI-RS TCI-StateId OPTIONAL, --Cond Periodic

...

}

-- TAG-NZP-CSI-RS-RESOURCE-STOP

-- ASN1STOP

#### – *NZP-CSI-RS-ResourceId*

The IE *NZP-CSI-RS-ResourceId* is used to identify one NZP-CSI-RS-Resource.

*NZP-CSI-RS-ResourceId* information element

-- ASN1START

-- TAG-NZP-CSI-RS-RESOURCEID-START

NZP-CSI-RS-ResourceId ::= INTEGER (0..maxNrofNZP-CSI-RS-Resources-1)

-- TAG-NZP-CSI-RS-RESOURCEID-STOP

-- ASN1STOP

#### – *P-Max*

The IE *P-Max* is used to limit the UE's uplink transmission power on a carrier frequency, see TS 38.101 [14].

*P-Max* information element

-- ASN1START

-- TAG-P-MAX-START

P-Max ::= INTEGER (-30..33)

-- TAG-P-MAX-STOP

-- ASN1STOP

#### – *PCI-List*

The IE *PCI-List* concerns a list of physical cell identities, which may be used for different purposes.

*PCI-List* information element

-- ASN1START

-- TAG-PCI-LIST-START

PCI-List ::= SEQUENCE (SIZE (1..maxNrofCellMeas)) OF PhysCellId

-- TAG-PCI-LIST-STOP

-- ASN1STOP

#### – *PCI-Range*

The IE *PCI-Range* is used to encode either a single or a range of physical cell identities. The range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range. For fields comprising multiple occurrences of *PCI-Range*, the Network may configure overlapping ranges of physical cell identities.

*PCI-Range* information element

-- ASN1START

-- TAG-PCI-RANGE-START

PCI-Range ::= SEQUENCE {

start PhysCellId,

range ENUMERATED {

n4, n8, n12, n16, n24, n32, n48, n64, n84,

n96, n128, n168, n252, n504, n1008,

spare1} OPTIONAL -- Need Nss

}

-- TAG-PCI-RANGE-STOP

-- ASN1STOP

| *PCI-Range* field descriptions |
| --- |
| ***range***  Indicates the number of physical cell identities in the range (including *start*). Value n4 corresponds with 4, n8 corresponds with 8 and so on. The UE shall apply value 1 in case the field is absent, in which case only the physical cell identity value indicated by *start* applies. |
| ***start***  Indicates the lowest physical cell identity in the range. |

#### – *PCI-RangeIndex*

The IE PCI-RangeIndex identifies a physical cell id range, which may be used for different purposes.

*PCI-RangeIndex* information element

-- ASN1START

-- TAG-PCI-RANGE-INDEX-START

PCI-RangeIndex ::= INTEGER (1..maxNrofPCI-Ranges)

-- TAG-PCI-RANGE-INDEX-STOP

-- ASN1STOP

#### – *PCI-RangeIndexList*

The IE *PCI-RangeIndexList* concerns a list of indexes of physical cell id ranges, which may be used for different purposes.

*PCI-RangeIndexList* information element

-- ASN1START

-- TAG-PCI-RANGE-INDEX-LIST-START

PCI-RangeIndexList ::= SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeIndex

-- TAG-PCI-Range-INDEX-LIST-STOP

-- ASN1STOP

#### – *PDCCH-Config*

The *PDCCH-Config* IE is used to configure UE specific PDCCH parameters such as control resource sets (CORESET), search spaces and additional parameters for acquiring the PDCCH.

*PDCCH-Config* information element

-- ASN1START

-- TAG-PDCCH-CONFIG-START

PDCCH-Config ::= SEQUENCE {

-- List of UE specifically configured Control Resource Sets (CORESETs) to be used by the UE.

-- The network configures at most 3 CORESETs per BWP per cell (including the initial CORESET).

controlResourceSetToAddModList SEQUENCE(SIZE (1..3)) OF ControlResourceSet OPTIONAL,

controlResourceSetToReleaseList SEQUENCE(SIZE (1..3)) OF ControlResourceSetId OPTIONAL,

-- List of UE specifically configured Control Resource Sets (CORESETs).

-- The network configures at most 10 Search Spaces per BWP per cell (including the initial Search Space).

searchSpacesToAddModList SEQUENCE(SIZE (1..10)) OF SearchSpace OPTIONAL,

searchSpacesToReleaseList SEQUENCE(SIZE (1..10)) OF SearchSpaceId OPTIONAL,

-- Configuration of downlink preemtption indications to be monitored in this cell.

-- Corresponds to L1 parameter 'Preemp-DL' (see 38.214, section 11.2)

-- FFS\_RAN1: LS R1-1801281 indicates this is "Per Cell (but association with each configured BWP is needed)" => Unclear, keep on BWP for now.

downlinkPreemption SetupRelease { DownlinkPreemption } OPTIONAL, -- Need M

-- Configuration of Slot-Format-Indicators to be monitored in this cell

-- FFS\_RAN1 discusses still whether this SFI payload configuration is BWP- or Cell-Specific.

slotFormatIndicator SetupRelease { SlotFormatIndicator } OPTIONAL, -- Need M

-- Enable and configure reception of group TPC commands for PUSCH

tpc-PUSCH SetupRelease { PUSCH-TPC-CommandConfig } OPTIONAL, -- Need M

-- Enable and configure reception of group TPC commands fpr PUCCH

tpc-PUCCH SetupRelease { PUCCH-TPC-CommandConfig } OPTIONAL, -- Cond PUCCH-CellOnly

...

}

-- TAG-PDCCH-CONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *PUCCH-CellOnly* | The field is optionally present, Need M, for the PDCCH-Config of an SpCells as well as for SCells configured with PUCCH. The Field is absent otherwise. |

#### – *PDCCH-ConfigCommon*

The IE *PDCCH-ConfigCommon* is used to configure cell specific PDCCH parameters provided in SIB as well as during handover and PSCell/SCell addition.

*PDCCH-ConfigCommon* information element

-- ASN1START

-- TAG-PDCCH-CONFIGCOMMON-START

PDCCH-ConfigCommon ::= SEQUENCE {

-- A list of common control resource sets. Only CORESETs with ControlResourceSetId = 0 or 1 are allowed. The CORESET#0

-- corresponds to the CORESET configured in MIB (see pdcch-ConfigSIB1) and is used to provide that information to the UE

-- by dedicated signalling during handover and (P)SCell addition. The CORESET#1 may be configured an used for RAR

-- (see ra-ControlResourceSet).

commonControlResourcesSets SEQUENCE (SIZE(1..2)) OF ControlResourceSet OPTIONAL, -- Need R

-- A list of additional common search spaces.

commonSearchSpaces SEQUENCE (SIZE(1..4)) OF SearchSpace OPTIONAL, -- Need R

-- ID of the search space for SIB1 message.

-- Corresponds to L1 parameter 'rmsi-SearchSpace' (see 38.213, section 10)

searchSpaceSIB1 SearchSpaceId OPTIONAL, -- Need R

-- ID of the Search space for other system information, i.e., SIB2 and beyond.

-- Corresponds to L1 parameter 'osi-SearchSpace' (see 38.213, section 10)

-- If the field is absent, the monitoring occasions are derived as described in 38.213, section 10.1 and section 13.

searchSpaceOtherSystemInformation SearchSpaceId OPTIONAL, -- Need R

-- ID of the Search space for paging. Corresponds to L1 parameter 'paging-SearchSpace' (see 38.213, section 10)

-- If the field is absent, the monitoring occasions are derived as described in 38.213, section 10.1 and section 13.

pagingSearchSpace SearchSpaceId OPTIONAL, -- Need R

-- CORESET configured for random access. When the field is absent the UE uses the CORESET according to pdcch-ConfigSIB1

-- which is associated with ControlResourceSetId = 0.

-- Corresponds to L1 parameter 'rach-coreset-configuration' (see 38.211?, section FFS\_Section)

ra-ControlResourceSet ControlResourceSetId OPTIONAL, -- Need S

-- ID of the Search space for random access procedure. Corresponds to L1 parameter 'ra-SearchSpace' (see 38.214?, section FFS\_Section)

-- If the field is absent, the monitoring occasions are derived as described in 38.213, section 10.1 and section 13.

ra-SearchSpace SearchSpaceId OPTIONAL, -- Need R

...

}

-- TAG-PDCCH-CONFIGCOMMON-STOP

-- ASN1STOP

#### – *PDCP-Config*

The IE *PDCP-Config* is used to set the configurable PDCP parameters for signalling and data radio bearers.

*PDCP-Config* information element

-- ASN1START

-- TAG-PDCP-CONFIG-START

PDCP-Config ::= SEQUENCE {

drb SEQUENCE {

discardTimer ENUMERATED {ms10, ms20, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200, ms250, ms300, ms500, ms750, ms1500, infinity} OPTIONAL, -- Cond Setup

pdcp-SN-SizeUL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2

pdcp-SN-SizeDL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2

headerCompression CHOICE {

notUsed NULL,

rohc SEQUENCE {

maxCID INTEGER (1..16383) DEFAULT 15,

profiles SEQUENCE {

profile0x0001 BOOLEAN,

profile0x0002 BOOLEAN,

profile0x0003 BOOLEAN,

profile0x0004 BOOLEAN,

profile0x0006 BOOLEAN,

profile0x0101 BOOLEAN,

profile0x0102 BOOLEAN,

profile0x0103 BOOLEAN,

profile0x0104 BOOLEAN

},

drb-ContinueROHC BOOLEAN

},

uplinkOnlyROHC SEQUENCE {

maxCID INTEGER (1..16383) DEFAULT 15,

profiles SEQUENCE {

profile0x0006 BOOLEAN

},

drb-ContinueROHC BOOLEAN

},

...

},

integrityProtection ENUMERATED { enabled } OPTIONAL, -- Cond ConnectedTo5GC

statusReportRequired ENUMERATED { true } OPTIONAL, -- Cond Rlc-AM

outOfOrderDelivery BOOLEAN

} OPTIONAL, -- Cond DRB

-- FFS / TODO: Handle more than two secondary cell groups

moreThanOneRLC SEQUENCE {

primaryPath SEQUENCE {

cellGroup CellGroupId OPTIONAL, -- Need R

logicalChannel LogicalChannelIdentity OPTIONAL -- Need R

},

ul-DataSplitThreshold UL-DataSplitThreshold OPTIONAL, -- Cond SplitBearer

pdcp-Duplication ENUMERATED { true } OPTIONAL -- Need R

} OPTIONAL, -- Cond MoreThanOneRLC

t-Reordering ENUMERATED {

ms0, ms1, ms2, ms4, ms5, ms8, ms10, ms15, ms20, ms30, ms40, ms50, ms60, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220,

ms240, ms260, ms280, ms300, ms500, ms750, ms1000, ms1250, ms1500, ms1750, ms2000, ms2250, ms2500, ms2750,

ms3000, spare28, spare27, spare26, spare25, spare24, spare23, spare22, spare21, spare20,

spare19, spare18, spare17, spare16, spare15, spare14, spare13, spare12, spare11, spare10, spare09,

spare08, spare07, spare06, spare05, spare04, spare03, spare02, spare01 } OPTIONAL, -- Need S

...

}

UL-DataSplitThreshold ::= ENUMERATED {

b0, b100, b200, b400, b800, b1600, b3200, b6400, b12800, b25600, b51200, b102400, b204800,

b409600, b819200, b1228800, b1638400, b2457600, b3276800, b4096000, b4915200, b5734400,

b6553600, infinity, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1}

-- TAG-PDCP-CONFIG-STOP

-- ASN1STOP

| *PDCP-Config*field descriptions |
| --- |
| ***discardTimer***  Value in ms of *discardTimer* specified in TS 38.323 [5]. Value ms50 corresponds to 50 ms, ms100 corresponds to 100 ms and so on. |
| ***drb-ContinueROHC***  Indicates whether the PDCP entity continues or resets the ROHC header compression protocol during PDCP re-establishment. This field is set to true only in case of reconfiguration with sync where the PDCP termination point is not changed. |
| ***headerCompression***  If rohc is configured, the UE shall apply the configured ROHC profile(s) in both uplink and downlink. If uplinkOnlyROHC is configured, the UE shall apply the configure ROHC profile(s) in uplink (there is no header compression in downlink). ROHC can be configured for any bearer type. ROHC should be configured at reconfiguration involving PDCP re-establishment if the RB was previously configured with ROHC. Header compression should not be configured when out-of-order delivery is allowed for PDCP SDUs. |
| ***integrityProtection***  Indicates whether or not integrity protection is configured for this radio bearer. The value of integrityProtection for a DRB can only be changed using reconfiguration with sync.  FFS: text to indicate where to find the key. |
| ***maxCID***  Indicates the value of the MAX\_CID parameter as specified in TS 38.323 [5]  FFS: need to specify something with respect to UE capabilities. |
| ***outOfOrderDelivery***  Indicates whether or not *outOfOrderDelivery* specified in TS 38.323 [5] is configured. Out-of-order delivery is configured only when the radio bearer is established |
| ***pdcp-Duplication***  Indicates whether or not uplink duplication is configured as specified in TS 38.323 [5]. This field is absent in this version of the specification. |
| ***pdcp-SN-Size***  PDCP sequence number size, 12 or 18 bits. |
| ***primaryPath***  Indicates the cell group ID and LCID of the primary RLC entity as specified in TS 38.323 clause 5.2.1 for UL data tranmission when more than one RLC entity is associated with the PDCP entity. In this version of the specification, only cell group ID corresponding to MCG is supported for SRBs. |
| ***pdcp-SN-Size***  PDCP sequence number size, 12 or 18 bits. |
| ***statusReportRequired***  For AM DRBs, indicates whether the DRB is configured to send a PDCP status report in the uplink, as specified in TS 38.323 [5]. For UL DRBs, the value shall be ignored by the UE. |
| ***t-Reordering***  Value in ms of t-Reordering specified in TS 38.323 [5]. Value ms0 corresponds to 0ms, value ms20 corresponds to 20ms, value ms40 corresponds to 40ms, and so on. When the field is absent the UE applies the value *infinity*. |
| ***ul-DataSplitThreshold***  Parameter specified in TS 38.323 [5]. Value b0 corresponds to 0 bits, value b100 corresponds to 100 bits, value b200 corresponds to 200 bits, and so on. |
|  |

| *Conditional presence* | Explanation |
| --- | --- |
| *DRB* | This field is mandatory present when the corresponding DRB is being set up, not present for SRBs. Otherwise this field is optionally present, need M. |
| *MoreThanOneRLC* | This field is mandatory present upon RRC reconfiguration with setup of a PDCP entity for a radio bearer with more than one associated logical channel and upon RRC reconfiguration with the association of an additional logical channel to the PDCP entity.  Upon RRC reconfiguration when a PDCP entity is associated with multiple logical channels, this field is optionally present need M. Otherwise, this field is absent and all its included parameters are released. |
| *Rlc-AM* | The field is mandatory present upon setup of a PDCP entity for a radio bearer configured with RLC AM. Otherwise, the field is optionally present, need R. |
| *Setup* | The field is mandatory present in case of radio bearer setup. Otherwise the field is optionally present, need M. |
| *SplitBearer* | The field is optional present, need M, in case of radio bearer with more than one associated RLC mapped to different cell groups. Otherwise the field is not present and the UE shall delete any existing value for this field. |
| *ConnectedTo5GC* | The field is optionally present, need R, if EN-DC is not configured, and absent if EN-DC is configured. |
| *Setup2* | This field is mandatory present in case for radio bearer setup for RLC-AM and RLC-UM. This field is optionally present in case for handover and reestablishment for for RLC-UM..Otherwise, ths field is not present. |

#### – *PDSCH-Config*

The *PDSCH-Config* IE is used to configure the UE specific PDSCH parameters.

*PDSCH-Config* information element

-- ASN1START

-- TAG-PDSCH-CONFIG-START

PDSCH-Config ::= SEQUENCE {

-- Identifer used to initalite data scrambling (c\_init) for both PDSCH.

-- Corresponds to L1 parameter 'Data-scrambling-Identity' (see 38,214, section FFS\_Section)

-- FFS:\_Replace by tye ScramblingId used in other places?

dataScramblingIdentityPDSCH INTEGER (0..1007) OPTIONAL,

-- DMRS configuration for PDSCH transmissions using PDSCH mapping type A (chosen dynamically via PDSCH-TimeDomainResourceAllocation).

dmrs-DownlinkForPDSCH-MappingTypeA SetupRelease { DMRS-DownlinkConfig } OPTIONAL, -- Need M

-- DMRS configuration for PDSCH transmissions using PDSCH mapping type B (chosen dynamically via PDSCH-TimeDomainResourceAllocation).

dmrs-DownlinkForPDSCH-MappingTypeB SetupRelease { DMRS-DownlinkConfig } OPTIONAL, -- Need M

-- A list of Transmission Configuration Indicator (TCI) states for dynamically indicating (over DCI) a transmission configuration

-- which includes QCL-relationships between the DL RSs in one RS set and the PDSCH DMRS ports

-- (see 38.214, section 5.1.4)

tci-StatesToAddModList SEQUENCE (SIZE(1..maxNrofTCI-States)) OF TCI-State OPTIONAL, -- Need N

tci-StatesToReleaseList SEQUENCE (SIZE(1..maxNrofTCI-States)) OF TCI-StateId OPTIONAL, -- Need N

-- Interleaving unit configurable between 2 and 4 PRBs

-- Corresponds to L1 parameter 'VRB-to-PRB-interleaver' (see 38.211, section 6.3.1.6)

vrb-ToPRB-Interleaver ENUMERATED {n2, n4},

-- Configuration of resource allocation type 0 and resource allocation type 1 for non-fallback DCI

-- Corresponds to L1 parameter 'Resouce-allocation-config' (see 38.214, section 5.1.2)

resourceAllocation ENUMERATED { resourceAllocationType0,

resourceAllocationType1,

dynamicSwitch},

-- List of time-domain configurations for timing of DL assignment to DL data. If configured, the values provided herein

-- override the values received in corresponding PDSCH-ConfigCommon.

pdsch-AllocationList SEQUENCE (SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation OPTIONAL, -- Need R

-- Number of repetitions for data. Corresponds to L1 parameter 'aggregation-factor-DL' (see 38.214, section FFS\_Section)

-- When the field is absent the UE applies the value 1

pdsch-AggregationFactor ENUMERATED { n2, n4, n8 } OPTIONAL, -- Need S

-- Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources

-- indicated in the nexted bitmaps. Corresponds to L1 parameter 'Resource-set-BWP' (see 38.214, section 5.1.2.2.3)

-- FFS: RAN1 indicates that there should be a set of patterns per cell and one per BWP => Having both seems unnecessary.

rateMatchPatternToAddModList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern OPTIONAL, -- Need N

rateMatchPatternToReleaseList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need N

-- The IDs of a first group of RateMatchPatterns defined in the rateMatchPatternToAddModList.

-- Corresponds to L1 parameter 'Resource-set-group-1'. (see 38.214, section FFS\_Section)

rateMatchPatternGroup1 SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need R

-- The IDs of a second group of RateMatchPatterns defined in the rateMatchPatternToAddModList

-- Corresponds to L1 parameter 'Resource-set-group-2'. (see 38.214, section FFS\_Section)

rateMatchPatternGroup2 SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need R

-- Selection between config 1 and config 2 for RBG size for PDSCH. Corresponds to L1 parameter 'RBG-size-PDSCH' (see 38.214, section 5.1.2.2.1)

rbg-Size ENUMERATED {config1, config2},

-- Indicates which MCS table the UE shall use for PDSCH. Corresponds to L1 parameter 'MCS-Table-PDSCH' (see 38.214, section 5.1.3.1).

mcs-Table ENUMERATED {qam64, qam256},

-- Maximum number of code words that a single DCI may schedule. This changes the number of MCS/RV/NDI bits in the DCI message from 1 to 2.

maxNrofCodeWordsScheduledByDCI ENUMERATED {n1, n2} OPTIONAL, -- Need R

-- Indicates the PRB bundle type and bundle size(s). If "dynamic" is chosen, the actual BundleSizeSet to use is indicated via DCI.

-- If a bundleSize(Set) value is absent, the UE applies the value n2. Corresponds to L1 parameter 'PRB\_bundling'

-- (see 38.214, section 5.1.2.3)

prb-BundlingType CHOICE {

static SEQUENCE {

bundleSize ENUMERATED { n4, wideband } OPTIONAL -- Need S

},

dynamic SEQUENCE {

bundleSizeSet1 ENUMERATED { n4, wideband, n2-wideband, n4-wideband } OPTIONAL, -- Need S

bundleSizeSet2 ENUMERATED { n4, wideband } OPTIONAL -- Need S

}

},

-- A list of Zero-Power (ZP) CSI-RS resources used for PDSCH rate-matching.

-- Corresponds to L1 parameter 'ZP-CSI-RS-ResourceConfigList' (see 38.214, section FFS\_Section)

zp-CSI-RS-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Resources)) OF ZP-CSI-RS-Resource OPTIONAL, -- Need N

zp-CSI-RS-ResourceToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Resources)) OF ZP-CSI-RS-ResourceId OPTIONAL, -- Need M

-- A list of sets. Each set contains a set-ID and the IDs of one or more ZP-CSI-RS-Resources (the actual resources are defined in the

-- zp-CSI-RS-ResourceToAddModList). The network triggers a set by indicating its set-ID (ZP-CSI-RS-ResourceSetId) in the DCI payload.

-- The resources referenced in these sets are confgiured with resourceType 'aperiodic'.

-- Corresponds to L1 parameter ' ZP-CSI-RS-ResourceSetConfigList' (see 38.214, section FFS\_Section)

aperiodic-ZP-CSI-RS-ResourceSetsToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Sets)) OF ZP-CSI-RS-ResourceSet OPTIONAL, -- Need N

aperiodic-ZP-CSI-RS-ResourceSetsToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Sets)) OF ZP-CSI-RS-ResourceSetId OPTIONAL, -- Need N

-- A list of sets. Each set contains a set-ID and the IDs of one or more ZP-CSI-RS-Resources (the actual resources are defined in the

-- zp-CSI-RS-ResourceToAddModList). The network triggers a set by indicating its set-ID (ZP-CSI-RS-ResourceSetId) in the MAC CE.

-- The resources referenced in these sets are confgiured with resourceType 'semi-persistent'.

-- Corresponds to L1 parameter 'SP-ZP-CSI-RS-Resource-List' (see 38.214, section 5.1.4\_Section)

sp-ZP-CSI-RS-ResourceSetsToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Sets)) OF ZP-CSI-RS-ResourceSet OPTIONAL, -- Need N

sp-ZP-CSI-RS-ResourceSetsToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Sets)) OF ZP-CSI-RS-ResourceSetId OPTIONAL, -- Need N

...

}

-- TAG-PDSCH-CONFIG-STOP

-- ASN1STOP

#### – *PDSCH-ConfigCommon*

The IE *PDSCH-ConfigCommon* is used to configure FFS

*PDSCH-ConfigCommon* information element

-- ASN1START

-- TAG-PDSCH-CONFIGCOMMON-START

PDSCH-ConfigCommon ::= SEQUENCE {

-- List of time-domain configurations for timing of DL assignment to DL data

pdsch-AllocationList SEQUENCE (SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation OPTIONAL, -- Need R

...

}

-- TAG-PDSCH-CONFIGCOMMON-STOP

-- ASN1STOP

#### – *PDSCH-ServingCellConfig*

The IE *PDSCH-ServingCellConfig* is used to configure UE specific PDSCH parameters that are common across the UE's BWPs of one serving cell.

*PDSCH-ServingCellConfig* information element

-- ASN1START

-- TAG-PDSCH-SERVINGCELLCONFIG-START

PDSCH-ServingCellConfig ::= SEQUENCE {

-- Enables and configures code-block-group (CBG) based transmission (see 38.213, section 9.1.1)

codeBlockGroupTransmission SetupRelease { PDSCH-CodeBlockGroupTransmission } OPTIONAL, -- Need M

-- Accounts for overhead from CSI-RS, CORESET, etc. If the field is absent, the UE applies value xOh0.

-- Corresponds to L1 parameter 'Xoh-PDSCH' (see 38.214, section 5.1.3.2)

xOverhead ENUMERATED { xOh6, xOh12, xOh18 } OPTIONAL, -- Need S

-- The number of HARQ processes to be used on the PDSCH of a serving cell. n2 corresponds to 2 HARQ processes, n4 to 4 HARQ processes

-- and so on. If the field is absent, the UE uses 8 HARQ processes.

-- Corresponds to L1 parameter 'number-HARQ-process-PDSCH' (see 38.214, section REF)

nrofHARQ-ProcessesForPDSCH ENUMERATED {n2, n4, n6, n10, n12, n16} OPTIONAL, -- Need S

-- The ID of the serving cell (of the same cell group) to use for PUCCH.

-- If the field is absent, the UE sends the HARQ feedback on the PUCCH of the SpCell of this cell group.

pucch-Cell ServCellIndex OPTIONAL , -- Cond SCellAddOnly

...

}

PDSCH-CodeBlockGroupTransmission ::= SEQUENCE {

-- Maximum number of code-block-groups (CBGs) per TB. In case of multiple CW the maximum CBG is 4 (see 38.213, section 9.1.1)

maxCodeBlockGroupsPerTransportBlock ENUMERATED {n2, n4, n6, n8},

-- Indicates whether CBGFI for CBG based (re)transmission in DL is enabled (true). (see 38.212, section 7.3.1.2.2)

codeBlockGroupFlushIndicator BOOLEAN,

...

}

-- TAG-PDSCH-SERVINGCELLCONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *SCellAddOnly* | It is optionally present, Need M, for SCells when adding a new SCell. The field is absent when reconfiguring SCells. The field is also absent for the SpCells. |

#### – *PDSCH-TimeDomainResourceAllocation*

The IE *PDSCH-TimeDomainResourceAllocation* is used to configure a time domain relation between PDCCH and PDSCH.

*PDSCH-TimeDomainResourceAllocation* information element

-- ASN1START

-- TAG-PDSCH-TIMEDOMAINRESOURCEALLOCATION-START

PDSCH-TimeDomainResourceAllocation ::= SEQUENCE {

-- Corresponds to L1 parameter 'K0' (see 38.214, section FFS\_Section)

-- When the field is absent the UE applies the value 0

k0 INTEGER (1..3) OPTIONAL, -- Need S

-- PDSCH mapping type. Corresponds to L1 parameter 'Mapping-type' (see 38.214, section FFS\_Section)

mappingType ENUMERATED {typeA, typeB},

-- An index into a table/equation in RAN1 specs capturing valid combinations of start symbol and length (jointly encoded)

-- Corresponds to L1 parameter 'Index-start-len' (see 38.214, section FFS\_Section)

startSymbolAndLength BIT STRING (SIZE (7))

}

-- TAG-PDSCH-TIMEDOMAINRESOURCEALLOCATION-STOP

-- ASN1STOP

#### – *PhysCellId*

The *PhysCellId* identifies the physical cell identity (PCI).

*PhysCellId* information element

-- ASN1START

-- TAG-PHYS-CELL-ID-START

PhysCellId ::= INTEGER (0..1007)

-- TAG-PHYS-CELL-ID-STOP

-- ASN1STOP

#### – *PRB-Id*

The *PRB-Id* indentifies a Physical Resource Block (PRB) position within a carrier.

*PRB-Id* information element

-- ASN1START

-- TAG-PRB-ID-START

PRB-Id ::= INTEGER (0..maxNrofPhysicalResourceBlocks-1)

-- TAG-PRB-ID-STOP

-- ASN1STOP

#### – *PTRS-DownlinkConfig*

The IE *PTRS-DownlinkConfig* is used to configure downlink phase tracking reference signals (PTRS) (see 38.214 section5.1.6.3)

*PTRS-DownlinkConfig* information element

-- ASN1START

-- TAG-PTRS-DOWNLINKCONFIG-START

PTRS-DownlinkConfig ::= SEQUENCE {

-- Presence and frequency density of DL PT-RS as a function of Scheduled BW

-- If the field is absent, the UE uses K\_PT-RS = 2.

-- Corresponds to L1 parameter 'DL-PTRS-frequency-density-table' (see 38.214, section 5.1)

frequencyDensity SEQUENCE (SIZE (2)) OF INTEGER (1..276) OPTIONAL, -- Need S

-- Presence and time density of DL PT-RS as a function of MCS. The value 29 is only applicable for MCS Table 5.1.3.1-1 (38.214)

-- If the field is absent, the UE uses L\_PT-RS = 1.

-- Corresponds to L1 parameter 'DL-PTRS-time-density-table' (see 38.214, section 5.1)

timeDensity SEQUENCE (SIZE (3)) OF INTEGER (0..29) OPTIONAL, -- Need S

-- EPRE ratio between PTRS and PDSCH. Value 0 correspond to the codepoint ”00” in table 4.1-2. Value 1 corresponds to codepoint ”01”

-- If the field is not provided, the UE applies value 0. Corresponds to L1 parameter 'DL-PTRS-EPRE-ratio' (see 38.214, section 4.1)

epre-RatioPort1 INTEGER (0..3) OPTIONAL, -- Need S

-- EPRE ratio between PTRS and PDSCH. Value 0 correspond to the codepoint ”00” in table 4.1-2. Value 1 corresponds to codepoint ”01”.

-- If the field is not provided, the UE applies value 0. Corresponds to L1 parameter 'DL-PTRS-EPRE-ratio' (see 38.214, section 4.1)

epre-RatioPort2 SEQUENCE (SIZE (1..2)) OF INTEGER (0..3) OPTIONAL, -- Cond TwoPorts

-- Indicates the subcarrier offset for DL PTRS. If the field is absent, the UE applies the value offset00.

-- Corresponds to L1 parameter 'DL-PTRS-RE-offset' (see 38.214, section 5.1.6.3)

resourceElementOffset ENUMERATED { offset01, offset10, offset11 } OPTIONAL, -- Need S

...

}

-- TAG-PTRS-DOWNLINKCONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *TwoPorts* | The field is optionally present, Need S, when the field *nrofPTRS-Ports* in at least one TCI-State (see PDSCH-Config) is set to n2. Otherwise the field is absent. |

#### – *PTRS-UplinkConfig*

The IE *PTRS-UplinkConfig* is used to configure uplink Phase-Tracking-Reference-Signals (PTRS).

*PTRS-UplinkConfig* information element

-- ASN1START

-- TAG-PTRS-UPLINKCONFIG-START

PTRS-UplinkConfig ::= SEQUENCE {

modeSpecificParameters CHOICE {

-- Configuration of UL PTRS for CP-OFDM

cp-OFDM SEQUENCE {

-- Presence and frequency density of UL PT-RS for CP-OFDM waveform as a function of scheduled BW

-- If the field is absent, the UE uses K\_PT-RS = 2.

-- Corresponds to L1 parameter 'UL-PTRS-frequency-density-table' (see 38.214, section 6.1)

frequencyDensity SEQUENCE (SIZE (2)) OF INTEGER (1..276) OPTIONAL, -- Need S

-- Presence and time density of UL PT-RS for CP-OFDM waveform as a function of MCS

-- If the field is absent, the UE uses L\_PT-RS = 1.

-- Corresponds to L1 parameter 'UL-PTRS-time-density-table' (see 38.214, section 6.1)

timeDensity SEQUENCE (SIZE (3)) OF INTEGER (0..29) OPTIONAL, -- Need S

-- The maximum number of UL PTRS ports for CP-OFDM.

-- Corresponds to L1 parameter 'UL-PTRS-ports' (see 38.214, section 6.2.3.1)

maxNrofPorts ENUMERATED {n1, n2},

-- Indicates the subcarrier offset for UL PTRS for CP-OFDM.

-- Corresponds to L1 parameter 'UL-PTRS-RE-offset' (see 38.214, section 6.1)

resourceElementOffset ENUMERATED {offset01, offset10, offset11 } OPTIONAL, -- Need S

-- UL PTRS power boosting factor per PTRS port. Corresponds to L1 parameter 'UL-PTRS-power' (see 38.214, section 6.1, table 6.2.3-5)

ptrs-Power ENUMERATED {p00, p01, p10, p11}

},

-- Configuration of UL PTRS for DFT-S-OFDM.

dft-S-OFDM SEQUENCE {

-- Sample density of PT-RS for DFT-s-OFDM, pre-DFT, indicating a set of thresholds T={NRBn,n=0,1,2,3,4},

-- that indicates dependency between presence of PT-RS and scheduled BW and the values of X and K the UE should

-- use depending on the scheduled BW according to the table in 38.214 FFS\_Section.

-- Corresponds to L1 parameter 'UL-PTRS-pre-DFT-density' (see 38.214, section 6.1, 6.2.3-3)

sampleDensity SEQUENCE (SIZE (5)) OF INTEGER (1..276),

-- Time density (OFDM symbol level) of PT-RS for DFT-s-OFDM. If the value is absent, the UE applies value d1.

-- Corresponds to L1 parameter 'UL-PTRS-time-density-transform-precoding' (see 38.214, section 6.1)

timeDensity ENUMERATED {d2} OPTIONAL -- Need S

}

} OPTIONAL, -- Cond M

...

}

-- TAG-PTRS-UPLINKCONFIG-STOP

-- ASN1STOP

#### – *PUCCH-Config*

The IE *PUCCH-Config* is used to configure UE specific PUCCH parameters (per BWP).

*PUCCH-Config* information element

-- ASN1START

-- TAG-PUCCH-CONFIG-START

PUCCH-Config ::= SEQUENCE {

-- Lists for adding and releasing PUCCH resource sets (see 38.213, section 9.2)

resourceSetToAddModList SEQUENCE (SIZE (1..maxNrofPUCCH-ResourceSets)) OF PUCCH-ResourceSet OPTIONAL, -- Need N

resourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofPUCCH-ResourceSets)) OF PUCCH-ResourceSetId OPTIONAL, -- Need N

-- Lists for adding and releasing PUCCH resources applicable for the UL BWP and serving cell in which the PUCCH-Config

-- is defined. The resources defined herein are referred to from other parts of the configuration to determine which

-- resource the UE shall use for which report.

resourceToAddModList SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-Resource OPTIONAL, -- Need N

resourceToReleaseList SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-ResourceId OPTIONAL, -- Need N

-- Parameters that are common for all PUCCH resources of format 1

format1 SetupRelease { PUCCH-FormatConfig } OPTIONAL, -- Need M

-- Parameters that are common for all PUCCH resources of format 2

format2 SetupRelease { PUCCH-FormatConfig } OPTIONAL, -- Need M

-- Parameters that are common for all PUCCH resources of format 3

format3 SetupRelease { PUCCH-FormatConfig } OPTIONAL, -- Need M

-- Parameters that are common for all PUCCH resources of format 4

format4 SetupRelease { PUCCH-FormatConfig } OPTIONAL, -- Need M

schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig OPTIONAL, -- Need M

schedulingRequestResourceToReleaseList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceId OPTIONAL, -- Need M

multi-CSI-PUCCH-ResourceList SEQUENCE (SIZE (1..2)) OF PUCCH-ResourceId OPTIONAL,-- Need M

-- List of timiing for given PDSCH to the DL ACK. In this version of the specification only the values [0..8] are applicable.

-- Corresponds to L1 parameter 'Slot-timing-value-K1' (see 38.213, section FFS\_Section)

dl-DataToUL-ACK SEQUENCE (SIZE (8)) OF INTEGER (0..15) OPTIONAL, -- Need M

-- Configuration of the spatial relation between a reference RS and PUCCH. Reference RS can be SSB/CSI-RS/SRS.

-- If the list has more than one element, MAC-CE selects a single element (see 38.321, section FFS\_Section).

-- Corresponds to L1 parameter 'PUCCH-SpatialRelationInfo' (see 38.213, section FFS\_Section)

spatialRelationInfoToAddModList SEQUENCE (SIZE (1..maxNrofSpatialRelationInfos)) OF PUCCH-SpatialRelationInfo OPTIONAL, -- Need N

spatialRelationInfoToReleaseList SEQUENCE (SIZE (1..maxNrofSpatialRelationInfos)) OF PUCCH-SpatialRelationInfoId OPTIONAL, -- Need N

pucch-PowerControl PUCCH-PowerControl OPTIONAL, -- Need M

...

}

PUCCH-FormatConfig ::= SEQUENCE {

-- Enabling inter-slot frequency hopping when PUCCH Format 1, 3 or 4 is repetead over multiple slots.

-- The field is not applicable for format 2.

interslotFrequencyHopping ENUMERATED {enabled} OPTIONAL, -- Need R

-- Enabling 2 DMRS symbols per hop of a PUCCH Format 3 or 4 if both hops are more than X symbols when FH is enabled (X=4).

-- Enabling 4 DMRS sybmols for a PUCCH Format 3 or 4 with more than 2X+1 symbols when FH is disabled (X=4).

-- Corresponds to L1 parameter 'PUCCH-F3-F4-additional-DMRS' (see 38.213, section 9.2.1)

-- The field is not applicable for format 1 and 2.

additionalDMRS ENUMERATED {true} OPTIONAL, -- Need R

-- Max coding rate to determine how to feedback UCI on PUCCH for format 2, 3 or 4

-- Corresponds to L1 parameter 'PUCCH-F2-maximum-coderate', 'PUCCH-F3-maximum-coderate' and 'PUCCH-F4-maximum-coderate'

-- (see 38.213, section 9.2.5)

-- The field is not applicable for format 1.

maxCodeRate PUCCH-MaxCodeRate OPTIONAL, -- Need R

-- Number of slots with the same PUCCH F1, F3 or F4. When the field is absent the UE applies the value n1.

-- Corresponds to L1 parameter 'PUCCH-F1-number-of-slots', 'PUCCH-F3-number-of-slots' and 'PUCCH-F4-number-of-slots'

-- (see 38.213, section 9.2.6)

-- The field is not applicable for format 2.

nrofSlots ENUMERATED {n2,n4,n8} OPTIONAL, -- Need S

-- Enabling pi/2 BPSK for UCI symbols instead of QPSK for PUCCH.

-- Corresponds to L1 parameter 'PUCCH-PF3-PF4-pi/2PBSK' (see 38.213, section 9.2.5)

-- The field is not applicable for format 1 and 2.

pi2PBSK ENUMERATED {enabled} OPTIONAL, -- Need R

-- Enabling simultaneous transmission of CSI and HARQ-ACK feedback with or without SR with PUCCH Format 2, 3 or 4

-- Corresponds to L1 parameter 'PUCCH-F2-Simultaneous-HARQ-ACK-CSI', 'PUCCH-F3-Simultaneous-HARQ-ACK-CSI' and

-- 'PUCCH-F4-Simultaneous-HARQ-ACK-CSI' (see 38.213, section 9.2.5)

-- When the field is absent the UE applies the value OFF

-- The field is not applicable for format 1.

simultaneousHARQ-ACK-CSI ENUMERATED {true} OPTIONAL -- Need R

}

PUCCH-MaxCodeRate ::= ENUMERATED {zeroDot08, zeroDot15, zeroDot25, zeroDot35, zeroDot45, zeroDot60, zeroDot80}

PUCCH-SpatialRelationInfo ::= SEQUENCE {

pucch-SpatialRelationInfoId PUCCH-SpatialRelationInfoId,

referenceSignal CHOICE {

ssb-Index SSB-Index,

csi-RS-Index NZP-CSI-RS-ResourceId,

srs SRS-ResourceId

},

pucch-PathlossReferenceRS-Id PUCCH-PathlossReferenceRS-Id,

p0-PUCCH-Id P0-PUCCH-Id,

closedLoopIndex ENUMERATED { i0, i1 }

}

PUCCH-SpatialRelationInfoId ::= INTEGER (1..maxNrofSpatialRelationInfos)

-- A set with one or more PUCCH resources

PUCCH-ResourceSet ::= SEQUENCE {

pucch-ResourceSetId PUCCH-ResourceSetId,

-- PUCCH resources of format0 and format1 are only allowed in the first PUCCH reosurce set,

-- i.e., in a PUCCH-ResourceSet with pucch-ResourceSetId = 0. This set may contain between 8 and 32 resources.

-- PUCCH resources of format2, format3 and format4 are only allowed in a PUCCH-ReosurceSet with pucch-ResourceSetId > 0. If present, these sets must contain 8 resources each.

-- The UE chooses a PUCCH-Resource from this list based on the 3-bit PUCCH resource indicator field in DCI as

-- speciied in 38.213, FFS\_section.

-- Note that this list contains only a list of resource IDs. The actual resources are configured in PUCCH-Config.

resources SEQUENCE (SIZE (8..maxNrofPUCCH-ResourcesPerSet)) OF PUCCH-ResourceId,

-- Maximum number of payload bits minus 1 that the UE may transmit using this PUCCH resource set. In a PUCCH occurrence, the UE

-- chooses the first of its PUCCH-ResourceSet which supports the number of bits that the UE wants to transmit.

-- The field is not present in the first set (Set0) since the maximum Size of Set0 is specified to be 3 bit.

-- The field is not present in the last configured set since the UE derives its maximum payload size as specified in 38.213.

