**3GPP TSG-RAN WG2 Meeting #101 *R2-180xxxx***

**Athens, Greece, 26th February - 2nd March 2018**

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| *CR-Form-v11.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.331** | **CR** | **CRNum** | **rev** | **-** | **Current version:** | **15.0.1** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Corrections on EN-DC | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Rapporteur (Ericsson) | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_newRAT-Core | | | | |  | | ***Date:*** | | 2018-02-05 |
|  |  | | | |  | | |  | |  |
| ***Category:*** | **F** |  | | | | | | ***Release:*** | | Rel-15 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12) Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
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| ***Reason for change:*** | | Corrections identified during ASN.1 review (RAN2 NR AH 1801), and email discussions after the AH.  This CR is based on  R2-1801218 Baseline TS 38331 v1.0.1 for ASN.1 review | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | To be completed.  Guidance for CR editors:   1. To avoid change marks for language formatting (typically happens when many users edit the same doc), please do the following word setting:   Review panel => Language => Set proofing languge => Detect automatically => OFF   1. Set the “User name” to indicate the company name. 2. When storing the CR in 3GPP folder, companies should add their Company ID (one letter) to the file name (see RIL). | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | |  | | | |
| ***Other specs*** | |  |  | Other core specifications | | | TS/TR ... CR ... | | | |
| ***affected:*** | |  |  | Test specifications | | | TS/TR ... CR ... | | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | TS/TR ... CR ... | | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |

# 5 Procedures

## 5.5 Measurements

### 5.5.1 Introduction

Editor’s Note: FFS In the context of subclause 5.5., the term “beam” will be later aligned with the RAN1 terminology when stabilized. For the current version, the term “beam” refers to the reference signals SS/PBCH Blocks and/or CSI-RS resources. Beam level measurements refer to the output of the L1 filters as defined in 38.215, i.e., SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ and CSI-SINR.

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 perform the following NR measurements, based on different RS types SS/PBCH Block or CSI-RS:

- SS/PBCH Block based intra-frequency measurements: measurements at SSB(s) of neighbour cell(s) where both the center frequency(ies) and subcarrier spacing are the same as the cell-defining SSB of each serving cell.

- SS/PBCH Block based inter-frequency measurements: measurements at SSB(s) of neighbour cell(s) that have different center frequency(ies) or different subcarrier spacing compared to the cell-defining SSB of each serving cell.

- CSI-RS based intra-frequency measurements: measurements at CSI-RS(s) resource(s) of configured neighbour cell(s) whose bandwidth(s) are within the bandwidth(s) of the CSI-RS resource(s) on the serving cell(s) configured for measurements and having the same subcarrier spacing of the CSI-RS resource(s) on the serving cell(s) configured for measurements.

- CSI-RS based inter-frequency measurements: measurements at CSI-RS(s) resource(s) of configured neighbour cell(s) whose bandwidth(s) are not within the bandwidth(s) or having different subcarrier spacing compared to the CSI-RS resource(s) on the serving cell(s) configured for measurements.

Editor’s Note: FFS Whether the definition of inter-frequency and intra-frequency measurements provided by RAN4 should be removed from 38.331.

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.

Editor’s Note: Revisit the formulation below, and as well as how to capture the following additional agreements:

2 More than one MO with CSI-RS resources for measurement can be associated to the same SSB location in frequency. The SSB is at least used for timing reference.

3 In case that more than one MO with CSI-RS resources for measurement is associated to the same SSB location in frequency the UE is indicated which MO corresponds to the serving carrier.

FFS whether the indication is in MO or serving cell configuration.

- UE determines which MO corresponds to the serving cell frequency from the frequency location of the cell-defining SSB that is contained within the serving cell configuration.

Editor’s Note: FFS Detailed definition of a measurement object based on RAN1/RAN4 input e.g. concerning SS Blocks transmissions. Revisit the procedures describing neighbouring cells on associated frequency and the concept of serving frequency. Consider summarizing the description if becomes lengthy.

- 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/or cell measurement results (SS/PBCH block or CSI-RS).

- Reporting format: The quantities per cell and/or 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.

An RRC\_CONNECTED UE maintains a single measurement object list, a single reporting configuration list, and a single measurement identities list. 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 serving cell(s) - these are the SpCell and one or more SCells, if configured for a UE supporting CA.

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 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;

Editor’s Note: FFS Whether we can simplify the procedural text and avoid using *VarMeasConfig*.

#### 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*;

Editor’s Note: FFS: Exceptions in handling *measObject* modification for other fields e.g. cells to add/remove from current cell list, measurement configuration for NR-SS and/or CSI-RS.