-- This field can take integer values that are multiples of 4. Corresponds to L1 parameter 'N\_2' or 'N\_3' (see 38.213, section 9.2)

maxPayloadMinus1 INTEGER (4..256) OPTIONAL -- Need R

}

PUCCH-ResourceSetId ::= INTEGER (0..maxNrofPUCCH-ResourceSets-1)

PUCCH-Resource ::= SEQUENCE {

pucch-ResourceId PUCCH-ResourceId,

startingPRB PRB-Id,

-- Corresponds to the L1 parameter 'PUCCH-frequency-hopping' (see 38.213, section 9.2)

intraSlotFrequencyHopping ENUMERATED { enabled } OPTIONAL, -- Need R

-- Index of starting PRB for second hop of PUCCH in case of FH. This value is appliable for intra-slot frequency hopping.

-- Corresponds to L1 parameter 'PUCCH-2nd-hop-PRB' (see 38.213, section 9.2)

secondHopPRB PRB-Id OPTIONAL, -- Need R

-- Selection of the PUCCH format and format-specific parameters

format CHOICE {

format0 PUCCH-format0, -- Cond InFirstSetOnly

format1 PUCCH-format1, -- Cond InFirstSetOnly

format2 PUCCH-format2, -- Cond NotInFirstSet

format3 PUCCH-format3, -- Cond NotInFirstSet

format4 PUCCH-format4 -- Cond NotInFirstSet

}

}

PUCCH-ResourceId ::= INTEGER (0..maxNrofPUCCH-Resources-1)

-- A PUCCH Format 0 resource configuration (see 38.213, section 9.2)

-- Corresponds to L1 parameter 'PUCCH-format0' (see 38.213, section 9.2.1)

PUCCH-format0 ::= SEQUENCE {

initialCyclicShift INTEGER(0..11),

nrofSymbols INTEGER (1..2),

startingSymbolIndex INTEGER(0..13)

}

-- A PUCCH Format 1 resource configuration (see 38.213, section 9.2)

-- Corresponds to L1 parameter 'PUCCH-format1' (see 38.213, section 9.2.1)

PUCCH-format1 ::= SEQUENCE {

initialCyclicShift INTEGER(0..11),

nrofSymbols INTEGER (4..14),

startingSymbolIndex INTEGER(0..10),

timeDomainOCC INTEGER(0..6)

}

-- A PUCCH Format 2 resource configuration (see 38.213, section 9.2)

-- Corresponds to L1 parameter 'PUCCH-format2onfig' (see 38.213, section 9.2.1)

PUCCH-format2 ::= SEQUENCE {

nrofPRBs INTEGER (1..16),

nrofSymbols INTEGER (1..2),

startingSymbolIndex INTEGER(0..13)

}

-- A PUCCH Format 3 resource configuration(see 38.213, section 9.2)

-- Corresponds to L1 parameter 'PUCCH-format3' (see 38.213, section 9.2.1)

PUCCH-format3 ::= SEQUENCE {

-- The supported values are 1,2,3,4,5,6,8,9,10,12,15 and 16

nrofPRBs INTEGER (1..16),

nrofSymbols INTEGER (4..14),

startingSymbolIndex INTEGER(0..10)

}

-- A PUCCH Format 4 resource configuration (see 38.213, section 9.2)

-- Corresponds to L1 parameter 'PUCCH-format4' (see 38.213, section 9.2.1)

PUCCH-format4 ::= SEQUENCE {

nrofSymbols INTEGER (4..14),

occ-Length ENUMERATED {n2,n4},

occ-Index ENUMERATED {n0,n1,n2,n3},

startingSymbolIndex INTEGER(0..10)

}

-- TAG-PUCCH-CONFIG-STOP

-- ASN1STOP

#### – *PUCCH-ConfigCommon*

The *PUCCH-ConfigCommon* IE is used to configure the cell specific PUCCH parameters.

*PUCCH-ConfigCommon* information element

-- ASN1START

-- TAG-PUCCH-CONFIGCOMMON-START

PUCCH-ConfigCommon ::= SEQUENCE {

-- An entry into a 16-row table where each row configures a set of cell-specific PUCCH resources/parameters. The UE uses

-- those PUCCH resources during initial access on the initial uplink BWP. Once the network provides a dedicated PUCCH-Config

-- for that bandwidth part the UE applies that one instead of the one provided in this field.

-- Corresponds to L1 parameter 'PUCCH-resource-common' (see 38.213, section 9.2)

pucch-ResourceCommon BIT STRING (SIZE (4)) OPTIONAL, -- Need R

-- Configuration of group- and sequence hopping for all the PUCCH formats 0, 1, 3 and 4. "neither" implies neither group

-- or sequence hopping is enabled. "enable" enables group hopping and disables sequence hopping. "disable"” disables group

-- hopping and enables sequence hopping. Corresponds to L1 parameter 'PUCCH-GroupHopping' (see 38.211, section 6.4.1.3)

pucch-GroupHopping ENUMERATED { neither, enable, disable },

-- Cell-Specific scrambling ID for group hoppping and sequence hopping if enabled.

-- Corresponds to L1 parameter 'HoppingID' (see 38.211, section 6.3.2.2)

hoppingId BIT STRING (SIZE (10)) OPTIONAL, -- Need R

-- Power control parameter P0 for PUCCH transmissions. Value in dBm. Only even values (step size 2) allowed.

-- Corresponds to L1 parameter 'p0-nominal-pucch' (see 38.213, section 7.2)

p0-nominal INTEGER (-202..24) OPTIONAL, -- Need R

...

}

-- TAG-PUCCH-CONFIGCOMMON-STOP

-- ASN1STOP

#### – *PUCCH-PowerControl*

The IE *PUCCH-PowerControl* is used to configure FFS

*PUCCH-PowerControl* information element

-- ASN1START

-- TAG-PUCCH-POWERCONTROL-START

PUCCH-PowerControl ::= SEQUENCE {

-- deltaF for PUCCH format 0 with 1dB step size (see 38.213, section 7.2)

deltaF-PUCCH-f0 INTEGER (-16..15) OPTIONAL, -- Need R

-- deltaF for PUCCH format 1 with 1dB step size (see 38.213, section 7.2)

deltaF-PUCCH-f1 INTEGER (-16..15) OPTIONAL, -- Need R

-- deltaF for PUCCH format 2 with 1dB step size (see 38.213, section 7.2)

deltaF-PUCCH-f2 INTEGER (-16..15) OPTIONAL, -- Need R

-- deltaF for PUCCH format 3 with 1dB step size (see 38.213, section 7.2)

deltaF-PUCCH-f3 INTEGER (-16..15) OPTIONAL, -- Need R

-- deltaF for PUCCH format 4 with 1dB step size (see 38.213, section 7.2)

deltaF-PUCCH-f4 INTEGER (-16..15) OPTIONAL, -- Need R

-- A set with dedicated P0 values for PUCCH, i.e., {P01, P02,... }. Corresponds to L1 parameter 'p0-pucch-set' (see 38.213, section 7.2)

p0-Set SEQUENCE (SIZE (1..maxNrofPUCCH-P0-PerSet)) OF P0-PUCCH OPTIONAL, -- Need M

-- A set of Reference Signals (e.g. a CSI-RS config or a SSblock) to be used for PUCCH pathloss estimation.

-- Up to maxNrofPUCCH-PathlossReference-RSs may be configured

-- FFS\_CHECK: Is it possible not to configure it at all? What does the UE use then? Any SSB?

-- Corresponds to L1 parameter 'pucch-pathlossReference-rs-config' (see 38.213, section 7.2)

pathlossReferenceRSs SEQUENCE (SIZE (1..maxNrofPUCCH-PathlossReferenceRSs)) OF PUCCH-PathlossReferenceRS OPTIONAL, -- Need M

-- Number of PUCCH power control adjustment states maintained by the UE (i.e., g(i)). If the field is present (n2) the UE maintains

-- two power control states (i.e., g(i,0) and g(i,1)). Otherwise, it applies one (i.e., g(i,0)).

-- Corresponds to L1 parameter 'num-pucch-pcadjustment-states' (see 38.213, section 7.2)

twoPUCCH-PC-AdjustmentStates ENUMERATED {twoStates} OPTIONAL, -- Need R

...

}

-- P0 value for PUCCH. Corresponds to L1 parameter 'p0-pucch' (see 3,213, section 7.2)

P0-PUCCH ::= SEQUENCE {

p0-PUCCH-Id P0-PUCCH-Id,

-- P0 value for PUCCH with 1dB step size.

p0-PUCCH-Value INTEGER (-16..15)

}

P0-PUCCH-Id ::= INTEGER (1..8)

-- A reference signal (RS) configured as pathloss reference signal for PUCCH power control

-- Corresponds to L1 parameter 'pucch-pathlossReference-rs' (see 38.213, section 7.2)

PUCCH-PathlossReferenceRS ::= SEQUENCE {

pucch-PathlossReferenceRS-Id PUCCH-PathlossReferenceRS-Id,

referenceSignal CHOICE {

ssb-Index SSB-Index,

csi-RS-Index NZP-CSI-RS-ResourceId

}

}

-- ID for a referemce signal (RS) configured as PUCCH pathloss reference

-- Corresponds to L1 parameter 'pucch-pathlossreference-index' (see 38.213, section 7.2)

-- FFS\_CHECK: Is this ID used anywhere except inside the PUCCH-PathlossReference-RS itself? If not, remove.

PUCCH-PathlossReferenceRS-Id ::= INTEGER (0..maxNrofPUCCH-PathlossReferenceRSs-1)

-- TAG-PUCCH-POWERCONTROL-STOP

-- ASN1STOP

#### – *PUCCH-TPC-CommandConfig*

The IE *PUCCH-TPC-CommandConfig* is used to configure the UE for extracting TPC commands for PUCCH from a group-TPC messages on DCI.

*PUCCH-TPC-CommandConfig* information element

-- ASN1START

-- TAG-PUCCH-TPC-COMMANDCONFIG-START

PUCCH-TPC-CommandConfig ::= SEQUENCE {

-- An index determining the position of the first bit of TPC command (applicable to the SpCell) inside the DCI format 2-2 payload.

tpc-IndexPCell INTEGER (1..15) OPTIONAL, -- Cond PUCCH-SCell

-- An index determining the position of the first bit of TPC command (applicable to the PUCCH-SCell) inside the DCI format 2-2 payload.

tpc-IndexPUCCH-SCell INTEGER (1..15) OPTIONAL, -- Cond PUCCH-SCellOnly

...

}

-- TAG-PUCCH-TPC-COMMANDCONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *PUCCH-SCellOnly* | The field is optionally present, need R, when the UE is configured with a PUCCH-SCell in this cell group. Otherwise, the field is absent. |
| *PUCCH-SCell* | The field is mandatory present if the UE is configured without PUCCH-SCell in this cell group. Otherwise, the field is optionally present, Need R. |

#### – *PUSCH-Config*

The IE *PUSCH-Config* is used to configure the UE specific PUSCH parameters applicable to a particular BWP.

*PUSCH-Config* information element

-- ASN1START

-- TAG-PUSCH-CONFIG-START

PUSCH-Config ::= SEQUENCE {

-- Identifer used to initalite data scrambling (c\_init) for both PUSCH.

-- Corresponds to L1 parameter 'Data-scrambling-Identity' (see 38,214, section FFS\_Section)

dataScramblingIdentityPUSCH INTEGER (0..1007) OPTIONAL, -- Need M

-- Whether UE uses codebook based or non-codebook based transmission. Corresponds to L1 parameter 'ulTxConfig' (see 38.214, section 6.1.1)

txConfig ENUMERATED {codebook, nonCodebook},

-- DMRS configuration for PUSCH transmissions using PUSCH mapping type A (chosen dynamically via PUSCH-TimeDomainResourceAllocation).

dmrs-UplinkForPUSCH-MappingTypeA SetupRelease { DMRS-UplinkConfig } OPTIONAL, -- Need M

-- DMRS configuration for PUSCH transmissions using PUSCH mapping type B (chosen dynamically via PUSCH-TimeDomainResourceAllocation)

dmrs-UplinkForPUSCH-MappingTypeB SetupRelease { DMRS-UplinkConfig } OPTIONAL, -- Need M

pusch-PowerControl PUSCH-PowerControl OPTIONAL, -- Need M

-- Configured one of two supported frequency hopping mode. If not configured frequency hopping is not configured

-- Corresponds to L1 parameter 'Frequency-hopping-PUSCH' (see 38.214, section 6)

-- When the field is absent the UE applies the value Not configured

frequencyHopping ENUMERATED {mode1, mode2} OPTIONAL, -- Need S

-- Set of frequency hopping offsets used when frequency hopping is enabled for granted transmission (not msg3) and type 2

-- Corresponds to L1 parameter 'Frequency-hopping-offsets-set' (see 38.214, section 6.3)

frequencyHoppingOffsetLists SEQUENCE (SIZE (1..4)) OF INTEGER (1.. maxNrofPhysicalResourceBlocks-1) OPTIONAL, -- Need M

-- Configuration of resource allocation type 0 and resource allocation type 1 for non-fallback DCI

-- Corresponds to L1 parameter 'Resouce-allocation-config' (see 38.214, section 6.1.2)

resourceAllocation ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch},

-- List of time domain allocations for timing of UL assignment to UL data. If configured, the values provided herein

-- override the values received in corresponding PUSCH-ConfigCommon.

pusch-AllocationList SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation OPTIONAL, -- Need R,

-- Number of repetitions for data. Corresponds to L1 parameter 'aggregation-factor-UL' (see 38.214, section FFS\_Section)

-- When the field is absent the UE applies the value 1.

pusch-AggregationFactor ENUMERATED { n2, n4, n8 } OPTIONAL, -- Need S

-- Indicates which MCS table the UE shall use for PUSCH without transform precoder

-- Corresponds to L1 parameter 'MCS-Table-PUSCH' (see 38.214, section 6.1.4)

-- When the field is absent the UE applies the value 64QAM

mcs-Table ENUMERATED {qam256} OPTIONAL, -- Need S

-- Indicates which MCS table the UE shall use for PUSCH with transform precoding

-- Corresponds to L1 parameter 'MCS-Table-PUSCH-transform-precoding' (see 38.214, section 6.1.4)

-- When the field is absent the UE applies the value 64QAM

mcs-TableTransformPrecoder ENUMERATED { qam256} OPTIONAL, -- Need S

-- The UE specific selection of transformer precoder for PUSCH. When the field is absent the UE applies the value msg3-tp.

-- Corresponds to L1 parameter 'PUSCH-tp' (see 38.211, section 6.3.1.4)

transformPrecoder ENUMERATED {enabled, disabled} OPTIONAL, -- Need S

-- Subset of PMIs addressed by TPMI, where PMIs are those supported by UEs with maximum coherence capabilities

-- Corresponds to L1 parameter 'ULCodebookSubset' (see 38.211, section 6.3.1.5)

codebookSubset ENUMERATED {fullyAndPartialAndNonCoherent, partialAndNonCoherent, nonCoherent},

-- Subset of PMIs addressed by TRIs from 1 to ULmaxRank. Corresponds to L1 parameter 'ULmaxRank' (see 38.211, section 6.3.1.5)

maxRank INTEGER (1..4),

-- Selection between config 1 and config 2 for RBG size for PUSCH. When the field is absent the UE applies the value config1.

-- Corresponds to L1 parameter 'RBG-size-PUSCH' (see 38.214, section 6.1.2.2.1)

rbg-Size ENUMERATED { config2} OPTIONAL, -- Need S

-- Selection between and configuration of dynamic and semi-static beta-offset.

-- If the field is absent or released, the UE applies the value 'semiStatic' and the BetaOffsets according to

-- FFS [BetaOffsets and/or section 9.x.x).

-- Corresponds to L1 parameter 'UCI-on-PUSCH' (see 38.213, section 9.3)

uci-OnPUSCH SetupRelease { UCI-OnPUSCH} OPTIONAL, -- Need M

-- Interleaving unit configurable between 2 and 4 PRBs

-- Corresponds to L1 parameter 'VRB-to-PRB-interleaver' (see 38.211, section 6.3.1.6)

vrb-ToPRB-Interleaver ENUMERATED {n2, n4},

...

}

UCI-OnPUSCH ::= SEQUENCE {

betaOffsets CHOICE {

dynamic SEQUENCE (SIZE (4)) OF BetaOffsets,

semiStatic BetaOffsets

} OPTIONAL, -- Need M

-- Indicates a scaling factor to limit the number of resource elements assigned to UCI on PUSCH.

-- Value f0p5 corresponds to 0.5, value f0p65 corresponds to 0.65, and so on.

-- Corresponds to L1 parameter 'uci-on-pusch-scaling' (see 38.212, section 6.3)

scaling ENUMERATED { f0p5, f0p65, f0p8, f1 }

}

-- TAG-PUSCH-CONFIG-STOP

-- ASN1STOP

#### – *PUSCH-ConfigCommon*

The IE *PUSCH-ConfigCommon* IE is used to configure the cell specific PUSCH parameters.

*PUSCH-Config* information element

-- ASN1START

-- TAG-PUSCH-CONFIGCOMMON-START

PUSCH-ConfigCommon ::= SEQUENCE {

-- Sequence-group hopping can be enabled or disabled by means of this cell-specific parameter.

-- Corresponds to L1 parameter 'Group-hopping-enabled-Transform-precoding' (see 38.211, section FFS\_Section)

-- This field is Cell specific

groupHoppingEnabledTransformPrecoding ENUMERATED {enabled} OPTIONAL, -- Need R

-- List of time domain allocations for timing of UL assignment to UL data

pusch-AllocationList SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation OPTIONAL, -- Need R

-- ------------------------

-- Power control parameters

-- Power offset between msg3 and RACH preamble transmission in steps of 1dB.

-- Corresponds to L1 parameter 'Delta-preamble-msg3' (see 38.213, section 7.1)

msg3-DeltaPreamble INTEGER (-1..6) OPTIONAL, -- Need R

-- P0 value for PUSCH with grant (except msg3). Value in dBm. Only even values (step size 2) allowed.

-- Corresponds to L1 parameter 'p0-nominal-pusch-withgrant' (see 38.213, section 7.1)

-- This field is cell specific

p0-NominalWithGrant INTEGER (-202..24) OPTIONAL, -- Need R

...

}

-- TAG-PUSCH-CONFIGCOMMON-STOP

-- ASN1STOP

#### – *PUSCH-PowerControl*

The IE *PUSCH-PowerControl* is used to configure UE specific power control parameter for PUSCH.

*PUSCH-PowerControl* information element

-- ASN1START

-- TAG-PUSCH-POWERCONTROL-START

PUSCH-PowerControl ::= SEQUENCE {

-- If enabled, UE applies TPC commands via accumulation. If not enabled, UE applies the TPC command without accumulation.

-- If absent, TPC accumulation is enabled. Corresponds to L1 parameter 'Accumulation-enabled' (see 38.213, section 7.1)

tpc-Accumulation ENUMERATED { disabled } OPTIONAL, -- Need R

-- Dedicated alpha value for msg3 PUSCH. Corresponds to L1 parameter 'alpha-ue-pusch-msg3' (see 38.213, section 7.1)

-- When the field is absent the UE applies the value 1.

msg3-Alpha Alpha OPTIONAL, -- Need S

-- P0 value for UL grant-free/SPS based PUSCH. Value in dBm. Only even values (step size 2) allowed.

-- Corresponds to L1 parameter 'p0-nominal-pusch-withoutgrant' (see 38.213, section 7.1)

p0-NominalWithoutGrant INTEGER (-202..24) OPTIONAL, -- Need M,

-- configuration {p0-pusch,alpha} sets for PUSCH (except msg3), i.e., { {p0,alpha,index1}, {p0,alpha,index2},...}.

-- Corresponds to L1 parameter 'p0-push-alpha-setconfig' (see 38,213, section 7.1)

p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF P0-PUSCH-AlphaSet OPTIONAL, -- Need M,

-- A set of Reference Signals (e.g. a CSI-RS config or a SSblock) to be used for PUSCH path loss estimation.

-- Up to maxNrofPUSCH-PathlossReferenceRSs may be configured when 'PUSCH beam indication' is present (FFS: in DCI???).

-- Otherwise, there may be only one entry.

-- Corresponds to L1 parameter 'pusch-pathlossReference-rs-config' (see 38.213, section 7.1)

pathlossReferenceRSToAddModList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS

OPTIONAL, -- Need N

pathlossReferenceRSToReleaseList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS-Id

OPTIONAL, -- Need N

-- Number of PUSCH power control adjustment states maintained by the UE (i.e., fc(i)). If the field is present (n2) the UE maintains

-- two power control states (i.e., fc(i,1) and fc(i,2)). Otherwise, it applies one (i.e., fc(i,1)).

-- Corresponds to L1 parameter 'num-pusch-pcadjustment-states' (see 38.213, section 7.1)

twoPUSCH-PC-AdjustmentStates ENUMERATED {twoStates} OPTIONAL, -- Need S

-- Indicates whether to apply dela MCS. When the field is absent, the UE applies Ks = 0 in delta\_TFC formula for PUSCH.

-- Corresponds to L1 parameter 'deltaMCS-Enabled' (see 38.213, section 7.1)

deltaMCS ENUMERATED {enabled} OPTIONAL, -- Need S

-- A list of SRI-PUSCH-PowerControl elements among which one is selected by the SRI field in DCI.

-- Corresponds to L1 parameter 'SRI-PUSCHPowerControl-mapping' (see 38.213, section 7.1)

sri-PUSCH-MappingToAddModList SEQUENCE (SIZE (1..maxNrofSRI-PUSCH-Mappings)) OF SRI-PUSCH-PowerControl OPTIONAL, -- Need M

sri-PUSCH-MappingToReleaseList SEQUENCE (SIZE (1..maxNrofSRI-PUSCH-Mappings)) OF SRI-PUSCH-PowerControlId OPTIONAL -- Need M

}

-- A set of p0-pusch and alpha used for PUSCH with grant. 'PUSCH beam indication' (if present) gives the index of the set to

-- be used for a particular PUSCH transmission.

-- FFS\_CHECK: Is the ”PUSCH beam indication” in DCI which schedules the PUSCH? If so, clarify in field description

-- Corresponds to L1 parameter 'p0-pusch-alpha-set' (see 38.213, section 7.1)

P0-PUSCH-AlphaSet ::= SEQUENCE {

p0-PUSCH-AlphaSetId P0-PUSCH-AlphaSetId,

-- P0 value for PUSCH with grant (except msg3) in steps of 1dB. Corresponds to L1 parameter 'p0-pusch' (see 38,213, section 7.1)

p0 INTEGER (-16..15) OPTIONAL,

-- alpha value for PUSCH with grant (except msg3) (see 38.213, section 7.1)

-- When the field is absent the UE applies the value 1

alpha Alpha OPTIONAL -- Need S

}

-- ID for a P0-PUSCH-AlphaSet. Corresponds to L1 parameter 'p0alphasetindex' (see 38.213, section 7.1)

P0-PUSCH-AlphaSetId ::= INTEGER (0..maxNrofP0-PUSCH-AlphaSets-1)

-- A reference signal (RS) configured as pathloss reference signal for PUSCH power control

-- Corresponds to L1 parameter 'pusch-pathlossReference-rs' (see 38.213, section 7.1)

PUSCH-PathlossReferenceRS ::= SEQUENCE {

pusch-PathlossReferenceRS-Id PUSCH-PathlossReferenceRS-Id,

referenceSignal CHOICE {

ssb-Index SSB-Index,

csi-RS-Index NZP-CSI-RS-ResourceId

}

}

-- ID for a referemce signal (RS) configured as PUSCH pathloss reference

-- Corresponds to L1 parameter 'pathlossreference-index' (see 38.213, section 7.1)

-- FFS\_CHECK: Is this ID used anywhere except inside the PUSCH-PathlossReference-RS itself?

PUSCH-PathlossReferenceRS-Id ::= INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1)

-- A set of PUSCH power control parameters associated with one SRS-ResourceIndex (SRI)

SRI-PUSCH-PowerControl ::= SEQUENCE {

-- The ID of this SRI-PUSCH-PowerControl configuration. It is used as the codepoint (payload) in the SRI DCI field.

sri-PUSCH-PowerControlId SRI-PUSCH-PowerControlId,

-- The ID of PUSCH-PathlossReferenceRS as configured in the pathlossReferenceRSToAddModList in PUSCH-PowerControl.

sri-PUSCH-PathlossReferenceRS-Id PUSCH-PathlossReferenceRS-Id,

-- The ID of a P0-PUSCH-AlphaSet as configured in p0-AlphaSets in PUSCH-PowerControl.

sri-P0-PUSCH-AlphaSetId P0-PUSCH-AlphaSetId,

-- The index of the closed power control loop associated with this SRI-PUSCH-PowerControl

sri-PUSCH-ClosedLoopIndex ENUMERATED { i0, i1 }

}

SRI-PUSCH-PowerControlId ::= INTEGER (0..maxNrofSRI-PUSCH-Mappings-1)

-- A set of beta-offset values

BetaOffsets ::= SEQUENCE {

-- Up to 2 bits HARQ-ACK. Corresponds to L1 parameter 'betaOffset-ACK-Index-1' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 11

betaOffsetACK-Index1 INTEGER(0..31) OPTIONAL, -- Need S

-- Up to 11 bits HARQ-ACK. Corresponds to L1 parameter 'betaOffset-ACK-Index-2' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 11

betaOffsetACK-Index2 INTEGER(0..31) OPTIONAL, -- Need S

-- Above 11 bits HARQ-ACK. Corresponds to L1 parameter 'betaOffset-ACK-Index-3' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 11

betaOffsetACK-Index3 INTEGER(0..31) OPTIONAL, -- Need S

-- Up to 11 bits of CSI part 1 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-1-Index-1' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 13

betaOffsetCSI-Part1-Index1 INTEGER(0..31) OPTIONAL, -- Need S

-- Above 11 bits of CSI part 1 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-1-Index-2' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 13

betaOffsetCSI-Part1-Index2 INTEGER(0..31) OPTIONAL, -- Need S

-- Up to 11 bits of CSI part 2 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-2-Index-1' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 13

betaOffsetCSI-Part2-Index1 INTEGER(0..31) OPTIONAL, -- Need S

-- Above 11 bits of CSI part 2 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-2-Index-2' (see 38.213, section 9.3)

-- When the field is absent the UE applies the value 13

betaOffsetCSI-Part2-Index2 INTEGER(0..31) OPTIONAL -- Need S

}

-- TAG-PUSCH-POWERCONTROL-STOP

-- ASN1STOP

#### – *PUSCH-ServingCellConfig*

The IE *PUSCH-ServingCellConfig* is used to configure UE specific PUSCH parameters that are common across the UE's BWPs of one serving cell.

*PUSCH-ServingCellConfig* information element

-- ASN1START

-- TAG-PUSCH-SERVINGCELLCONFIG-START

PUSCH-ServingCellConfig ::= SEQUENCE {

-- Enables and configures code-block-group (CBG) based transmission (see 38.214, section FFS\_Section)

codeBlockGroupTransmission SetupRelease { PUSCH-CodeBlockGroupGransmission } OPTIONAL, -- Need M

-- Enables LBRM (Limited buffer rate-matching). When the field is absent the UE applies FBRM (Full buffer rate-matchingLBRM).

-- Corresponds to L1 parameter 'LBRM-FBRM-selection' (see 38.212, section 5.4.2)

rateMatching ENUMERATED {limitedBufferRM} OPTIONAL, -- Need S

-- Accounts for overhead from CSI-RS, CORESET, etc. If the field is absent, the UE applies the value 'xoh0'.

-- Corresponds to L1 parameter 'Xoh-PUSCH' (see 38.214, section 5.1.3.2)

xOverhead ENUMERATED {xoh6, xoh12, xoh18} OPTIONAL, -- Need S

...

}

PUSCH-CodeBlockGroupGransmission ::= SEQUENCE {

-- Maximum number of code-block-groups (CBGs) per TB (see 38.xxx, section x.x.x, FFS\_Ref)

-- For 2 codewords, only the values { n2, n4 } are valid.

maxCodeBlockGroupsPerTransportBlock ENUMERATED {n2, n4, n6, n8},

...

}

-- TAG-PUSCH-SERVINGCELLCONFIG-STOP

-- ASN1STOP

#### – *PUSCH-TimeDomainResourceAllocation*

The IE *PUSCH-TimeDomainResourceAllocation* is used to configure a time domain relation between PDCCH and PUSCH.

*PUSCH-TimeDomainResourceAllocation* information element

-- ASN1START

-- TAG-PUSCH-TIMEDOMAINRESOURCEALLOCATION-START

PUSCH-TimeDomainResourceAllocation ::= SEQUENCE {

-- Corresponds to L1 parameter 'K2' (see 38.214, section FFS\_Section)

-- When the field is absent the UE applies the value 01 when PUSCH SCS is 15/30KHz; 2 when PUSCH SCS is 60KHz and 3 when PUSCH SCS is 120KHz.

k2 INTEGER (0..7) OPTIONAL, -- Need S

-- Mapping type. Corresponds to L1 parameter 'Mapping-type' (see 38.214, section FFS\_Section)

mappingType ENUMERATED {typeA, typeB},

-- An index into a table/equation in RAN1 specs capturing valid combinations of start symbol and length (jointly encoded)

-- Corresponds to L1 parameter 'Index-start-len' (see 38.214, section FFS\_Section)

startSymbolAndLength BIT STRING (SIZE (7))

}

-- TAG-PUSCH-TIMEDOMAINRESOURCEALLOCATION-STOP

-- ASN1STOP

#### – *PUSCH-TPC-CommandConfig*

The IE *PUSCH-TPC-CommandConfig* is used to configure the UE for extracting TPC commands for PUSCH from a group-TPC messages on DCI.

*PUSCH-TPC-CommandConfig* information element

-- ASN1START

-- TAG-PUSCH-TPC-COMMANDCONFIG-START

PUSCH-TPC-CommandConfig ::= SEQUENCE {

-- An index determining the position of the first bit of TPC command inside the DCI format 2-2 payload.

tpc-Index INTEGER (1..15) OPTIONAL, -- Cond SUL

-- An index determining the position of the first bit of TPC command inside the DCI format 2-2 payload.

tpc-IndexSUL INTEGER (1..15) OPTIONAL, -- Cond SUL-Only

-- The serving cell to which the acquired power control commands are applicable. If the value is absent, the UE applies the

-- TPC commands to the serving cell on which the command has been received.

targetCell ServCellIndex OPTIONAL, -- Need S

...

}

-- TAG-PUSCH-TPC-COMMANDCONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *SUL-Only* | The field is optionally present, Need R, if this serving cell is configured with a supplementary uplink (SUL). It is absent otherwise. |
| *SUL* | The field is optionally present, Need R, if this serving cell is configured with a supplementary uplink (SUL). It is mandatory present otherwise. |

#### *– Q-OffsetRange*

The IE *Q-OffsetRange* is used to indicate a cell, beam or frequency specific offset to be applied when evaluating candidates for cell re-selection or when evaluating triggering conditions for measurement reporting. The value in dB. Value dB-24 corresponds to -24 dB, dB-22 corresponds to -22 dB and so on.

*Q-OffsetRange* information element

-- ASN1START

Q-OffsetRange ::= ENUMERATED {

dB-24, dB-22, dB-20, dB-18, dB-16, dB-14,

dB-12, dB-10, dB-8, dB-6, dB-5, dB-4, dB-3,

dB-2, dB-1, dB0, dB1, dB2, dB3, dB4, dB5,

dB6, dB8, dB10, dB12, dB14, dB16, dB18,

dB20, dB22, dB24}

-- ASN1STOP

Editor’s Note: FFS Confirm the exact values that are supported.

#### – *QuantityConfig*

The IE *QuantityConfig* specifies the measurement quantities and layer 3 filtering coefficients for NR and inter-RAT measurements.

QuantityConfig information element

-- ASN1START

-- TAG-QUANTITY-CONFIG-START

QuantityConfig ::= SEQUENCE {

quantityConfigNR-List QuantityConfigNR-List OPTIONAL, -- Need M

...

}

QuantityConfigNR-List::= SEQUENCE (SIZE (1..maxNrofQuantityConfig)) OF QuantityConfigNR

QuantityConfigNR::= SEQUENCE {

quantityConfigCell QuantityConfigRS,

quantityConfigRS-Index QuantityConfigRS OPTIONAL -- Need M

}

QuantityConfigRS ::= SEQUENCE {

-- SS Block based L3 filter configurations:

ssb-FilterConfig FilterConfig,

-- CSI-RS basedL3 filter configurations:

cs-RS-FilterConfig FilterConfig

}

FilterConfig ::= SEQUENCE {

filterCoefficientRSRP FilterCoefficient DEFAULT fc4,

filterCoefficientRSRQ FilterCoefficient DEFAULT fc4,

filterCoefficientRS-SINR FilterCoefficient DEFAULT fc4

}

-- TAG-QUANTITY-CONFIG-STOP

-- ASN1STOP

| QuantityConfig field descriptions |
| --- |
| ***quantityConfigCell***  Specifies L3 filter configurations for cell measurement results for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR). |
| ***quantityConfigNR***  Specifies filter configurations for NR measurements. |
| ***quantityConfig-RSindex***  Specifies L3 filter configurations for measurement results per RS index for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR). |
| ***ssb-FilterConfig***  Specifies L3 filter configurations for SS-RSRP, SS-RSRQ and SS-SINR measurement results from the L1 filter(s), as defined in 38.215 [9]. |
| ***csi-rs-FilterConfig***  Specifies L3 filter configurations for CSI-RSRP, CSI-RSRQ and CSI-SINR measurement results from the L1 filter(s), as defined in 38.215 [9]. |

#### – *RACH-ConfigCommon*

The *RACH-ConfigCommon* IE is used to specify the cell specific random-access parameters.

*RACH-ConfigCommon* information element

-- ASN1START

-- TAG-RACH-CONFIG-COMMON-START

RACH-ConfigCommon ::= SEQUENCE {

-- Generic RACH parameters

rach-ConfigGeneric RACH-ConfigGeneric,

-- Total number of preambles used for contention based and contention free random access, excluding

-- preambles used for other purposes (e.g. for SI request). If the field is absent, the UE may use all 64 preambles for RA.

totalNumberOfRA-Preambles INTEGER (1..63) OPTIONAL, -- Need S

-- Number of SSBs per RACH occasion (L1 parameter 'SSB-per-rach-occasion') and the number of Contention Based preambles per SSB

-- (L1 parameter 'CB-preambles-per-SSB'). By multiplying the two values, the UE determines the total number of CB preambles.

ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE {

oneEighth ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

oneFourth ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

oneHalf ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

one ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

two ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32},

four INTEGER (1..16),

eight INTEGER (1..8),

sixteen INTEGER (1..4)

} OPTIONAL, -- Need M

groupBconfigured SEQUENCE {

-- Transport Blocks size threshold in bit below which the UE shall use a contention based RA premable

-- of group A. (see 38.321, section 5.1.2)

ra-Msg3SizeGroupA ENUMERATED {b56, b144, b208, b256, b282, b480, b640, b800, b1000, spare7, spare6, spare5,

spare4, spare3, spare2, spare1},

-- Threshold for preamble selection. Value in dB. Value minusinfinity corresponds to –infinity.

-- Value dB0 corresponds to 0 dB, dB5 corresponds to 5 dB and so on. (see FFS\_Spec, section FFS\_Section)

messagePowerOffsetGroupB ENUMERATED { minusinfinity, dB0, dB5, dB8, dB10, dB12, dB15, dB18},

-- The number of CB preambles per SSB in group A. This determines implicitly the number of CB preambles per SSB available in group B.

-- (see 38.321, section 5.1.1)

numberOfRA-PreamblesGroupA INTEGER (1..64)

} OPTIONAL, -- Need R

-- The initial value for the contention resolution timer (see 38.321, section 5.1.5)

ra-ContentionResolutionTimer ENUMERATED { sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64},

-- UE may select the SS block and corresponding PRACH resource for path-loss estimation and (re)transmission

-- based on SS blocks that satisfy the threshold (see 38.213, section REF)

rsrp-ThresholdSSB RSRP-Range OPTIONAL, -- Need R

-- UE may select the SS block and corresponding PRACH resource for path-loss estimation and (re)transmission on the SUL carrier

-- based on SS blocks that satisfy the threshold

-- Corresponds to L1 parameter 'SUL-RSRP-Threshold' (see FFS\_Spec, section FFS\_Section)

rsrp-ThresholdSSB-SUL RSRP-Range OPTIONAL, -- Need R

-- PRACH root sequence index. Corresponds to L1 parameter 'PRACHRootSequenceIndex' (see 38.211, section 6.3.3.1).

-- The value range depends on whether L=839 or L=139

prach-RootSequenceIndex CHOICE {

l839 INTEGER (0..837),

l139 INTEGER (0..137)

},

-- Subcarrier spacing of PRACH. Only the values 15 or 30 kHz (<6GHz), 60 or 120 kHz (>6GHz) are applicable.

-- Corresponds to L1 parameter 'prach-Msg1SubcarrierSpacing' (see 38.211, section FFS\_Section)

msg1-SubcarrierSpacing SubcarrierSpacing,

-- Configuration of an unrestricted set or one of two types of restricted sets, see 38.211 6.3.3.1

restrictedSetConfig ENUMERATED {unrestrictedSet, restrictedSetTypeA, restrictedSetTypeB},

-- Indicates to a UE whether transform precoding is enabled for Msg3 transmission.

-- Corresponds to L1 parameter 'msg3-tp' (see 38.213, section 8.1)

msg3-transformPrecoding ENUMERATED {enabled} OPTIONAL, -- Need R

...

}

-- TAG-RACH-CONFIG-COMMON-STOP

-- ASN1STOP

#### – *RACH-ConfigGeneric*

The *RACH-ConfigGeneric* IE is used to specify the cell specific random-access parameters both for regular random access as well as for beam failure recovery.

*RACH-Configeneric* information element

-- ASN1START

-- TAG-RACH-CONFIG-GENERIC-START

RACH-ConfigGeneric ::= SEQUENCE {

-- PRACH configuration index. Corresponds to L1 parameter 'PRACHConfigurationIndex' (see 38.211, section 6.3.3.2)

prach-ConfigurationIndex INTEGER (0..255),

-- The number of PRACH transmission occasions FDMed in one time instance.

-- Corresponds to L1 parameter 'prach-FDM' (see 38.211, section FFS\_Section)

msg1-FDM ENUMERATED {one, two, four, eight},

-- Offset of lowest PRACH transmission occasion in frequency domain with respective to PRB 0.

-- The value is configured so that the corresponding RACH resource is entirely within the bandwidth of the UL BWP.

-- Corresponds to L1 parameter 'prach-frequency-start' (see 38,211, section FFS\_Section)

msg1-FrequencyStart INTEGER (0..maxNrofPhysicalResourceBlocks-1),

-- N-CS configuration, see Table 6.3.3.1-3 in 38.211

zeroCorrelationZoneConfig INTEGER(0..15),

-- The target power level at the network receiver side (see 38.213, section 7.4, 38.321, section 5.1.2, 5.1.3)

-- Only multiples of 2 dBm may be chosen (e.g. -200, -198, ...).

-- FFS-Value: Actual values to be updated based on input from RAN4 (see LS in R2-1800004 and R4-1803466).

preambleReceivedTargetPower INTEGER (-200..-74),

-- Max number of RA preamble transmission perfomed before declaring a failure (see 38.321, section 5.1.4, 5.1.5)

preambleTransMax ENUMERATED {n3, n4, n5, n6, n7, n8, n10, n20, n50, n100, n200},

-- Power ramping steps for PRACH (see 38.321,5.1.3)

powerRampingStep ENUMERATED {dB0, dB2, dB4, dB6},

-- Msg2 (RAR) window length in number of slots. The network configures a value lower than or euqal to 10 ms (see 38.321, section 5.1.4)

ra-ResponseWindow ENUMERATED {sl1, sl2, sl4, sl8, sl10, sl20, sl40, sl80}

}

-- TAG-RACH-CONFIG-GENERIC-STOP

-- ASN1STOP

#### – *RACH-ConfigDedicated*

The IE *RACH-ConfigDedicated* is used to specify the dedicated random access parameters.

*RACH-ConfigDedicated* information element

-- ASN1START

-- TAG-RACH-CONFIG-DEDICATED-START

-- FFS\_Standlone: resources for msg1-based on-demand SI request

RACH-ConfigDedicated ::= SEQUENCE {

-- Resources for contention free random access to a given target cell

cfra-Resources CFRA-Resources,

...

}

CFRA-Resources ::= CHOICE {

ssb SEQUENCE {

ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,

-- Explicitly signalled PRACH Mask Index for RA Resource selection in TS 36.321. The mask is valid for all SSB

-- resources signalled in ssb-ResourceList

ra-ssb-OccasionMaskIndex INTEGER (0..15)

},

csirs SEQUENCE {

csirs-ResourceList SEQUENCE (SIZE(1..maxRA-CSIRS-Resources)) OF CFRA-CSIRS-Resource,

cfra-csirs-DedicatedRACH-Threshold RSRP-Range

}

}

CFRA-SSB-Resource ::= SEQUENCE {

-- The ID of an SSB transmitted by this serving cell.

ssb SSB-Index,

-- The preamble index that the UE shall use when performing CF-RA upon selecting the candidate beams identified by this SSB.

ra-PreambleIndex INTEGER (0..63),

...

}

CFRA-CSIRS-Resource ::= SEQUENCE {

-- The ID of a CSI-RS resource defined in the measurement object associated with this serving cell.

csi-RS CSI-RS-Index,

-- RA occasions that the UE shall use when performing CF-RA upon selecting the candidate beam identified by this CSI-RS.

ra-OccasionList SEQUENCE (SIZE(1..maxRA-OccasionsPerCSIRS)) OF INTEGER (0..maxRA-Occasions-1),

-- The RA preamble index to use in the RA occasions assoicated with this CSI-RS.

ra-PreambleIndex INTEGER (0..63),

...

}

-- TAG-RACH-CONFIG-DEDICATED-STOP

-- ASN1STOP

#### – *RadioBearerConfig*

The IE *RadioBearerConfig* is used to add, modify and release signalling and/or data radio bearers. Specifically, this IE carries the parameters for PDCP and, if applicable, SDAP entities for the radio bearers.

*RadioBearerConfig* information element

-- ASN1START

-- TAG-RADIO-BEARER-CONFIG-START

RadioBearerConfig ::= SEQUENCE {

srb-ToAddModList SRB-ToAddModList OPTIONAL, -- Need N

srb3-ToRelease ENUMERATED{true} OPTIONAL, -- Need N

drb-ToAddModList DRB-ToAddModList OPTIONAL, -- Need N

drb-ToReleaseList DRB-ToReleaseList OPTIONAL, -- Need N

securityConfig SecurityConfig OPTIONAL, -- Cond M

...

}

SRB-ToAddModList ::= SEQUENCE (SIZE (1..2)) OF SRB-ToAddMod

SRB-ToAddMod ::= SEQUENCE {

srb-Identity SRB-Identity,

-- may only be set if the cell groups of all linked logical channels are reset or released

reestablishPDCP ENUMERATED{true} OPTIONAL, -- Need N

discardOnPDCP ENUMERATED{true} OPTIONAL, -- Need N

pdcp-Config PDCP-Config OPTIONAL, -- Cond PDCP

...

}

DRB-ToAddModList ::= SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod

DRB-ToAddMod ::= SEQUENCE {

cnAssociation CHOICE {

-- The EPS bearer ID determines the EPS bearer when NR connects to EPC using EN-DC

eps-BearerIdentity INTEGER (0..15), -- EPS-DRB-Setup

-- The SDAP configuration determines how to map QoS flows to DRBs when NR connects to the 5GC

sdap-Config SDAP-Config -- 5GC

} OPTIONAL, -- Cond DRBSetup

drb-Identity DRB-Identity,

-- may only be set if the cell groups of all linked logical channels are reset or released

reestablishPDCP ENUMERATED{true} OPTIONAL, -- Need N

recoverPDCP ENUMERATED{true} OPTIONAL, -- Need N

pdcp-Config PDCP-Config OPTIONAL, -- Cond PDCP

...

}

DRB-ToReleaseList ::= SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity

SecurityConfig ::= SEQUENCE {

securityAlgorithmConfig SecurityAlgorithmConfig OPTIONAL, -- Cond RBTermChange

keyToUse ENUMERATED{keNB, s-KgNB} OPTIONAL, -- Cond RBTermChange

...

}

-- TAG-RADIO-BEARER-CONFIG-STOP

-- ASN1STOP

|  |
| --- |
| *RadioBearerConfig* field descriptions |
| ***drb-Identity***  In case of DC, the DRB identity is unique within the scope of the UE, i.e. an MCG DRB cannot use the same value as a split DRB. For a split DRB the same identity is used for the MCG and SCG parts of the configuration. |
| ***cnAssociation***  Indicates if the bearer is associated with the eps-bearerIdentity (when connected to EPC) or sdap-Config (when connected to 5GC). |
| ***keyToUse***  Indicates if the bearers configured with the list in this *radioBearerConfig* is using KeNB or S-KgNB for deriving ciphering and/or integrity protection keys. Network should not configure SRB1 and SRB2 with S-KgNB and SRB3 with KeNB. When the field is not included, the UE shall continue to use the currently configured *keyToUse* for the radio bearers reconfigured with the lists in this *radioBearerConfig*. |
| reestablishPDCP  Indicates that PDCP should be re-established. Network sets this to TRUE whenever the security key used for this radio bearer changes. |
| ***srb-Identity***  Value 1 is applicable for SRB1 only.  Value 2 is applicable for SRB2 only.  Value 3 is applicable for SRB3 only. |
| ***securityAlgorithmConfig***  Indicates the security algorithm for the signalling and data radio bearers configured with the list in this radioBearerConfig. When the field is not included, the UE shall continue to use the currently configured security algorithm for the radio bearers reconfigured with the lists in this radioBearerConfig. |
| ***securityConfig***  Indicates the security algorithm and key to use for the signalling and data radio bearers configured with the list in this radioBearerConfig When the field is not included, the UE shall continue to use the currently configured keyToUse and security algorithm for the radio bearers reconfigured with the lists in this radioBearerConfig. |
| ***srb3-toRelease***  Release SRB3. SRB3 release can only be done at SCG release and reconfiguration with sync. |

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *RBTermChange* | The field is mandatory present in case of set up of signalling and data radio bearer and change of termination point for the radio bearer between MN and SN. It is optionally present otherwise, Need S. |
| *PDCP* | The field is mandatory present if the corresponding DRB is being setup or corresponding RB is reconfigured with NR PDCP; otherwise the field is optionally present, need M. |
| *DRBSetup* | The field is mandatory present if the corresponding DRB is being setup; otherwise the field is optionally present, need M. |

#### – *RadioLinkMonitoringConfig*

The *RadioLinkMonitoringConfig* IE is used to configure radio link monitoring for detection of beam- and/or cell radio link failure. See also 38.321, section 5.1.1.

*RadioLinkMonitoringConfig* information element

-- ASN1START

-- TAG-RADIOLINKMONITORINGCONFIG-START

RadioLinkMonitoringConfig ::= SEQUENCE {

-- A list of reference signals for detecting beam failure and/or cell level radio link failure (RLF).

-- The network configures at most two detectionResources per BWP for the purpose "beamFailure" or "both".

-- If no RSs are provided for the purpose of beam failure detection, the UE performs beam monitoring based on the activated TCI-State

-- for PDCCH. However, if the activated TCI state refers to an aperiodic or semi-persistent CSI-RS, the gNB configures the failure

-- detection resources explicitly (FFS\_RAN1: TBC by RAN1).

-- If no RSs are provided in this list at all (neither for Cell- nor for Beam-RLM), the UE performs also Cell-RLM based

-- on the activated TCI-State of PDCCH (FFS\_RAN1: TBC by RAN1).

-- When the network reconfigures this field, the UE resets on-going RLF timers and counters.

failureDetectionResources SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS OPTIONAL, -- Need M

-- This field determines after how many beam failure events the UE triggers beam failure recovery (see 38.321, section 5.17).

-- Value n1 corresponds to 1 beam failure instance, n2 corresponds to 2 beam failure instances and so on.

-- When the network reconfigures this field, the UE resets on-going RLF timers and counters.

-- If the field is absent, the UE does not trigger beam failure recovery.

beamFailureInstanceMaxCount ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10} OPTIONAL, -- Need S

-- Timer for beam failure detection (see 38.321, section FFS\_Section). See also the BeamFailureRecoveryConfig IE.

-- Value in number of "periods of Beam Failure Detection" Reference Signal. Value pbfd1 corresponds to 1 period of Beam Failure

-- Detection Reference Signal, value pbfd2 corresponds to 2 periods of Beam Failure Detection Reference Signal and so on.

-- When the network reconfigures this field, the UE resets on-going RLF timers and counters.

beamFailureDetectionTimer ENUMERATED {pbfd1, pbfd2, pbfd3, pbfd4, pbfd5, pbfd6, pbfd8, pbfd10} OPTIONAL, -- Need R

...

}

RadioLinkMonitoringRS ::= SEQUENCE {

-- Determines whether the UE shall monitor the associated reference signal for the purpose of cell- and/or beam failure detection.

purpose ENUMERATED {beamFailure, rlf, both},

-- A reference signal that the UE shall use for radio link monitoring. The network provides an ssb-Index only if

-- the purpose is set to rlf.

detectionResource CHOICE {

ssb-Index SSB-Index,

csi-RS-Index NZP-CSI-RS-ResourceId

},

...

}

-- TAG-RADIOLINKMONITORINGCONFIG-STOP

-- ASN1STOP

#### – *RateMatchPattern*

The IE *RateMatchPattern* is used to configure one rate matching pattern for PDSCH. Corresponds to L1 IE 'rate-match-PDSCH-resource-set', see 38.214, section FFS\_Section.

*RateMatchPattern* information element

-- ASN1START

-- TAG-RATEMATCHPATTERN-START

RateMatchPattern ::= SEQUENCE {

rateMatchPatternId RateMatchPatternId,

patternType CHOICE {

bitmaps SEQUENCE {

-- A resource block level bitmap in the frequency domain. It indicates the PRBs to which the symbolsInResourceBlock bitmap applies.

-- Corresponds to L1 parameter 'rate-match-PDSCH-bitmap1' (see 38.214, section FFS\_Section)

-- FFS\_ASN1: Consider multiple options with different number of bits (for narrower carriers)

resourceBlocks BIT STRING (SIZE (275)),

-- A symbol level bitmap in time domain. It indicates (FFS: with a bit set to true) the symbols which the UE shall rate match around.

-- This pattern recurs (in time domain) with the configured periodicityAndOffset.

-- Corresponds to L1 parameter 'rate-match-PDSCH-bitmap2' (see 38.214, section FFS\_Section)

-- FFS: Why not split it into two BIT STRINGs of 14 bit each?

symbolsInResourceBlock CHOICE {

oneSlot BIT STRING (SIZE (14)),

twoSlots BIT STRING (SIZE (28))

},

-- A time domain repetition pattern. at which the symbolsInResourceBlock

-- pattern recurs. This slot pattern repeats itself continuously. Absence of this field indicates the value n1, i.e., the

-- symbolsInResourceBlock recurs every 14 symbols.

-- Corresponds to L1 parameter 'rate-match-PDSCH-bitmap3' (see 38.214, section FFS\_Section)

periodicityAndPattern CHOICE {

n2 BIT STRING (SIZE (2)),

n4 BIT STRING (SIZE (4)),

n5 BIT STRING (SIZE (5)),

n8 BIT STRING (SIZE (8)),

n10 BIT STRING (SIZE (10)),

n20 BIT STRING (SIZE (20)),

n40 BIT STRING (SIZE (40))

} OPTIONAL, -- Need S

...

},

-- This ControlResourceSet us used as a PDSCH rate matching pattern, i.e., PDSCH reception rate matches around it.

controlResourceSet ControlResourceSetId

},

-- The SubcarrierSpacing for this resource pattern. If the field is absent, the UE applies the SCS of the associcated BWP.

-- The value kHz15 corresponds to µ=0, kHz30 to µ=1, and so on. Only the values 15 or 30 kHz (<6GHz), 60 or 120 kHz (>6GHz) are

-- applicable. Corresponds to L1 parameter 'resource-pattern-scs' (see 38.214, section FFS\_Section)

subcarrierSpacing SubcarrierSpacing OPTIONAL, -- Cond CellLevel

-- FFS\_Description, FFS\_Section

mode ENUMERATED { dynamic, semiStatic },

...

}

-- TAG-RATEMATCHPATTERN-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *CellLevel* | The field is mandatory present if the RateMatchPattern is defined on cell level. The field is absent when the RateMatchPattern is defined on BWP level. If the RateMatchPattern is defined on BWP level, the UE applies the SCS of the BWP. |

#### – *RateMatchPatternId*

The IE *RateMatchPatternId* identifies one RateMatchMattern. Corresponds to L1 parameter 'resource-set-index' (see 38.214, section 5.1.2.2.3)

*RateMatchPatternId* information element

-- ASN1START

-- TAG-RATEMATCHPATTERNID-START

RateMatchPatternId ::= INTEGER (0..maxNrofRateMatchPatterns-1)

-- TAG-RATEMATCHPATTERNID-STOP

-- ASN1STOP

#### – *RateMatchPatternLTE-CRS*

The IE *RateMatchPatternLTE-CRS* is used to configure a pattern to rate match around LTE CRS.

*RateMatchPatternLTE-CRS* information element

-- ASN1START

-- TAG-RATEMATCHPATTERNLTE-CRS-START

RateMatchPatternLTE-CRS ::= SEQUENCE {

-- Center of the LTE carrier. Corresponds to L1 parameter 'center-subcarrier-location' (see 38.214, section 5.1.4)

carrierFreqDL INTEGER (0..16383),

-- BW of the LTE carrier in numbewr of PRBs. Corresponds to L1 parameter 'BW' (see 38.214, section 5.1.4)

carrierBandwidthDL ENUMERATED {n6, n15, n25, n50, n75, n100, spare2, spare1},

-- LTE MBSFN subframe configuration. Corresponds to L1 parameter 'MBSFN-subframconfig' (see 38.214, section 5.1.4)

-- FFS\_ASN1: Import the LTE MBSFN-SubframeConfigList

mbsfn-SubframeConfigList EUTRA-MBSFN-SubframeConfigList OPTIONAL, -- Need M

-- Number of LTE CRS antenna port to rate-match around.

-- Corresponds to L1 parameter 'rate-match-resources-numb-LTE-CRS-antenna-port' (see 38.214, section 5.1.4)

nrofCRS-Ports ENUMERATED {n1, n2, n4},

-- Shifting value v-shift in LTE to rate match around LTE CRS

-- Corresponds to L1 parameter 'rate-match-resources-LTE-CRS-v-shift' (see 38.214, section 5.1.4)

v-Shift ENUMERATED {n0, n1, n2, n3, n4, n5}

}

-- TAG-RATEMATCHPATTERNLTE-CRS-STOP

-- ASN1STOP

#### – *ReportConfigId*

The IE *ReportConfigId* is used to identify a measurement reporting configuration.

*ReportConfigId* information element

-- ASN1START

-- TAG-REPORT-CONFIG-ID-START

ReportConfigId ::= INTEGER (1..maxReportConfigId)

-- TAG-REPORT-CONFIG-ID-STOP

-- ASN1STOP

#### – *ReportConfigNR*

The IE *ReportConfigNR* specifies criteria for triggering of an NR measurement reporting event. Measurement reporting events are based on cell measurement results, which can either be derived based on SS/PBCH block or CSI-RS. These events are labelled AN with N equal to 1, 2 and so on.

Event A1: Serving becomes better than absolute threshold;

Event A2: Serving becomes worse than absolute threshold;

Event A3: Neighbour becomes amount of offset better than PCell/PSCell;

Event A4: Neighbour becomes better than absolute threshold;

Event A5: PCell/PSCell becomes worse than absolute threshold1 AND Neighbour becomes better than another absolute threshold2.

Event A6: Neighbour becomes amount of offset better than SCell.

*ReportConfigNR* information element

-- ASN1START

-- TAG-REPORT-CONFIG-START

ReportConfigNR ::= SEQUENCE {

reportType CHOICE {

periodical PeriodicalReportConfig,

eventTriggered EventTriggerConfig,

-- reportCGI is to be completed before the end of Rel-15.

reportCGI ENUMERATED {ffsTypeAndValue},

...

}

}

-- FFS / TODO: Consider separating trgger configuration (trigger, periodic, ...) from report configuration.

-- Current structure allows easier definiton of new events and new report types e.g. CGI, etc.

EventTriggerConfig::= SEQUENCE {

eventId CHOICE {

eventA1 SEQUENCE {

a1-Threshold MeasTriggerQuantity,

reportOnLeave BOOLEAN,

hysteresis Hysteresis,

timeToTrigger TimeToTrigger

},

eventA2 SEQUENCE {

a2-Threshold MeasTriggerQuantity,

reportOnLeave BOOLEAN,

hysteresis Hysteresis,

timeToTrigger TimeToTrigger

},

eventA3 SEQUENCE {

a3-Offset MeasTriggerQuantityOffset,

reportOnLeave BOOLEAN,

hysteresis Hysteresis,

timeToTrigger TimeToTrigger,

useWhiteCellList BOOLEAN

},

eventA4 SEQUENCE {

a4-Threshold MeasTriggerQuantity,

reportOnLeave BOOLEAN,

hysteresis Hysteresis,

timeToTrigger TimeToTrigger,

useWhiteCellList BOOLEAN

},

eventA5 SEQUENCE {

a5-Threshold1 MeasTriggerQuantity,

a5-Threshold2 MeasTriggerQuantity,

reportOnLeave BOOLEAN,

hysteresis Hysteresis,

timeToTrigger TimeToTrigger,

useWhiteCellList BOOLEAN

},

eventA6 SEQUENCE {

a6-Offset MeasTriggerQuantityOffset,

reportOnLeave BOOLEAN,

hysteresis Hysteresis,

timeToTrigger TimeToTrigger,

useWhiteCellList BOOLEAN

},

...

},

rsType NR-RS-Type,

-- Common reporting config (at least to periodical and eventTriggered)

reportInterval ReportInterval,

reportAmount ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},

-- Cell reporting configuration

reportQuantityCell MeasReportQuantity,

maxReportCells INTEGER (1..maxCellReport),

-- RS index reporting configuration

reportQuantityRsIndexes MeasReportQuantity OPTIONAL, -- Need M

maxNrofRSIndexesToReport INTEGER (1..maxNrofIndexesToReport) OPTIONAL, -- Need M

includeBeamMeasurements BOOLEAN,

-- If configured the UE includes the best neighbour cells per serving frequency

reportAddNeighMeas ENUMERATED {setup} OPTIONAL, -- Need R

...

}

PeriodicalReportConfig ::= SEQUENCE {

rsType NR-RS-Type,

-- Common reporting config (at least to periodical and eventTriggered)

reportInterval ReportInterval,

reportAmount ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},

-- Cell reporting configuration

reportQuantityCell MeasReportQuantity,

maxReportCells INTEGER (1..maxCellReport),

-- RS index reporting configuration

reportQuantityRsIndexes MeasReportQuantity OPTIONAL, -- Need R

maxNrofRsIndexesToReport INTEGER (1..maxNrofIndexesToReport) OPTIONAL, -- Need R

includeBeamMeasurements BOOLEAN,

useWhiteCellList BOOLEAN,

...

}

NR-RS-Type ::= ENUMERATED {ssb, csi-rs}

MeasTriggerQuantity ::= CHOICE {

rsrp RSRP-Range,

rsrq RSRQ-Range,

sinr SINR-Range

}

MeasTriggerQuantityOffset ::= CHOICE {

rsrp INTEGER (-30..30),

rsrq INTEGER (-30..30),

sinr INTEGER (-30..30)

}

MeasReportQuantity ::= SEQUENCE {

rsrp BOOLEAN,

rsrq BOOLEAN,

sinr BOOLEAN

}

-- TAG-REPORT-CONFIG-START

-- ASN1STOP

| *ReportConfigNR* field descriptions |
| --- |
| ***a3-Offset/a6-Offset***  Offset value(s) to be used in NR measurement report triggering condition for event a3/a6.The actual value is field value \* 0.5 dB. |
| ***aN-ThresholdM***  Threshold value associated to the selected trigger quantity (e.g. RSRP, RSRQ, SINR) per RS Type (e.g. SS/PBCH block, CSI-RS) to be used in NR measurement report triggering condition for event number aN. If multiple thresholds are defined for event number aN, the thresholds are differentiated by M. The network configures aN-Threshold1 only for events A1, A2, A4, A5 and a5-Threshold2 only for event A5. |
| ***eventId***  Choice of NR event triggered reporting criteria. |
| ***maxReportCells***  Max number of non-serving cells to include in the measurement report. |
| ***maxNrofRsIndexesToReport***  Max number of measurement information per RS index to include in the measurement report for A1-A6 events. |
| ***reportAmount***  *Number* of measurement reports applicable for *eventTriggered* as well as for *periodical* report types |
| ***reportOnLeave***  Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a cell in cellsTriggeredList, as specified in 5.5.4.1. |
| ***reportQuantityCell***  The cell measurement quantities to be included in the measurement report. |
| ***reportQuantityRsIndexes***  Indicates which measurement information per RS index the UE shall include in the measurement report. |
| ***reportAddNeighMeas***  Indicates that the UE shall includes the best neighbour cells per serving frequency. |
| ***timeToTrigger***  Time during which specific criteria for the event needs to be met in order to trigger a measurement report. |
| ***useWhiteCellList***  Indicates whether only the cells included in the white-list of the associated measObject are applicable as specified in 5.5.4.1. |

#### – *ReportConfigToAddModList*

The IE *ReportConfigToAddModList* concerns a list of reporting configurations to add or modify.

ReportConfigToAddModList information element

-- ASN1START

-- TAG-REPORT-CONFIG-TO-ADD-MOD-LIST-START

ReportConfigToAddModList ::= SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigToAddMod

ReportConfigToAddMod ::= SEQUENCE {

reportConfigId ReportConfigId,

reportConfig CHOICE {

reportConfigNR ReportConfigNR,

...

}

}

-- TAG- REPORT-CONFIG-TO-ADD-MOD-LIST-STOP

-- ASN1STOP

#### – *ReportInterval*

The *ReportInterval* indicates the interval between periodical reports. The *ReportInterval* is applicable if the UE performs periodical reporting (i.e. when *reportAmount* exceeds 1), for *triggerTypeevent* as well as for *triggerTypeperiodical*. Value ms120 corresponds to 120 ms, ms240 corresponds to 240 ms and so on, while value min1 corresponds to 1 min, min6 corresponds to 6 min and so on.

*ReportInterval* information element

-- ASN1START

ReportInterval ::= ENUMERATED {ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, ms20480, ms40960, min1,

min6, min12, min30 }

-- ASN1STOP

#### – *RLC-Config*

The IE *RLC-Config* is used to specify the RLC configuration of SRBs and DRBs.

*RLC-Config* information element

-- ASN1START

-- TAG-RLC-CONFIG-START

RLC-Config ::= CHOICE {

am SEQUENCE {

ul-AM-RLC UL-AM-RLC,

dl-AM-RLC DL-AM-RLC

},

um-Bi-Directional SEQUENCE {

ul-UM-RLC UL-UM-RLC,

dl-UM-RLC DL-UM-RLC

},

um-Uni-Directional-UL SEQUENCE {

ul-UM-RLC UL-UM-RLC

},

um-Uni-Directional-DL SEQUENCE {

dl-UM-RLC DL-UM-RLC

},

...

}

UL-AM-RLC ::= SEQUENCE {

sn-FieldLength SN-FieldLengthAM,

t-PollRetransmit T-PollRetransmit,

pollPDU PollPDU,

pollByte PollByte,

maxRetxThreshold ENUMERATED { t1, t2, t3, t4, t6, t8, t16, t32 }

}

DL-AM-RLC ::= SEQUENCE {

sn-FieldLength SN-FieldLengthAM,

t-Reassembly T-Reassembly,

t-StatusProhibit T-StatusProhibit

}

UL-UM-RLC ::= SEQUENCE {

sn-FieldLength SN-FieldLengthUM

}

DL-UM-RLC ::= SEQUENCE {

sn-FieldLength SN-FieldLengthUM,

t-Reassembly T-Reassembly

}

T-PollRetransmit ::= ENUMERATED {

ms5, ms10, ms15, ms20, ms25, ms30, ms35,

ms40, ms45, ms50, ms55, ms60, ms65, ms70,

ms75, ms80, ms85, ms90, ms95, ms100, ms105,

ms110, ms115, ms120, ms125, ms130, ms135,

ms140, ms145, ms150, ms155, ms160, ms165,

ms170, ms175, ms180, ms185, ms190, ms195,

ms200, ms205, ms210, ms215, ms220, ms225,

ms230, ms235, ms240, ms245, ms250, ms300,

ms350, ms400, ms450, ms500, ms800, ms1000,

ms2000, ms4000, spare5, spare4, spare3,

spare2, spare1}

PollPDU ::= ENUMERATED {

p4, p8, p16, p32, p64, p128, p256, p512, p1024, p2048, p4096, p6144, p8192, p12288, p16384, p20480,

p24576, p28672, p32768, p40960, p49152, p57344, p65536, infinity, spare8, spare7, spare6, spare5, spare4,

spare3, spare2, spare1}

PollByte ::= ENUMERATED {

kB1, kB2, kB5, kB8, kB10, kB15, kB25, kB50, kB75,

kB100, kB125, kB250, kB375, kB500, kB750, kB1000,

kB1250, kB1500, kB2000, kB3000, kB4000, kB4500,

kB5000, kB5500, kB6000, kB6500, kB7000, kB7500,

mB8, mB9, mB10, mB11, mB12, mB13, mB14, mB15,

mB16, mB17, mB18, mB20, mB25, mB30, mB40, infinity,

spare20, spare19, spare18, spare17, spare16,

spare15, spare14, spare13, spare12, spare11,

spare10, spare9, spare8, spare7, spare6, spare5,

spare4, spare3, spare2, spare1}

T-Reassembly ::= ENUMERATED {

ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,

ms40, ms45, ms50, ms55, ms60, ms65, ms70,

ms75, ms80, ms85, ms90, ms95, ms100, ms110,

ms120, ms130, ms140, ms150, ms160, ms170,

ms180, ms190, ms200, spare1}

T-StatusProhibit ::= ENUMERATED {

ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,

ms40, ms45, ms50, ms55, ms60, ms65, ms70,

ms75, ms80, ms85, ms90, ms95, ms100, ms105,

ms110, ms115, ms120, ms125, ms130, ms135,

ms140, ms145, ms150, ms155, ms160, ms165,

ms170, ms175, ms180, ms185, ms190, ms195,

ms200, ms205, ms210, ms215, ms220, ms225,

ms230, ms235, ms240, ms245, ms250, ms300,

ms350, ms400, ms450, ms500, ms800, ms1000,

ms1200, ms1600, ms2000, ms2400, spare2, spare1}

SN-FieldLengthUM ::= ENUMERATED {size6, size12}

SN-FieldLengthAM ::= ENUMERATED {size12, size18}

-- TAG-RLC-CONFIG-STOP

-- ASN1STOP

| *RLC-Config*field descriptions |
| --- |
| ***maxRetxThreshold***  Parameter for RLC AM in TS 38.322 [4]. Value t1 corresponds to 1 retransmission, t2 to 2 retransmissions and so on. |
| ***pollByte***  Parameter for RLC AM in TS 38.322 [4]. Value kB25 corresponds to 25 kBytes, kB50 to 50 kBytes and so on. infinity corresponds to an infinite amount of kBytes. |
| ***pollPDU***  Parameter for RLC AM in TS 38.322 [4]. Value p4 corresponds to 4 PDUs, p8 to 8 PDUs and so on. infinity corresponds to an infinite number of PDUs. |
| ***sn-FieldLength***  Indicates the RLC SN field size, see TS 38.322 [4], in bits. Value size6 means 6 bits, size12 means 12 bits, size18 means 18 bits. The value of sn-FieldLength for a DRB shall be changed only using reconfiguration with sync. |
| ***t-PollRetransmit***  Timer for RLC AM inTS 38.322 [4], in milliseconds. Value ms5 means 5ms, ms10 means 10ms and so on. |
| ***t-Reassembly***  Timer for reassembly in TS 38.322 [4], in milliseconds. Value ms0 means 0ms, ms5 means 5ms and so on. |
| ***t-StatusProhibit***  Timer for status reporting in TS 38.322 [4], in milliseconds. Value ms0 means 0ms, ms5 means 5ms and so on. |

#### – *RLF-TimersAndConstants*

Editor’s Note: FFS / TODO: Insert the RLF timers and related functionality. Check what is needed for EN-DC.

The *RLF-TimersAndConstants* IE is used to configure UE specific timers and constants.

*RLF-TimersAndConstants* information element

-- ASN1START

-- TAG-RLF-TIMERS-AND-CONSTANTS-START

RLF-TimersAndConstants ::= SEQUENCE {

t310 ENUMERATED {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000, ms4000, ms6000},

n310 ENUMERATED {n1, n2, n3, n4, n6, n8, n10, n20},

n311 ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10},

...

}

-- TAG-RLF-TIMERS-AND-CONSTANTS-STOP

-- ASN1STOP

| *RLF-TimersAndConstants* field descriptions |
| --- |
| ***n3xy***  Constants are described in section 7.4. n1 corresponds with 1, n2 corresponds to 2 and so on. |
| ***t3xy***  Timers are described in section 7.3. Value ms0 corresponds with 0 ms, ms50 corresponds to 50 ms and so on. |

#### – *RNTI-Value*

The *RNTI-Value* IE represents a Radio Network Temporary Identity.

*RNTI-Value* information element

-- ASN1START

-- TAG-RNTI-VALUE-START

RNTI-Value ::= INTEGER (0..65535)

-- TAG-RNTI-VALUE-STOP

-- ASN1STOP

#### – *RSRP-Range*

The IE *RSRP-Range* specifies the value range used in RSRP measurements and thresholds. Integer value for RSRP measurements according to mapping table in TS 38.133 [14].

*RSRP-Range* information element

-- ASN1START

-- TAG-RSRP-RANGE-START

RSRP-Range ::= INTEGER(0..124)

-- TAG-RSRP-RANGE-STOP

-- ASN1STOP

#### – *RSRQ-Range*

The IE *RSRQ-Range* specifies the value range used in RSRQ measurements and thresholds. Integer value for RSRQ measurements is according to mapping table in TS 38.133 [14].

*RSRQ-Range* information element

-- ASN1START

-- TAG-RSRQ-RANGE-START

RSRQ-Range ::= INTEGER(0..127)

-- TAG-RSRQ-RANGE-STOP

-- ASN1STOP

#### – *SCellIndex*

The IE *SCellIndex* concerns a short identity, used to identify an SCell.

*SCellIndex* information element

-- ASN1START

-- TAG-SCELL-INDEX-START

-- The value range is shared across the Cell Groups

SCellIndex ::= INTEGER (1..31)

-- TAG-SCELL-INDEX-STOP

-- ASN1STOP

#### – *SchedulingRequestConfig*

The IE *SchedulingRequestConfig* is used to configure the parameters, for the dedicated scheduling request (SR) resources.

*SchedulingRequestConfig* information element

-- ASN1START

-- TAG-SCHEDULING-REQUEST-CONFIG-START

SchedulingRequestConfig ::= SEQUENCE {

schedulingRequestToAddModList SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestToAddMod OPTIONAL, -- Need N

schedulingRequestToReleaseList SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestId OPTIONAL -- Need N

}

SchedulingRequestToAddMod ::= SEQUENCE {

sr-ConfigIndex SchedulingRequestId,

sr-ProhibitTimer ENUMERATED {ms1, ms2, ms4, ms8, ms16, ms32, ms64, ms128} OPTIONAL, -- Need S

sr-TransMax ENUMERATED { n4, n8, n16, n32, n64, spare3, spare2, spare1}

}

SchedulingRequestId ::= INTEGER (0..7)

-- FFS\_TODO: provide resources for each SchedulingRequestID in ServingCellConfig (TBD whether directly, in PUCCH-Config, in each BWP)

-- TAG-SCHEDULING-REQUEST-CONFIG-STOP

-- ASN1STOP

| *SchedulingRequestConfig* field descriptions |
| --- |
| ***schedulingRequestToAddModList***  List of Scheduling Request configurations to add or modify. |
| ***schedulingRequestToReleaseList***  List of Scheduling Request configurations to release |
| ***sr-ConfigIndex***  Used to modify a SR configuration and to indicate, in LogicalChannelConfig, the SR configuration to which a logical channel is mapped. |
| ***sr-ProhibitTimer***  Timer for SR transmission on PUCCH in TS 38.321 [3]. Value in ms. ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on. When the field is absent, the UE applies the value 0. |
| ***sr-TransMax***  Maximum number of SR transmissions as described in 38.321 [3]. n4 corresponds to 4, n8 corresponds to 8, and so on. |

#### – *SchedulingRequestResourceConfig*

The IE *SchedulingRequestResourceConfig* determines physical layer resources on PUCCH where the UE may send the dedicated scheduling request (D-SR) (see 38.213, section 9.2.2).

*SchedulingRequestResourceConfig* information element

-- ASN1START

-- TAG-SCHEDULING-REQUEST-RESOURCE-CONFIG-START

SchedulingRequestResourceConfig ::= SEQUENCE {

schedulingRequestResourceId SchedulingRequestResourceId,

-- The ID of the SchedulingRequestConfig that uses this scheduling request resource.

schedulingRequestID SchedulingRequestId,

-- SR periodicity and offset in number of slots. Corresponds to L1 parameter 'SR-periodicity' and 'SR-offset' (see 38.213, section 9.2.2)

-- The following periodicities may be configured depending on the chosen subcarrier spacing:

-- SCS = 15 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 5sl, 8sl, 10sl, 16sl, 20sl, 40sl, 80sl

-- SCS = 30 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 8sl, 10sl, 16sl, 20sl, 40sl, 80sl, 160sl

-- SCS = 60 kHz: 2sym, 7sym/6sym, 1sl, 2sl, 4sl, 8sl, 16sl, 20sl, 40sl, 80sl, 160sl, 320sl

-- SCS = 120 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 8sl, 16sl, 40sl, 80sl, 160sl, 320sl, sl640

-- sym6or7 corresponds to 6 symbols if extended cyclic prefix and a SCS of 60 kHz are configured, otherwise it corresponds to 7 symbols.

-- For periodicities sym2, sym7 and sl1 the UE assumes an offset of 0 slots.

periodicityAndOffset CHOICE {

sym2 NULL,

sym6or7 NULL,

sl1 NULL, -- Recurs in every slot

sl2 INTEGER (0..1),

sl4 INTEGER (0..3),

sl5 INTEGER (0..4),

sl8 INTEGER (0..7),

sl10 INTEGER (0..9),

sl16 INTEGER (0..15),

sl20 INTEGER (0..19),

sl40 INTEGER (0..39),

sl80 INTEGER (0..79),

sl160 INTEGER (0..159),

sl320 INTEGER (0..319),

sl640 INTEGER (0..639)

} OPTIONAL, -- Need M

-- ID of the PUCCH resource in which the UE shall send the scheduling request. The

-- actual PUCCH-Resource is configured in PUCCH-Config of the same UL BWP and serving cell as this SchedulingRequestResourceConfig.

-- The network configures a PUCCH-Resource of PUCCH-format0 or PUCCH-format1

-- (other formats not supported). Corresponds to L1 parameter 'SR-resource' (see 38.213, section 9.2.2)

resource PUCCH-ResourceId OPTIONAL -- Need M

}

-- TAG-SCHEDULING-REQUEST-RESOURCE-CONFIG-STOP

-- ASN1STOP

#### – *SchedulingRequestResourceId*

The IE *SchedulingRequestResourceId* is used to identify scheduling request resources on PUCCH.

*SchedulingRequestResourceId* information element

-- ASN1START

-- TAG-SCHEDULINGREQUESTRESOURCEID-START

SchedulingRequestResourceId ::= INTEGER (1..maxNrofSR-Resources)

-- TAG-SCHEDULINGREQUESTRESOURCEID-STOP

-- ASN1STOP

#### – *ScramblingId*

The IE *ScramblingID* is used for scrambling channels and reference signals.

-- ASN1START

-- TAG-SCRAMBLING-ID-START

ScramblingId ::= INTEGER (0..1023)

-- TAG-SCRAMBLING-ID-STOP

-- ASN1STOP

#### – *SCS-SpecificCarrier*

The IE *SCS-SpecificCarrier* provides parameters determining the location and width of the actual carrier. It is defined specifically for a numerology (subcarrier spacing (SCS)) and in relation (frequency offset) to Point A.

-- ASN1START

-- TAG-SCS-SPECIFIC-CARRIER-START

SCS-SpecificCarrier ::= SEQUENCE {

-- Offset in frequency domain between Point A (lowest subcarrier of common RB 0) and the lowest usable subcarrier on this carrier

-- in number of PRBs (using the subcarrierSpacing defined for this carrier). The maximum value corresponds to 275\*8-1.

-- Corresponds to L1 parameter 'offset-pointA-low-scs' (see 38.211, section FFS\_Section)

offsetToCarrier INTEGER (0..2199),

-- Subcarrier spacing of this carrier. It is used to convert the offsetToCarrier into an actual frequency.

-- Only the values 15 or 30 kHz (<6GHz), 60 or 120 kHz (>6GHz) are applicable.

-- Corresponds to L1 parameter 'ref-scs' (see 38.211, section FFS\_Section)

subcarrierSpacing SubcarrierSpacing,

-- Corresponds to L1 parameter k0 (see 38.211, section 5.3.1). n-6 corresponds to value -6, n0 corresponds to value 0 and n6 corresponds

-- to value +6.

k0 ENUMERATED {n-6, n0, n6},

-- Width of this carrier in number of PRBs (using the subcarrierSpacing defined for this carrier)

-- Corresponds to L1 parameter 'BW' (see 38.211, section FFS\_Section)

carrierBandwidth INTEGER (1..maxNrofPhysicalResourceBlocks),

...

}

-- TAG-SCS-SPECIFIC-CARRIER-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *OnePerServCell* | This field must be present for exactly one SCS-SpecificCarrier of a serving cell. |

#### – *SDAP-Config*

The IE *SDAP-Config* is used to set the configurable SDAP parameters for a data radio bearer. All configured instances of SDAP-Config with the same value of pdu-Session correspond to the same SDAP entity as specified in TS 37.324 [FFS\_Ref].

*SDAP-Config* information element

-- ASN1START

-- TAG-SDAP-CONFIG-START

SDAP-Config ::= SEQUENCE {

pdu-Session PDU-SessionID,

-- FFS: separate configuration for UL and DL

sdap-HeaderDL ENUMERATED {present, absent},

sdap-HeaderUL ENUMERATED {present, absent},

defaultDRB BOOLEAN,

-- A list of QoS-Flow-IDs that the UE shall map to the DRB of this SDAP-Config.

mappedQoS-FlowsToAdd SEQUENCE (SIZE (1..maxNrofQFIs)) OF QFI OPTIONAL, -- Need N

-- A list of QoS-Flow-IDs that the UE shall no longer map to the DRB of this SDAP-Config.

mappedQoS-FlowsToRelease SEQUENCE (SIZE (1..maxNrofQFIs)) OF QFI OPTIONAL, -- Need N

...

}

QFI ::= INTEGER (0..maxQFI)

PDU-SessionID ::= INTEGER (0..255)

-- TAG-SDAP-CONFIG-STOP

-- ASN1STOP

| *SDAP-Config*field descriptions |
| --- |
| ***defaultDRB***  Indicates whether or not this is the default DRB for this PDU session. Among all configured instances of *SDAP-Config* with the same value of *pdu-Session*, this field shall be set to TRUE in at most one instance of SDAP-Config and to FALSE in all other instances. |
| ***mappedQoS-FlowsToAdd***  Indicates the list of QFIs of QoS flows of the PDU session to be additionally mapped to this DRB. A QFI value can be included at most once in all configured instances of *SDAP-Config* with the same value of *pdu-Session*. |
| ***mappedQoS-FlowsToRelease***  Indicates the list of QFIs of QoS flows of the PDU session to be released from existing QoS flow to DRB mapping of this DRB. |
| ***pdu-Session***  Identity of the PDU session whose QoS flows are mapped to the DRB |
| ***reflectiveQoS***  Indicates whether or not reflective QoS is active for QoS flows transmitted via this DRB. |
| ***sdap-HeaderUL***  Indicates whether or not a SDAP header is present for UL data on this DRB. |
| ***sdap-HeaderDL***  Indicates whether or not a SDAP header is present for DL data on this DRB. |

#### – *SearchSpace*

The IE *SearchSpace* defines how/where to search for PDCCH candidates. Each search space is associated with one *ControlResourceSet*.

*SearchSpace* information element

-- ASN1START

-- TAG-SEARCHSPACE-START

SearchSpace ::= SEQUENCE {

-- Identity of the search space. SearchSpaceId = 0 identifies the SearchSpace configured via PBCH (MIB) or ServingCellConfigCommon.

-- The searchSpaceId is unique among the BWPs of a Serving Cell.

searchSpaceId SearchSpaceId,

-- The CORESET applicable for this SearchSpace.

-- Value 0 identifies the common CORESET configured in MIB and in ServingCellConfigCommon

-- Values 1..maxNrofControlResourceSets-1 identify CORESETs configured by dedicated signalling

controlResourceSetId ControlResourceSetId OPTIONAL, -- Cond SetupOnly

-- Slots for PDCCH Monitoring configured as periodicity and offset. Corresponds to L1 parameters 'Montoring-periodicity-PDCCH-slot' and

-- 'Montoring-offset-PDCCH-slot' (see 38.213, section 10)

monitoringSlotPeriodicityAndOffset CHOICE {

sl1 NULL,

sl2 INTEGER (0..1),

sl4 INTEGER (0..3),

sl5 INTEGER (0..4),

sl8 INTEGER (0..7),

sl10 INTEGER (0..9),

sl16 INTEGER (0..15),

sl20 INTEGER (0..19)

} OPTIONAL, -- Cond Setup

-- Symbols for PDCCH monitoring in the slots configured for PDCCH monitoring (see monitoringSlotPeriodicityAndOffset).