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 1: For each *physCellId* 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

Editor’s Note: FFS How measurement gaps are configured.

Editor’s Note: FFS how to capture the e.g. following agreement: For the independent gap case where UE is able to apply a different gap pattern for LTE/FR1 and FR2: a NR RRC configures a measurement gap configuration for FR2.

#### 5.5.2.10 Reference signal measurement timing configuration

Editor’s Note: FFS How SS/PBCH block measurement timing is configured.

### 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*:

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*:

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*:

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*:

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 not set to *reportCGI*:

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 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 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* for the associated *reportConfig* is 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* for the associated *reportConfig* is 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;

Editor’s Note: FFS Exact value of the sampling rate (i.e. X) for layer 3 filtering.

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*;

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 RSRP when the concerned CSI-RS resource is included in the *csi-rs-ResourceConfigMobility* with the corresponding *cellId* and *CSI-RS-ResourceId-RRM* within the *VarMeasConfig* for this *measId*;

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*;

#### 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;

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 SpCell;

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

5> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the SpCell and 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 NR SCell that are configured 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 SpCell or 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> in EN-DC, 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 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 PCell/PSCell, not taking into account any offsets.

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

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

***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> in EN-DC, 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 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 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 1: The neighbour(s) is on the same frequency as the SCell i.e. both are on the frequency indicated in the associated *measObjectNR*.

NOTE 2: In EN-DC, The cell(s) that triggers the event is on the frequency indicated in the associated measObject shall be different from the frequency used by the PSCell.

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.

Editor’s Note: FFS Details of B1/B2 inter-RAT events and periodical reporting for LTE measurements.

### 5.5.5 Measurement reporting

#### 5.5.5.1 General





Figure 5.5.5-1: 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> in EN-DC, set the *measResultServingCell* within *measResultServingFreqList* to include for each NR SCell that is configured, if any, the *servFreqId*;

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

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 infcludes *reportAddNeighMeas*:

2> for each serving frequency for which *measObjectId* is referencedin 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 and *rsType* indicated in *reportConfig* of the best non-serving cell on the concerned serving frequency;

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

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* is configured, 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* is configured, 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* is configured, 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 block index;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;

## 5.7 Other

### 5.7.3 SCG failure 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, 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 of the best non-serving cell, based on RSRP, on the concerned serving frequency;

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, 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 2: 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.

## 6.2 RRC messages

### 6.2.2 Message definitions

#### – *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,

-- FFS

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-MEASUREMENTREPORT-STOP

-- ASN1STOP

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

## 6.3 RRC information elements

### 6.3.2 Radio resource control information elements

#### *–* *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

-- FFS if failureType is needed

MeasResultSCG-Failure ::= SEQUENCE {

measResultServFreqList MeasResultServFreqList2NR,

measResultNeighCells MeasResultList2NR,

...

}

MeasResultServFreqList2NR ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF MeasResultServFreq2NR

MeasResultServFreq2NR ::= SEQUENCE {

carrierFreq ARFCN-ValueNR,

measResultServingCell MeasResultNR,

measResultBestNeighCell MeasResultNR OPTIONAL

}

MeasResultList2NR ::= SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

MeasResult2NR ::= SEQUENCE {

carrierFreq ARFCN-ValueNR,

measResultListNR MeasResultListNR

}

-- TAG-MEAS-RESULT -SCG-FAILURE-STOP

-- ASN1STOP

#### – *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 SetupRelease{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.

Editor’s Note: FFS Whether measScaleFactor (or equivalent) is supported in Rel-15.

Editor’s Note: FFS How to support allowInterruptions in NR (RAN4 input needed) in Rel-15.

Editor’s Note: FFS where to add RLM related parameters: rlm-ResourceConfigCSI-RS, rlm-ResourceConfigSS

| *MeasConfig* field descriptions |
| --- |
| ***measGapConfig***  Used to setup and release measurement gaps in NR. |
| ***measIdToAddModList***  List of measurement identities. |
| ***measIdToRemoveList***  List of measurement identities to remove. |
| ***measObjectToAddModList***  List of measurement objects to add and/or modify. |
| ***measObjectToRemoveList***  List of measurement objects to remove. |
| ***reportConfigToRemoveList***  List of measurement reporting configurations to remove. |
| ***s-MeasureConfig***  Threshold for SpCell RSRP measurement controlling when the UE is required to perform measurements associated to neighbouring 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. |

#### – *MeasGapConfig*

The IE *MeasGapConfig* specifies the measurement gap configuration and controls setup/ release of measurement gaps.

*MeasGapConfig* information element

-- ASN1START

MeasGapConfig ::= SEQUENCE {

gapFR2 GapConfig OPTIONAL,

...