-- The most significant (left) bit represents the first OFDM in a slot. The least significant (right) bit represents the last symbol.

-- Corresponds to L1 parameter 'Montoring-symbols-PDCCH-within-slot' (see 38.213, section 10)

monitoringSymbolsWithinSlot BIT STRING (SIZE (14)) OPTIONAL, -- Cond Setup

-- Number of PDCCH candidates per aggregation level. Corresponds to L1 parameter 'Aggregation-level-1' to 'Aggregation-level-8'.

-- The number of candidates and aggregation levels configured here applies to all formats unless a particular value is specified or

-- a format-specific value is provided (see inside searchSpaceType).

-- (see 38.213, section 10)

nrofCandidates SEQUENCE {

aggregationLevel1 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},

aggregationLevel2 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},

aggregationLevel4 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},

aggregationLevel8 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},

aggregationLevel16 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8}

} OPTIONAL, -- Cond Setup

-- Indicates whether this is a common search space (present) or a UE specific search space as well as DCI formats to monitor for.

searchSpaceType CHOICE {

-- Configures this search space as common search space (CSS) and DCI formats to monitor.

common SEQUENCE {

-- If configured, the UE monitors the DCI formats 0\_0 and 1\_0 with CRC scrambled by C-RNTI, CS-RNTI (if configured),

-- SP-CSI-RNTI (if configured), RA-RNTI, TC-RNTI, P-RNTI, SI-RNTI

dci-Format0-0-AndFormat1-0 SEQUENCE {

...

} OPTIONAL, -- Need R

-- If configured, UE monitors the DCI format format 2\_0 with CRC scrambled by SFI-RNTI

dci-Format2-0 SEQUENCE {

-- The number of PDCCH candidates specifically for format 2-0 for the configured aggregation level.

-- If an aggregation level is absent, the UE does not search for any candidates with that aggregation level.

-- Corresponds to L1 parameters 'SFI-Num-PDCCH-cand' and 'SFI-Aggregation-Level' (see 38.213, section 11.1.1).

nrofCandidates-SFI SEQUENCE {

aggregationLevel1 ENUMERATED {n1, n2} OPTIONAL, -- Need R

aggregationLevel2 ENUMERATED {n1, n2} OPTIONAL, -- Need R

aggregationLevel4 ENUMERATED {n1, n2} OPTIONAL, -- Need R

aggregationLevel8 ENUMERATED {n1, n2} OPTIONAL, -- Need R

aggregationLevel16 ENUMERATED {n1, n2} OPTIONAL -- Need R

},

...

} OPTIONAL, -- Need R

-- If configured, UE monitors the DCI format format 2\_1 with CRC scrambled by INT-RNTI

dci-Format2-1 SEQUENCE {

...

} OPTIONAL, -- Need R

-- If configured, UE monitors the DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI or TPC-PUCCH-RNTI

dci-Format2-2 SEQUENCE {

...

} OPTIONAL, -- Need R

-- If configured, UE monitors the DCI format 2\_3 with CRC scrambled by TPC-SRS-RNTI

dci-Format2-3 SEQUENCE {

-- Monitoring periodicity of SRS PDCCH in number of slots for DCI format 2-3.

-- Corresponds to L1 parameter 'SRS-monitoring-periodicity' (see 38.212, 38.213, section 7.3.1, 11.3)

monitoringPeriodicity ENUMERATED {n1, n2, n4, n5, n8, n10, n16, n20 } OPTIONAL, -- Cond Setup

-- The number of PDCCH candidates for DCI format 2-3 for the configured aggregation level.

-- Corresponds to L1 parameter 'SRS-Num-PDCCH-cand' (see 38.212, 38.213, section 7.3.1, 11.3)

nrofPDCCH-Candidates ENUMERATED {n1, n2},

...

} OPTIONAL -- Need R

},

-- Configures this search space as UE specific search space (USS). The UE monitors the DCI format with CRC scrambled

-- by C-RNTI, CS-RNTI (if configured), TC-RNTI (if a certain condition is met), and SP-CSI-RNTI (if configured)

ue-Specific SEQUENCE {

-- Indicates whether the UE monitors in this USS for DCI formats 0-0 and 1-0 or for formats 0-1 and 1-1.

dci-Formats ENUMERATED {formats0-0-And-1-0, formats0-1-And-1-1},

...

}

} OPTIONAL -- Cond Setup

}

-- TAG-SEARCHSPACE-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *Setup* | This field is mandatory present upon creation of a new SearchSpace. It is optionally present, Need M, otherwise. |
| *SetupOnly* | This field is mandatory present upon creation of a new SearchSpace. It is absent otherwise. |

#### – *SearchSpaceId*

The IE *SearchSpaceId* is used to identify Search Spaces. The search space with the *SearchSpaceId* = 0 identifies the search space configured via PBCH (MIB) and in ServingCellConfigCommon. The number of Search Spaces per BWP is limited to 10 including the initial Search Space.

*SearchSpaceId* information element

-- ASN1START

-- TAG-SEARCHSPACEID-START

SearchSpaceId ::= INTEGER (0..maxNrofSearchSpaces-1)

-- TAG-SEARCHSPACEID-STOP

-- ASN1STOP

#### – *SecurityAlgorithmConfig*

The IE *SecurityAlgorithmConfig* is used to configure AS integrity protection algorithm (SRBs) and AS ciphering algorithm (SRBs and DRBs).

*SecurityAlgorithmConfig* information element

-- ASN1START

-- TAG-SECURITY-ALGORITHM-CONFIG-START

SecurityAlgorithmConfig ::= SEQUENCE {

cipheringAlgorithm CipheringAlgorithm,

integrityProtAlgorithm IntegrityProtAlgorithm OPTIONAL, -- Need R

...

}

IntegrityProtAlgorithm ::= ENUMERATED {

nia0, nia1, nia2, nia3, spare4, spare3,

spare2, spare1, ...}

CipheringAlgorithm ::= ENUMERATED {

nea0, nea1, nea2, nea3, spare4, spare3,

spare2, spare1, ...}

-- TAG-SECURITY-ALGORITHM-CONFIG-STOP

-- ASN1STOP

| *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 and the algorithms configured for bearers using KgNB shall be the same as for all bearers using KgNB. |
| ***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 and the algorithms configured for bearers using KgNB shall be the same as for all bearers using KgNB. |

#### – *ServCellIndex*

The IE *ServCellIndex* concerns a short identity, used to identify a serving cell (i.e. the PCell or an SCell). Value 0 applies for the PCell, while the *SCellIndex* that has previously been assigned applies for SCells.

*ServCellIndex* information element

-- ASN1START

-- TAG-SERV-CELL-INDEX-START

ServCellIndex ::= INTEGER (0..maxNrofServingCells-1)

-- TAG-SERV-CELL-INDEX-STOP

-- ASN1STOP

#### – *ServingCellConfig*

The *ServingCellConfig* IE is used to configure (add or modify) the UE with a serving cell, which may be the SpCell or an SCell of an MCG or SCG. The parameters herein are mostly UE specific but partly also cell specific (e.g. in additionally configured bandwidth parts).

*ServingCellConfig* information element

-- ASN1START

-- TAG-SERVING-CELL-CONFIG-START

ServingCellConfig ::= SEQUENCE {

-- L1 parameters:

tdd-UL-DL-ConfigurationDedicated TDD-UL-DL-ConfigDedicated OPTIONAL, -- Cond TDD

-- The dedicated (UE-specific) configuration for the initial downlink bandwidth-part.

initialDownlinkBWP BWP-DownlinkDedicated OPTIONAL, -- Cond ServCellAdd

-- List of additional downlink bandwidth parts to be released. (see 38.211, 38.213, section 12).

downlinkBWP-ToReleaseList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id OPTIONAL, -- Need N

-- List of additional downlink bandwidth parts to be added or modified. (see 38.211, 38.213, section 12).

downlinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Downlink OPTIONAL, -- Need N

-- If configured for an SpCell, this field contains the ID of the DL BWP to be activated upon performing the reconfiguration

-- in which it is received. If the field is absent, the RRC reconfiguration does not impose a BWP switch (corresponds to L1

-- parameter 'active-BWP-DL-Pcell').

-- If configured for an SCell, this field contains the ID of the downlink bandwidth part to be used upon MAC-activation of an SCell.

-- If not provided, the UE uses the default BWP.

-- The initial bandwidth part is referred to by BWP-Id = 0.

firstActiveDownlinkBWP-Id BWP-Id OPTIONAL, -- Need R

-- The duration in ms after which the UE falls back to the default Bandwidth Part. (see 38.321, section 5.15)

-- The value 0.5 ms is only applicable for carriers >6 GHz.

-- When the network releases the timer configuration, the UE stops the timer without swithching to the default BWP.

bwp-InactivityTimer ENUMERATED {ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40,ms50, ms60, ms80,

ms100, ms200, ms300, ms500, ms750, ms1280, ms1920, ms2560, spare10, spare9,

spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 } OPTIONAL, -- Need R

-- Corresponds to L1 parameter 'default-DL-BWP'. The initial bandwidth part is referred to by BWP-Id = 0.

-- ID of the downlink bandwidth part to be used upon expiry of txxx.

-- This field is UE specific. When the field is absent the UE uses the the initial BWP as default BWP.

-- (see 38.211, 38.213, section 12 and 38.321, section 5.15)

defaultDownlinkBWP-Id BWP-Id OPTIONAL, -- Need M

uplinkConfig UplinkConfig OPTIONAL, -- Cond ServCellAdd-UL

supplementaryUplink UplinkConfig OPTIONAL, -- Cond ServCellAdd-SUL

-- PDSCH releated parameters that are not BWP-specific.

pdsch-ServingCellConfig SetupRelease { PDSCH-ServingCellConfig } OPTIONAL, -- Need M

csi-MeasConfig SetupRelease { CSI-MeasConfig } OPTIONAL, -- Need M

-- Includes parameters for configuration of carrier based SRS switching

-- Corresponds to L1 parameter 'SRS-CarrierSwitching' (see 38,214, section FFS\_Section)

carrierSwitching SetupRelease { SRS-CarrierSwitching } OPTIONAL, -- Need M

-- MAC parameters:

sCellDeactivationTimer ENUMERATED {ms20, ms40, ms80, ms160, ms200, ms240, ms320, ms400, ms480, ms520, ms640,

ms720, ms840, ms1280, spare2,spare1} OPTIONAL, -- Cond ServingCellWithoutPUCCH

-- Indicates whether this SCell is cross-carrier scheduled by another serving cell.

crossCarrierSchedulingConfig CrossCarrierSchedulingConfig OPTIONAL, -- Need M

-- Timing Advance Group ID, as specified in TS 38.321 [3], which this cell belongs to.

tag-Id TAG-Id,

-- Enables the "UE beam lock function (UBF)", which disable changes to the UE beamforming configuration when in NR\_RRC\_CONNECTED.

-- FFS: Parameter added preliminary based on RAN4 LS in R4-1711823. Decide where to place it (maybe ServingCellConfigCommon or

-- in a BeamManagement IE??)

ue-BeamLockFunction ENUMERATED {enabled} OPTIONAL, -- Need R

-- Indicates whether UE shall apply as pathloss reference either the downlink of PCell or of SCell that corresponds with this uplink

-- (see 38.213, section 7)

pathlossReferenceLinking ENUMERATED {pCell, sCell} OPTIONAL -- Cond SCellOnly

}

UplinkConfig ::= SEQUENCE {

-- Configuration of UL BWPs (including BWP-specific parameters:

-- The dedicated (UE-specific) configuration for the initial uplink bandwidth-part.

initialUplinkBWP BWP-UplinkDedicated OPTIONAL, -- Cond ServCellAdd

-- The additional bandwidth parts for uplink. In case of TDD uplink- and downlink BWP with the same bandwidthPartId are considered

-- as a BWP pair and must have the same center frequency.

uplinkBWP-ToReleaseList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id OPTIONAL, -- Need N

uplinkBWP-ToAddModList SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Uplink OPTIONAL, -- Need N

-- If configured for an SpCell, this field contains the ID of the DL BWP to be activated upon performing the reconfiguration

-- in which it is received. If the field is absent, the RRC reconfiguration does not impose a BWP switch (corresponds to

-- L1 parameter 'active-BWP-UL-Pcell').

-- If configured for an SCell, this field contains the ID of the uplink bandwidth part to be used upon MAC-activation of an SCell.

-- If not provided, the UE uses the FFS: default BWP.

-- The initial bandwidth part is referred to by BandiwdthPartId = 0.

firstActiveUplinkBWP-Id BWP-Id OPTIONAL, -- Need R

-- Configuration that is common across the UL BWPs:

-- PUSCH related parameters that are not BWP-specific.

pusch-ServingCellConfig SetupRelease { PUSCH-ServingCellConfig } OPTIONAL, -- Need M

...

}

-- TAG-SERVING-CELL-CONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *SCellOnly* | This field is optionally present, Need R, for SCells. It is absent otherwise. |
| *ServCellAdd* | This field is mandatory present upon serving cell addition (for PSCell and SCell). It is optionally present, Need M otherwise. |
| *ServCellAdd-UL* | This field is mandatory present upon serving cell addition (for PSCell and SCell) provided that the serving cell is configured with uplink. It is optionally present, Need M otherwise. |
| *ServCellAdd-SUL* | This field is mandatory present upon serving cell addition (for PSCell and SCell) provided that the serving cell is configured with a supplementary uplink. It is optionally present, Need M otherwise. |

#### – *ServingCellConfigCommon*

The *ServingCellConfigCommon* IE is used to configure cell specific parameters of a UE’s serving cell. The IE contains parameters which a UE would typically acquire from SSB, MIB or SIBs when accessing the cell from IDLE. With this IE, the network provides this information in dedicated signalling when configuring a UE with a SCells or with an additional cell group (SCG). It also provides it for SpCells (MCG and SCG) upon reconfiguration with sync.

*ServingCellConfigCommon* information element

-- ASN1START

-- TAG-SERVING-CELL-CONFIG-COMMON-START

ServingCellConfigCommon ::= SEQUENCE {

physCellId PhysCellId OPTIONAL, -- Cond HOAndServCellAdd,

frequencyInfoDL FrequencyInfoDL OPTIONAL, -- Cond InterFreqHOAndServCellAdd

-- The initial downlink BWP configuration for a SpCell (PCell of MCG or SCG).

initialDownlinkBWP BWP-DownlinkCommon OPTIONAL, -- Cond ServCellAdd

uplinkConfigCommon UplinkConfigCommon OPTIONAL, -- Cond ServCellAdd-UL

supplementaryUplinkConfig UplinkConfigCommon OPTIONAL, -- Cond ServCellAdd-SUL

-- Indicates the time domain positions of the transmitted SS-blocks in an SS-burst. The first/ leftmost bit corresponds to SS/PBCH

-- block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the

-- corresponding SS/PBCH block is not transmitted while value 1 indicates that the corresponding SS/PBCH block is transmitted.

-- Corresponds to L1 parameter 'SSB-Transmitted' (see 38.213, section 4.1)

ssb-PositionsInBurst CHOICE {

-- bitmap for sub 3 GHz

shortBitmap BIT STRING (SIZE (4)),

-- bitmap for 3-6 GHz

mediumBitmap BIT STRING (SIZE (8)),

-- bitmap for above 6 GHz

longBitmap BIT STRING (SIZE (64))

} OPTIONAL, -- Need R,

-- The SSB periodicity in msec for the rate matching purpose. If the field is absent, the UE applies the value ms5.

-- (see 38.211, section [7.4.3.1])

ssb-periodicityServingCell ENUMERATED { ms5, ms10, ms20, ms40, ms80, ms160, spare2, spare1 } OPTIONAL, -- Need S

-- Position of (first) DL DM-RS (see 38.211, section 7.4.1.1.1)

dmrs-TypeA-Position ENUMERATED {pos2, pos3},

-- Parameters to determine an LTE CRS pattern that the UE shall rate match around.

lte-CRS-ToMatchAround SetupRelease { RateMatchPatternLTE-CRS } OPTIONAL, -- Need M

-- Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources

-- indicated in the nested bitmaps. Rate match patterns defined here on cell level apply only to PDSCH of the same numerology.

-- Corresponds to L1 parameter 'Resource-set-cekk' (see 38.214, section 5.1.2.2.3)

rateMatchPatternToAddModList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern OPTIONAL, -- Need N

rateMatchPatternToReleaseList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need N

-- Subcarrier spacing of SSB. Used only for non-initial access (e.g. SCells, PCell of SCG).

-- If the field is absent the UE shall assume the default value of the band.

-- Only the values 15 or 30 kHz (<6GHz), 120 or 240 kHz (>6GHz) are applicable.

subcarrierSpacing SubcarrierSpacing OPTIONAL, -- Need S

-- A cell-specific TDD UL/DL configuration. Corresponds to L1 parameter 'UL-DL-configuration-common' (see 38.213, section 11.1)

tdd-UL-DL-ConfigurationCommon TDD-UL-DL-ConfigCommon OPTIONAL, -- Cond TDD

-- A second cell-specific TDD UL/DL configuration. When tdd-UL-DL-ConfigurationCommon2 is configured, the cell specific DL/UL

-- pattern is a concatenation of the pattern specified in tdd-UL-DL-ConfigurationCommon and the pattern specified in

-- tdd-UL-DL-ConfigurationCommon2. Corresponds to L1 parameter 'UL-DL-configuration-common-Set2' (see 38.211, section 11.1)

tdd-UL-DL-ConfigurationCommon2 TDD-UL-DL-ConfigCommon OPTIONAL, -- Cond TDD

-- TX power that the NW used for SSB transmission. The UE uses it to estimate the RA preamble TX power.

-- (see 38.213, section 7.4)

ss-PBCH-BlockPower INTEGER (-60..50),

...

}

UplinkConfigCommon ::= SEQUENCE {

-- Absolute uplink frequency configuration and subcarrier specific virtual carriers.

frequencyInfoUL FrequencyInfoUL OPTIONAL, -- Cond InterFreqHOAndServCellAdd

-- The initial uplink BWP configuration for a SpCell (PCell of MCG or SCG). Corresponds to L1 parameter 'initial-UL-BWP'.

-- (see 38.331, section FFS\_Section).

initialUplinkBWP BWP-UplinkCommon OPTIONAL -- Cond ServCellAdd

}

-- TAG-SERVING-CELL-CONFIG-COMMON-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *HOAndServCellAdd* | This field is mandatory present for inter-cell handover and upon serving cell (PSCell/SCell) addition. Otherwise, the field is absent, Need M. |
| *InterFreqHOAndServCellAdd* | This field is mandatory present for inter-frequency handover and upon serving cell (PSCell/SCell) addition. Otherwise, the field isoptionally present, Need M. |
| *ServCellAdd* | This field is mandatory present upon serving cell addition (for PSCell and SCell). It is optionally present, Need M otherwise. |
| *ServCellAdd-UL* | This field is mandatory present upon serving cell addition (for PSCell and SCell) provided that the serving cell is configured with uplink. It is optionally present, Need M otherwise. |
| *ServCellAdd-SUL* | This field is mandatory present upon serving cell addition (for PSCell and SCell) provided that the serving cell is configured with a supplementary uplink. It is optionally present, Need M otherwise. |

#### – *SINR-Range*

The IE *SINR-Range* specifies the value range used in SINR measurements and thresholds. Integer value for SINR measurements is according to mapping table in TS 38.133 [14].

*SINR-Range* information element

-- ASN1START

-- TAG-SINR-RANGE-START

SINR-Range ::= INTEGER(0..127)

-- TAG-SINR-RANGE-STOP

-- ASN1STOP

#### – *SlotFormatCombinationsPerCell*

The IE *SlotFormatCombinationsPerCell* is used to configure FFS

*SlotFormatCombinationsPerCell* information element

-- ASN1START

-- TAG-SLOTFORMATCOMBINATIONSPERCELL-START

-- The SlotFormatCombinations applicable for one serving cell. Corresponds to L1 parameter 'cell-to-SFI' (see 38.213, section 11.1.1)

SlotFormatCombinationsPerCell ::= SEQUENCE {

-- The ID of the serving cell for which the slotFormatCombinations are applicable

servingCellId ServCellIndex,

-- Reference subcarrier spacing for this Slot Format Combination. Corresponds to L1 parameter 'SFI-scs' (see 38.213, section FFS\_Section)

subcarrierSpacing SubcarrierSpacing,

-- Reference subcarrier spacing for a Slot Format Combination on an FDD or SUL cell.

-- Corresponds to L1 parameter 'SFI-scs2' (see 38.213, section FFS\_Section).

-- For FDD, subcarrierSpacing (SFI-scs) is the reference SCS for DL BWP and subcarrierSpacing2 (SFI-scs2) is the reference SCS for UL BWP.

-- For SUL, subcarrierSpacing (SFI-scs) is the reference SCS for non-SUL carrier and subcarrierSpacing2 (SFI-scs2) is the reference

-- SCS for SUL carrier.

subcarrierSpacing2 SubcarrierSpacing OPTIONAL, -- Need R

-- A list with SlotFormatCombinations. Each SlotFormatCombination comprises of one or more SlotFormats (see 38.211, section 4.3.2)

-- FFS\_CHECK: RAN1 indicates that the combinations could be of two different types... but they don't specify the second

slotFormatCombinations SEQUENCE (SIZE (1..maxNrofSlotFormatCombinationsPerSet)) OF SlotFormatCombination OPTIONAL,

-- The (starting) position (bit) of the slotFormatCombinationId (SFI-Index) for this serving cell (servingCellId) within the DCI payload.

-- Corresponds to L1 parameter 'SFI-values' (see 38.213, section FFS\_Section)

positionInDCI INTEGER(0..maxSFI-DCI-PayloadSize-1) OPTIONAL,

...

}

SlotFormatCombination ::= SEQUENCE {

-- This ID is used in the DCI payload to dynamically select this SlotFormatCombination.

-- Corresponds to L1 parameter 'SFI-index' (see 38.213, section FFS\_Section)

slotFormatCombinationId SlotFormatCombinationId,

-- Slot formats that occur in consecutive slots in time domain order as listed here. The the slot formats are

-- defined in 38.211, table 4.3.2-3 and numbered with 0..255.

slotFormats SEQUENCE (SIZE (1..maxNrofSlotFormatsPerCombination)) OF INTEGER (0..255)

}

-- SFI index that is assoicated with a certian slot-format-combination

-- Corresponds to L1 parameter 'SFI-index' (see 38.213, section FFS\_Section)

SlotFormatCombinationId ::= INTEGER (0..maxNrofSlotFormatCombinationsPerSet-1)

-- TAG-SLOTFORMATCOMBINATIONSPERCELL-STOP

-- ASN1STOP

#### – *SlotFormatIndicator*

The IE *SlotFormatIndicator* is used to configure monitoring a Group-Common-PDCCH for Slot-Format-Indicators (SFI).

*SlotFormatIndicator* information element

-- ASN1START

-- TAG-SLOTFORMATINDICATOR-START

SlotFormatIndicator ::= SEQUENCE {

-- RNTI used for SFI on the given cell

-- Corresponds to L1 parameter 'SFI-RNTI' (see 38.213, section 11.1.1)

sfi-RNTI RNTI-Value,

-- Total length of the DCI payload scrambled with SFI-RNTI.

-- Corresponds to L1 parameter 'SFI-DCI-payload-length' (see 38.213, section 11.1.1)

dci-PayloadSize INTEGER (1..maxSFI-DCI-PayloadSize),

-- A list of SlotFormatCombinations for the UE's serving cells.

-- Corresponds to L1 parameter 'SFI-cell-to-SFI' (see 38.213, section 11.1.1)

slotFormatCombToAddModList SEQUENCE (SIZE(1..maxNrofAggregatedCellsPerCellGroup)) OF SlotFormatCombinationsPerCell OPTIONAL, -- Need N

slotFormatCombToReleaseList SEQUENCE (SIZE(1..maxNrofAggregatedCellsPerCellGroup)) OF ServCellIndex OPTIONAL, -- Need N

...

}

-- TAG-SLOTFORMATINDICATOR-STOP

-- ASN1STOP

#### – *SPS-Config*

Editor’s Note: FFS: RAN1 indicated in the L1 table: "Note: Multiple configurations is possible, how many needs to be determined". RAN2 agreed that SPS can be used on Pcell and SCell... But each UE can use it on at most one serving cell of a cell group at a time. Are the ”multiple configuration” meant for one carrier? Does the UE then use several SPS-RNTIs?

The *SPS-Config* IE is used to configure downlink semi-persistent transmission.

*SPS-Config* information element

-- ASN1START

-- TAG-SPS-CONFIG-START

-- Downlink SPS may be configured on the PCell as well as on SCells. But it shall not be configured for more than

-- one serving cell of a cell group at once.

SPS-Config ::= SEQUENCE {

-- Periodicity for DL SPS

-- Corresponds to L1 parameter 'semiPersistSchedIntervalDL' (see 38.214 and 38.321, section FFS\_Section)

-- FFS-Value: Support also shorter periodicities for DL?

periodicity ENUMERATED {ms10, ms20, ms32, ms40, ms64, ms80, ms128, ms160, ms320, ms640,

spare6, spare5, spare4, spare3, spare2, spare1},

-- Number of configured HARQ processes for SPS DL. Corresponds to L1 parameter 'numberOfConfSPS-Processes' (see 38.214, section FFS\_Section)

nrofHARQ-Processes INTEGER (1..8),

-- HARQ resource for PUCCH for DL SPS. The network configures the resource either as format0 or format1. (see 38.214, section FFS\_Section)

n1PUCCH-AN PUCCH-Resource OPTIONAL -- Need M

}

-- TAG-SPS-CONFIG-STOP

-- ASN1STOP

| *SPS-Config*field descriptions |
| --- |
| ***n1PUCCH-AN***  HARQ resource for PUCCH for DL SPS. The network configures the resource either as format0 or format1. |
| ***nrofHARQ-Processes***  Number of configured HARQ processes for SPS DL. Corresponds to L1 parameter 'numberOfConfSPS-Processes' |
| ***periodicity***  Periodicity for DL SPS, corresponding to L1 parameter ‘semiPersistSchedIntervalDL’. |

#### – *SRB-Identity*

The IE SRB-Identity is used to identify a Signalling Radio Bearer (SRB) used by a UE.

-- ASN1START

-- TAG-SRB-IDENTITY-START

SRB-Identity ::= INTEGER (1..3)

-- TAG-SRB-IDENTITY-STOP

-- ASN1STOP

#### – *SRS-Config*

The *SRS-Config* IE is used to configure sounding reference signal transmissions. The configuration defines a list of SRS-Resources and a list of SRS-ResourceSets. Each resource set defines a set of SRS-Resources. The network triggers the transmission of the set of SRS-Resources using a configured aperiodicSRS-ResourceTrigger (L1 DCI).

*SRS-Config* information element

-- ASN1START

-- TAG-SRS-CONFIG-START

SRS-Config ::= SEQUENCE {

srs-ResourceSetToReleaseList SEQUENCE (SIZE(0..maxNrofSRS-ResourceSets)) OF SRS-ResourceSetId OPTIONAL, -- Need N

srs-ResourceSetToAddModList  SEQUENCE (SIZE(0..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet OPTIONAL, -- Need N

srs-ResourceToReleaseList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-ResourceId OPTIONAL, -- Need N

srs-ResourceToAddModList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-Resource OPTIONAL, -- Need N

-- If absent, UE applies TPC commands via accumulation. If disabled, UE applies the TPC command without accumulation

-- (this applies to SRS when a separate closed loop is configured for SRS)

-- Corresponds to L1 parameter 'Accumulation-enabled-srs' (see 38,213, section 7.3)

tpc-Accumulation ENUMERATED {disabled} OPTIONAL, -- Need S

...

}

SRS-ResourceSet ::= SEQUENCE {

-- The ID of this resource set. It is unique in the context of the BWP in which the parent SRS-Config is defined.

srs-ResourceSetId SRS-ResourceSetId,

-- The IDs of the SRS-Reosurces used in this SRS-ResourceSet

srs-ResourceIdList SEQUENCE (SIZE(1..maxNrofSRS-ResourcesPerSet)) OF SRS-ResourceId OPTIONAL, -- Cond Setup

resourceType CHOICE {

aperiodic SEQUENCE {

-- The DCI "code point" upon which the UE shall transmit SRS according to this SRS resource set configuration.

-- Corresponds to L1 parameter 'AperiodicSRS-ResourceTrigger' (see 38.214, section 6.1.1.2)

aperiodicSRS-ResourceTrigger INTEGER (0..maxNrofSRS-TriggerStates-1),

-- ID of CSI-RS resource associated with this SRS resource set. (see 38.214, section 6.1.1.2)

csi-RS NZP-CSI-RS-ResourceId,

-- An offset in number of slots between the triggering DCI and the actual transmission of this SRS-ResourceSet.

-- If the field is absent the UE applies no offset (value 0)

slotOffset INTEGER (1..8) OPTIONAL, -- Need S

...

},

semi-persistent SEQUENCE {

-- ID of CSI-RS resource associated with this SRS resource set in non-codebook based operation.

-- Corresponds to L1 parameter 'SRS-AssocCSIRS' (see 38.214, section 6.2.1)

associatedCSI-RS NZP-CSI-RS-ResourceId OPTIONAL, -- Cond nonCodebook

...

},

periodic SEQUENCE {

-- ID of CSI-RS resource associated with this SRS resource set in non-codebook based operation.

-- Corresponds to L1 parameter 'SRS-AssocCSIRS' (see 38.214, section 6.2.1)

associatedCSI-RS NZP-CSI-RS-ResourceId OPTIONAL, -- Cond nonCodebook

...

}

},

-- Indicates if the SRS resource set is used for beam management vs. used for either codebook based or non-codebook based transmission.

-- Corresponds to L1 parameter 'SRS-SetUse' (see 38.214, section 6.2.1)

-- FFS\_CHECK: Isn't codebook/noncodebook already known from the ulTxConfig in the SRS-Config? If so, isn't the only distinction

-- in the set between BeamManagement, AtennaSwitching and "Other”? Or what happens if SRS-Config=Codebook but a Set=NonCodebook?

usage ENUMERATED {beamManagement, codebook, nonCodebook, antennaSwitching},

-- alpha value for SRS power control. Corresponds to L1 parameter 'alpha-srs' (see 38.213, section 7.3)

-- When the field is absent the UE applies the value 1

alpha Alpha OPTIONAL, -- Need S

-- P0 value for SRS power control. The value is in dBm. Only even values (step size 2) are allowed.

-- Corresponds to L1 parameter 'p0-srs' (see 38.213, section 7.3)

p0 INTEGER (-202..24) OPTIONAL, -- Cond Setup

-- A reference signal (e.g. a CSI-RS config or a SSblock) to be used for SRS path loss estimation.

-- Corresponds to L1 parameter 'srs-pathlossReference-rs-config' (see 38.213, section 7.3)

pathlossReferenceRS CHOICE {

ssb-Index SSB-Index,

csi-RS-Index NZP-CSI-RS-ResourceId

} OPTIONAL, -- Need M

-- Indicates whether hsrs,c(i) = fc(i,1) or hsrs,c(i) = fc(i,2) (if twoPUSCH-PC-AdjustmentStates are configured)

-- or serarate close loop is configured for SRS. This parameter is applicable only for Uls on which UE also transmits PUSCH.

-- If absent or release, the UE applies the value sameAs-Fci1

-- Corresponds to L1 parameter 'srs-pcadjustment-state-config' (see 38.213, section 7.3)

srs-PowerControlAdjustmentStates ENUMERATED { sameAsFci2, separateClosedLoop} OPTIONAL, -- Need S

...

}

SRS-ResourceSetId ::= INTEGER (0..maxNrofSRS-ResourceSets-1)

SRS-Resource ::= SEQUENCE {

srs-ResourceId SRS-ResourceId,

nrofSRS-Ports ENUMERATED {port1, ports2, ports4},

-- The PTRS port index for this SRS resource for non-codebook based UL MIMO. This is only applicable when the corresponding

-- PTRS-UplinkConfig is set to CP-OFDM. The ptrs-PortIndex configured here must be smaller than or equal to the maxNnrofPorts

-- configured in the PTRS-UplinkConfig.

-- Corresponds to L1 parameter 'UL-PTRS-SRS-mapping-non-CB' (see 38.214, section 6.1)

ptrs-PortIndex ENUMERATED {n0, n1 } OPTIONAL, -- Need R

-- Comb value (2 or 4) and comb offset (0..combValue-1). Corresponds to L1 parameter 'SRS-TransmissionComb' (see 38.214, section 6.2.1)

transmissionComb CHOICE {

n2 SEQUENCE {

combOffset-n2 INTEGER (0..1),

-- Cyclic shift configuration. Corresponds to L1 parameter 'SRS-CyclicShiftConfig' (see 38.214, section 6.2.1)

cyclicShift-n2 INTEGER (0..7)

},

n4 SEQUENCE {

combOffset-n4 INTEGER (0..3),

-- Cyclic shift configuration. Corresponds to L1 parameter 'SRS-CyclicShiftConfig' (see 38.214, section 6.2.1)

cyclicShift-n4 INTEGER (0..11)

}

},

-- OFDM symbol location of the SRS resource within a slot including number of OFDM symbols (N = 1, 2 or 4 per SRS resource),

-- startPosition (SRSSymbolStartPosition = 0..5; "0" refers to the last symbol, "1" refers to the second last symbol) and

-- RepetitionFactor (r = 1, 2 or 4).

-- Corresponds to L1 parameter 'SRS-ResourceMapping' (see 38.214, section 6.2.1 and 38.211, section 6.4.1.4).

-- FFS: Apparently, RAN1 considers replacing these three fields by a table in RAN1 specs and a corresponding index in ASN.1?!

resourceMapping SEQUENCE {

startPosition INTEGER (0..5),

nrofSymbols ENUMERATED {n1, n2, n4},

repetitionFactor ENUMERATED {n1, n2, n4}

},

-- Parameter(s) defining frequency domain position and configurable shift to align SRS allocation to 4 PRB grid.

-- Corresponds to L1 parameter 'SRS-FreqDomainPosition' (see 38.214, section 6.2.1)

freqDomainPosition INTEGER (0..67),

freqDomainShift INTEGER (0..268),

-- Includes parameters capturing SRS frequency hopping

-- Corresponds to L1 parameter 'SRS-FreqHopping' (see 38.214, section 6.2.1)

freqHopping SEQUENCE {

c-SRS INTEGER (0..63),

b-SRS INTEGER (0..3),

b-hop INTEGER (0..3)

},

-- Parameter(s) for configuring group or sequence hopping

-- Corresponds to L1 parameter 'SRS-GroupSequenceHopping' (see 38.211, section FFS\_Section)

groupOrSequenceHopping ENUMERATED { neither, groupHopping, sequenceHopping },

-- Time domain behavior of SRS resource configuration.

-- Corresponds to L1 parameter 'SRS-ResourceConfigType' (see 38.214, section 6.2.1).

-- For codebook based uplink transmission, the network configures SRS resources in the same resource set with the same

-- time domain behavior on periodic, aperiodic and semi-persistent SRS.

-- FFS: Add configuration parameters for the different SRS resource types?

resourceType CHOICE {

aperiodic SEQUENCE {

...

},

semi-persistent SEQUENCE {

-- Periodicity and slot offset for for this SRS resource. All values in "number of slots".

-- sl1 corresponds to a periodicity of 1 slot, value sl2 corresponds to a periodicity of 2 slots, and so on.

-- For each periodicity the corresponding offset is given in number of slots. For periodicity sl1 the offset is 0 slots.

-- Corresponds to L1 parameter 'SRS-SlotConfig' (see 38.214, section 6.2.1)

periodicityAndOffset-sp SRS-PeriodicityAndOffset,

...

},

periodic SEQUENCE {

-- Periodicity and slot offset for for this SRS resource. All values in "number of slots"

-- sl1 corresponds to a periodicity of 1 slot, value sl2 corresponds to a periodicity of 2 slots, and so on.

-- For each periodicity the corresponding offset is given in number of slots. For periodicity sl1 the offset is 0 slots.

-- Corresponds to L1 parameter 'SRS-SlotConfig' (see 38.214, section 6.2.1)

periodicityAndOffset-p SRS-PeriodicityAndOffset,

...

}

},

-- Sequence ID used to initialize psedo random group and sequence hopping.

-- Corresponds to L1 parameter 'SRS-SequenceId' (see 38.214, section 6.2.1)

sequenceId BIT STRING (SIZE (10)),

-- Configuration of the spatial relation between a reference RS and the target SRS. Reference RS can be SSB/CSI-RS/SRS

-- Corresponds to L1 parameter 'SRS-SpatialRelationInfo' (see 38.214, section 6.2.1)

spatialRelationInfo CHOICE {

ssb-Index SSB-Index,

csi-RS-Index NZP-CSI-RS-ResourceId,

srs SRS-ResourceId

} OPTIONAL, -- Need R

...

}

SRS-ResourceId ::= INTEGER (0..maxNrofSRS-Resources-1)

SRS-PeriodicityAndOffset ::= CHOICE {

sl1 NULL,

sl2 INTEGER(0..1),

sl4 INTEGER(0..3),

sl5 INTEGER(0..4),

sl8 INTEGER(0..7),

sl10 INTEGER(0..9),

sl16 INTEGER(0..15),

sl20 INTEGER(0..19),

sl32 INTEGER(0..31),

sl40 INTEGER(0..39),

sl64 INTEGER(0..63),

sl80 INTEGER(0..79),

sl160 INTEGER(0..159),

sl320 INTEGER(0..319),

sl640 INTEGER(0..639),

sl1280 INTEGER(0..1279),

sl2560 INTEGER(0..2559)

}

-- TAG-SRS-CONFIG-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *Setup* | This field is mandatory present upon configuration of SRS-ResourceSet or SRS-Resource and optional (Need M) otherwise |

#### – *SRS-CarrierSwitching*

The IE *SRS-CarrierSwitching* is used to configure FFS

*SRS-CarrierSwitching* information element

-- ASN1START

-- TAG-SRS-CARRIERSWITCHING-START

SRS-CarrierSwitching ::= SEQUENCE {

-- Indicates the serving cell whose UL transmission may be interrupted during SRS transmission on a PUSCH-less cell.

-- During SRS transmission on a PUSCH-less cell, the UE may temporarily suspend the UL transmission on a serving cell with PUSCH

-- in the same CG to allow the PUSCH-less cell to transmit SRS. (see 38.214, section 6.2.1.3)

srs-SwitchFromServCellIndex INTEGER (0..31) OPTIONAL, -- Cond Setup

-- Network configures the UE with either typeA-SRS-TPC-PDCCH-Group or typeB-SRS-TPC-PDCCH-Group, if any.

srs-TPC-PDCCH-Group CHOICE {

-- Type A trigger configuration for SRS transmission on a PUSCH-less SCell.

-- Corresponds to L1 parameter 'typeA-SRS-TPC-PDCCH-Group' (see 38.212, 38.213, section 7.3.1, 11.3)

typeA SEQUENCE (SIZE (1..32)) OF SRS-TPC-PDCCH-Config,

-- Type B trigger configuration for SRS transmission on a PUSCH-less SCell.

-- Corresponds to L1 parameter 'typeB-SRS-TPC-PDCCH-Config' (see 38.212, 38.213, section 7.3.1, 11.3)

typeB SRS-TPC-PDCCH-Config

} OPTIONAL, -- Cond Setup

-- Maps a specific cell to a given SFI value within the DCI message

-- Corresponds to L1 parameter 'SRS-cell-to-SFI' (see 38.212, 38.213, section 7.3.1, 11.3)

srs-CellToSFI SEQUENCE (SIZE (1..maxNrofServingCells)) OF SlotFormatCombinationsPerCell OPTIONAL, -- Cond Setup

-- A set of serving cells for monitoring PDCCH conveying SRS DCI format with CRC scrambled by TPC-SRS-RNTI

-- Corresponds to L1 parameter 'SRS-monitoring-cells' (see 38.212, 38.213, section 7.3.1, 11.3)

monitoringCells SEQUENCE (SIZE (1..maxNrofServingCells)) OF ServCellIndex OPTIONAL, -- Cond Setup

...

}

-- One trigger configuration for SRS-Carrier Switching. (see 38.212, 38.213, section 7.3.1, 11.3)

SRS-TPC-PDCCH-Config ::= SEQUENCE {

-- The starting bit position of a block within the group DCI with SRS request fields (optional) and TPC commands

-- for a PUSCH-less SCell. (see 38.212, 38.213, section 7.3.1, 11.3)

startingBitOfFormat2-3 INTEGER (1..31) OPTIONAL, -- Cond Setup

-- The type of a field within the group DCI with SRS request fields (optional) for a PUSCH-less SCell,

-- which indicates how many bits in the field are for SRS request (0 or 1/2).

-- Note that for Type A, there is a common SRS request field for all SCells in the set, but each SCell has its

-- own TPC command bits. See TS 38.212. Network configures this field with the same value for all PUSCH-less SCells.

-- (see 38.212, 38.213, section 7.3.1, 11.3)

fieldTypeFormat2-3 INTEGER (0..1) OPTIONAL, -- Cond Setup

-- A list of paris of [cc-SetIndex; cc-IndexInOneCC-Set] (see 38.212, 38.213, section 7.3.1, 11.3)

-- FFS: Improve description. What is a "CC"? Where is a CC-Set defined? ...

srs-CC-SetIndexlist SEQUENCE (SIZE(1..4)) OF SRS-CC-SetIndex OPTIONAL -- Cond Setup

}

SRS-CC-SetIndex ::= SEQUENCE {

-- Indicates the CC set index for Type A associated (see 38.212, 38.213, section 7.3.1, 11.3)

cc-SetIndex INTEGER (0..3) OPTIONAL, -- Cond Setup

-- Indicates the CC index in one CC set for Type A (see 38.212, 38.213, section 7.3.1, 11.3)

cc-IndexInOneCC-Set INTEGER (0..7) OPTIONAL -- Cond Setup

}

-- TAG-SRS-CARRIERSWITCHING-STOP

-- ASN1STOP

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *Setup* | This field is mandatory present upon configuration of SRS-CarrierSwitching or SRS-TPC-PDCCH-Config and optional (Need M) otherwise |

#### – *SSB-Index*

The IE *SSB-Index* identifies an SS-Block within an SS-Burst. See FFS\_Ref, section FFS\_Section.

*SSB-Index* information element

-- ASN1START

-- TAG-SSB-INDEX-START

SSB-Index ::= INTEGER (0..63)

-- TAG-SSB-INDEX-STOP

-- ASN1STOP

#### – *SubcarrierSpacing*

The *SubcarrierSpacing* IE determines the subcarrier spacing.

*SubcarrierSpacing* information element

-- ASN1START

-- TAG-SUBCARRIER-SPACING-START

-- The subcarrier spacing supported in NR. Restrictions applicable for certain frequencies, channels or signals are clarified

-- in the fields that use this IE.

SubcarrierSpacing ::= ENUMERATED {kHz15, kHz30, kHz60, kHz120, kHz240, spare3, spare2, spare1}

-- TAG-SUBCARRIER-SPACING-STOP

-- ASN1STOP

#### – *TCI-State*

The *TCI-State* IE associates one or two DL reference signals with a corresponding quasi-colocation (QCL) type.

*TCI-State* information element

-- ASN1START

-- TAG-TCI-STATE-START

TCI-State ::= SEQUENCE {

tci-StateId TCI-StateId,

qcl-Type1 QCL-Info,

qcl-Type2 QCL-Info OPTIONAL, -- Need R

nrofPTRS-Ports ENUMERATED {n1, n2} OPTIONAL, -- Need R

...

}

QCL-Info ::= SEQUENCE {

-- The carrier which the RS is located in. If the field is absent, it applies to the serving cell in which the TCI-State is configured

cell ServCellIndex OPTIONAL, -- Need R

-- The DL BWP which the RS is located in.

bwp-Id BWP-Id OPTIONAL, -- Cond CSI-RS-Indicated

-- Cond NZP-CSI-RS-Indicated: mandatory if csi-rs or csi-RS-for-tracking is included, absent otherwise

referenceSignal CHOICE {

csi-rs NZP-CSI-RS-ResourceId,

ssb SSB-Index,

-- A set of CSI-RS resources for tracking

csi-RS-for-tracking NZP-CSI-RS-ResourceSetId

},

qcl-Type ENUMERATED {typeA, typeB, typeC, typeD},

...

}

-- TAG-TCI-STATE-STOP

-- ASN1STOP

#### – *TCI-StateId*

The IE *TCI-StateId* is used to identify one *TCI-State* configuration.

*TCI-StateId* information element

-- ASN1START

-- TAG-TCI-STATEID-START

TCI-StateId ::= INTEGER (0..maxNrofTCI-States-1)

-- TAG-TCI-STATEID-STOP

-- ASN1STOP

#### – *TDD-UL-DL-Config*

The *TDD-UL-DL-Config* IEs determines the Uplink/Downlink TDD configuration. There are both, UE- and cell specific IEs.

*TDD-UL-DL-Config* information element

-- ASN1START

-- TAG-TDD-UL-DL-CONFIG-START

TDD-UL-DL-ConfigCommon ::= SEQUENCE {

-- Reference SCS used to determine the time domain boundaries in the UL-DL pattern which must be common across all subcarrier specific

-- virtual carriers, i.e., independent of the actual subcarrier spacing using for data transmission.

-- Only the values 15 or 30 kHz (<6GHz), 60 or 120 kHz (>6GHz) are applicable.

-- Corresponds to L1 parameter 'reference-SCS' (see 38.211, section FFS\_Section)

referenceSubcarrierSpacing SubcarrierSpacing OPTIONAL,

-- Periodicity of the DL-UL pattern. Corresponds to L1 parameter 'DL-UL-transmission-periodicity' (see 38.211, section FFS\_Section)

dl-UL-TransmissionPeriodicity ENUMERATED {ms0p5, ms0p625, ms1, ms1p25, ms2, ms2p5, ms5, ms10} OPTIONAL,

-- Number of consecutive full DL slots at the beginning of each DL-UL pattern.

-- Corresponds to L1 parameter 'number-of-DL-slots' (see 38.211, Table 4.3.2-1)

nrofDownlinkSlots INTEGER (0..maxNrofSlots) OPTIONAL,

-- Number of consecutive DL symbols in the beginning of the slot following the last full DL slot (as derived from nrofDownlinkSlots).

-- If the field is absent or released, there is no partial-downlink slot.

-- Corresponds to L1 parameter 'number-of-DL-symbols-common' (see 38.211, section FFS\_Section).

nrofDownlinkSymbols INTEGER (0..maxNrofSymbols-1) OPTIONAL, -- Need R

-- Number of consecutive full UL slots at the end of each DL-UL pattern.

-- Corresponds to L1 parameter 'number-of-UL-slots' (see 38.211, Table 4.3.2-1)

nrofUplinkSlots INTEGER (0..maxNrofSlots) OPTIONAL,

-- Number of consecutive UL symbols in the end of the slot preceding the first full UL slot (as derived from nrofUplinkSlots).

-- If the field is absent or released, there is no partial-uplink slot.

-- Corresponds to L1 parameter 'number-of-UL-symbols-common' (see 38.211, section FFS\_Section)

nrofUplinkSymbols INTEGER (0..maxNrofSymbols-1) OPTIONAL -- Need R

}

TDD-UL-DL-ConfigDedicated ::= SEQUENCE {

-- The slotSpecificConfiguration allows overriding UL/DL allocations provided in tdd-UL-DL-configurationCommon.

-- FFS\_ASN1: Consider making this an AddMod/Release list

-- FFS\_ASN1: Replace absolute numbers by variables... once RAN1 confirms.

-- FFS\_CHECK: This list will grow very large if used for many slots.

slotSpecificConfigurationsToAddModList SEQUENCE (SIZE (1..maxNrofSlots)) OF TDD-UL-DL-SlotConfig OPTIONAL, -- Need N

slotSpecificConfigurationsToreleaseList SEQUENCE (SIZE (1..maxNrofSlots)) OF TDD-UL-DL-SlotIndex OPTIONAL -- Need N

}

TDD-UL-DL-SlotConfig ::= SEQUENCE {

-- Identifies a slot within a dl-UL-TransmissionPeriodicity (given in tdd-UL-DL-configurationCommon)

slotIndex TDD-UL-DL-SlotIndex,

-- The direction (downlink or uplink) for the symbols in this slot. "allDownlink" indicates that all symbols in this slot are used

-- for downlink; "allUplink" indicates that all symbols in this slot are used for uplink; "explicit" indicates explicitly how many symbols

-- in the beginning and end of this slot are allocated to downlink and uplink, respectively.

symbols CHOICE {

allDownlink NULL,

allUplink NULL,

explicit SEQUENCE {

-- Number of consecutive DL symbols in the beginning of the slot identified by slotIndex.

-- If the field is absent the UE assumes that there are no leading DL symbols.

-- Corresponds to L1 parameter 'number-of-DL-symbols-dedicated' (see 38.211, section FFS\_Section)

nrofDownlinkSymbols INTEGER (1..maxNrofSymbols-1) OPTIONAL, -- Need S

-- Number of consecutive UL symbols in the end of the slot identified by slotIndex.

-- If the field is absent the UE assumes that there are no trailing UL symbols.

-- Corresponds to L1 parameter 'number-of-UL-symbols-dedicated' (see 38.211, section FFS\_Section)

nrofUplinkSymbols INTEGER (1..maxNrofSymbols-1) OPTIONAL -- Need S

}

}

}

TDD-UL-DL-SlotIndex ::= INTEGER (0..maxNrofSlots-1)

-- TAG-TDD-UL-DL-CONFIG-STOP

-- ASN1STOP

#### – *TimeToTrigger*

The IE *TimeToTrigger* specifies the value range used for time to trigger parameter, which concerns the time during which specific criteria for the event needs to be met in order to trigger a measurement report. Value ms0 corresponds to 0 ms and behaviour as specified in 7.1.2 applies, ms40 corresponds to 40 ms, and so on.

*TimeToTrigger* information element

-- ASN1START

TimeToTrigger ::= ENUMERATED {

ms0, ms40, ms64, ms80, ms100, ms128, ms160, ms256,

ms320, ms480, ms512, ms640, ms1024, ms1280, ms2560,

ms5120}

-- ASN1STOP

Editor's Note:: Values should be checked.

#### – *ZP-CSI-RS-Resource*

The IE *ZP-CSI-RS-Resource* is used to configure a Zero-Power (ZP) CSI-RS resource. Corresponds to L1 parameter 'ZP-CSI-RS-ResourceConfig' (see 38.214, section 5.1.4.2).

*ZP-CSI-RS-Resource* information element

-- ASN1START

-- TAG-ZP-CSI-RS-RESOURCE-START

ZP-CSI-RS-Resource ::= SEQUENCE {

-- ZP CSI-RS resource configuration ID

-- Corresponds to L1 parameter 'ZP-CSI-RS-ResourceConfigId' (see 38.214, section 5.1.4.2)

zp-CSI-RS-ResourceId ZP-CSI-RS-ResourceId,

-- OFDM symbol and subcarrier occupancy of the ZP-CSI-RS resource within a slot

resourceMapping CSI-RS-ResourceMapping,

-- Periodicity and slot offset for periodic/semi-persistent ZP-CSI-RS

-- Corresponds to L1 parameter 'ZP-CSI-RS-timeConfig' (see 38.214, section 5.1.4.2)

periodicityAndOffset CSI-ResourcePeriodicityAndOffset OPTIONAL, --Cond PeriodicOrSemiPersistent

...

}

ZP-CSI-RS-ResourceId ::= INTEGER (0..maxNrofZP-CSI-RS-Resources-1)

-- TAG-ZP-CSI-RS-RESOURCE-STOP

-- ASN1STOP

#### – *ZP-CSI-RS-ResourceSet*

The IE *ZP-CSI-RS-ResourceSet* refers to a set of *ZP-CSI-RS-Resources* using their *ZP-CSI-RS-ResourceId*s. It corresponds to the L1 parameter '*ZP-CSI-RS-ResourceSetConfigList*'.

*ZP-CSI-RS-ResourceSet* information element

-- ASN1START

-- TAG-ZP-CSI-RS-RESOURCESET-START

ZP-CSI-RS-ResourceSet ::= SEQUENCE {

zp-CSI-RS-ResourceSetId ZP-CSI-RS-ResourceSetId,

-- The list of ZP-CSI-RS-ResourceId identifying the ZP-CSI-RS-Resource elements belonging to this set.

zp-CSI-RS-ResourceIdList SEQUENCE (SIZE(1..maxNrofZP-CSI-RS-ResourcesPerSet)) OF ZP-CSI-RS-ResourceId,

-- Time domain behavior of ZP-CSI-RS resource configuration.

-- Corresponds to L1 parameter 'ZP-CSI-RS-ResourceConfigType' (see 38.214, section 5.1.4.2)

resourceType ENUMERATED {aperiodic, semiPersistent, periodic},

...

}

-- TAG-ZP-CSI-RS-RESOURCESET-STOP

-- ASN1STOP

#### – *ZP-CSI-RS-ResourceSetId*

The IE *ZP-CSI-RS-ResourceSetId* identifies a *ZP-CSI-RS-ResourceSet*.

*ZP-CSI-RS-ResourceSetId* information element

-- ASN1START

-- TAG-ZP-CSI-RS-RESOURCESETID-START

ZP-CSI-RS-ResourceSetId ::= INTEGER (0..maxNrofZP-CSI-RS-ResourceSets-1)

-- TAG-ZP-CSI-RS-RESOURCESETID-STOP

-- ASN1STOP

### 6.3.3 UE capability information elements

#### – *BandCombinationList*

The IE *BandCombinationList* contains a list of NR CA and/or MR-DC band combinations (also including DL only or UL only band).

*BandCombinationList* information element

-- ASN1START

-- TAG-BANDCOMBINATIONLIST-START

BandCombinationList ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination

BandCombination ::= SEQUENCE {

bandList SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandParameter,

bandCombinationParameters BandCombinationParameters OPTIONAL

}

BandParameter ::= CHOICE {

bandParameterEUTRA BandParameterEUTRA,

bandParameterNR BandParameterNR

}

BandCombinationParameters ::= SEQUENCE {

bandCombFeatureSetEUTRA-Id BandCombFeatureSetEUTRAId OPTIONAL,

ca-ParametersNR CA-ParametersNR OPTIONAL,

mrdc-Parameters MRDC-Parameters OPTIONAL

}

CA-ParametersNR ::= SEQUENCE {

multipleTimingAdvances ENUMERATED {supported} OPTIONAL,

-- R4 2-5: Simultaneous reception and transmission for inter band CA (TDD-TDD or TDD-FDD)

simultaneousRxTxInterBandCA ENUMERATED {supported} OPTIONAL,

-- BCS related to R4 2-1 and Updated CA BW class in R4-1803374

supportedBandwidthCombinationSet BIT STRING (SIZE (1..32)) OPTIONAL

}

MRDC-Parameters ::= SEQUENCE {

singleUL-Transmission ENUMERATED {supported} OPTIONAL,

-- R4 1-10: Support of EN-DC with LTE-NR coexistence in UL sharing from UE perspective

ul-SharingEUTRA-NR ENUMERATED {supported} OPTIONAL,

-- R4 1-11: Switching time between LTE UL and NR UL for EN-DC with LTE-NR coexistence in UL sharing from UE perspective

ul-SwitchingTimeEUTRA-NR ENUMERATED {type1, type2} OPTIONAL,

-- R4 2-4: Simultaneous reception and transmission for inter-band EN-DC (TDD-TDD or TDD-FDD)

simultaneousRxTxInterBandENDC ENUMERATED {supported} OPTIONAL,

-- R4 2-6: Asynchronous FDD-FDD intra-band EN-DC

asyncIntraBandENDC ENUMERATED {supported} OPTIONAL

}

-- TAG-BANDCOMBINATIONLIST-STOP

-- ASN1STOP

| *BandCombinationList* field descriptions |
| --- |
| ***Ca-ParametersEUTRA***  Includes the EUTRA *BandCombinationParametersMRDC* IE as specified in TS 36.331 [10]. The field includes the EUTRA part of band combination parameters supported for a given MR-DC band combination. |

#### – *BandParameterEUTRA*

The IE *BandParameterEUTRA* is used to indicate the band number and lists of uplink and downlink feature sets that the UE supports on the carrier(s) corresponding to this band entry.

The feature sets referred to from this list are defined in TS 36.331 as and conveyed as part of the UE-EUTRA-Capability container. The FeatureSetUL-Id-r15 and FeatureSetDL-Id-r15 in the EUTRA feature sets correspond to the FeatureSetEUTRA-DownlinkId and FeatureSetEUTRA-UplinkId, respectively.

The featureSetEUTRA-DownlinkList and featureSetEUTRA-UplinkList in all BandEntries of a band combination shall have the same number of elements. The UE shall support the combination of feature sets that are at the same position in all band entries and at the same position in the featureSetEUTRA-DownlinkList and featureSetEUTRA-UplinkList.

*BandParameterEUTRA* information element

-- ASN1START

-- TAG-BAND-PARAMETER-EUTRA-START

BandParameterEUTRA ::= SEQUENCE {

bandEUTRA FreqBandIndicatorEUTRA,

featureSetEUTRA-DownlinkList SEQUENCE (SIZE (1..maxEUTRA-FeatureSetsPerBC)) OF FeatureSetEUTRA-DownlinkId,

featureSetEUTRA-UplinkList SEQUENCE (SIZE (1..maxEUTRA-FeatureSetsPerBC)) OF FeatureSetEUTRA-UplinkId

}

-- TAG-BAND-PARAMETER-EUTRA-STOP

-- ASN1STOP

#### – *BandParameterNR*

The IE *BandParameterNR* is used to indicate the band number and lists of uplink and downlink feature sets that the UE supports on the carrier(s) corresponding to this band entry.

The featureSetDownlinkList and featureSetUplinkList in all BandEntries of a band combination shall have the same number of elements. The UE shall support the combination of feature sets that are at the same position in all band entries and at the same position in the featureSetDownlinkList and featureSetUplinkList.

*BandParameterNR* information element

-- ASN1START

-- TAG-BAND-PARAMETER-NR-START

BandParameterNR ::= SEQUENCE {

bandNR FreqBandIndicatorNR,

featureSetDownlinkList SEQUENCE (SIZE (1..maxFeatureSetsPerBC)) OF FeatureSetDownlinkId,

featureSetUplinkList SEQUENCE (SIZE (1..maxFeatureSetsPerBC)) OF FeatureSetUplinkId

}

-- TAG-BAND-PARAMETER-NR-STOP

-- ASN1STOP

|  |
| --- |
| *BandParameterNR field descriptions* |
| ***featureSetDownlinkList***  The downlink feature sets that are supported on the downlink carrier(s) corresponding to this band entry. The FeatureSetDownlinkId = 0 indicates that the UE does not support configuration of a serving cell. |
| ***featureSetUplinkList***  The uplink feature sets that are supported on the uplink carrier(s) corresponding to this band entry. The FeatureSetUplinkId = 0 indicates that the UE does not support configuration of a serving cell. |

#### – *CA-BandwidthClassNR*

-- ASN1START

-- TAG-CA-BANDWIDTHCLASSNR-START

-- Updated based on R4-1803374

CA-BandwidthClassNR ::= ENUMERATED {a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, ...}

-- TAG-CA-BANDWIDTHCLASSNR-STOP

-- ASN1STOP

#### – *CA-BandwidthClassEUTRA*

-- ASN1START

-- TAG-CA-BANDWIDTHCLASSEUTRA-START

CA-BandwidthClassEUTRA ::= ENUMERATED {a, b, c, d, e, f, ...}

-- TAG-CA-BANDWIDTHCLASSEUTRA-STOP

-- ASN1STOP

#### – *FeatureSetDownlink*

The IE *FeatureSetDownlink* is used to indicate the features that the UE supports on the carriers corresponding to one band entry in a band combination.

*FeatureSetDownlink* information element

-- ASN1START

-- TAG-FEATURESETDOWNLINK-START

FeatureSetDownlink ::= SEQUENCE {

featureSetDownlinkId FeatureSetDownlinkId,

ca-bandwidthClassDL CA-BandwidthClassNR,

-- R4 2-3: Non-contiguous intra-band CA frequency separation class for FR2 as in the RAN4 LS R4-1803363

intraBandFreqSeparationDL FreqSeparationClass OPTIONAL,

featureSetListPerDownlinkCC SEQUENCE (SIZE (1..maxNrofServingCells)) OF FeatureSetDownlinkPerCC-Id,

...

}

-- TAG-FEATURESETDOWNLINK-STOP

-- ASN1STOP

|  |
| --- |
| *FeatureSetDownlink field descriptions* |
| ***featureSetDownlinkId***  A unique ID for this feature set which is used to refer from a BandEntry in a BandCombination to the supported feature sets. |
| ***featureSetListPerDownlinkCC***  Indicates which features the UE supports on the individual carriers of the feature set (and hence of a band entry that refer to the feature set). The UE shall hence include as many FeatureSetDownlinkPerCC-Id in this list as the number of carriers it supports according to the ca-bandwidthClassDL. The order of the elements in this list is not relevant, i.e., the network may configure any of the carriers in accordance with any of the FeatureSetDownlinkPerCC-Id in this list. |

#### – *FeatureSetDownlinkId*

The IE *FeatureSetDownlinkId* identifies a downlink feature set. The *FeatureSetDownlinkId=0* is not used by an actual *FeatureSetDownlink* but means that the UE does not support a carrier in this band of a band combination.

*FeatureSetDownlinkId* information element

-- ASN1START

-- TAG-FEATURESET-DOWNLINK-ID-START

FeatureSetDownlinkId ::= INTEGER (0..maxDownlinkFeatureSets)

-- TAG-FEATURESET-DOWNLINK-ID-STOP

-- ASN1STOP

#### – *FeatureSetEUTRA-DownlinkId*

The IE *FeatureSetEUTRA-DownlinkId* identifies a downlink feature set in EUTRA. The *FeatureSetEUTRA-DownlinkId=0* is used when the UE does not support a carrier in this band of a band combination.

*FeatureSetEUTRA-DownlinkId* information element

-- ASN1START

-- TAG-FEATURESET-EUTRA-DOWNLINK-ID-START

FeatureSetEUTRA-DownlinkId ::= INTEGER (0..maxEUTRA-DL-FeatureSets)

-- TAG-FEATURESET-EUTRA-DOWNLINK-ID-STOP

-- ASN1STOP

#### – *FeatureSetDownlinkPerCC-Id*

The IE *FeatureSetDownlinkPerCC-Id* identifies a set of features applicable to one carrier of a feature set.

*FeatureSetDownlinkPerCC-Id* information element

-- ASN1START

-- TAG-FEATURESET-DOWNLINK-PER-CC-ID-START

FeatureSetDownlinkPerCC-Id ::= INTEGER (1..maxPerCC-FeatureSets)

-- TAG-FEATURESET-DOWNLINK-PER-CC-ID-STOP

-- ASN1STOP

#### – *FeatureSetUplink*

The IE *FeatureSetUplink* is used to indicate the features that the UE supports on the carriers corresponding to one band entry in a band combination.

*FeatureSetUplink* information element

-- ASN1START

-- TAG-FEATURESETUPLINK-START

FeatureSetUplink ::= SEQUENCE {

featureSetUplinkId FeatureSetUplinkId,

ca-BandwidthClassesUL CA-BandwidthClassNR,

-- R4 2-3: Non-contiguous intra-band CA frequency separation class for FR2 as in the RAN4 LS R4-1803363

intraBandFreqSeparationUL FreqSeparationClass OPTIONAL,

featureSetListPerUplinkCC SEQUENCE (SIZE (1.. maxNrofServingCells)) OF FeatureSetUplinkPerCC-Id,

...

}

-- TAG- FEATURESETUPLINK-STOP

-- ASN1STOP

|  |
| --- |
| *FeatureSetUplink field descriptions* |
| ***featureSetsPerUplinkCC***  Indicates which features the UE supports on the individual carriers of the feature set (and hence of a band entry that refer to the feature set). The UE shall hence include as many FeatureSetUplinkPerCC-Id in this list as the number of carriers it supports according to the ca-bandwidthClassUL. The order of the elements in this list is not relevant, i.e., the network may configure any of the carriers in accordance with any of the FeatureSetUplinkPerCC-Id in this list. |
| ***featureSetUplinkId***  A unique ID for this feature set which is used to refer from a BandEntry in a BandCombination to the supported feature sets. |
| ***intraBandFreqSeparationUL***  R4 2-3: Non-contiguous intra-band CA frequency separation class for FR2 as in the RAN4 LS R4-1803363 |

#### – *FeatureSetUplinkId*

The IE *FeatureSetUplinkId* identifies a downlink feature set. The *FeatureSetUplinkId =0* is not used by an actual *FeatureSetUplink* but means that the UE does not support a carrier in this band of a band combination.

*FeatureSetUplinkId* information element

-- ASN1START

-- TAG-FEATURESET-UPLINK-ID-START

FeatureSetUplinkId ::= INTEGER (0..maxUplinkFeatureSets)

-- TAG-FEATURESET-UPLINK-ID-STOP

-- ASN1STOP

#### – *FeatureSetEUTRA-UplinkId*

The IE *FeatureSetEUTRA-UplinkId* identifies an uplink feature set. The *FeatureSetEUTRA-UplinkId* *=0* is used when the UE does not support a carrier in this band of a band combination.

*FeatureSetEUTRA-UplinkId* information element

-- ASN1START

-- TAG-FEATURESET-EUTRA-UPLINK-ID-START

FeatureSetEUTRA-UplinkId ::= INTEGER (0..maxEUTRA-UL-FeatureSets)

-- TAG-FEATURESET-EUTRA-UPLINK-ID-STOP

-- ASN1STOP

#### – *FeatureSetUplinkPerCC-Id*

The IE *FeatureSetUplinkPerCC-Id* identifies a set of features applicable to one carrier of a feature set.

*FeatureSetUplinkPerCC-Id* information element

-- ASN1START

-- TAG-FEATURESET-UPLINK-PER-CC-ID-START

FeatureSetUplinkPerCC-Id ::= INTEGER (1..maxPerCC-FeatureSets)

-- TAG-FEATURESET-UPLINK-PER-CC-ID-STOP

-- ASN1STOP

#### – *FeatureSets*

The IE *FeatureSets* is used to configure pools of downlink and uplink features sets. The band combinations refer to the IDs of the feature set(s) that the UE supports.

*FeatureSets* information element

-- ASN1START

-- TAG-FEATURESETS-START

FeatureSets ::= SEQUENCE {

featureSetsDownlink SEQUENCE (SIZE (1..maxDownlinkFeatureSets)) OF FeatureSetDownlink OPTIONAL,

featureSetPerCC-DL SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetPerCC-DL OPTIONAL,

featureSetsUplink SEQUENCE (SIZE (1..maxUplinkFeatureSets)) OF FeatureSetUplink OPTIONAL,

featureSetPerCC-UL SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetPerCC-UL OPTIONAL

}

-- ASN1STOP

-- TAG-FEATURESETS-STOP

#### – *FeatureSetPerCC-DL*

-- ASN1START

-- TAG-FEATURESET-PER-CC-DL-START

FeatureSetPerCC-DL ::= SEQUENCE {

featureSetDonwlinkPerCC-Id FeatureSetDownlinkPerCC-Id,

-- R4 2-2: Simultaneous reception or transmission with same or different numerologies in CA

-- It is expressed by the combination of SCS whether simultaneous RxTx is supported or not.

supportedSubcarrierSpacingDL SubcarrierSpacing,

-- Accoding to the RAN4 LS R4-1803563, maximum Bandwidth supported per CC is added in BPC

-- FFS how to work together with BCS and max BW for each CC to be defined for each CA band combination in the RAN4 spec.

supportedBandwidthDL CHOICE {

fr1 ENUMERATED {mhz5, mhz10, mhz15, mhz20, mhz25, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100},

fr2 ENUMERATED {mhz50, mhz100, mhz200, mhz400}

},

-- R2-1800012. To be confirmed by RAN1

scalingFactor0dot75 ENUMERATED {supported} OPTIONAL,

-- R1 2-2: PDSCH beam switching

timeDurationForQCL SEQUENCE {

scs-60kHz ENUMERATED {s7, s14, s28} OPTIONAL,

sch-120kHz ENUMERATED {s14, s28} OPTIONAL

} OPTIONAL,

-- R1 1-10: Support of SCell without SS/PBCH block

scellWithoutSSB ENUMERATED {supported} OPTIONAL,

-- R1 1-11: Support of CSI-RS RRM measurement for SCell without SS/PBCH block

csi-RS-MeasSCellWithoutSSB ENUMERATED {supported} OPTIONAL,

-- R1 2-3: PDSCH MIMO layers. Absence of this field implies support of one layer.

maxNumberMIMO-LayersPDSCH MIMO-LayersDL OPTIONAL,

-- Accoding to the RAN4 LS R4-1803563, modulation order is added per CC granularity in BPC

-- FFS whether all of modulation order specified in the spec need to be signalled.

-- FFS how to address the requirements agreed by RAN4, e.g. mandaotry w/o capabiltiy for 64QAM. mandaotry with capabiltiy for DL 256QAM in FR1.

supportedModulationOrderDL ModulationOrder OPTIONAL,

-- R1 2-15a: Association between CSI-RS and SRS

srs-AssocCSI-RS ENUMERATED {supported} OPTIONAL,

-- R1 3-1a: For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 3 OFDM symbols for FR2

type1-3-CSS ENUMERATED {supported} OPTIONAL,

-- R1 3-5 & 3-5a: For type 1 with dedicated RRC configuration, type 3, and UE-SS,, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 (with a DCI gap)

pdcchMonitoringAnyOccasions ENUMERATED {withoutDCI-gap, withDCI-gap} OPTIONAL,

-- R1 5-1a: UE specific RRC configure UL/DL assignment

ue-SpecificUL-DL-Assignment ENUMERATED {supported} OPTIONAL,

-- R1 5-11 & 5-11a: Up to 2/7 unicast PDSCHs per slot for different TBs

pdsch-DifferentTB-PerSlot SEQUENCE {

scs-15kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-30kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-60kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-120kHz ENUMERATED {upto2, upto7} OPTIONAL

} OPTIONAL,

-- R1 6-10: Cross carrier scheduling

crossCarrierScheduling ENUMERATED {supported} OPTIONAL,

-- R1 6-21: DL search space sharing for CA

searchSpaceSharingCA-DL ENUMERATED {supported} OPTIONAL

}

-- TAG-FEATURESET-PER-CC-DL-STOP

-- ASN1STOP

#### – *FeatureSetPerCC-UL*

-- ASN1START

-- TAG-FEATURESET-PER-CC-UL-START

FeatureSetPerCC-UL ::= SEQUENCE {

featureSetUplinkPerCC-Id FeatureSetUplinkPerCC-Id,

-- R4 2-2: Simultaneous reception or transmission with same or different numerologies in CA

-- It is expressed by the combination of SCS whether simultaneous RxTx is supported or not.

supportedSubcarrierSpacingUL SubcarrierSpacing,

-- Accoding to the RAN4 LS R4-1803563, maximum Bandwidth supported per CC is added in BPC

-- FFS how to work together with BCS and max BW for each CC to be defined for each CA band combination in the RAN4 spec.

supportedBandwidthUL CHOICE {

fr1 ENUMERATED {mhz5, mhz10, mhz15, mhz20, mhz25, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100},

fr2 ENUMERATED {mhz50, mhz100, mhz200, mhz400}

},

-- R2-1800012. To be confirmed by RAN1

scalingFactor0dot75 ENUMERATED {supported} OPTIONAL,

-- R1 2-14: Codebook based PUSCH MIMO transmission. Absence of this field implies that CB-based PUSCH is not supported.

maxNumberMIMO-LayersCB-PUSCH MIMO-LayersUL OPTIONAL,

-- R1 2-15: Non-codebook based PUSCH MIMO transmission. Absence of this field implies that Non-CB-based PUSCH is not supported.

maxNumberMIMO-LayersNonCB-PUSCH MIMO-LayersUL OPTIONAL,

-- Accoding to the RAN4 LS R4-1803563, modulation order is added per CC granularity in BPC

-- FFS whether all of modulation order specified in the spec need to be signalled.

-- FFS how to address the requirements agreed by RAN4, e.g. mandaotry w/o capabiltiy for 64QAM. mandaotry with capabiltiy for DL 256QAM in FR1.

supportedModulationOrderUL ModulationOrder OPTIONAL,

-- R1 2-53: SRS resources

supportedSRS-Resources SRS-Resources OPTIONAL,

-- R1 2-55: SRS Tx switch

srs-TxSwitch SRS-TxSwitch OPTIONAL,

-- R1 2-57: Support low latency CSI feedback

lowLatencyCSI-Feedback ENUMERATED {supported} OPTIONAL,

-- R1 5-12 & 5-12a: Up to 2/7 PUSCHs per slot for different TBs

pusch-DifferentTB-PerSlot SEQUENCE {

scs-15kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-30kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-60kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-120kHz ENUMERATED {upto2, upto7} OPTIONAL

} OPTIONAL,

-- R1 6-7: Two PUCCH group

twoPUCCH-Group ENUMERATED {supported} OPTIONAL,

-- R1 6-8: Different numerology across PUCCH groups

diffNumerologyAcrossPUCCH-Group ENUMERATED {supported} OPTIONAL,

-- R1 6-9: Different numerologies across carriers within the same PUCCH group

diffNumerologyWithinPUCCH-Group ENUMERATED {supported} OPTIONAL,

-- R1 6-10: Cross carrier scheduling

crossCarrierScheduling ENUMERATED {supported} OPTIONAL,

-- R1 6-11: Number of supported TAGs

supportedNumberTAG ENUMERATED {n2, n3, n4} OPTIONAL,

-- R1 6-18: Supplemental uplink with dynamic switch

dynamicSwitchSUL ENUMERATED {supported} OPTIONAL,

-- R1 6-19: Simultaneous transmission of SRS on an SUL/non-SUL carrier and PUSCH/PUCCH/SRS/PRACH on the other UL carrier in the same cell

-- Details on the channel/signal combination are to be described in TS 38.306

simultaneousTxSUL-NonSUL ENUMERATED {supported} OPTIONAL,

-- R1 6-22: UL search space sharing for CA

searchSpaceSharingCA-UL ENUMERATED {supported} OPTIONAL

}

-- TAG-FEATURESET-PER-CC-UL-STOP

-- ASN1STOP

#### – *FreqBandList*

The IE *FreqBandList* is used to contain list of NR and/or E-UTRA frequency bands for which the UE is requested to provide its supported NR CA and/or MR-DC band combinations (i.e. within the UE capability containers for NR and MR-DC, as requested by E-UTRA).

*FreqBandList* information element

-- ASN1START

-- TAG-FREQBANDLIST-START

FreqBandList ::= SEQUENCE (SIZE (1..maxBandsMRDC)) OF FreqBandInformation

FreqBandInformation ::= CHOICE {

bandEUTRA FreqBandIndicatorEUTRA,

bandNR FreqBandIndicatorNR

}

-- TAG-FREQBANDLIST-STOP

-- ASN1STOP

#### – *FreqBandIndicatorEUTRA*

-- ASN1START

-- TAG-FREQ-BAND-INDICATOR-EUTRA-START

FreqBandIndicatorEUTRA ::= INTEGER (1..maxBandsEUTRA)

-- TAG-FREQ-BAND-INDICATOR-EUTRA-STOP

-- ASN1STOP

#### – *FreqSeparationClass*

The IE *FreqSeparationClas*s is used for an intra-band non-contiguous CA band combination to indicate frequency separation between lower edge of lowest CC and upper edge of highest CC in a frequency band.

*FreqSeparationClass* information element

-- ASN1START

-- TAG-FREQSEPARATIONCLASS-START

FreqSeparationClass ::= ENUMERATED {c1, c2, c3, ...}

-- TAG-FREQSEPARATIONCLASS-STOP

-- ASN1STOP

#### – *MIMO-Layers*

-- ASN1START

-- TAG-MIMO-LAYERS-START

MIMO-LayersDL ::= ENUMERATED {twoLayers, fourLayers, eightLayers}

MIMO-LayersUL ::= ENUMERATED {oneLayer, twoLayers, fourLayers}

-- TAG-MIMO-LAYERS-STOP

-- ASN1STOP

#### – *ModulationOrder*

-- ASN1START

-- TAG-MODULATION-ORDER-START

ModulationOrder ::= ENUMERATED {bpsk-halfpi, bpsk, qpsk, qam16, qam64, qam256}

-- TAG-MODULATION-ORDER-STOP

-- ASN1STOP

#### – *RAT-Type*

The IE *RAT-Type* is used to indicate the radio access technology (RAT), including NR, of the requested/transferred UE capabilities.

*RAT-Type* information element

-- ASN1START

-- TAG-RAT-TYPE-START

RAT-Type ::= ENUMERATED {nr, eutra-nr, spare2, spare1, ...}

-- TAG-RAT-TYPE-STOP

-- ASN1STOP

#### – *UE-CapabilityRAT-ContainerList*

The IE *UE-CapabilityRAT-ContainerList* contains a list of containers, one for each RAT for which UE capabilities are transferred, if any.

*UE-CapabilityRAT-ContainerList* information element

-- ASN1START

-- TAG-UE-CAPABILITY-RAT-CONTAINER-LIST-START

UE-CapabilityRAT-ContainerList ::=SEQUENCE (SIZE (0.. maxRAT-CapabilityContainers)) OF UE-CapabilityRAT-Container

UE-CapabilityRAT-Container ::= SEQUENCE {

rat-Type RAT-Type,

ue-CapabilityRAT-Container OCTET STRING

}

-- TAG-UE-CAPABILITY-RAT-CONTAINER-LIST-STOP

-- ASN1STOP

|  |
| --- |
| *UE-CapabilityRAT-ContainerList* field descriptions |
| ***ue-CapabilityRAT-Container***  Container for the UE capabilities of the indicated RAT. The encoding is defined in the specification of each RAT:  For NR: the encoding of UE capabilities is defined in UE-NR-Capability.  For EUTRA-NR: the encoding of UE capabilities is defined in UE-MRDC-Capability |

#### – *UE-MRDC-Capability*

The IE *UE-MRDC-Capability* is used to convey the UE Radio Access Capability Parameters for MR-DC, see TS 38.306 [yy].

*UE-MRDC-Capability* information element

-- ASN1START

-- TAG-UE-MRDC-CAPABILITY-START

UE-MRDC-Capability ::= SEQUENCE {

measParametersMRDC MeasParametersMRDC OPTIONAL,

rf-ParametersMRDC RF-ParametersMRDC,

phy-ParametersMRDC Phy-ParametersMRDC OPTIONAL,

generalParametersMRDC GeneralParametersMRDC-XDD-Diff OPTIONAL,

fdd-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddXDD-Mode OPTIONAL,

tdd-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddXDD-Mode OPTIONAL,

fr1-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddFRX-Mode OPTIONAL,

fr2-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddFRX-Mode OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-MRDC-CapabilityAddXDD-Mode ::= SEQUENCE {

phy-ParametersMRDC-XDD-Diff Phy-ParametersMRDC-XDD-Diff OPTIONAL,

measParametersMRDC-XDD-Diff MeasParametersMRDC-XDD-Diff OPTIONAL,

generalParametersMRDC-XDD-Diff GeneralParametersMRDC-XDD-Diff OPTIONAL

}

UE-MRDC-CapabilityAddFRX-Mode ::= SEQUENCE {

phy-ParametersMRDC-FRX-Diff Phy-ParametersMRDC-FRX-Diff OPTIONAL,

measParametersMRDC-FRX-Diff MeasParametersMRDC-FRX-Diff

}

RF-ParametersMRDC ::= SEQUENCE {

supportedBandCombination BandCombinationList OPTIONAL

}

Phy-ParametersMRDC ::= SEQUENCE {

phy-ParametersMRDC-XDD-Diff Phy-ParametersMRDC-XDD-Diff OPTIONAL,

phy-ParametersMRDC-FRX-Diff Phy-ParametersMRDC-FRX-Diff OPTIONAL

}

Phy-ParametersMRDC-XDD-Diff ::= SEQUENCE {

-- R1 8-1: Dynamic power sharing for LTE-NR DC

dynamicPowerSharing ENUMERATED {supported} OPTIONAL,

-- R1 6-13 & 8-2: Case 1 Single Tx UL LTE-NR DC

tdm-Pattern ENUMERATED {supported} OPTIONAL

}

Phy-ParametersMRDC-FRX-Diff ::= SEQUENCE {

-- R1 8-1: Dynamic power sharing for LTE-NR DC

dynamicPowerSharing ENUMERATED {supported} OPTIONAL,

-- R1 6-13 & 8-2: Case 1 Single Tx UL LTE-NR DC

tdm-Pattern ENUMERATED {supported} OPTIONAL

}

MeasParametersMRDC ::= SEQUENCE {

measParametersMRDC-Common MeasParametersMRDC-Common,

measParametersMRDC-XDD-Diff MeasParametersMRDC-XDD-Diff OPTIONAL,

measParametersMRDC-FRX-Diff MeasParametersMRDC-FRX-Diff

}

MeasParametersMRDC-Common ::= SEQUENCE {

-- R4 3-1: Independent measurement gap configurations for FR1 and FR2

independentGapConfig ENUMERATED {supported} OPTIONAL

}

MeasParametersMRDC-XDD-Diff ::= SEQUENCE {

sftd-MeasPSCell ENUMERATED {supported} OPTIONAL,

sftd-MeasNR-Cell ENUMERATED {supported} OPTIONAL

}

MeasParametersMRDC-FRX-Diff ::= SEQUENCE {

-- R4 3-2: Simultaneous reception of data and SS block with different numerologies when UE conducts the serving cell measurement or intra-frequency measurement

simultaneousRxDataSSB-DiffNumerology ENUMERATED {supported} OPTIONAL

}

GeneralParametersMRDC-XDD-Diff ::= SEQUENCE {

splitSRB-WithOneUL-Path ENUMERATED {supported} OPTIONAL,

splitDRB-withUL-Both-MCG-SCG ENUMERATED {supported} OPTIONAL,

srb3 ENUMERATED {supported} OPTIONAL

}

-- TAG-UE-MRDC-CAPABILITY-STOP

-- ASN1STOP

#### – *UE-NR-Capability*

The IE *UE-NR-Capability* is used to convey the NR UE Radio Access Capability Parameters, see TS 38.306 [yy].