}

GapConfig ::= SEQUENCE {

gapOffset INTEGER (0..159),

mgl ENUMERATED {ms1dot5, ms3, ms3dot5, ms4, ms5dot5, ms6},

mgrp ENUMERATED {ms20, ms40, ms80, ms160},

...

}

-- 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 indicates 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]. |
| ***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]. |
|  |

#### – *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 OPTIONAL,

reportConfigId ReportConfigId

}

-- TAG-MEAS-ID-TO-ADD-MOD-LIST-STOP

-- ASN1STOP

Editor’s Note: FFS Whether measObjectId is an OPTIONAL field or mandatory as in LTE (discuss the implication in procedural text).

#### *– MeasObjectEUTRA*

The IE *MeasObjectEUTRA* specifies information applicable for intra-frequency or inter-frequency E‑UTRA cells.

Editor’s Note: FFS Details of *measObjectEUTRA* that can be configured via NR.

#### *– 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 {

ssbAbsoluteFreq GSCN-ValueNR,

--FFS whether reference frequency represents pointA

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

-- FFS: Where to include L1 parameters for RSSI measurements (SS-RSSI-MeasurementConfig in L1 table)

}

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 CSI-RS-ResourceConfigMobility OPTIONAL -- Need R

}

-- A measurement timing configuration

SSB-ConfigMobility ::= SEQUENCE {

} 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

}

CSI-RS-ResourceConfigMobility ::= SEQUENCE {

-- MO specific values

isServingCellMO BOOLEAN,

-- Subcarrier spacing of CSI-RS.

-- Supported values are 15, 30 or 60 kHz (<6GHz), 60 or 120 kHz (>6GHz).

-- Corresponds to L1 parameter 'Numerology' (see 38.211, section FFS\_Section)

subcarrierSpacingCSI-RS SubcarrierSpacingCSI-RS,

-- 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..251)

},

-- 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-ResourceId-RRM CSI-RS-ResourceId-RRM,

-- FFS\_CHECK whether the following fields are supposed to be per resource (here) or in the resource config (above)

-- Contains periodicity and slot offset for periodic/semi-persistent CSI-RS (see 38.211, section x.x.x.x)FFS\_Ref

slotConfig CHOICE {

ms5 INTEGER (0..79),

ms10 INTEGER (0..159),

ms20 INTEGER (0..319),

ms40 INTEGER (0..639)

},

-- 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)

-- FFS: What does the UE do if it there is no such SSB-Index?

associatedSSB SEQUENCE {

-- FFS\_Value: Check the value range

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,

-- Resource Element mapping pattern for CSI-RS (see 38.211, section x.x.x.x) FFS\_Ref

resourceElementMappingPattern ENUMERATED {ffsTypeAndValue},

-- Sequence generation parameter for CSI-RS (see 38.211, section x.x.x.x) FFS\_Ref

sequenceGenerationConfig INTEGER (0..1023),

...

}

CSI-RS-ResourceId-RRM ::= 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

}

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,

physCellIdRange PhysCellIdRange

}

-- 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)

Editor’s Note: FFS Whether alternative TTT is supported in Rel-15.

Editor’s Note: FFS measCycleSCell.

Editor’s Note: FFS reducedMeasPerformance.

Editor’s Note: FFS Whether *offsetFreq* within *measObject* can be set differently for CSI-RS and SS/PBCH block.

| *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 5.5.3.3 and the L3 filter(s) per SS/PBCH block index as described in 5.5.3.2. |
| ***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. |
| ***carrierFreq***  Identifies NR carrier frequency for which this configuration is valid. |
| ***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. |
| ***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 in that carrierFreq. |
| ***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 in that carrierFreq. |
| ***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. |
| ***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 ms5/ms10/ms20/ms40 are 4/9/19/39 slots. When *subcarrierSpacingCSI-RS* is set to 30kHZ, the maximum offset values for periodicities ms5/ms10/ms20/ms40 are 9/19/39/79 slots. When *subcarrierSpacingCSI-RS* is set to 60kHZ, the maximum offset values for periodicities ms5/ms10/ms20/ms40 are 19/39/79/159 slots. When *subcarrierSpacingCSI-RS* is set 120kHZ, the maximum offset values for periodicities ms5/ms10/ms20/ms40 are 39/79/159/319 slots. When *subcarrierSpacingCSI-RS* is set 240kHZ, the maximum offset values for periodicities ms5/ms10/ms20/ms40 are 79/159/319/639 slots. |
|  |
|  |
| ***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. |