*UE-NR-Capability* information element

-- ASN1START

-- TAG-UE-NR-CAPABILITY-START

UE-NR-Capability ::= SEQUENCE {

pdcp-Parameters PDCP-Parameters,

rlc-Parameters RLC-Parameters OPTIONAL,

mac-Parameters MAC-Parameters OPTIONAL,

phy-Parameters Phy-Parameters,

rf-Parameters RF-Parameters,

measParameters MeasParameters OPTIONAL,

fdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode OPTIONAL,

tdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode OPTIONAL,

fr1-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode OPTIONAL,

fr2-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode OPTIONAL,

featureSets FeatureSets OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-NR-CapabilityAddXDD-Mode ::= SEQUENCE {

phy-ParametersXDD-Diff Phy-ParametersXDD-Diff OPTIONAL,

mac-ParametersXDD-Diff MAC-ParametersXDD-Diff OPTIONAL,

measParametersXDD-Diff MeasParametersXDD-Diff OPTIONAL

}

UE-NR-CapabilityAddFRX-Mode ::= SEQUENCE {

phy-ParametersFRX-Diff Phy-ParametersFRX-Diff OPTIONAL,

measParametersFRX-Diff MeasParametersFRX-Diff OPTIONAL

}

Phy-Parameters ::= SEQUENCE {

phy-ParametersCommon Phy-ParametersCommon OPTIONAL,

phy-ParametersXDD-Diff Phy-ParametersXDD-Diff OPTIONAL,

phy-ParametersFRX-Diff Phy-ParametersFRX-Diff OPTIONAL,

phy-ParametersFR1 Phy-ParametersFR1 OPTIONAL,

phy-ParametersFR2 Phy-ParametersFR2 OPTIONAL

}

Phy-ParametersCommon ::= SEQUENCE {

-- R1 1-9: CSI-RS based CFRA for HO

csi-RS-CFRA-ForHO ENUMERATED {supported} OPTIONAL,

-- R1 2-11: Downlink dynamic PRB bundling (DL)

dynamicPRB-BundlingDL ENUMERATED {supported} OPTIONAL,

-- R1 2-32a: Semi-persistent CSI report on PUCCH

sp-CSI-ReportPUCCH ENUMERATED {supported} OPTIONAL,

-- R1 2-32b: Semi-persistent CSI report on PUSCH

sp-CSI-ReportPUSCH ENUMERATED {supported} OPTIONAL,

-- R1 2-34: NZP-CSI-RS based interference measurement

nzp-CSI-RS-IntefMgmt ENUMERATED {supported} OPTIONAL,

-- R1 2-42: Support Type II SP-CSI feedback on long PUCCH

type2-SP-CSI-Feedback-LongPUCCH ENUMERATED {supported} OPTIONAL,

-- R1 3-3: More than one CORESET per BWP (in addition to CORESET #0)

multipleCORESET ENUMERATED {supported} OPTIONAL,

-- R1 3-6: Dynamic SFI monitoring and dynamic UL/DL determination

dynamicSFI ENUMERATED {supported} OPTIONAL,

-- R1 3-7: Precoder-granularity of CORESET size

precoderGranularityCORESET ENUMERATED {supported} OPTIONAL,

-- R1 4-10: Dynamic HARQ-ACK codebook

dynamicHARQ-ACK-Codebook ENUMERATED {supported} OPTIONAL,

-- R1 4-11: Semi-static HARQ-ACK codebook

semiStaticHARQ-ACK-Codebook ENUMERATED {supported} OPTIONAL,

-- R1 4-12: HARQ-ACK spatial bundling for PUCCH or PUSCH per PUCCH group

spatialBundlingHARQ-ACK ENUMERATED {supported} OPTIONAL,

-- R1 4-21: Dynamic beta-offset configuration and indication for HARQ-ACK and/or CSI

dynamicBetaOffsetInd-HARQ-ACK-CSI ENUMERATED {supported} OPTIONAL,

-- R1 4-23: Repetitions for PUCCH format 1, 3,and 4 over multiple slots with K = 1, 2, 4, 8

pucch-Repetition-F1-3-4 ENUMERATED {supported} OPTIONAL,

-- R1 5-2: RA type 0 for PUSCH

ra-Type0-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-3: Dynamic switching between RA type 0 and RA type 1 for PDSCH

dynamicSwitchRA-Type0-1-PDSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-4: Dynamic switching between RA type 0 andRA type 1 for PUSCH

dynamicSwitchRA-Type0-1-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-6: PDSCH mapping type A with less than 7 OFDM symbols

pdsch-MappingTypeA ENUMERATED {supported} OPTIONAL,

-- R1 5-6a: PDSCH mapping type B

pdsch-MappingTypeB ENUMERATED {supported} OPTIONAL,

-- R1 5-7: Interleaving for VRB-to-PRB mapping for PDSCH

interleavingVRB-ToPRB-PDSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-8: Interleaving for VRB-to-PRB mapping for PUSCH

interleavingVRB-ToPRB-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-10: Inter-slot frequency hopping for PUSCH

interSlotFreqHopping-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-13: Type 1 configured PUSCH repetitions within a slot

type1-PUSCH-RepetitionOneSlot ENUMERATED {supported} OPTIONAL,

-- R1 5-14: Type 1 configured PUSCH repetitions over multiple slots

type1-PUSCH-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

-- R1 5-15: Type 2 configured PUSCH repetitions within a slot

type2-PUSCH-RepetitionOneSlot ENUMERATED {supported} OPTIONAL,

-- R1 5-16: Type 2 configured PUSCH repetitions over multiple slots

type2-PUSCH-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

-- R1 5-17: PUSCH repetitions over multiple slots

pusch-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

-- R1 5-17a: PDSCH repetitions over multiple slots

pdsch-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

-- R1 5-18: DL SPS

downlinkSPS ENUMERATED {supported} OPTIONAL,

-- R1 5-19: Type 1 Configured UL grant

configuredUL-GrantType1 ENUMERATED {supported} OPTIONAL,

-- R1 5-20: Type 2 Configured UL grant

configuredUL-GrantType2 ENUMERATED {supported} OPTIONAL,

-- R1 5-21: Pre-emption indication for DL

pre-EmptIndication-DL ENUMERATED {supported} OPTIONAL,

-- R1 5-22 & 5-25: CBG-based re-transmission for DL/UL using CBGTI

cbg-TransIndication BIT STRING (SIZE (2)) OPTIONAL,

-- R1 5-23: CBGFI for CBG-based re-transmission for DL

cbg-FlushIndication-DL ENUMERATED {supported} OPTIONAL,

-- R1 5-24: Dynamic HARQ-ACK codebook using sub-codebooks for CBG-based re-transmission for DL

dynamicHARQ-ACK-CodeB-CBG-Retx-DL ENUMERATED {supported} OPTIONAL,

-- R1 5-26: Semi-static rate-matching resource set configuration for DL

rateMatchingResrcSetSemi-Static ENUMERATED {supported} OPTIONAL,

-- R1 5-27: Dynamic rate-matching resource set configuration for DL

rateMatchingResrcSetDynamic ENUMERATED {supported} OPTIONAL,

-- R1 5-28: Rate-matching around LTE CRS

rateMatchingLTE-CRS ENUMERATED {supported} OPTIONAL,

-- R4 1-8: BWP switching delay

bwp-SwitchingDelay ENUMERATED {type1, type2} OPTIONAL

}

Phy-ParametersXDD-Diff ::= SEQUENCE {

-- R1 4-2: 2 PUCCH of format 0 or 2 in consecutive symbols

twoPUCCH-F0-2-ConsecSymbols ENUMERATED {supported} OPTIONAL,

-- R1 8-7: UL power control with 2 PUSCH closed loops

twoDifferentTPC-Loop-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 8-8: UL power control with 2 PUCCH closed loops

twoDifferentTPC-Loop-PUCCH ENUMERATED {supported} OPTIONAL

}

Phy-ParametersFRX-Diff ::= SEQUENCE {

-- R1 2-6 & 2-16b: Support 1+2 DMRS (DL/UL)

oneFL-DMRS-TwoAdditionalDMRS BIT STRING (SIZE (2)) OPTIONAL,

-- R1 2-7 & 2-18: Supported 2 symbols front-loaded DMRS(DL/UL)

twoFL-DMRS BIT STRING (SIZE (2)) OPTIONAL,

-- R1 2-8 & 2-18a: Supported 2 symbols front-loaded +2 symbols additional DMRS(DL/UL)

twoFL-DMRS-TwoAdditionalDMRS BIT STRING (SIZE (2)) OPTIONAL,

-- R1 2-9 & 2-19: Support 1+3 DMRS (DL/UL)

oneFL-DMRS-ThreeAdditionalDMRS BIT STRING (SIZE (2)) OPTIONAL,

-- R1 2-10: Support DMRS type (DL)

supportedDMRS-TypeDL ENUMERATED {type1, type2} OPTIONAL,

-- R1 2-17: Support DMRS type (UL)

supportedDMRS-TypeUL ENUMERATED {type1, type2} OPTIONAL,

-- R1 2-37: Support Semi-open loop CSI

semiOpenLoopCSI ENUMERATED {supported} OPTIONAL,

-- R1 2-38: CSI report without PMI

csi-ReportWithoutPMI ENUMERATED {supported} OPTIONAL,

-- R1 2-39: CSI report with CRI

csi-ReportWithCRI ENUMERATED {supported} OPTIONAL,

-- R1 2-39a: CSI report without CQI

csi-ReportWithoutCQI ENUMERATED {supported} OPTIONAL,

-- R1 2-44 & 2-47: 1 port of DL/UL PTRS

onePortsPTRS BIT STRING (SIZE (2)) OPTIONAL,

-- R1 4-2: 2 PUCCH of format 0 or 2 in consecutive symbols

twoPUCCH-F0-2-ConsecSymbols ENUMERATED {supported} OPTIONAL,

-- R1 4-3: PUCCH format 2 over 1 – 2 OFDM symbols once per slot with FH

pucch-F2-WithFH ENUMERATED {supported} OPTIONAL,

-- R1 4-4: PUCCH format 3 over 4 – 14 OFDM symbols once per slot with FH

pucch-F3-WithFH ENUMERATED {supported} OPTIONAL,

-- R1 4-5: PUCCH format 4 over 4 – 14 OFDM symbols once per slot with FH

pucch-F4-WithFH ENUMERATED {supported} OPTIONAL,

-- R1 4-6: Non-frequency hopping for PUCCH formats 0 and 2

freqHoppingPUCCH-F0-2 ENUMERATED {notSupported} OPTIONAL,

-- R1 4-7: Non-frequency hopping for PUCCH format 1, 3, and 4

freqHoppingPUCCH-F1-3-4 ENUMERATED {notSupported} OPTIONAL,

-- R1 4-19: SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or piggybacked on a PUSCH)

mux-SR-HARQ-ACK-CSI-PUCCH ENUMERATED {supported} OPTIONAL,

-- R1 4-20: UCI code-block segmentation

uci-CodeBlockSegmentation ENUMERATED {supported} OPTIONAL,

-- R1 4-22: 1 long PUCCH format and 1 short PUCCH format in the same slot

onePUCCH-LongAndShortFormat ENUMERATED {supported} OPTIONAL,

-- R1 4-22a: 2 PUCCH transmissions in the same slot which are not covered by 4-22 and 4-2

twoPUCCH-AnyOthersInSlot ENUMERATED {supported} OPTIONAL,

-- R1 5-9: Intra-slot frequency-hopping for PUSCH except for PUSCH scheduled by Type 1 before RRC connection

intraSlotFreqHopping-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 5-29: LBRM for PUSCH

pusch-LBRM ENUMERATED {supported} OPTIONAL,

-- R1 6-5a: PDCCH blind detection capability for CA

pdcch-BlindDetectionCA ENUMERATED {supported} OPTIONAL,

-- R1 8-3: TPC-PUSCH-RNTI

tpc-PUSCH-RNTI ENUMERATED {supported} OPTIONAL,

-- R1 8-4: TPC-PUCCH-RNTI

tpc-PUCCH-RNTI ENUMERATED {supported} OPTIONAL,

-- R1 8-5: TPC-SRS-RNTI

tpc-SRS-RNTI ENUMERATED {supported} OPTIONAL,

-- R1 8-6: Absolute TPC command mode

absoluteTPC-Command ENUMERATED {supported} OPTIONAL,

-- R1 8-7: UL power control with 2 PUSCH closed loops

twoDifferentTPC-Loop-PUSCH ENUMERATED {supported} OPTIONAL,

-- R1 8-8: UL power control with 2 PUCCH closed loops

twoDifferentTPC-Loop-PUCCH ENUMERATED {supported} OPTIONAL,

-- R4 1-6: pi/2-BPSK for PUSCH

pusch-HalfPi-BPSK ENUMERATED {supported} OPTIONAL,

-- R4 1-7: pi/2-BPSK for PUCCH format 3/4

pucch-F3-4-HalfPi-BPSK ENUMERATED {supported} OPTIONAL,

-- R4 1-9: 1-symbol GP in unpaired spectrum

oneSymbolGP-TDD ENUMERATED {supported} OPTIONAL,

-- R4 2-7: Almost contiguous UL CP-OFDM

almostContiguousCP-OFDM-UL ENUMERATED {supported} OPTIONAL

}

Phy-ParametersFR1 ::= SEQUENCE {

-- R1 3-2: Unicast PDCCH monitoring following Case 1-2

pdcchMonitoringSingleOccasion ENUMERATED {supported} OPTIONAL,

-- R4 1-1: 60kHz of subcarrier spacing for FR1

scs-60kHz ENUMERATED {supported} OPTIONAL,

-- R4 1-4: 256QAM for PDSCH in FR1

pdsch-256QAM-FR1 ENUMERATED {supported} OPTIONAL

}

Phy-ParametersFR2 ::= SEQUENCE {

-- R4 2-8: PA calibration gap

calibrationGapPA ENUMERATED {supported} OPTIONAL

}

RF-Parameters ::= SEQUENCE {

supportedBandListNR SupportedBandListNR,

supportedBandCombination BandCombinationList

}

SupportedBandListNR ::= SEQUENCE (SIZE (1..maxBands)) OF BandNR

BandNR ::= SEQUENCE {

bandNR FreqBandIndicatorNR,

-- Modified MPR behaviour as in RAN4 LS R2-1804077, which is needed for NSA as well as SA

modifiedMPR-Behaviour BIT STRING (SIZE (8)) OPTIONAL,

-- R4 2-1: Maximum channel bandwidth supported in each band for DL and UL separately and for each SCS that UE supports within a single CC

-- RAN4 agreed that 400 MHz is optional for FR2. The other values defined for FR1/fR2 in TS 38.101 are mandatory w/o capability bit.

maxChannelBW-PerCC ENUMERATED {mhz400} OPTIONAL,

mimo-ParametersPerBand MIMO-ParametersPerBand OPTIONAL,

-- R1 0-10: Extended CP

extendedCP ENUMERATED {supported} OPTIONAL,

-- R1 0-13: Phase coherence across non-contiguous UL symbols in slot in the transmission of one channel

phaseCoherenceUL ENUMERATED {supported} OPTIONAL,

-- R1 1-10: Support of SCell without SS/PBCH block

scellWithoutSSB ENUMERATED {supported} OPTIONAL,

-- R1 1-11: Support of CSI-RS RRM measurement for SCell without SS/PBCH block

csi-RS-MeasSCellWithoutSSB ENUMERATED {supported} OPTIONAL,

-- R1 2-15a: Association between CSI-RS and SRS

srs-AssocCSI-RS ENUMERATED {supported} OPTIONAL,

-- R1 3-1a: For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 3 OFDM symbols for FR2

type1-3-CSS ENUMERATED {supported} OPTIONAL,

-- R1 3-4: More than one TCI state configurations per CORESET

multipleTCI ENUMERATED {supported} OPTIONAL,

-- R1 3-5 & 3-5a: For type 1 with dedicated RRC configuration, type 3, and UE-SS,, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 (with a DCI gap)

pdcchMonitoringAnyOccasions ENUMERATED {withoutDCI-gap, withDCI-gap} OPTIONAL,

-- R1 5-1a: UE specific RRC configure UL/DL assignment

ue-SpecificUL-DL-Assignment ENUMERATED {supported} OPTIONAL,

-- R1 5-11 & 5-11a: Up to 2/7 unicast PDSCHs per slot for different TBs

pdsch-DifferentTB-PerSlot SEQUENCE {

scs-15kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-30kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-60kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-120kHz ENUMERATED {upto2, upto7} OPTIONAL

} OPTIONAL,

-- R1 5-12 & 5-12a: Up to 2/7 PUSCHs per slot for different TBs

pusch-DifferentTB-PerSlot SEQUENCE {

scs-15kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-30kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-60kHz ENUMERATED {upto2, upto7} OPTIONAL,

scs-120kHz ENUMERATED {upto2, upto7} OPTIONAL

} OPTIONAL,

-- R1 6-2 & 6-3: Type A/B BWP adaptation (up to 2/4 BWPs) with same numerology

bwp-SameNumerology ENUMERATED {upto2, upto4} OPTIONAL,

-- R1 6-4: BWP adaptation (up to 4 BWPs) with different numerologies

bwp-DiffNumerology ENUMERATED {upto4} OPTIONAL,

-- R1 6-7: Two PUCCH group

twoPUCCH-Group ENUMERATED {supported} OPTIONAL,

-- R1 6-8: Different numerology across PUCCH groups

diffNumerologyAcrossPUCCH-Group ENUMERATED {supported} OPTIONAL,

-- R1 6-9: Different numerologies across carriers within the same PUCCH group

diffNumerologyWithinPUCCH-Group ENUMERATED {supported} OPTIONAL,

-- R1 6-10: Cross carrier scheduling

crossCarrierScheduling ENUMERATED {supported} OPTIONAL,

-- R1 6-11: Number of supported TAGs

supportedNumberTAG ENUMERATED {n2, n3, n4} OPTIONAL,

-- R1 6-19: Simultaneous transmission of SRS on an SUL/non-SUL carrier and PUSCH/PUCCH/SRS/PRACH on the other UL carrier in the same cell

-- Details on the channel/signal combination are to be described in TS 38.306

simultaneousTxSUL-NonSUL ENUMERATED {supported} OPTIONAL,

-- R1 6-21: DL search space sharing for CA

searchSpaceSharingCA-DL ENUMERATED {supported} OPTIONAL,

-- R1 6-22: UL search space sharing for CA

searchSpaceSharingCA-UL ENUMERATED {supported} OPTIONAL,

-- R4 1-4: 256QAM for PDSCH in FR2

pdsch-256QAM-FR2 ENUMERATED {supported} OPTIONAL,

-- R4 1-5: 256QAM for PUSCH

pusch-256QAM ENUMERATED {supported} OPTIONAL

}

MIMO-ParametersPerBand ::= SEQUENCE {

-- R1 2-2: PDSCH beam switching

timeDurationForQCL SEQUENCE {

scs-60kHz ENUMERATED {s7, s14, s28} OPTIONAL,

sch-120kHz ENUMERATED {s14, s28} OPTIONAL

} OPTIONAL,

-- R1 2-3: PDSCH MIMO layers. Absence of this field implies support of one layer.

maxNumberMIMO-LayersPDSCH MIMO-LayersDL OPTIONAL,

-- R1 2-14: Codebook based PUSCH MIMO transmission. Absence of this field implies that CB-based PUSCH is not supported.

maxNumberMIMO-LayersCB-PUSCH MIMO-LayersUL OPTIONAL,

-- R1 2-15: Non-codebook based PUSCH MIMO transmission. Absence of this field implies that Non-CB-based PUSCH is not supported.

maxNumberMIMO-LayersNonCB-PUSCH MIMO-LayersUL OPTIONAL,

-- R1 2-4: TCI states for PDSCH

maxNumberConfiguredTCIstates ENUMERATED {n4, n8, n16, n32, n64} OPTIONAL,

maxNumberActiveTCI-PerCC ENUMERATED {n1, n2, n4, n8} OPTIONAL,

-- R1 2-13: PUSCH transmission coherence

pusch-TransCoherence ENUMERATED {nonCoherent, partialNonCoherent, fullCoherent} OPTIONAL,

-- R1 2-20: Beam correspondence

beamCorrespondence ENUMERATED {supported} OPTIONAL,

-- R1 2-21: Periodic beam report on PUCCH

periodicBeamReport ENUMERATED {supported} OPTIONAL,

-- R1 2-22: Aperiodic beam report on PUSCH

aperiodicBeamReport ENUMERATED {supported} OPTIONAL,

-- R1 2-23: Semi-persistent beam report on PUCCH

sp-BeamReportPUCCH ENUMERATED {supported} OPTIONAL,

-- R1 2-23a: Semi-persistent beam report on PUSCH

sp-BeamReportPUSCH ENUMERATED {supported} OPTIONAL,

-- R1 2-24: SSB/CSI-RS for beam management

beamManagementSSB-CSI-RS BeamManagementSSB-CSI-RS OPTIONAL,

-- R1 2-26: Receiving beam selection using CSI-RS resource repetition "ON"

maxNumberRxBeam INTEGER (2..8) OPTIONAL,

-- R1 2-27: Beam switching (including SSB and CSI-RS)

maxNumberRxTxBeamSwitchDL SEQUENCE {

scs-15kHz ENUMERATED {n4, n7, n14} OPTIONAL,

scs-30kHz ENUMERATED {n4, n7, n14} OPTIONAL,

scs-60kHz ENUMERATED {n4, n7, n14} OPTIONAL,

scs-120kHz ENUMERATED {n4, n7, n14} OPTIONAL,

scs-240kHz ENUMERATED {n4, n7, n14} OPTIONAL

} OPTIONAL,

-- R1 2-29: Non-group based beam reporting

maxNumberNonGroupBeamReporting ENUMERATED {n1, n2, n4} OPTIONAL,

-- R1 2-29a: Group based beam reporting

groupBeamReporting ENUMERATED {supported} OPTIONAL,

-- R1 2-30: UL beam management

uplinkBeamManagement SEQUENCE {

maxNumberSRS-ResourcePerSet ENUMERATED {n8, n16, n32},

maxNumberSRS-ResourceSet INTEGER (1..8)

} OPTIONAL,

-- R1 2-31: Beam failure recovery

maxNumberCSI-RS-BFR INTEGER (1..64) OPTIONAL,

maxNumberSSB-BFR INTEGER (1..64) OPTIONAL,

maxNumberCSI-RS-SSB-BFR INTEGER (1..256) OPTIONAL,

-- R1 2-45 & 2-48: 2 ports of DL/UL PTRS

twoPortsPTRS BIT STRING (SIZE (2)) OPTIONAL,

-- R1 2-53: SRS resources

supportedSRS-Resources SRS-Resources OPTIONAL,

-- R1 2-55: SRS Tx switch

srs-TxSwitch SRS-TxSwitch OPTIONAL,

-- R1 2-54a: Simultaneous SRS Tx

maxNumberSimultaneousSRS-PerCC INTEGER (1..4) OPTIONAL,

-- R1 2-57: Support low latency CSI feedback

lowLatencyCSI-Feedback ENUMERATED {supported} OPTIONAL

}

-- R1 2-24: SSB/CSI-RS for beam management

BeamManagementSSB-CSI-RS ::= SEQUENCE {

maxNumberSSB-CSI-RS-ResourceOneTx ENUMERATED {n8, n16, n32, n64},

maxNumberSSB-CSI-RS-ResourceTwoTx ENUMERATED {n0, n4, n8, n16, n32, n64},

supportedCSI-RS-Density ENUMERATED {one, three, oneAndThree}

}

-- R1 2-53: SRS resources

SRS-Resources ::= SEQUENCE {

maxNumberAperiodicSRS-PerBWP ENUMERATED {n1, n2, n4, n8, n16},

maxNumberAperiodicSRS-PerBWP-PerSlot INTEGER (1..6),

maxNumberPeriodicSRS-PerBWP ENUMERATED {n1, n2, n4, n8, n16},

maxNumberPeriodicSRS-PerBWP-PerSlot INTEGER (1..6),

maxNumberSemiPersitentSRS-PerBWP ENUMERATED {n0, n1, n2, n4, n8, n16},

maxNumberSP-SRS-PerBWP-PerSlot INTEGER (0..6),

maxNumberSRS-Ports-PerResource ENUMERATED {n1, n2, n4}

}

-- R1 2-55: SRS Tx switch

SRS-TxSwitch ::= SEQUENCE {

supportedSRS-TxPortSwitch ENUMERATED {t1r2, t1r4, t2r4, t1r4-t2r4},

txSwitchImpactToRx ENUMERATED {true} OPTIONAL

}

PDCP-Parameters ::= SEQUENCE {

supportedROHC-Profiles SEQUENCE {

profile0x0000 BOOLEAN,

profile0x0001 BOOLEAN,

profile0x0002 BOOLEAN,

profile0x0003 BOOLEAN,

profile0x0004 BOOLEAN,

profile0x0006 BOOLEAN,

profile0x0101 BOOLEAN,

profile0x0102 BOOLEAN,

profile0x0103 BOOLEAN,

profile0x0104 BOOLEAN

},

maxNumberROHC-ContextSessions ENUMERATED {cs2, cs4, cs8, cs12, cs16, cs24, cs32, cs48, cs64, cs128, cs256, cs512, cs1024, cs16384, spare2, spare1},

uplinkOnlyROHC-Profiles ENUMERATED {supported} OPTIONAL,

continueROHC-Context ENUMERATED {supported} OPTIONAL,

outOfOrderDelivery ENUMERATED {supported} OPTIONAL,

shortSN ENUMERATED {supported} OPTIONAL

}

RLC-Parameters ::= SEQUENCE {

am-WithShortSN ENUMERATED {supported} OPTIONAL,

um-WithShortSN ENUMERATED {supported} OPTIONAL,

um-WIthLongSN ENUMERATED {supported} OPTIONAL

}

MAC-Parameters ::= SEQUENCE {

mac-ParametersCommon MAC-ParametersCommon OPTIONAL,

mac-ParametersXDD-Diff MAC-ParametersXDD-Diff OPTIONAL

}

MAC-ParametersCommon ::= SEQUENCE {

lcp-Restriction ENUMERATED {supported} OPTIONAL,

-- R1 4-24: PUCCH-spatialrelationinfo indication by a MAC CE per PUCCH resource

pucch-SpatialRelInfoMAC-CE ENUMERATED {supported} OPTIONAL

}

MAC-ParametersXDD-Diff ::= SEQUENCE {

skipUplinkTxDynamic ENUMERATED {supported} OPTIONAL,

logicalChannelSR-DelayTimer ENUMERATED {supported} OPTIONAL,

longDRX-Cycle ENUMERATED {supported} OPTIONAL,

shortDRX-Cycle ENUMERATED {supported} OPTIONAL,

multipleSR-Configurations ENUMERATED {supported} OPTIONAL,

-- If supported UE supports 8 SR configurations, otherwise 1 SR config is supported.

-- Confirmation is needed whether to align the number to what the configuration signalling can support.

multipleConfiguredGrantConfigurations ENUMERATED {supported} OPTIONAL

-- If supported UE supports 16 configured grant configurations, otherwise 1 ConfiguredGrant config is supported.

-- Confirmation is needed whether to align the number to what the configuration signalling can support, and to consider whether the 16 refers

-- to the configurations or the active ones only (as they are within the BWP).

}

MeasParameters ::= SEQUENCE {

measParametersXDD-Diff MeasParametersXDD-Diff OPTIONAL,

measParametersFRX-Diff MeasParametersFRX-Diff OPTIONAL

}

MeasParametersXDD-Diff ::= SEQUENCE {

intraAndInterF-MeasAndReport ENUMERATED {supported} OPTIONAL,

eventA-MeasAndReport ENUMERATED {supported} OPTIONAL

-- Confirmation is needed on the need of capability/IOT signaling in LTE for support of the additional measurement gap configurations.

}

MeasParametersFRX-Diff ::= SEQUENCE {

-- R1 1-3: SSB based SINR measurement

ss-SINR-Meas ENUMERATED {supported} OPTIONAL,

-- R1 1-5: CSI-RS based RRM measurement with associated SS-block

csi-RSRP-AndRSRQ-MeasWithSSB ENUMERATED {supported} OPTIONAL,

-- R1 1-5a: CSI-RS based RRM measurement without associated SS-block

csi-RSRP-AndRSRQ-MeasWithoutSSB ENUMERATED {supported} OPTIONAL,

-- R1 1-6: CSI-RS based SINR measurement

csi-SINR-Meas ENUMERATED {supported} OPTIONAL,

-- R1 1-7: CSI-RS based RLM

csi-RS-RLM ENUMERATED {supported} OPTIONAL

}

-- TAG-UE-NR-CAPABILITY-STOP

-- ASN1STOP

### 6.3.4 Other information elements

#### – *RRC-TransactionIdentifier*

The IE *RRC-TransactionIdentifier* is used, together with the message type, for the identification of an RRC procedure (transaction).

*RRC-TransactionIdentifier* information element

-- ASN1START

-- TAG-RRC-TRANSACTIONIDENTIFIER-START

RRC-TransactionIdentifier ::= INTEGER (0..3)

-- TAG-RRC-TRANSACTIONIDENTIFIER-STOP

-- ASN1STOP

## 6.4 RRC multiplicity and type constraint values

### – Multiplicity and type constraint definitions

-- ASN1START

-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-START

maxBandComb INTEGER ::= 65536 -- Maximum number of DL band combinations

maxNrofServingCells INTEGER ::= 32 -- Max number of serving cells (SpCell + SCells) per cell group

maxNrofServingCells-1 INTEGER ::= 31 -- Max number of serving cells (SpCell + SCells) per cell group minus 1

maxNrofAggregatedCellsPerCellGroup INTEGER ::= 16

maxNrofSCells INTEGER ::= 31 -- Max number of secondary serving cells per cell group

maxNrofCellMeas INTEGER ::= 32 -- Maximum number of entries in each of the cell lists in a measurement object

maxNrofSS-BlocksToAverage INTEGER ::= 16 -- Max number for the (max) number of SS blocks to average to determine cell

-- measurement

maxNrofCSI-RS-ResourcesToAverage INTEGER ::= 16 -- Max number for the (max) number of CSI-RS to average to determine cell

-- measurement

maxNrofDL-Allocations INTEGER ::= 16 -- Maximum number of PDSCH time domain resource allocations

maxNrofSR-ConfigPerCellGroup INTEGER ::= 8 -- Maximum number of SR configurations per cell group

maxLCG-ID INTEGER ::= 7 -- Maximum value of LCG ID

maxLC-ID INTEGER ::= 32 -- Maximum value of Logical Channel ID

maxNrofTAGs INTEGER ::= 4 -- Maximum number of Timing Advance Groups

maxNrofTAGs-1 INTEGER ::= 3 -- Maximum number of Timing Advance Groups minus 1

maxNrofBWPs INTEGER ::= 4 -- Maximum number of BWPs per serving cell

maxNrofSymbols-1 INTEGER ::= 13 -- Maximum index identifying a symbol within a slot (14 symbols, indexed from 0..13)

maxNrofSlots INTEGER ::= 320 -- Maximum number of slots in a 10 ms period

maxNrofSlots-1 INTEGER ::= 319 -- Maximum number of slots in a 10 ms period minus 1

maxNrofPhysicalResourceBlocks INTEGER ::= 275 -- Maximum number of PRBs

maxNrofPhysicalResourceBlocks-1 INTEGER ::= 274 -- Maximum number of PRBs

maxNrofControlResourceSets INTEGER ::= 12 -- Max number of CoReSets configurable on a serving cell

maxNrofControlResourceSets-1 INTEGER ::= 11 -- Max number of CoReSets configurable on a serving cell minus 1

maxCoReSetDuration INTEGER ::= 3 -- Max number of OFDM symbols in a control resource set

maxNrofSearchSpaces INTEGER ::= 40 -- Max number of Search Spaces

maxNrofSearchSpaces-1 INTEGER ::= 39 -- Max number of Search Spaces minus 1

maxSFI-DCI-PayloadSize INTEGER ::= 128 -- Max number payload of a DCI scrambled with SFI-RNTI

maxSFI-DCI-PayloadSize-1 INTEGER ::= 127 -- Max number payload of a DCI scrambled with SFI-RNTI minus 1

maxINT-DCI-PayloadSize INTEGER ::= 126 -- Max number payload of a DCI scrambled with INT-RNTI

maxINT-DCI-PayloadSize-1 INTEGER ::= 125 -- Max number payload of a DCI scrambled with INT-RNTI minus 1

maxNrofRateMatchPatterns INTEGER ::= 4 -- Max number of rate matching patterns that may be configured

maxNrofRateMatchPatterns-1 INTEGER ::= 3 -- Max number of rate matching patterns that may be configured minus 1

maxNrofCSI-ReportConfigurations INTEGER ::= 48 -- Maximum number of report configurations

maxNrofCSI-ReportConfigurations-1 INTEGER ::= 47 -- Maximum number of report configurations minus 1

maxNrofCSI-ResourceConfigurations INTEGER ::= 112 -- Maximum number of resource configurations

maxNrofCSI-ResourceConfigurations-1 INTEGER ::= 111 -- Maximum number of resource configurations minus 1

maxNrofAP-CSI-RS-ResourcesPerSet INTEGER ::= 16

maxNrOfCSI-AperiodicTriggers INTEGER ::= 128 -- Maximum number of triggers for aperiodic CSI reporting

maxNrofReportConfigPerAperiodicTrigger INTEGER ::= 16 -- Maximum number of report configurations per trigger state for aperiodic reporting

maxNrofNZP-CSI-RS-Resources INTEGER ::= 192 -- Maximum number of Non-Zero-Power (NZP) CSI-RS resources

maxNrofNZP-CSI-RS-Resources-1 INTEGER ::= 191 -- Maximum number of Non-Zero-Power (NZP) CSI-RS resources minus 1

maxNrofNZP-CSI-RS-ResourcesPerSet INTEGER ::= 64 -- Maximum number of NZP CSI-RS resources per resource set

maxNrofNZP-CSI-RS-ResourceSetsPerConfig INTEGER ::= 16 -- Maximum number of resource sets per resource configuration

maxNrofZP-CSI-RS-Resources INTEGER ::= 32 -- Maximum number of Zero-Power (NZP) CSI-RS resources

maxNrofZP-CSI-RS-Resources-1 INTEGER ::= 31 -- Maximum number of Zero-Power (NZP) CSI-RS resources minus 1

maxNrofZP-CSI-RS-ResourceSets-1 INTEGER ::= 16

maxNrofZP-CSI-RS-ResourcesPerSet INTEGER ::= 16

maxNrofZP-CSI-RS-Sets INTEGER ::= 16

maxNrofCSI-IM-Resources INTEGER ::= 32 -- Maximum number of CSI-IM resources. See CSI-IM-ResourceMax in 38.214.

maxNrofCSI-IM-Resources-1 INTEGER ::= 31 -- Maximum number of CSI-IM resources minus 1. See CSI-IM-ResourceMax in 38.214.

maxNrofCSI-IM-ResourcesPerSet INTEGER ::= 8 -- Maximum number of CSI-IM resources per set. See CSI-IM-ResourcePerSetMax in 38.214

maxNrofCSI-IM-ResourceSetsPerConfig INTEGER ::= 16 -- Maximum number of CSI IM resource sets per resource configuration

maxNrofSSB-Resources-1 INTEGER ::= 63 -- Maximum number of SSB resources in a resource set minus 1

maxNrofCSI-SSB-ResourcePerSet INTEGER ::= 64

maxNrofCSI-SSB-ResourceSetsPerConfig INTEGER ::= 1 -- Maximum number of CSI SSB resource sets per resource configuration

maxNrofFailureDetectionResources INTEGER ::= 10 -- Maximum number of failure detection resources

maxNrofObjectId INTEGER ::= 64 -- Maximum number of measurement objects

maxNrofPCI-Ranges INTEGER ::= 8 -- Maximum number of PCI ranges

maxNrofCSI-RS-ResourcesRRM INTEGER ::= 96 -- Maximum number of CSI-RS resources for an RRM measurement object

maxNrofCSI-RS-ResourcesRRM-1 INTEGER ::= 95 -- Maximum number of CSI-RS resources for an RRM measurement object minus 1

maxNrofMeasId INTEGER ::= 64 -- Maximum number of configured measurements

maxNrofQuantityConfig INTEGER ::= 2 -- Maximum number of quantity configurations

maxNrofCSI-RS-CellsRRM INTEGER ::= 96 -- Maximum number of FFS

maxNrofSRS-ResourceSets INTEGER ::= 16 -- Maximum number of SRS resource sets in a BWP.

maxNrofSRS-ResourceSets-1 INTEGER ::= 15 -- Maximum number of SRS resource sets in a BWP minus 1.

maxNrofSRS-Resources INTEGER ::= 64 -- Maximum number of SRS resources in an SRS resource set.

maxNrofSRS-Resources-1 INTEGER ::= 63 -- Maximum number of SRS resources in an SRS resource set minus 1.

maxNrofSRS-TriggerStates-1 INTEGER ::= 3 -- Maximum number of SRS trigger states minus 1, i.e., the largest code point.

maxRAT-CapabilityContainers INTEGER ::= 8 -- Maximum number of interworking RAT containers (incl NR and MRDC)

maxSimultaneousBands INTEGER ::= 32 -- Maximum number of simultaneously aggregated bands

maxNrofSlotFormatCombinationsPerCell INTEGER ::= 16 -- Maximum number of

maxNrofSlotFormatCombinationsPerSet INTEGER ::= 4096 -- Maximum number of Slot Format Combinations in a SF-Set.

maxNrofSlotFormatCombinationsPerSet-1 INTEGER ::= 4095 -- Maximum number of Slot Format Combinations in a SF-Set minus 1.

maxNrofPUCCH-Resources INTEGER ::= 128

maxNrofPUCCH-Resources-1 INTEGER ::= 127

maxNrofPUCCH-ResourceSets INTEGER ::= 4 -- Maximum number of PUCCH Resource Sets

maxNrofPUCCH-ResourceSets-1 INTEGER ::= 3 -- Maximum number of PUCCH Resource Sets minus 1.

maxNrofPUCCH-ResourcesPerSet INTEGER ::= 32 -- Maximum number of PUCCH Resources per PUCCH-ResourceSet

maxNrofPUCCH-ResourcesPerSet-1 INTEGER ::= 31 -- Maximum number of PUCCH Resources per PUCCH-ResourceSet minus 1.

maxNrofPUCCH-P0-PerSet INTEGER ::= 8 -- Maximum number of P0-pucch present in a p0-pucch set

maxNrofPUCCH-PathlossReferenceRSs INTEGER ::= 4 -- Maximum number of RSs used as pathloss reference for PUCCH power control.

maxNrofPUCCH-PathlossReferenceRSs-1 INTEGER ::= 3 -- Maximum number of RSs used as pathloss reference for PUCCH power control minus 1.

maxNrofP0-PUSCH-AlphaSets INTEGER ::= 30 -- Maximum number of P0-pusch-alpha-sets (see 38,213, section 7.1)

maxNrofP0-PUSCH-AlphaSets-1 INTEGER ::= 29 -- Maximum number of P0-pusch-alpha-sets minus 1 (see 38,213, section 7.1)

maxNrofPUSCH-PathlossReferenceRSs INTEGER ::= 4 -- Maximum number of RSs used as pathloss reference for PUSCH power control.

maxNrofPUSCH-PathlossReferenceRSs-1 INTEGER ::= 3 -- Maximum number of RSs used as pathloss reference for PUSCH power control minus 1.

maxBands INTEGER ::= 1024 -- Maximum number of supported bands in UE capability.

maxBandsMRDC INTEGER ::= 1280

maxBandsEUTRA INTEGER ::= 256

maxCellPrep INTEGER ::= 32

maxCellReport INTEGER ::= 8

maxDRB INTEGER ::= 29 -- Maximum number of DRBs (that can be added in DRB-ToAddModLIst).

maxFreq INTEGER ::= 8 -- Max number of non-serving frequencies in MeasResultSCG-Failure.

maxNrofCSI-RS INTEGER ::= 64

maxNrofCandidateBeams INTEGER ::= 16 -- Max number of PRACH-ResourceDedicatedBFR that in BFR config.

maxNrofPCIsPerSMTC INTEGER ::= 64 -- Maximun number of PCIs per SMTC.

maxNrofQFIs INTEGER ::= 64

maxNrofSR-Resources INTEGER ::= 8 -- Maximum number of SR resources per BWP in a cell.

maxNrofSlotFormatsPerCombination INTEGER ::= 256

maxNrofSpatialRelationInfos INTEGER ::= 8

maxNrofSRS-ResourcesPerSet INTEGER ::= 16

maxNrofIndexesToReport INTEGER ::= 32

maxNrofSSBs INTEGER ::= 64 -- Maximum number of SSB resources in a resource set.

maxNrofSSBs-1 INTEGER ::= 63 -- Maximum number of SSB resources in a resource set minus 1.

maxNrofTCI-StatesPDCCH INTEGER ::= 64

maxNrofTCI-States INTEGER ::= 64 -- Maximum number of TCI states.

maxNrofTCI-States-1 INTEGER ::= 63 -- Maximum number of TCI states minus 1.

maxNrofUL-Allocations INTEGER ::= 16 -- Maximum number of PUSCH time domain resource allocations.

maxQFI INTEGER ::= 63

maxRA-CSIRS-Resources INTEGER ::= 96

maxRA-OccasionsPerCSIRS INTEGER ::= 64 -- Maximum number of RA occasions for one CSI-RS

maxRA-Occasions-1 INTEGER ::= 511 -- Maximum number of RA occasions in the system

maxRA-SSB-Resources INTEGER ::= 64

maxSCSs INTEGER ::= 5

maxSecondaryCellGroups INTEGER ::= 3

maxNrofServingCellsEUTRA INTEGER ::= 32

maxMBSFN-Allocations INTEGER ::= 8

maxNrofMultiBands INTEGER ::= 8

maxCellSFTD INTEGER ::= 3 -- Maximum number of cells for SFTD reporting

maxReportConfigId INTEGER ::= 64

maxNrofSRI-PUSCH-Mappings INTEGER ::= 16

maxNrofSRI-PUSCH-Mappings-1 INTEGER ::= 15

maxDownlinkFeatureSets INTEGER ::= 4096 -- (for NR DL) Total number of FeatureSets (size of the pool)

maxUplinkFeatureSets INTEGER ::= 256 -- (for NR UL) Total number of FeatureSets (size of the pool)

maxFeatureSetsPerBC INTEGER ::= 64 -- (for NR) The number of feature sets associatd with one band combination.

maxPerCC-FeatureSets INTEGER ::= 32 -- (for NR) Total number of CC-specific FeatureSets (size of the pool)

maxEUTRA-DL-FeatureSets INTEGER ::= 4096 -- (for EUTRA) Total number of FeatureSets (size of the pool)

maxEUTRA-UL-FeatureSets INTEGER ::= 256 -- (for EUTRA) Total number of FeatureSets (size of the pool)

maxEUTRA-FeatureSetsPerBC INTEGER ::= 64 -- (for EUTRA) The number of feature sets associatd with one band combination.