#### – *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-CellRSRP***  Measured RSRP result per NR cell based on CSI-RSRP value(s) from the L1 filter(s). |
| ***csi-rs-CellRSRQ***  Measured RSRQ result per NR cell based on CSI-RSRQ value(s) from the L1 filter(s). |
| ***csi-rs-CellSINR***  Measured SINR result per NR cell based on CSI-SINR value(s) from the L1 filter(s). |
| ***csi-rs-Index***  CSI-RS resource index associated to the measurement information to be reported. |
| ***csi-RSRP***  L3 filtered CSI-RSRP measurement per CSI-RS resource index, as defined in 5.5.4.x. CSI-RSRP is defined in TS 38.215 [9]. |
| ***csi-RSRQ***  L3 filtered CSI-RSRQ measurement per CSI-RS resource index, as defined in 5.5.4.x. CSI-RSRQ is defined in TS 38.215 [9]. |
| ***csi-SINR***  L3 filtered CSI-SINR measurement per CSI-RS resource index, as defined in 5.5.4.x. CSI-SINR is defined in TS 38.215 [9]. |
| ***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. |
| ***resultSSB-Cell***  Cell level measurement results (e.g. RSRP, RSRQ, SINR) to be reported derived on SS/PBCH block measurements. |
| ***smtc2***  Secondary measurement timing configuration for explicitly signalled PCIs. The timing offset is equal to SMTC1 offset mod SMTC2 periodicity. |
| ***ssb-CellRSRP***  Measured RSRP result per NR cell based on SS-RSRP value(s) from the L1 filter(s). |
| ***ssb-CellRSRQ***  Measured RSRQ result of an NR Cell based on SS-RSRP value(s) from the L1 filter(s). |
| ***ssb-CellSINR***  Measured SS-SINR result of an NR Cell based on SS-SINR value(s) from the L1 filter(s).. |
| ***ssb-Index***  SS/PBCH block index associated to the measurement information to be reported. |
| ***ss-rsrp***  L3 filtered SS-RSRP measurement per SS/PBCH block index, as defined in 5.5.4.x. SS-RSRP is defined in TS 38.215 [9]. |
| ***ss-rsrq***  L3 filtered SS-RSRQ measurement per SS/PBCH block index, as defined in 5.5.4.x. SS-RSRQ is defined in TS 38.215 [9]. |
| ***ss-sinr***  L3 filtered SS-SINR measurement per SS/PBCH block index, as defined in 5.5.4.x. SS-SINR is defined in TS 38.215 [9]. |

#### – *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 OP

}

-- 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 of physical cell id range, which may be used for different purposes.

*PCI-RangeIndex* information element

-- ASN1START

-- TAG-PCI-RANGE-INDEX-START

PCI-RangeIndex ::= INTEGER (0..maxNrofPCI-Ranges)

-- TAG-PCI-RANGE-INDEX-STOP

-- ASN1STOP

#### – *PCI-RangeIndexList*

The IE *PCI-RangeIndexList* concerns a list of indices 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

*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,

...

}

NR-RS-Type ::= ENUMERATED {ssb, csi-rs}

MeasTriggerQuantity ::= CHOICE {

rsrp RSRP-Range,

rsrq RSRQ-Range,

sinr SINR-Range

}

MeasTriggerQuantityOffset ::= CHOICE {

rsrp INTEGER (1..ffsValue),

rsrq INTEGER (1..ffsValue),

sinr INTEGER (1..ffsValue)

}

MeasReportQuantity ::= SEQUENCE {

rsrp BOOLEAN,

rsrq BOOLEAN,

sinr BOOLEAN

}

-- TAG-REPORT-CONFIG-START

-- ASN1STOP

#### – *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 based L3 filter configurations:

cs-RS-FilterConfig FilterConfig

}

FilterConfig ::= SEQUENCE {

filterCoefficientRSRP FilterCoefficient DEFAULT ffsTypeAndValue,

filterCoefficientRSRQ FilterCoefficient DEFAULT ffsTypeAndValue,

filterCoefficientRS-SINR FilterCoefficient DEFAULT ffsTypeAndValue

}

-- 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. |
| ***quantityConfigRSindex***  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]. |
|  |
|  |

#### – *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 *triggerType* *event* as well as for *triggerType* *periodical*. 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, spare2, spare1}

-- 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

#### – *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

# 7 Variables and constants

## 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,

PhysCellIdEUTRA,

PhyCellNR,

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 {

physCellIdEUTRA PhysCellIdEUTRA,

phyCellNR PhyCellNR

}

-- TAG-VAR-MEAS-REPORT-STOP

-- ASN1STOP

#### – End of *NR-UE-Variables*

-- ASN1START

END

-- ASN1STOP