-- Editor’s Note: Targeted for completion in June 2018. Not used in EN-DC drop.

CellIdentity ::= ENUMERATED {ffsTypeAndValue}

ShortMAC-I ::= ENUMERATED {ffsTypeAndValue}

-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-STOP

-- ASN1STOP

### – End of NR-RRC-Definitions

-- ASN1START

END

-- ASN1STOP

# 7 Variables and constants

## 7.1 Timers

### 7.1.1 Timers (Informative)

| Timer | Start | Stop | At expiry |
| --- | --- | --- | --- |
| T304 | Reception of *RRCReconfiguration* message including *reconfigurationWithSync* | Successful completion of random access on the corresponding SpCell  For T304 of SCG, upon SCG release | For T304 of SCG, inform network about the reconfiguration with sync failure by initiating the SCG failure information procedure as specified in 5.7.3. |
| T310 | Upon detecting physical layer problems for the SpCell i.e. upon receiving N310 consecutive out-of-sync indications from lower layers. | Upon receiving N311 consecutive in-sync indications from lower layers for the SpCell, upon receiving RRCReconfiguration with *reconfigurationWithSync* for that cell group, and upon initiating the connection re-establishment procedure.  Upon SCG release, if the T310 is kept in SCG. | If the T310 is kept in MCG: If security is not activated: go to RRC\_IDLE else: initiate the connection re-establishment procedure.  If the T310 is kept in SCG, Inform E-UTRAN/NR about the SCG radio link failure by initiating the SCG failure information procedure as specified in 5.7.3. |
| T311 | Upon initiating the RRC connection re-establishment procedure | Selection of a suitable NR cell or a cell using another RAT. | Enter RRC\_IDLE |

### 7.1.2 Timer handling

When the UE applies zero value for a timer, the timer shall be started and immediately expire unless explicitly stated otherwise.

## 7.2 Counters

| Counter | Reset | Incremented | When reaching max value |
| --- | --- | --- | --- |
|  |  |  |  |

## 7.3 Constants

| Constant | Usage |
| --- | --- |
| N310 | Maximum number of consecutive "out-of-sync" indications for the PCell received from lower layers |
| N311 | Maximum number of consecutive "in-sync" indications for the PCell received from lower layers |

## 7.4 UE variables

NOTE: To facilitate the specification of the UE behavioural requirements, UE variables are represented using ASN.1. Unless explicitly specified otherwise, it is however up to UE implementation how to store the variables. The optionality of the IEs in ASN.1 is used only to indicate that the values may not always be available.

#### – *NR-UE-Variables*

This ASN.1 segment is the start of the NR UE variable definitions.

-- ASN1START

NR-UE-Variables DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS

MeasId,

MeasIdToAddModList,

MeasObjectToAddModList,

PhysCellId,

ReportConfigToAddModList,

RSRP-Range,

QuantityConfig,

maxNrofCellMeas,

maxNrofMeasId

FROM NR-RRC-Definitions;

-- ASN1STOP

#### – *VarMeasConfig*

The UE variable *VarMeasConfig* includes the accumulated configuration of the measurements to be performed by the UE, covering intra-frequency, inter-frequency and inter-RAT mobility related measurements.

*VarMeasConfig UE variable*

-- ASN1START

-- TAG-VAR-MEAS-CONFIG-START

VarMeasConfig ::= SEQUENCE {

-- Measurement identities

measIdList MeasIdToAddModList OPTIONAL,

-- Measurement objects

measObjectList MeasObjectToAddModList OPTIONAL,

-- Reporting configurations

reportConfigList ReportConfigToAddModList OPTIONAL,

-- Other parameters

quantityConfig QuantityConfig OPTIONAL,

s-MeasureConfig CHOICE {

ssb-RSRP RSRP-Range,

csi-RSRP RSRP-Range

} OPTIONAL

}

-- TAG-VAR-MEAS-CONFIG-STOP

-- ASN1STOP

Editor’s Note: FFS Revisit whether we really need *VarMeasConfig*.

#### – *VarMeasReportList*

The UE variable *VarMeasReportList* includes information about the measurements for which the triggering conditions have been met.

*VarMeasReportList UE variable*

-- ASN1START

-- TAG-VAR-MEAS-REPORT-START

VarMeasReportList ::= SEQUENCE (SIZE (1..maxNrofMeasId)) OF VarMeasReport

VarMeasReport ::= SEQUENCE {

-- List of measurement that have been triggered

measId MeasId,

cellsTriggeredList CellsTriggeredList OPTIONAL,

numberOfReportsSent INTEGER

}

CellsTriggeredList ::= SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CHOICE {

physCellId PhysCellId,

-- Not needed for EN-DC.

physCellIdEUTRA ENUMERATED {ffsTypeAndValue}

}

-- TAG-VAR-MEAS-REPORT-STOP

-- ASN1STOP

#### – End of *NR-UE-Variables*

-- ASN1START

END

-- ASN1STOP

# 8 Protocol data unit abstract syntax

## 8.1 General

The RRC PDU contents in clause 6 and clause 10 are described using abstract syntax notation one (ASN.1) as specified in ITU-T Rec. X.680 [6] and X.681 [7]. Transfer syntax for RRC PDUs is derived from their ASN.1 definitions by use of Packed Encoding Rules, unaligned as specified in ITU-T Rec. X.691 [8].

The following encoding rules apply in addition to what has been specified in X.691:

- When a bit string value is placed in a bit-field as specified in 15.6 to 15.11 in X.691, the leading bit of the bit string value shall be placed in the leading bit of the bit-field, and the trailing bit of the bit string value shall be placed in the trailing bit of the bit-field;

NOTE: The terms 'leading bit' and 'trailing bit' are defined in ITU-T Rec. X.680. When using the 'bstring' notation, the leading bit of the bit string value is on the left, and the trailing bit of the bit string value is on the right.

- When decoding types constrained with the ASN.1 Contents Constraint ("CONTAINING"), automatic decoding of the contained type should not be performed because errors in the decoding of the contained type should not cause the decoding of the entire RRC message PDU to fail. It is recommended that the decoder first decodes the outer PDU type that contains the OCTET STRING or BIT STRING with the Contents Constraint, and then decodes the contained type that is nested within the OCTET STRING or BIT STRING as a separate step;

- When decoding a) RRC message PDUs, b) BIT STRING constrained with a Contents Constraint, or c) OCTET STRING constrained with a Contents Constraint, PER decoders are required to never report an error if there are extraneous zero or non-zero bits at the end of the encoded RRC message PDU, BIT STRING or OCTET STRING.

## 8.2 Structure of encoded RRC messages

An RRC PDU, which is the bit string that is exchanged between peer entities/across the radio interface contains the basic production as defined in X.691.

RRC PDUs shall be mapped to and from PDCP SDUs (in case of DCCH) or RLC SDUs (in case of PCCH, BCCH or CCCH) upon transmission and reception as follows:

- when delivering an RRC PDU as an PDCP SDU to the PDCP layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the PDCP SDU and onwards; and

- when delivering an RRC PDU as an RLC SDU to the RLC layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the RLC SDU and onwards; and

- upon reception of an PDCP SDU from the PDCP layer, the first bit of the PDCP SDU shall represent the first bit of the RRC PDU and onwards; and

- upon reception of an RLC SDU from the RLC layer, the first bit of the RLC SDU shall represent the first bit of the RRC PDU and onwards.

## 8.3 Basic production

The 'basic production' is obtained by applying UNALIGNED PER to the abstract syntax value (the ASN.1 description) as specified in X.691. It always contains a multiple of 8 bits.

## 8.4 Extension

The following rules apply with respect to the use of protocol extensions:

- A transmitter compliant with this version of the specification shall, unless explicitly indicated otherwise on a PDU type basis, set the extension part empty. Transmitters compliant with a later version may send non-empty extensions;

- A transmitter compliant with this version of the specification shall set spare bits to zero.

## 8.5 Padding

If the encoded RRC message does not fill a transport block, the RRC layer shall add padding bits. This applies to PCCH and BCCH.

Padding bits shall be set to 0 and the number of padding bits is a multiple of 8.



Figure 8.5-1: RRC level padding

# 9 Specified and default radio configurations

Specified and default configurations are configurations of which the details are specified in the standard. Specified configurations are fixed while default configurations can be modified using dedicated signalling.

Editor’s Note: FFS / FIXME: Default configurations

## 9.1 Specified configurations

Editor’s Note: FFS

### 9.1.1 Logical channel configurations

### 9.1.2 SRB configurations

#### 9.1.2.1 SRB1/SRB1S

Parameters

| Name | Value | Semantics description | Ver |
| --- | --- | --- | --- |
| RLC configuration |  |  |  |
| *logicalChannelIdentity* | 1 |  |  |

#### 9.1.2.2 SRB2/SRB2S

Parameters

| Name | Value | Semantics description | Ver |
| --- | --- | --- | --- |
| RLC configuration |  |  |  |
| *logicalChannelIdentity* | 2 |  |  |

#### 9.1.2.3 SRB3

Parameters

| Name | Value | Semantics description | Ver |
| --- | --- | --- | --- |
| RLC configuration |  |  |  |
| *logicalChannelIdentity* | 3 |  |  |

## 9.2 Default radio configurations

### 9.2.1 SRB configurations

#### 9.2.1.1 SRB1/SRB1S

Parameters (FFS)

| Name | Value | Semantics description | Ver |
| --- | --- | --- | --- |
| *PDCP-Config*  *>t-Reordering* | *infinity* |  |  |
| *RLC-Config* CHOICE | am |  |  |
| *ul-RLC-Config*  *>sn-FieldLength*  *>t-PollRetransmit*  *>pollPDU*  *>pollByte*  *>maxRetxThreshold* | size12  ms45  infinity  infinity  t4 |  |  |
| *dl-RLC-Config*  *>sn-FieldLength*  *>t-Reassembly*  *>t-StatusProhibit* | size12  ms35  ms0 |  |  |
| *LogicalChannelConfig* |  |  |  |
| *>priority* | 1 | Highest priority |  |
| *>prioritisedBitRate* | infinity |  |  |
| *>bucketSizeDuration* | N/A |  |  |
| *>allowedSubCarrierSpacing* | FFS |  |  |
| *>allowedTiming* | FFS |  |  |
| *>logicalChannelGroup* | 0 |  |  |
| *>logicalChannelSR-DelayTimerApplied* | false |  |  |

#### 9.2.1.2 SRB2/SRB2S

Parameters (FFS)

| Name | Value | Semantics description | Ver |
| --- | --- | --- | --- |
| *PDCP-Config*  *>t-Reordering* | *infinity* |  |  |
| *RLC-Config* CHOICE | am |  |  |
| *ul-RLC-Config*  *>sn-FieldLength*  *>t-PollRetransmit*  *>pollPDU*  *>pollByte*  *>maxRetxThreshold* | size12  ms45  infinity  infinity  t4 |  |  |
| *dl-RLC-Config*  *>sn-FieldLength*  *>t-Reassembly*  *>t-StatusProhibit* | size12  ms35  ms0 |  |  |
| *LogicalChannelConfig* |  |  |  |
| *>priority* | 3 |  |  |
| *>prioritisedBitRate* | infinity |  |  |
| *>bucketSizeDuration* | N/A |  |  |
| *>allowedSubCarrierSpacing* | FFS |  |  |
| *>allowedTiming* | FFS |  |  |
| *>logicalChannelGroup* | 0 |  |  |
| *>logicalChannelSR-DelayTimerApplied* | false |  |  |

#### 9.2.1.3 SRB3

Parameters (FFS)

| Name | Value | Semantics description | Ver |
| --- | --- | --- | --- |
| *PDCP-Config*  *>t-Reordering* | *infinity* |  |  |
| *RLC-Config* CHOICE | am |  |  |
| *ul-RLC-Config*  *>sn-FieldLength*  *>t-PollRetransmit*  *>pollPDU*  *>pollByte*  *>maxRetxThreshold* | size12  ms45  infinity  infinity  t4 |  |  |
| *dl-RLC-Config*  *>sn-FieldLength*  *>t-Reassembly*  *>t-StatusProhibit* | size12  ms35  ms0 |  |  |
| *LogicalChannelConfig* |  |  |  |
| *>priority* | 1 | Highest priority |  |
| *>prioritisedBitRate* | infinity |  |  |
| *>bucketSizeDuration* | N/A |  |  |
| *>allowedSubCarrierSpacing* | FFS |  |  |
| *>allowedTiming* | FFS |  |  |
| *>logicalChannelGroup* | 0 |  |  |
| *>logicalChannelSR-DelayTimerApplied* | false |  |  |

# 10 Generic error handling

## 10.1 General

The generic error handling defined in the subsequent sub-clauses applies unless explicitly specified otherwise e.g. within the procedure specific error handling.

The UE shall consider a value as not comprehended when it is set:

- to an extended value that is not defined in the version of the transfer syntax supported by the UE;

- to a spare or reserved value unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/reserved value.

The UE shall consider a field as not comprehended when it is defined:

- as spare or reserved unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/reserved field.

## 10.2 ASN.1 violation or encoding error

The UE shall:

1> when receiving an RRC message on the [BCCH] for which the abstract syntax is invalid [6]:

2> ignore the message.

NOTE: This section applies in case one or more fields is set to a value, other than a spare, reserved or extended value, not defined in this version of the transfer syntax. E.g. in the case the UE receives value 12 for a field defined as INTEGER (1..11). In cases like this, it may not be possible to reliably detect which field is in the error hence the error handling is at the message level.

## 10.3 Field set to a not comprehended value

The UE shall, when receiving an RRC message on any logical channel:

1> if the message includes a field that has a value that the UE does not comprehend:

2> if a default value is defined for this field:

3> treat the message while using the default value defined for this field;

2> else if the concerned field is optional:

3> treat the message as if the field were absent and in accordance with the need code for absence of the concerned field;

2> else:

3> treat the message as if the field were absent and in accordance with sub-clause 10.4.

## 10.4 Mandatory field missing

The UE shall:

1> if the message includes a field that is mandatory to include in the message (e.g. because conditions for mandatory presence are fulfilled) and that field is absent or treated as absent:

2> if the RRC message was received on DCCH or CCCH:

3> ignore the message;

2> else:

3> if the field concerns a (sub-field of) an entry of a list (i.e. a SEQUENCE OF):

4> treat the list as if the entry including the missing or not comprehended field was not present;

3> else if the field concerns a sub-field of another field, referred to as the 'parent' field i.e. the field that is one nesting level up compared to the erroneous field:

4> consider the 'parent' field to be set to a not comprehended value;

4> apply the generic error handling to the subsequent 'parent' field(s), until reaching the top nesting level i.e. the message level;

3> else (field at message level):

4> ignore the message.

NOTE 1: The error handling defined in these sub-clauses implies that the UE ignores a message with the message type or version set to a not comprehended value.

NOTE 2: The nested error handling for messages received on logical channels other than DCCH and CCCH applies for errors in extensions also, even for errors that can be regarded as invalid network operation e.g. the network not observing conditional presence.

The following ASN.1 further clarifies the levels applicable in case of nested error handling for errors in extension fields.

-- /example/ ASN1START

-- Example with extension addition group

ItemInfoList ::= SEQUENCE (SIZE (1..max)) OF ItemInfo

ItemInfo ::= SEQUENCE {

itemIdentity INTEGER (1..max),

field1 Field1,

field2 Field2 OPTIONAL, -- Need N

...

[[ field3-r9 Field3-r9 OPTIONAL, -- Cond Cond1

field4-r9 Field4-r9 OPTIONAL -- Need N

]]

}

-- Example with traditional non-critical extension (empty sequence)

BroadcastInfoBlock1 ::= SEQUENCE {

itemIdentity INTEGER (1..max),

field1 Field1,

field2 Field2 OPTIONAL, -- Need N

nonCriticalExtension BroadcastInfoBlock1-v940-IEs OPTIONAL

}

BroadcastInfoBlock1-v940-IEs::= SEQUENCE {

field3-r9 Field3-r9 OPTIONAL, -- Cond Cond1

field4-r9 Field4-r9 OPTIONAL, -- Need N

nonCriticalExtension SEQUENCE {} OPTIONAL -- Need S

}

-- ASN1STOP

The UE shall, apply the following principles regarding the levels applicable in case of nested error handling:

- an extension additon group is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, a error regarding the conditionality of *field3* would result in the entire itemInfo entry to be ignored (rather than just the extension addition group containing *field3* and *field4*);

- a traditional *nonCriticalExtension* is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, a error regarding the conditionality of *field3* would result in the entire *BroadcastInfoBlock1* to be ignored (rather than just the non critical extension containing *field3* and *field4*).

## 10.5 Not comprehended field

The UE shall, when receiving an RRC message on any logical channel:

1> if the message includes a field that the UE does not comprehend:

2> treat the rest of the message as if the field was absent.

NOTE: This section does not apply to the case of an extension to the value range of a field. Such cases are addressed instead by the requirements in section 10.3.

# 11 Radio information related interactions between network nodes

## 11.1 General

This section specifies RRC messages that are transferred between network nodes. These RRC messages may be transferred to or from the UE via another Radio Access Technology. Consequently, these messages have similar characteristics as the RRC messages that are transferred across the NR radio interface, i.e. the same transfer syntax and protocol extension mechanisms apply.

## 11.2 Inter-node RRC messages

### 11.2.1 General

This section specifies RRC messages that are sent either across the X2-, Xn- or the NG-interface, either to or from the gNB, i.e. a single 'logical channel' is used for all RRC messages transferred across network nodes. The information could originate from or be destined for another RAT.

-- ASN1START

-- TAG\_NR-INTER-NODE-DEFINITIONS-START

NR-InterNodeDefinitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS

ARFCN-ValueNR,

CellIdentity,

CSI-RS-Index,

GapConfig,

maxBandComb,

maxNrofSCells,

maxNrofIndexesToReport,

MeasQuantityResults,

MeasResultSCG-Failure,

MeasResultCellListSFTD,

P-Max,

PhysCellId,

RadioBearerConfig,

RRCReconfiguration,

ServCellIndex,

SSB-Index,

ShortMAC-I,

UE-CapabilityRAT-ContainerList

FROM NR-RRC-Definitions;

-- TAG\_NR-INTER-NODE-DEFINITIONS-STOP

-- ASN1STOP

### 11.2.2 Message definitions

#### – *HandoverCommand*

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

This message is used to transfer the handover command as generated by the target gNB.

Direction: target gNB to source gNB/source RAN.

*HandoverCommand* message

-- ASN1START

-- TAG-HANDOVER-COMMAND-START

HandoverCommand ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE{

handoverCommand HandoverCommand-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

HandoverCommand-IEs ::= SEQUENCE {

handoverCommandMessage OCTET STRING (CONTAINING RRCReconfiguration),

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-HANDOVER-COMMAND-STOP

-- ASN1STOP

|  |
| --- |
| *HandoverCommand* field descriptions |
| ***handoverCommandMessage***  Contains the *RRCReconfiguration* message used to perform handover within NR or handover to NR, as generated (entirely) by the target gNB. |

#### – *HandoverPreparationInformation*

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

This message is used to transfer the NR RRC information used by the target gNB during handover preparation, including UE capability information.

Direction: source gNB/source RAN to target gNB.

*HandoverPreparationInformation* message

-- ASN1START

-- TAG-HANDOVER-PREPARATION-INFORMATION-START

HandoverPreparationInformation ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE{

handoverPreparationInformation HandoverPreparationInformation-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

HandoverPreparationInformation-IEs ::= SEQUENCE {

ue-CapabilityRAT-List UE-CapabilityRAT-ContainerList,

sourceConfig OCTET STRING (CONTAINING RRCReconfiguration),

rrm-Config RRM-Config OPTIONAL,

as-Context AS-Context OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

AS-Context ::= SEQUENCE {

reestablishmentInfo SEQUENCE {

sourcePhysCellId PhysCellId,

targetCellShortMAC-I ShortMAC-I,

additionalReestabInfoList ReestabNCellInfoList OPTIONAL

} OPTIONAL,

-- FFS Whether to change e.g. move all re-establishment info to Xx

configRestrictInfo ConfigRestrictInfoSCG OPTIONAL,

...

}

ReestabNCellInfoList ::= SEQUENCE ( SIZE (1..maxCellPrep) ) OF ReestabNCellInfo

ReestabNCellInfo::= SEQUENCE{

cellIdentity CellIdentity,

key-gNodeB-Star BIT STRING (SIZE (256)),

shortMAC-I ShortMAC-I

}

RRM-Config ::= SEQUENCE {

ue-InactiveTime ENUMERATED {

s1, s2, s3, s5, s7, s10, s15, s20,

s25, s30, s40, s50, min1, min1s20c, min1s40,

min2, min2s30, min3, min3s30, min4, min5, min6,

min7, min8, min9, min10, min12, min14, min17, min20,

min24, min28, min33, min38, min44, min50, hr1,

hr1min30, hr2, hr2min30, hr3, hr3min30, hr4, hr5, hr6,

hr8, hr10, hr13, hr16, hr20, day1, day1hr12, day2,

day2hr12, day3, day4, day5, day7, day10, day14, day19,

day24, day30, dayMoreThan30} OPTIONAL ,

candidateCellInfoList CandidateCellInfoList OPTIONAL,

...

}

-- TAG-HANDOVER-PREPARATION-INFORMATION-STOP

-- ASN1STOP

|  |
| --- |
| *HandoverPreparationInformation* field descriptions |
| ***as-Context***  Local RAN context required by the target gNB. |
| ***sourceConfig***  The radio resource configuration as used in the source cell. |
| ***rrm-Config***  Local RAN context used mainly for RRM purposes. |
| ***ue-CapabilityRAT-List***  The UE radio access related capabilities concerning RATs supported by the UE. FFS whether certain capabilities are mandatory to provide by source e.g. of target and/or source RAT. |

#### – *CG-Config*

This message is used to transfer the SCG radio configuration as generated by the SgNB.

Direction: Secondary gNB to master gNB or eNB.

*CG-Config* message

-- ASN1START

-- TAG-CG-CONFIG-START

CG-Config ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE{

cg-Config CG-Config-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

CG-Config-IEs ::= SEQUENCE {

scg-CellGroupConfig OCTET STRING (CONTAINING RRCReconfiguration) OPTIONAL,

scg-RB-Config OCTET STRING (CONTAINING RadioBearerConfig) OPTIONAL,

configRestrictModReq ConfigRestrictModReqSCG OPTIONAL,

drx-InfoSCG DRX-Info OPTIONAL,

candidateCellInfoListSN OCTET STRING (CONTAINING CandidateCellInfoList) OPTIONAL,

measConfigSN MeasConfigSN OPTIONAL,

selectedBandCombinationNR BandCombinationIndex OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

MeasConfigSN ::= SEQUENCE {

measuredFrequenciesFR1 SEQUENCE (SIZE (1..maxMeasFreqsMN)) OF NR-FreqInfo OPTIONAL,

...

}

NR-FreqInfo ::= SEQUENCE {

measuredFrequency ARFCN-ValueNR OPTIONAL,

...

}

ConfigRestrictModReqSCG ::= SEQUENCE {

requestedBC-MRDC BandCombinationIndex OPTIONAL,

requestedP-MaxFR1 P-Max OPTIONAL,

...

}

BandCombinationIndex ::= INTEGER (1..maxBandComb)

-- TAG-CG-CONFIG-STOP

-- ASN1STOP

|  |
| --- |
| *CG-Config* field descriptions |
| ***candidateCellInfoListSN***  Contains information regarding cells that the source secondary node suggests the target secondary gNB to consider configuring. |
| ***requestedP-MaxFR1***  IRequested value for the maximum power for FR1 (see TS 38.104 [12]) the UE can use in NR SCG. |
| ***requestedBC-MRDC***  Used to request configuring an NR band combination which is forbidden to use by MN. Each entry refers to a band combination numbered according to supportedBandCombination in the UE-MRDC-Capability. |
| ***scg-CellGroupConfig***  Contains the RRCReconfiguration message, used to (re-)configure the SCG configuration upon SCG establishment or modification, as generated (entirely) by the (target) SgNB |
| ***scg-RB-Config***  Contains the IE RadioBearerConfig, used to establish or reconfigure the SCG configuration, used to (re-)configure the SCG RB configuration upon SCG establishment or modification, as generated (entirely) by the (target) SgNB |
| ***selectedBandCombinationNR***  Indicates the band combination selected by SN for the EN-DC. |
| ***configRestrictModReq***  Used by SN to request changes to SCG configuration restrictions previously set by MN to ensure UE capabilities are respected. E.g. can used to request configuring an NR band combination whose use MN has previously forbidden. |

#### *– CG-ConfigInfo*

This message is used by master eNB or gNB to request the SgNB to perform certain actions e.g. to establish, modify or release an SCG. The message may include additional information e.g. to assist the SgNB to set the SCG configuration. It can also be used by a CU to request a DU to perform certain actions, e.g. to establish, modify or release an MCG or SCG.

Direction: Master eNB or gNB to secondary gNB, alternatively CU to DU.

*CG-ConfigInfo* message

-- ASN1START

-- TAG-CG-CONFIG-INFO-START

CG-ConfigInfo ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE{

cg-ConfigInfo CG-ConfigInfo-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

CG-ConfigInfo-IEs ::= SEQUENCE {

ue-CapabilityInfo OCTET STRING (CONTAINING UE-CapabilityRAT-ContainerList) OPTIONAL,-- Cond SN-Addition

candidateCellInfoListMN CandidateCellInfoList OPTIONAL,

candidateCellInfoListSN OCTET STRING (CONTAINING CandidateCellInfoList) OPTIONAL,

measResultCellListSFTD MeasResultCellListSFTD OPTIONAL,

scgFailureInfo SEQUENCE {

failureType ENUMERATED { t310-Expiry, randomAccessProblem,

rlc-MaxNumRetx, scg-ChangeFailure,

scg-reconfigFailure,

srb3-IntegrityFailure},

measResultSCG OCTET STRING (CONTAINING MeasResultSCG-Failure)

} OPTIONAL,

configRestrictInfo ConfigRestrictInfoSCG OPTIONAL,

drx-InfoMCG DRX-Info OPTIONAL,

measConfigMN MeasConfigMN OPTIONAL,

sourceConfigSCG OCTET STRING (CONTAINING RRCReconfiguration) OPTIONAL,

scg-RB-Config OCTET STRING (CONTAINING RadioBearerConfig) OPTIONAL,

mcg-RB-Config OCTET STRING (CONTAINING RadioBearerConfig) OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

ConfigRestrictInfoSCG ::= SEQUENCE {

allowedBC-ListMRDC BandCombinationIndexList OPTIONAL,

powerCoordination-FR1 SEQUENCE {

p-maxNR P-Max OPTIONAL,

p-maxEUTRA P-Max OPTIONAL

} OPTIONAL,

servCellIndexRangeSCG SEQUENCE {

lowBound ServCellIndex,

upBound ServCellIndex

} OPTIONAL, -- Cond SN-Addition

maxMeasFreqsSCG-NR INTEGER(1..maxMeasFreqsMN) OPTIONAL,

...

}

BandCombinationIndexList ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombinationIndex

DRX-Info ::= SEQUENCE {

drx-LongCycleStartOffset CHOICE {

ms10 INTEGER(0..9),

ms20 INTEGER(0..19),

ms32 INTEGER(0..31),

ms40 INTEGER(0..39),

ms60 INTEGER(0..59),

ms64 INTEGER(0..63),

ms70 INTEGER(0..69),

ms80 INTEGER(0..79),

ms128 INTEGER(0..127),

ms160 INTEGER(0..159),

ms256 INTEGER(0..255),

ms320 INTEGER(0..319),

ms512 INTEGER(0..511),

ms640 INTEGER(0..639),

ms1024 INTEGER(0..1023),

ms1280 INTEGER(0..1279),

ms2048 INTEGER(0..2047),

ms2560 INTEGER(0..2559),

ms5120 INTEGER(0..5119),

ms10240 INTEGER(0..10239)

},

shortDRX SEQUENCE {

drx-ShortCycle ENUMERATED {

ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,

ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,

spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },

drx-ShortCycleTimer INTEGER (1..16)

} OPTIONAL

}

MeasConfigMN ::= SEQUENCE {

measuredFrequenciesMN SEQUENCE (SIZE (1..maxMeasFreqsMN)) OF NR-FreqInfo OPTIONAL,

measGapConfigFR1 GapConfig OPTIONAL,

gapPurpose ENUMERATED {perUE, perFR1} OPTIONAL,

...

}

-- TAG-CG-CONFIG-INFO-STOP

-- ASN1STOP

|  |
| --- |
| *CG-ConfigInfo* field descriptions |
| ***allowedBandCombinationListMRDC***  A list of indices referring to band combinations in MR-DC capabilities from which SN is allowed to select an NR band combination. Each entry refers to a band combination numbered according to supportedBandCombination in the UE-MRDC-Capability. All MR-DC band combinations indicated by this field comprise the same LTE band combination. |
| ***candidateCellInfoListMN***, ***candidateCellInfoListSN***  Contains information regarding cells that the master node or the source node suggests the target gNB to consider configuring.  Including CSI-RS measurement results in candidateCellInfoListMN is not supported in this version of the specification. |
| ***maxMeasFreqsSCG-NR***  Indicates the maximum number of allowed NR frequencies SCG should configure for measurements. |
| mcg-RB-Config  Contains the IE RadioBearerConfig of the MN, used to support delta configuration for bearer type change between MN terminated to SN terminated bearer and SN change. |
| ***p-maxEUTRA***  Indicates the maximum power for EUTRA (see TS 36.104 [XX]) the UE can use in LTE MCG. |
| ***p-maxNR***  Indicates the maximum power for NR (see TS 38.104 [12]) the UE can use in NR SCG. |
| ***powerCoordination-FR1***  Indicates the maximum power that the UE can use in FR1. |
| ***scg-RB-Config***  Contains the IE RadioBearerConfig of the SN, used to support delta configuration e.g. during SN change. This field is absent when master eNB uses full configuration option. |
| ***sourceConfigSCG***  Includes the current dedicated SCG configuration in the same format as the *RRCReconfiguration* message, i.e. not only CellGroupConfig but also e.g. measConfig. This field is absent when master eNB uses full configuration option. |
| ***ConfigRestrictInfo***  Includes fields for which SgNB is explictly indicated to observe a configuration restriction. |
|  |
|  |
| ***servCellIndexRangeSCG***  Range of serving cell indices that SN is allowed to configure for SCG serving cells. |

|  |  |
| --- | --- |
| Conditional Presence | Explanation |
| *SN-Addition* | The field is mandatory present upon SN addition. |

#### – *MeasurementTimingConfiguration*

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

The *MeasurementTimingConfiguration* message is used to convey assistance information for measurement timing betwen by master eNB and secondary gNB.

Direction: Master eNB to secondary gNB.

*MeasurementTimingConfiguration* message

-- ASN1START

-- TAG-MEASUREMENT-TIMING-CONFIGURATION-START

MeasurementTimingConfiguration ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE{

measTimingConf MeasurementTimingConfiguration-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

MeasurementTimingConfiguration-IEs ::= SEQUENCE {

measTiming MeasTimingList OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

MeasTimingList ::= SEQUENCE (SIZE (1..maxMeasFreqsMN)) OF MeasTiming

MeasTiming ::= SEQUENCE {

carrierFreq ARFCN-ValueNR OPTIONAL,

ssb-MeasurementTimingConfiguration ENUMERATED {ffsTypeAndValue} OPTIONAL,

...

}

-- TAG-MEASUREMENT-TIMING-CONFIGURATION-STOP

-- ASN1STOP

## 11.3 Inter-node RRC information element definitions

#### – *CandidateCellInfoList*

The *CandidateCellInfoList* IE contains information regarding cells that the source suggests the target gNB to consider configuring.

*CandidateCellInfoList* information element

-- ASN1START

-- TAG-CANDIDATE-CELL-INFO-LIST-START

CandidateCellInfoList ::= SEQUENCE (SIZE (1.. maxNrofSCells)) OF CandidateCellInfo

CandidateCellInfo ::= SEQUENCE {

cellIdentification SEQUENCE {

physCellId PhysCellId,

dl-CarrierFreq ARFCN-ValueNR

},

measResultCell MeasQuantityResults OPTIONAL,

candidateRS-IndexListSSB CandidateRS-IndexInfoListSSB OPTIONAL,

candidateRS-IndexListCSI-RS CandidateRS-IndexInfoListCSI-RS OPTIONAL,

...

}

CandidateRS-IndexInfoListSSB ::= SEQUENCE (SIZE (1..maxNrofIndexesToReport)) OF CandidateRS-IndexInfoSSB

CandidateRS-IndexInfoSSB ::= SEQUENCE {

ssb-Index SSB-Index,

measResultSSB MeasQuantityResults OPTIONAL,

...

}

CandidateRS-IndexInfoListCSI-RS ::= SEQUENCE (SIZE (1..maxNrofIndexesToReport)) OF CandidateRS-IndexInfoCSI-RS

CandidateRS-IndexInfoCSI-RS ::= SEQUENCE {

csi-RS-Index CSI-RS-Index,

measResultCSI-RS MeasQuantityResults OPTIONAL,

...

}

-- TAG-CANDIDATE-CELL-INFO-LIST-STOP

-- ASN1STOP

## 11.4 Inter-node RRC multiplicity and type constraint values

#### – Multiplicity and type constraints definitions

-- ASN1START

-- TAG\_NR-MULTIPLICITY-AND-CONSTRAINTS-START

maxMeasFreqsMN INTEGER ::= 32 -- Maximum number of MN-configured measurement frequencies

maxCellPrep INTEGER ::= 32 -- Maximum number of cells prepared for handover

-- TAG\_NR-MULTIPLICITY-AND-CONSTRAINTS-STOP

-- ASN1STOP

#### – *End of NR-InterNodeDefinitions*

-- ASN1START

-- TAG\_NR-INTER-NODE-DEFINITIONS-END-START

END

-- TAG\_NR-INTER-NODE-DEFINITIONS-END-STOP

-- ASN1STOP

# 12 Processing delay requirements for RRC procedures

The UE performance requirements for RRC procedures are specified in the following tables. The performance requirement is expressed as the time in [ms] from the end of reception of the network -> UE message on the UE physical layer up to when the UE shall be ready for the reception of uplink grant for the UE -> network response message with no access delay other than the TTI-alignment (e.g. excluding delays caused by scheduling, the random access procedure or physical layer synchronisation).



Figure 11.2-1: Illustration of RRC procedure delay

Table 11.2-1: UE performance requirements for RRC procedures for UEs

| Procedure title: | Network -> UE | UE -> Network | Value [ms] | Notes |
| --- | --- | --- | --- | --- |
| **RRC Connection Control Procedures** | | | | |
| RRC reconfiguration | *RRCReconfiguration* | *RRCReconfigurationComplete* | X |  |

Annex A (informative): Guidelines, mainly on use of ASN.1

# A.1 Introduction

The following clauses contain guidelines for the specification of RRC protocol data units (PDUs) with ASN.1.

# A.2 Procedural specification

## A.2.1 General principles

The procedural specification provides an overall high level description regarding the UE behaviour in a particular scenario.

It should be noted that most of the UE behaviour associated with the reception of a particular field is covered by the applicable parts of the PDU specification. The procedural specification may also include specific details of the UE behaviour upon reception of a field, but typically this should be done only for cases that are not easy to capture in the PDU section e.g. general actions, more complicated actions depending on the value of multiple fields.

Likewise, the procedural specification need not specify the UE requirements regarding the setting of fields within the messages that are sent to the network i.e. this may also be covered by the PDU specification.

## A.2.2 More detailed aspects

The following more detailed conventions should be used:

- Bullets:

- Capitals should be used in the same manner as in other parts of the procedural text i.e. in most cases no capital applies since the bullets are part of the sentence starting with 'The UE shall:'

- All bullets, including the last one in a sub-clause, should end with a semi-colon i.e. an ';.

- Conditions:

- Whenever multiple conditions apply, a semi-colon should be used at the end of each conditions with the exception of the last one, i.e. as in 'if cond1, or cond2.

# A.3 PDU specification

## A.3.1 General principles

### A.3.1.1 ASN.1 sections

The RRC PDU contents are formally and completely described using abstract syntax notation (ASN.1), see X.680 [13], X.681 (02/2002) [14].

The complete ASN.1 code is divided into a number of ASN.1 sections in the specifications. In order to facilitate the extraction of the complete ASN.1 code from the specification, each ASN.1 section begins with the following:

- a first text paragraph consisting entirely of an *ASN.1 start tag*, which consists of a double hyphen followed by a single space and the text string "ASN1START" (in all upper case letters);

- a second text paragraph consisting entirely of a *block start tag* is included, which consists of a double hyphen followed by a single space and the text string "TAG-NAME-START" (in all upper case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters).

Similarly, each ASN.1 section ends with the following:

- a first text paragraph consisting entirely of a *block* *stop tag*, which consists of a double hyphen followed by a single space and the text string "TAG-NAME-STOP" (in all upper-case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters);

- a second text paragraph consisting entirely of an *ASN.1 stop tag*, which consists of a double hyphen followed by a singlespace and the text "ASN1STOP" (in all upper case letters).

This results in the following tags:

-- ASN1START

-- TAG-NAME-START

-- TAG-NAME-STOP

-- ASN1STOP

The text paragraphs containing either of thestart and stop tags should not contain any ASN.1 code significant for the complete description of the RRC PDU contents. The complete ASN.1 code may be extracted by copying all the text paragraphs between an ASN.1 start tag and the following ASN.1 stop tag in the order they appear, throughout the specification.

NOTE: A typical procedure for extraction of the complete ASN.1 code consists of a first step where the entire RRC PDU contents description (ultimately the entire specification) is saved into a plain text (ASCII) file format, followed by a second step where the actual extraction takes place, based on the occurrence of the ASN.1 start and stop tags.

### A.3.1.2 ASN.1 identifier naming conventions

The naming of identifiers (i.e., the ASN.1 field and type identifiers) should be based on the following guidelines:

- Message (PDU) identifiers should be ordinary mixed case without hyphenation. These identifiers, *e.g.*, the *RRCConnectionModificationCommand*, should be used for reference in the procedure text. Abbreviations should be avoided in these identifiers and abbreviated forms of these identifiers should not be used.

- Type identifiers other than PDU identifiers should be ordinary mixed case, with hyphenation used to set off acronyms only where an adjacent letter is a capital, *e.g.*, *EstablishmentCause, SelectedPLMN* (not *Selected-PLMN*, since the "d" in "Selected" is lowercase)*, InitialUE-Identity* and *MeasSFN-SFN-TimeDifference*.

- Field identifiers shall start with a lowercase letter and use mixed case thereafter, *e.g.*, *establishmentCause*. If a field identifier begins with an acronym (which would normally be in upper case), the entire acronym is lowercase (*plmn-Identity*, not *pLMN-Identity*). The acronym is set off with a hyphen (*ue-Identity*, not *ueIdentity*), in order to facilitate a consistent search pattern with corresponding type identifiers.

- Identifiers should convey the meaning of the identifier and should avoid adding unnecessary postfixes (e.g. abstractions like 'Info') for the name.

- Identifiers that are likely to be keywords of some language, especially widely used languages, such as C++ or Java, should be avoided to the extent possible.

- Identifiers, other than PDU identifiers, longer than 25 characters should be avoided where possible. It is recommended to use abbreviations, which should be done in a consistent manner i.e. use 'Meas' instead of 'Measurement' for all occurrences. Examples of typical abbreviations are given in table A.3.1.2.1-1 below.

- *For future extension:* When an extension is introduced a suffix is added to the identifier of the concerned ASN.1 field and/or type. A suffix of the form "‑rX" is used, with X indicating the release, for ASN.1 fields or types introduced in a later release (i.e. a release later than the original/first release of the protocol) as well as for ASN.1 fields or types for which a revision is introduced in a later release replacing a previous version, *e.g.*, *Foo-r9* for the Rel-9 version of the ASN.1 type *Foo*. A suffix of the form "‑rXb" is used for the first revision of a field that it appears in the same release (X) as the original version of the field, "‑rXc" for a second intra-release revision and so on. A suffix of the form "‑vXYZ" is used for ASN.1 fields or types that only are an extension of a corresponding earlier field or type (see sub-clause A.4), e.g., *AnElement-v10b0* for the extension of the ASN.1 type *AnElement* introduced in version 10.11.0 of the specification. A number *0...9, 10, 11, etc.* is used to represent the first part of the version number, indicating the release of the protocol. Lower case letters *a, b, c, etc.* are used to represent the second (and third) part of the version number if they are greater than 9. In the procedural specification, in field descriptions as well as in headings suffices are not used, unless there is a clear need to distinguish the extension from the original field.

- More generally, in case there is a need to distinguish different variants of an ASN.1 field or IE, a suffix should be added at the end of the identifiers e.g. *MeasObjectUTRA*, *ConfigCommon*. When there is no particular need to distinguish the fields (e.g. because the field is included in different IEs), a common field identifier name may be used. This may be attractive e.g. in case the procedural specification is the same for the different variants.

- It should be avoided to use field identifiers with the same name within the elements of a CHOICE, including using a CHOICE inside a SEQUENCE (to avoid certain compiler errors).

Table A.3.1.2-1: Examples of typical abbreviations used in ASN.1 identifiers

| Abbreviation | Abbreviated word |
| --- | --- |
| Config | Configuration |
| DL | Downlink |
| Ext | Extension |
| Freq | Frequency |
| Id | Identity |
| Ind | Indication |
| Meas | Measurement |
| MIB | MasterInformationBlock |
| Neigh | Neighbour(ing) |
| Param(s) | Parameter(s) |
| Phys | Physical |
| PCI | Physical Cell Id |
| Proc | Process |
| Reconfig | Reconfiguration |
| Reest | Re-establishment |
| Req | Request |
| Rx | Reception |
| Sched | Scheduling |
| SIB | SystemInformationBlock |
| Sync | Synchronisation |
| Thr | Threshold |
| Tx | Transmission |
| UL | Uplink |

NOTE: The table A.3.1.2.1-1 is not exhaustive. Additional abbreviations may be used in ASN.1 identifiers when needed.

### A.3.1.3 Text references using ASN.1 identifiers

A text reference into the RRC PDU contents description from other parts of the specification is made using the ASN.1 field identifier of the referenced type. The ASN.1 field and type identifiers used in text references should be in the *italic font style*. The "do not check spelling and grammar" attribute in Word should be set. Quotation marks (i.e., " ") should not be used around the ASN.1 field or type identifier.

A reference to an RRC PDU should be made using the corresponding ASN.1 field identifier followed by the word "message", e.g., a reference to the *RRCRelease* message.

A reference to a specific part of an RRC PDU, or to a specific part of any other ASN.1 type, should be made using the corresponding ASN.1 field identifier followed by the word "field", e.g., a reference to the *prioritisedBitRate* field in the example below.

-- /example/ ASN1START

LogicalChannelConfig ::= SEQUENCE {

ul-SpecificParameters SEQUENCE {

priority Priority,

prioritisedBitRate PrioritisedBitRate,

bucketSizeDuration BucketSizeDuration,

logicalChannelGroup INTEGER (0..3)

} OPTIONAL

}

-- ASN1STOP

NOTE: All the ASN.1 start tags in the ASN.1 sections, used as examples in this annex to the specification, are deliberately distorted, in order not to include them when the ASN.1 description of the RRC PDU contents is extracted from the specification.

A reference to a specific type of information element should be made using the corresponding ASN.1 type identifier preceded by the acronym "IE", e.g., a reference to the IE *LogicalChannelConfig* in the example above.

References to a specific type of information element should only be used when those are generic, i.e., without regard to the particular context wherein the specific type of information element is used. If the reference is related to a particular context, e.g., an RRC PDU type (message) wherein the information element is used, the corresponding field identifier in that context should be used in the text reference.

A reference to a specific value of an ASN.1 field should be made using the corresponding ASN.1 value without using quotation marks around the ASN.1 value, e.g., 'if the *status* field is set to value *true*'.

## A.3.2 High-level message structure

Within each logical channel type, the associated RRC PDU (message) types are alternatives within a CHOICE, as shown in the example below.

-- /example/ ASN1START

DL-DCCH-Message ::= SEQUENCE {

message DL-DCCH-MessageType

}

DL-DCCH-MessageType ::= CHOICE {

c1 CHOICE {

dlInformationTransfer DLInformationTransfer,

handoverFromEUTRAPreparationRequest HandoverFromEUTRAPreparationRequest,

mobilityFromEUTRACommand MobilityFromEUTRACommand,

rrcConnectionReconfiguration RRCConnectionReconfiguration,

rrcConnectionRelease RRCConnectionRelease,

securityModeCommand SecurityModeCommand,

ueCapabilityEnquiry UECapabilityEnquiry,

spare1 NULL

},

messageClassExtension SEQUENCE {}

}

-- ASN1STOP

A nested two-level CHOICE structure is used, where the alternative PDU types are alternatives within the inner level *c1* CHOICE.

Spare alternatives (i.e., *spare1* in this case) may be included within the *c1* CHOICE to facilitate future extension. The number of such spare alternatives should not extend the total number of alternatives beyond an integer-power-of-two number of alternatives (i.e., eight in this case).

Further extension of the number of alternative PDU types is facilitated using the *messageClassExtension* alternative in the outer level CHOICE.

## A.3.3 Message definition

Each PDU (message) type is specified in an ASN.1 section similar to the one shown in the example below.

-- /example/ ASN1START

RRCConnectionReconfiguration ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

c1 CHOICE{

rrcConnectionReconfiguration-r8 RRCConnectionReconfiguration-r8-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

RRCConnectionReconfiguration-r8-IEs ::= SEQUENCE {

-- Enter the IEs here.

...

}

-- ASN1STOP

Hooks for *critical* and *non-critical* extension should normally be included in the PDU type specification. How these hooks are used is further described in sub-clause A.4.

Critical extensions are characterised by a redefinition of the PDU contents and need to be governed by a mechanism for protocol version agreement between the encoder and the decoder of the PDU, such that the encoder is prevented from sending a critically extended version of the PDU type, which is not comprehended by the decoder.

Critical extension of a PDU type is facilitated by a two-level CHOICE structure, where the alternative PDU contents are alternatives within the inner level *c1* CHOICE. Spare alternatives (i.e., *spare3* down to *spare1* in this case) may be included within the *c1* CHOICE. The number of spare alternatives to be included in the original PDU specification should be decided case by case, based on the expected rate of critical extension in the future releases of the protocol.

Further critical extension, when the spare alternatives from the original specifications are used up, is facilitated using the *criticalExtensionsFuture* in the outer level CHOICE.

In PDU types where critical extension is not expected in the future releases of the protocol, the inner level *c1* CHOICE and the spare alternatives may be excluded, as shown in the example below.

-- /example/ ASN1START

RRCConnectionReconfigurationComplete ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

rrcConnectionReconfigurationComplete-r8

RRCConnectionReconfigurationComplete-r8-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

RRCConnectionReconfigurationComplete-r8-IEs ::= SEQUENCE {

-- Enter the fields here.

...

}

-- ASN1STOP

Non-critical extensions are characterised by the addition of new information to the original specification of the PDU type. If not comprehended, a non-critical extension may be skipped by the decoder, whilst the decoder is still able to complete the decoding of the comprehended parts of the PDU contents.

Non-critical extensions at locations other than the end of the message or other than at the end of a field contained in a BIT or OCTET STRING are facilitated by use of the ASN.1 extension marker "...". The original specification of a PDU type should normally include the extension marker at the end of the sequence of information elements contained.

Non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING may be facilitated by use of an empty sequence that is marked OPTIONAL e.g. as shown in the following example:

-- /example/ ASN1START

RRCMessage-r8-IEs ::= SEQUENCE {

field1 InformationElement1,

field2 InformationElement2,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- ASN1STOP

The ASN.1 section specifying the contents of a PDU type may be followed by a *field description* table where a further description of, e.g., the semantic properties of the fields may be included. The general format of this table is shown in the example below. The field description table is absent in case there are no fields for which further description needs to be provided e.g. because the PDU does not include any fields, or because an IE is defined for each field while there is nothing specific regarding the use of this IE that needs to be specified.

| *%PDU-TypeIdentifier%* field descriptions |
| --- |
| ***%field identifier%***  Field description. |
| ***%field identifier%***  Field description. |

The field description table has one column. The header row shall contain the ASN.1 type identifier of the PDU type.

The following rows are used to provide field descriptions. Each row shall include a first paragraph with a *field identifier* (in ***bold and italic*** font style) referring to the part of the PDU to which it applies. The following paragraphs at the same row may include (in regular font style), e.g., semantic description, references to other specifications and/or specification of value units, which are relevant for the particular part of the PDU.

The parts of the PDU contents that do not require a field description shall be omitted from the field description table.

## A.3.4 Information elements

Each IE (information element) type is specified in an ASN.1 section similar to the one shown in the example below.

-- /example/ ASN1START

PRACH-ConfigSIB ::= SEQUENCE {

rootSequenceIndex INTEGER (0..1023),

prach-ConfigInfo PRACH-ConfigInfo

}

PRACH-Config ::= SEQUENCE {

rootSequenceIndex INTEGER (0..1023),

prach-ConfigInfo PRACH-ConfigInfo OPTIONAL -- Need N

}

PRACH-ConfigInfo ::= SEQUENCE {

prach-ConfigIndex ENUMERATED {ffs},

highSpeedFlag ENUMERATED {ffs},

zeroCorrelationZoneConfig ENUMERATED {ffs}

}

-- ASN1STOP

IEs should be introduced whenever there are multiple fields for which the same set of values apply. IEs may also be defined for other reasons e.g. to break down a ASN.1 definition in to smaller pieces.

A group of closely related IE type definitions, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in this example, are preferably placed together in a common ASN.1 section. The IE type identifiers should in this case have a common base, defined as the *generic type identifier*. It may be complemented by a suffix to distinguish the different variants. The "*PRACH-Config*" is the generic type identifier in this example, and the "*SIB*" suffix is added to distinguish the variant. The sub-clause heading and generic references to a group of closely related IEs defined in this way should use the generic type identifier.

The same principle should apply if a new version, or an extension version, of an existing IE is created for *critical* or *non-critical* extension of the protocol (see sub-clause A.4). The new version, or the extension version, of the IE is included in the same ASN.1 section defining the original. A suffix is added to the type identifier, using the naming conventions defined in sub-clause A.3.1.2, indicating the release or version of the where the new version, or extension version, was introduced.

Local IE type definitions, like the IE *PRACH-ConfigInfo* in the example above, may be included in the ASN.1 section and be referenced in the other IE types defined in the same ASN.1 section. The use of locally defined IE types should be encouraged, as a tool to break up large and complex IE type definitions. It can improve the readability of the code. There may also be a benefit for the software implementation of the protocol end-points, as these IE types are typically provided by the ASN.1 compiler as independent data elements, to be used in the software implementation.

An IE type defined in a local context, like the IE *PRACH-ConfigInfo*, should not be referenced directly from other ASN.1 sections in the RRC specification. An IE type which is referenced in more than one ASN.1 section should be defined in a separate sub-clause, with a separate heading and a separate ASN.1 section (possibly as one in a set of closely related IE types, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in the example above). Such IE types are also referred to as 'global IEs'.

NOTE: Referring to an IE type, that is defined as a local IE type in the context of another ASN.1 section, does not generate an ASN.1 compilation error. Nevertheless, using a locally defined IE type in that way makes the IE type definition difficult to find, as it would not be visible at an outline level of the specification. It should be avoided.

The ASN.1 section specifying the contents of one or more IE types, like in the example above, may be followed by a *field description* table, where a further description of, e.g., the semantic properties of the fields of the information elements may be included. This table may be absent, similar as indicated in sub-clause A.3.3 for the specification of the PDU type. The general format of the *field description* table is the same as shown in sub-clause A.3.3 for the specification of the PDU type.

## A.3.5 Fields with optional presence

A field with optional presence may be declared with the keyword DEFAULT. It identifies a default value to be assumed, if the sender does not include a value for that field in the encoding:

-- /example/ ASN1START

PreambleInfo ::= SEQUENCE {

numberOfRA-Preambles INTEGER (1..64) DEFAULT 1,

...

}

-- ASN1STOP

Alternatively, a field with optional presence may be declared with the keyword OPTIONAL. It identifies a field for which a value can be omitted. The omission carries semantics, which is different from any normal value of the field:

-- /example/ ASN1START

PRACH-Config ::= SEQUENCE {

rootSequenceIndex INTEGER (0..1023),

prach-ConfigInfo PRACH-ConfigInfo OPTIONAL -- Need N

}

-- ASN1STOP

The semantics of an optionally present field, in the case it is omitted, should be indicated at the end of the paragraph including the keyword OPTIONAL, using a short comment text with a need code. The need code includes the keyword "Need", followed by one of the predefined semantics tags (S, M, N or R) defined in sub-clause 6.1. If the semantics tag S is used, the semantics of the absent field are further specified either in the field description table following the ASN.1 section, or in procedure text.

The addition of OPTIONAL keywords for capability groups is based on the following guideline. If there is more than one field in the lower level IE, then OPTIONAL keyword is added at the group level. If there is only one field in the lower level IE, OPTIONAL keyword is not added at the group level.

## A.3.6 Fields with conditional presence

A field with conditional presence is declared with the keyword OPTIONAL. In addition, a short comment text shall be included at the end of the paragraph including the keyword OPTIONAL. The comment text includes the keyword "Cond", followed by a condition tag associated with the field ("UL" in this example):

-- /example/ ASN1START

LogicalChannelConfig ::= SEQUENCE {

ul-SpecificParameters SEQUENCE {

priority INTEGER (0),

...

} OPTIONAL -- Cond UL

}

-- ASN1STOP

When conditionally present fields are included in an ASN.1 section, the field description table after the ASN.1 section shall be followed by a *conditional presence* table. The conditional presence table specifies the conditions for including the fields with conditional presence in the particular ASN.1 section.

| Conditional presence | Explanation |
| --- | --- |
| UL | Specification of the conditions for including the field associated with the condition tag = "UL". Semantics in case of optional presence under certain conditions may also be specified. |

The conditional presence table has two columns. The first column (heading: "Conditional presence") contains the condition tag (in *italic* font style), which links the fields with a condition tag in the ASN.1 section to an entry in the table. The second column (heading: "Explanation") contains a text specification of the conditions and requirements for the presence of the field. The second column may also include semantics, in case of an optional presence of the field, under certain conditions i.e. using the same predefined tags as defined for optional fields in A.3.5.

Conditional presence should primarily be used when presence of a field depends on the presence and/or value of other fields within the same message. If the presence of a field depends on whether another feature/function has been configured, while this function can be configured independently e.g. by another message and/or at another point in time, the relation is best reflected by means of a statement in the field description table.

If the ASN.1 section does not include any fields with conditional presence, the conditional presence table shall not be included.

Whenever a field is only applicable in specific cases e.g. TDD, use of conditional presence should be considered.

## A.3.7 Guidelines on use of lists with elements of SEQUENCE type

Where an information element has the form of a list (the SEQUENCE OF construct in ASN.1) with the type of the list elements being a SEQUENCE data type, an information element shall be defined for the list elements even if it would not otherwise be needed.

For example, a list of PLMN identities with reservation flags is defined as in the following example:

-- /example/ ASN1START

PLMN-IdentityInfoList ::= SEQUENCE (SIZE (1..6)) OF PLMN-IdentityInfo

PLMN-IdentityInfo ::= SEQUENCE {

plmn-Identity PLMN-Identity,

cellReservedForOperatorUse ENUMERATED {reserved, notReserved}

}

-- ASN1STOP

rather than as in the following (bad) example, which may cause generated code to contain types with unpredictable names:

-- /bad example/ ASN1START

PLMN-IdentityList ::= SEQUENCE (SIZE (1..6)) OF SEQUENCE {

plmn-Identity PLMN-Identity,

cellReservedForOperatorUse ENUMERATED {reserved, notReserved}

}

-- ASN1STOP

## A.3.8 Guidelines on use of parameterised SetupRelease type

The usage of the parameterised *SetupRelease* type is like a function call in programming languages where the element type parameter is passed as a parameter. The parameterised type only implies a textual change in abstract syntax where all references to the parameterised type are replaced by the compiler with the release/setup choice. Two examples of the usage are shown below:

-- /example/ ASN1START

RRCMessage-r15-IEs ::= SEQUENCE {

field-r15 SetupRelease { IE-r15 } OPTIONAL, -- Need M

...

}

RRCMessage-r15-IEs ::= SEQUENCE {

field-r15 SetupRelease { Element-r15 }

} OPTIONAL, -- Need M

Element-r15 ::= SEQUENCE {

field1-r15 IE1-r15,

field2-r15 IE2-r15 OPTIONAL -- Need N

} OPTIONAL, -- Need M

-- /example/ ASN1STOP

The *SetupRelease* is always be used with only named IEs, i.e. the example below is not allowed:

-- /example/ ASN1START

RRCMessage-r15-IEs ::= SEQUENCE {

field-r15 SetupRelease { SEQUENCE { -- Unnamed SEQUENCEs are not allowed!

field1-r15 IE1-r15,

field2-r15 IE2-r15 OPTIONAL -- Need N

}

} OPTIONAL, -- Need M

}

-- /example/ ASN1STOP

If a field defined using the parameterized SetupRelease type requires procedural text, the field is referred to using the values defined for the type itself, namely, "setup" and "release". For example, procedural text for field-r15 above could be as follows:

1> if *field-r15* is set to "setup":

2> do something;

1> else (*field-r15* is set to "release"):

2> release *field-r15* (if appropriate).

## A.3.9 Guidelines on use of ToAddModList and ToReleaseList

In order to benefit from delta signalling when modifying lists with many and/or large elements, so-called add/mod- and release- lists should be used. Instead of a single list containing all elements of the list, the ASN.1 provides two lists. One list is used to convey the actual elements that are to be added to the list or modified in the list. The second list conveys only the identities (IDs) of the list elements that are to be released from the list. In other words, the ASN.1 defines only means to signal modifications to a list maintained in the receiver (typically the UE). An example is provided below:

-- /example/ ASN1START

AnExampleIE ::= SEQUENCE {

elementsToAddModList SEQUENCE (SIZE (1..maxNrofElements)) OF Element OPTIONAL, -- Need N

elementsToReleaseList SEQUENCE (SIZE (1..maxNrofElements)) OF ElementId OPTIONAL, -- Need N

...

}

Element ::= SEQUENCE {

elementId ElementId,

aField INTEGER (0..16777215),

anotherField OCTET STRING,

...

}

ElementId ::= INTEGER (0..maxNrofElements-1)

maxNrofElements INTEGER ::= 50

maxNrofElements-1 INTEGER ::= 49

-- /example/ ASN1STOP

As can be seen, the elements of the list must contain an identity (INTEGER) that identifies the elements unambiguously upon addition, modification and removal. It is recommended to define an IE for that identifier (here ElementId) so that it can be used both for a field inside the element as well as in the *elementsToReleaseList*.

Both lists should be made OPTIONAL and flagged as ”Need N”. The need code reflects that the UE does not maintain the received lists as such but rather updates its configuration using the information therein. In other words, it is not possible to provide via delta signalling an update to a previously signalled *elementsToAddModList* or elementsToReleaseList (which Need M would imply). The update is always in relation to the UE's internal configuration.

If no procedural text is provided for a set of ToAddModList and ToReleaseList, the following generic procedure applies:

The UE shall:

1> for each *ElementId* in the *elementsToReleaseList*,:

2> if the current UE configuration includes an *Element* with the given *ElementId*:

3> release the *Element* from the current UE configuration;

1> for each *Element* in the *elementsToAddModList*:

2> if the current UE configuration includes an *Element* with the given *ElementId*:

3> modify the configured *Element* in accordance with the received *Element*;

2> else:

3> add received *Element* to the UE configuration.

# A.4 Extension of the PDU specifications

## A.4.1 General principles to ensure compatibility

It is essential that extension of the protocol does not affect interoperability i.e. it is essential that implementations based on different versions of the RRC protocol are able to interoperate. In particular, this requirement applies for the following kind of protocol extensions:

- Introduction of new PDU types (i.e. these should not cause unexpected behaviour or damage).

- Introduction of additional fields in an extensible PDUs (i.e. it should be possible to ignore uncomprehended extensions without affecting the handling of the other parts of the message).

- Introduction of additional values of an extensible field of PDUs. If used, the behaviour upon reception of an uncomprehended value should be defined.

It should be noted that the PDU extension mechanism may depend on the logical channel used to transfer the message e.g. for some PDUs an implementation may be aware of the protocol version of the peer in which case selective ignoring of extensions may not be required.

The non-critical extension mechanism is the primary mechanism for introducing protocol extensions i.e. the critical extension mechanism is used merely when there is a need to introduce a 'clean' message version. Such a need appears when the last message version includes a large number of non-critical extensions, which results in issues like readability, overhead associated with the extension markers. The critical extension mechanism may also be considered when it is complicated to accommodate the extensions by means of non-critical extension mechanisms.

## A.4.2 Critical extension of messages and fields

The mechanisms to critically extend a message are defined in A.3.3. There are both "outer branch" and "inner branch" mechanisms available. The "outer branch" consists of a CHOICE having the name *criticalExtensions*, with two values, *c1* and *criticalExtensionsFuture*. The *criticalExtensionsFuture* branch consists of an empty SEQUENCE, while the c1 branch contains the "inner branch" mechanism.

The "inner branch" structure is a CHOICE with values of the form "*MessageName-rX-IEs*" (e.g., "*RRCConnectionReconfiguration-r8-IEs*") or "*spareX*", with the spare values having type NULL. The "-rX-IEs" structures contain the *complete* structure of the message IEs for the appropriate release; i.e., the critical extension branch for the Rel-10 version of a message includes all Rel-8 and Rel-9 fields (that are not obviated in the later version), rather than containing only the additional Rel-10 fields.

The following guidelines may be used when deciding which mechanism to introduce for a particular message, i.e. only an 'outer branch', or an 'outer branch' in combination with an 'inner branch' including a certain number of spares:

- For certain messages, e.g. initial uplink messages, messages transmitted on a broadcast channel, critical extension may not be applicable.

- An outer branch may be sufficient for messages not including any fields.

- The number of spares within inner branch should reflect the likelihood that the message will be critically extended in future releases (since each release with a critical extension for the message consumes one of the spare values). The estimation of the critical extension likelyhood may be based on the number, size and changeability of the fields included in the message.

- In messages where an inner branch extension mechanism is available, all spare values of the inner branch should be used before any critical extensions are added using the outer branch.

The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release

-- /example/ ASN1START -- Original release

RRCMessage ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

c1 CHOICE{

rrcMessage-r8 RRCMessage-r8-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

-- ASN1STOP

-- /example/ ASN1START -- Later release

RRCMessage ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

c1 CHOICE{

rrcMessage-r8 RRCMessage-r8-IEs,

rrcMessage-r10 RRCMessage-r10-IEs,

rrcMessage-r11 RRCMessage-r11-IEs,

rrcMessage-r14 RRCMessage-r14-IEs

},

later CHOICE {

c2 CHOICE{

rrcMessage-r16 RRCMessage-r16-IEs,

spare7 NULL, spare6 NULL, spare5 NULL, spare4 NULL,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

}

-- ASN1STOP

It is important to note that critical extensions may also be used at the level of individual fields i.e. a field may be replaced by a critically extended version. When sending the extended version, the original version may also be included (e.g. original field is mandatory, EUTRAN is unaware if UE supports the extended version). In such cases, a UE supporting both versions may be required to ignore the original field. The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release.

-- /example/ ASN1START -- Original release

RRCMessage ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

c1 CHOICE{

rrcMessage-r8 RRCMessage-r8-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

RRCMessage-rN-IEs ::= SEQUENCE {

field1-rN ENUMERATED {

value1, value2, value3, value4} OPTIONAL, -- Need N

field2-rN InformationElement2-rN OPTIONAL, -- Need N

nonCriticalExtension RRCConnectionReconfiguration-vMxy-IEs OPTIONAL

}

RRCConnectionReconfiguration-vMxy-IEs ::= SEQUENCE {

field2-rM InformationElement2-rM OPTIONAL, -- Cond NoField2rN

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NoField2rN* | The field is optionally present, need N, if field2-rN is absent. Otherwise the field is not present |

Finally, it is noted that a critical extension may be introduced in the same release as the one in which the original field was introduced e.g. to correct an essential ASN.1 error. In such cases a UE capability may be introduced, to assist the network in deciding whether or not to use the critically extension.

## A.4.3 Non-critical extension of messages

### A.4.3.1 General principles

The mechanisms to extend a message in a non-critical manner are defined in A.3.3. W.r.t. the use of extension markers, the following additional guidelines apply:

- When further non-critical extensions are added to a message that has been critically extended, the inclusion of these non-critical extensions in earlier critical branches of the message should be avoided when possible.

- The extension marker ("...") is the primary non-critical extension mechanism that is used but empty sequences may be used if length determinant is not required. Examples of cases where a length determinant is not required:

- at the end of a message;

- at the end of a structure contained in a BIT STRING or OCTET STRING.

- When an extension marker is available, non-critical extensions are preferably placed at the location (e.g. the IE) where the concerned parameter belongs from a logical/ functional perspective (referred to as the '*default extension location*').

- It is desirable to aggregate extensions of the same release or version of the specification into a group, which should be placed at the lowest possible level.

- In specific cases it may be preferrable to place extensions elsewhere (referred to as the '*actual extension location*') e.g. when it is possible to aggregate several extensions in a group. In such a case, the group should be placed at the lowest suitable level in the message. <TBD: ref to seperate example>

- In case placement at the default extension location affects earlier critical branches of the message, locating the extension at a following higher level in the message should be considered.

- In case an extension is not placed at the defaultextension location, an IE should be defined. The IE's ASN.1 definition should be placed in the same ASN.1 section as the default extension location. In case there are intermediate levels in-between the actual and the defaultextension location, an IE may be defined for each level. Intermediate levels are primarily introduced for readability and overview. Hence intermediate levels need not allways be introduced e.g. they may not be needed when the default and the actual extension location are within the same ASN.1 section. <TBD: ref to seperate example>

### A.4.3.2 Further guidelines

Further to the general principles defined in the previous section, the following additional guidelines apply regarding the use of extension markers:

- Extension markers within SEQUENCE:

- Extension markers are primarily, but not exclusively, introduced at the higher nesting levels.

- Extension markers are introduced for a SEQUENCE comprising several fields as well as for information elements whose extension would result in complex structures without it (e.g. re-introducing another list).

- Extension markers are introduced to make it possible to maintain important information structures e.g. parameters relevant for one particular RAT.

- Extension markers are also used for size critical messages (i.e. messages on BCCH, BR-BCCH, PCCH and CCCH), although introduced somewhat more carefully.

- The extension fields introduced (or frozen) in a specific version of the specification are grouped together using double brackets.

- Extension markers within ENUMERATED:

- Spare values may be used until the number of values reaches the next power of 2, while the extension marker caters for extension beyond that limit, given that the use of spare values in a later Release is possible without any error cases.

- A suffix of the form "vXYZ" is used for the identifier of each new value, e.g. "value-vXYZ".

- Extension markers within CHOICE:

- Extension markers are introduced when extension is foreseen and when comprehension is not required by the receiver i.e. behaviour is defined for the case where the receiver cannot comprehend the extended value (e.g. ignoring an optional CHOICE field). It should be noted that defining the behaviour of a receiver upon receiving a not comprehended choice value is not required if the sender is aware whether or not the receiver supports the extended value.

- A suffix of the form "vXYZ" is used for the identifier of each new choice value, e.g. "choice-vXYZ".

Non-critical extensions at the end of a message/ of a field contained in an OCTET or BIT STRING:

- When a nonCriticalExtension is actually used, a "Need" code should not be provided for the field, which always is a group including at least one extension and a field facilitating further possible extensions. For simplicity, it is recommended not to provide a "Need" code when the field is not actually used either.

Further, more general, guidelines:

- In case a need code is not provided for a group, a "Need" code is provided for all individual extension fields within the group i.e. including for fields that are not marked as OPTIONAL. The latter is to clarify the action upon absence of the whole group.

### A.4.3.3 Typical example of evolution of IE with local extensions

The following example illustrates the use of the extension marker for a number of elementary cases (sequence, enumerated, choice). The example also illustrates how the IE may be revised in case the critical extension mechanism is used.

NOTE In case there is a need to support further extensions of release n while the ASN.1 of release (n+1) has been frozen, without requiring the release n receiver to support decoding of release (n+1) extensions, more advanced mechanisms are needed e.g. including multiple extension markers.

-- /example/ ASN1START

InformationElement1 ::= SEQUENCE {

field1 ENUMERATED {

value1, value2, value3, value4-v880,

..., value5-v960 },

field2 CHOICE {

field2a BOOLEAN,

field2b InformationElement2b,

...,

field2c-v960 InformationElement2c-r9

},

...,

[[ field3-r9 InformationElement3-r9 OPTIONAL -- Need R

]],

[[ field3-v9a0 InformationElement3-v9a0 OPTIONAL, -- Need R

field4-r9 InformationElement4 OPTIONAL -- Need R

]]

}

InformationElement1-r10 ::= SEQUENCE {

field1 ENUMERATED {

value1, value2, value3, value4-v880,

value5-v960, value6-v1170, spare2, spare1, ... },

field2 CHOICE {

field2a BOOLEAN,

field2b InformationElement2b,

field2c-v960 InformationElement2c-r9,

...,

field2d-v12b0 INTEGER (0..63)

},

field3-r9 InformationElement3-r10 OPTIONAL, -- Need R

field4-r9 InformationElement4 OPTIONAL, -- Need R

field5-r10 BOOLEAN,

field6-r10 InformationElement6-r10 OPTIONAL, -- Need R

...,

[[ field3-v1170 InformationElement3-v1170 OPTIONAL -- Need R

]]

}

-- ASN1STOP

Some remarks regarding the extensions of *InformationElement1* as shown in the above example:

– The *InformationElement1* is initially extended with a number of non-critical extensions. In release 10 however, a critical extension is introduced for the message using this IE. Consequently, a new version of the IE *InformationElement1* (i.e. *InformationElement1-r10*) is defined in which the earlier non-critical extensions are incorporated by means of a revision of the original field.

– The *value4-v880* is replacing a spare value defined in the original protocol version for *field1*. Likewise *value6-v1170* replaces *spare3* that was originally defined in the r10 version of *field1.*

– Within the critically extended release 10 version of *InformationElement1*, the names of the original fields/IEs are not changed, unless there is a real need to distinguish them from other fields/IEs. E.g. the *field1* and *InformationElement4* were defined in the original protocol version (release 8) and hence not tagged. Moreover, the *field3-r9* is introduced in release 9 and not re-tagged; although, the *InformationElement3* is also critically extended and therefore tagged *InformationElement3-r10* in the release 10 version of InformationElement1.

### A.4.3.4 Typical examples of non critical extension at the end of a message

The following example illustrates the use of non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING i.e. when an empty sequence is used.

-- /example/ ASN1START

RRCMessage-r8-IEs ::= SEQUENCE {

field1 InformationElement1,

field2 InformationElement2,

field3 InformationElement3 OPTIONAL, -- Need N

nonCriticalExtension RRCMessage-v860-IEs OPTIONAL

}

RRCMessage-v860-IEs ::= SEQUENCE {

field4-v860 InformationElement4 OPTIONAL, -- Need S

field5-v860 BOOLEAN OPTIONAL, -- Cond C54

nonCriticalExtension RRCMessage-v940-IEs OPTIONAL

}

RRCMessage-v940-IEs ::= SEQUENCE {

field6-v940 InformationElement6-r9 OPTIONAL, -- Need R

nonCriticalExtensions SEQUENCE {} OPTIONAL

}

-- ASN1STOP

Some remarks regarding the extensions shown in the above example:

– The *InformationElement4* is introduced in the original version of the protocol (release 8) and hence no suffix is used.

### A.4.3.5 Examples of non-critical extensions not placed at the default extension location

The following example illustrates the use of non-critical extensions in case an extension is not placed at the defaultextension location.

#### – *ParentIE-WithEM*

The IE *ParentIE-WithEM* is an example of a high level IE including the extension marker (EM). The root encoding of this IE includes two lower level IEs *ChildIE1-WithoutEM* and *ChildIE2-WithoutEM* which not include the extension marker. Consequently, non-critical extensions of the Child-IEs have to be included at the level of the Parent-IE.

The example illustrates how the two extension IEs *ChildIE1-WithoutEM-vNx0* and *ChildIE2-WithoutEM-vNx0* (both in release N) are used to connect non-critical extensions with a default extension location in the lower level IEs to the actual extension location in this IE.

*ParentIE-WithEM* information element

-- /example/ ASN1START

ParentIE-WithEM ::= SEQUENCE {

-- Root encoding, including:

childIE1-WithoutEM ChildIE1-WithoutEM OPTIONAL, -- Need N

childIE2-WithoutEM ChildIE2-WithoutEM OPTIONAL, -- Need N

...,

[[ childIE1-WithoutEM-vNx0 ChildIE1-WithoutEM-vNx0 OPTIONAL, -- Need N

childIE2-WithoutEM-vNx0 ChildIE2-WithoutEM-vNx0 OPTIONAL -- Need N

]]

}

-- ASN1STOP

Some remarks regarding the extensions shown in the above example:

– The fields *childIEx-WithoutEM-vNx0* may not really need to be optional (depends on what is defined at the next lower level).

– In general, especially when there are several nesting levels, fields should be marked as optional only when there is a clear reason.

#### *– ChildIE1-WithoutEM*

The IE *ChildIE1-WithoutEM* is an example of a lower level IE, used to control certain radio configurations including a configurable feature which can be setup or released using the local IE *ChIE1-ConfigurableFeature*. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature. The example is based on the following assumptions:

– When initially configuring as well as when modifying the new field, the original fields of the configurable feature have to be provided also i.e. as if the extended ones were present within the setup branch of this feature.

– When the configurable feature is released, the new field should be released also.

– When omitting the original fields of the configurable feature the UE continues using the existing values (which is used to optimise the signalling for features that typically continue unchanged upon handover).

– When omitting the new field of the configurable feature the UE releases the existing values and discontinues the associated functionality (which may be used to support release of unsupported functionality upon handover to an eNB supporting an earlier protocol version).

The above assumptions, which affect the use of conditions and need codes, may not always apply. Hence, the example should not be re-used blindly.

*ChildIE1-WithoutEM* information elements

-- /example/ ASN1START

ChildIE1-WithoutEM ::= SEQUENCE {

-- Root encoding, including:

chIE1-ConfigurableFeature ChIE1-ConfigurableFeature OPTIONAL -- Need N

}

ChildIE1-WithoutEM-vNx0 ::= SEQUENCE {

chIE1-ConfigurableFeature-vNx0 ChIE1-ConfigurableFeature-vNx0 OPTIONAL -- Cond ConfigF

}

ChIE1-ConfigurableFeature ::= CHOICE {

release NULL,

setup SEQUENCE {

-- Root encoding

}

}

ChIE1-ConfigurableFeature-vNx0 ::= SEQUENCE {

chIE1-NewField-rN INTEGER (0..31)

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *ConfigF* | The field is optional present, need R, in case of chIE1-ConfigurableFeature is included and set to "setup"; otherwise the field is not present and the UE shall delete any existing value for this field. |

#### *– ChildIE2-WithoutEM*

The IE *ChildIE2-WithoutEM* is an example of a lower level IE, typically used to control certain radio configurations. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature.

*ChildIE2-WithoutEM* information element

-- /example/ ASN1START

ChildIE2-WithoutEM ::= CHOICE {

release NULL,

setup SEQUENCE {

-- Root encoding

}

}

ChildIE2-WithoutEM-vNx0 ::= SEQUENCE {

chIE2-NewField-rN INTEGER (0..31) OPTIONAL -- Cond ConfigF

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *ConfigF* | The field is optional present, need R, in case of chIE2-ConfigurableFeature is included and set to "setup"; otherwise the field is not present and the UE shall delete any existing value for this field. |

# A.5 Guidelines regarding inclusion of transaction identifiers in RRC messages

The following rules provide guidance on which messages should include a Transaction identifier

1: DL messages on CCCH that move UE to RRC-Idle should not include the RRC transaction identifier.

2: All network initiated DL messages by default should include the RRC transaction identifier.

3: All UL messages that are direct response to a DL message with an RRC Transaction identifier should include the RRC Transaction identifier.

4: All UL messages that require a direct DL response message should include an RRC transaction identifier.

5: All UL messages that are not in response to a DL message nor require a corresponding response from the network should not include the RRC Transaction identifier.

# A.6 Guidelines regarding use of need codes

The following rule provides guidance for determining need codes for optional downlink fields:

- if the field needs to be stored by the UE (i.e. maintained) when absent:

- use Need M (=Maintain);

- else, if the field needs to be released by the UE when absent:

- use Need R (=Release);

- else, if UE shall take no action when the field is absent (i.e. UE does not even need to maintain any existing value of the field):

- use Need N (=None);

- else (UE behaviour upon absence doesn’t fit any of the above conditions):

- use Need S (=Specified);

- specify the UE behaviour upon absence of the field in the procedural text or in the field description table.

# A.7 Guidelines regarding use of conditions

Conditions are primarily used to specify network restrictions, for which the following types can be distinguished:

- CondM: Message Contents related constraints e.g. that a field B is mandatory present if the same message includes field A and when it is set value X.

- CondC: Configuration Constraints e.g. that a field D can only be signalled if field C is configured and set to value Y. (i.e. regardless of whether field C is present in the same message or previously configured).

The use of these conditions is illustrated by an example.

-- /example/ ASN1START

RRCMessage-IEs ::= SEQUENCE {

fieldA FieldA OPTIONAL, -- Need M

fieldB FieldB OPTIONAL, -- CondM-FieldAsetToX

fieldC FieldC OPTIONAL, -- Need M

fieldD FieldD OPTIONAL, -- CondC-FieldCsetToY

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- /example/ ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| Message (content) constraints | |
| *CondM-FieldAsetToX* | The field is mandatory present if fieldA is included and set to valueX. Otherwise the field is optional present, need R. |
| Configuration constraints | |
| *CondC- FieldCsetToY* | The field is optional present, need M, if fieldC is configured and set to valueY. Otherwise the field is not present and the UE does not maintain the value |

Annex B (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Change history | | | | | | | |
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 04/2017 | RAN2#97bis | R2-1703395 |  |  |  |  | 0.0.1 |
| 04/2017 | RAN2#97bis | R2-1703922 |  |  |  |  | 0.0.2 |
| 05/2017 | RAN2#98 | R2-1705815 |  |  |  |  | 0.0.3 |
| 06/2017 | RAN2#NR2 | R2-1707187 |  |  |  |  | 0.0.4 |
| 08/2017 | RAN2#99 | R2-1708468 |  |  |  |  | 0.0.5 |
| 09/2017 | RAN2#99bis | R2-1710557 |  |  |  |  | 0.1.0 |
| 11/2017 | RAN2#100 | R2-1713629 |  |  |  |  | 0.2.0 |
| 11/2017 | RAN2#100 | R2-1714126 |  |  |  |  | 0.3.0 |
| 12/2017 | RAN2#100 | R2-1714259 |  |  |  |  | 0.4.0 |
| 12/2017 | RAN#78 | RP-172570 |  |  |  | Submitted for Approval in RAN#78 | 1.0.0 |
| 12/2017 | RAN#78 |  |  |  |  | Upgraded to Rel-15 (MCC) | 15.0.0 |
| 03/2018 | RAN#79 | RP-180479 | 0008 | 1 | F | Corrections for EN-DC (Note: the clause numbering between 15.0.0 and 15.1.0 has changed in some cases). | 15.1.0 |