**3GPP TSG-RAN WG2 Meeting #116 electronic R2-21xxxxx**

**Online, 1 – 12 Nov 2021**

**Agenda Item: 8.13.4 L2 Measurements**

**Source: Huawei**

**Title: Report of email discussion [AT116e][852][SON/MDT] Packet “reliability” measurement for D1 (Huawei)**

**Document for: Discussion and decision**

# Introduction

This document is to kick off the following email discussion:

* CB on Thursday:
* **[AT115e][852][SON/MDT]**  Packet “reliability” measurement for D1 **(Huawei)**

Scope: progress the detail including the definition and also requirements through email.

 Intended outcome: Report

 Deadline: 05:00 UTC, Wednesday November 10th

**Contact Information**

|  |  |
| --- | --- |
| Company | Email |
| Qualcomm | rkum@qti.qualcomm.com |
| Huawei, HiSilicon | jun.chen@huawei.com |
| Ericsson | pradeepa.ramachandra@ericsson.com |
| CATT | Shijie@catt.cn |
| ZTE | qiu.zhihong@zte.com.cn |
| CMCC | chenningyu@chinamobile.com |
|  |  |
|  |  |
|  |  |
|  |  |

# Discussion

During online discussion in the 1st meeting week, the following agreement was made:

=> Introduce packet “reliability” measurement for D1, i.e. reuse the LTE metric.

In LTE, the excess packet delay ratio measurement was introduced in Rel-13 (see RP-152082), and it is for QoS verification of MDT. The specification impacts are listed in section 5 Annex.

Here is a comparison between two options:

**Table 1: comparison of option 1 and option 2**

|  |  |  |
| --- | --- | --- |
|  | **Option 1:****LTE metric – excess packet delay** | **Option 2:****Packet “reliability” measurement** |
| Definition | It represents the ratio of packets in UL per QCI exceeding the configured delay threshold among the UL PDCP SDUs transmitted (from UE’s PDCP to UE’s RLC).The packet delay is defined as following:the delay from packet arrival at PDCP upper SAP until the packet starts to be delivered to RLC. | Similar as option 1, it represents the ratio of packets in UL per DRB exceeding the configured delay threshold among the UL PDCP SDUs received (at UE’s PDCP).The packet delay is about D1 which is different from option 1, i.e.:the delay from packet arrival at PDCP upper SAP until the UL grant to transmit the packet is available, which has included the delay the UE gets resources granted (from sending SR/RACH to get the first grant). |
| Requirements | The network can collect the per QCI excess packet delay information from the UE. | The network can collect the per DRB excess packet delay information for D1 from the UE. |
| Configuration | Delay threshold, e.g. ms30, ms750 | There could be some candidate options (together with reporting):(a) the network can indicate the delay threshold and the percentage threshold, and then the UE just indicates a bit flag to the network. The threshold values are FFS(b) the network can indicate the delay threshold, and then the UE reports the excess delay results (like LTE excess packet delay reporting). The threshold values are FFS(c) others |
| Reporting | Excess delay reporting per QCI | See analysis for configuration part |

Based on table 1, it is suggested to collect companies’ opinions about the detail including the definition and also requirements. It is noted that for option 2, the measurement granularity is per DRB because Rel-16 D1 measurements are collected per DRB, and companies are free to comment on this part if there are different views.

**Q1: For the definition, do companies agree with the definition of packet “reliability” measurement for D1 (i.e. option 2) in table 1?**

|  |  |  |
| --- | --- | --- |
| Company | Agree(Yes or No) | Comments |
| Qualcomm | We would prefer to call it excess delay same as LTE | I want to point out that this delay measurement may have very limited scope and may be waste of UE resources, as the delay cannot be combined with RAN side existing delay.Furthermore, we want to ask whether this measurement is for QoS verification of MDT only, same as LTE. |
| Huawei, HiSilicon | Yes | Firstly, as mentioned in our paper R2-2110642, Rel-16 average value mechanism can not identify bad packets. So the intention of having new measurements is to check whether each delay component is ok or not, and if not, the network can exactly know where the problem occured. For D1, only UE knows the value, and other delay components can be collected by network sides. Without this new measurement, if some packets have large D1 value, the network may not identify the problem as the average D1 value can be always good enough.Secondly, we are ok to call it **excess packet delay for D1**.Thirdly, we does not think that the delay can be accumulated with other delay components because it is a ratio value, so QoS verification of MDT is the main purpose. We are also open to think about QoS monitoring purpose, i.e. RAN can also report this new measurement to CN, in addition to Rel-16 total delay measurement. |
| Ericsson | Yes | The definition of option-2 is better suited at capturing those packets that had a much longer D1 measurement compared to the rest of the packets.We also prefer the name to be changed so that it does not include the term ‘reliability’ to avoid confusion. We can decide on the name after seeing the outcome of question-3.  |
| CATT | See comments | The option 1 mainly reflects the QoS delay requirements, i.e. queuing delay. For the option 2, it seems like to indicate whether the D1 results of M6 measurement is above the configured threshold. The gain of this is not clear to us. |
| ZTE | See comments | We think it is useful to introduce such delay measurement to identify packet experiencing delay larger than expected, and we are fine to adjust the delay value to be compared with to NR definition, which is our initial proposal. However, for the analysis in configuration part it seems more like optimization, we are not certain on the extra configuration flexibility. For simplicity, it seems for this release, similar mechanism as LTE is sufficient. Also, we prefer to reuse excess Delay naming, and to differentiate with LTE measurement we can have small twist in the name, e.g., excessDelay-NR or excessAverageDelay.  |
| CMCC | Yes | We see the new measurement is quite similar as the LTE, with some modification to fit in NR. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary:**

Regarding the naming, it seems “excess packet delay for NR” is acceptable (instead of the previous naming).

Regarding the definition, 4 companies agree that the new measurement is similar as the LTE, so it should be accpetable to define it as below:

* Excess packet delay for NR: it represents the ratio of packets in UL per DRB exceeding the configured delay threshold among the UL PDCP SDUs received. The delay for each packet is calculated from packet arrival at PDCP upper SAP until the UL grant to transmit the packet is available, which has included the delay the UE gets resources granted (from sending SR/RACH to get the first grant)

**Proposal 1: The new delay measurement can be called excess packet delay for NR.**

**Proposal 2: the definition of the measurement of excess packet delay for NR is:**

* **it represents the ratio of packets in UL per DRB exceeding the configured delay threshold among the UL PDCP SDUs received. The delay for each packet is calculated from packet arrival at PDCP upper SAP until the UL grant to transmit the packet is available, which has included the delay the UE gets resources granted (from sending SR/RACH to get the first grant)**

**Q2: For the requirements, do companies agree with the requirements of packet “reliability” measurement for D1 (i.e. option 2) in table 1?**

|  |  |  |
| --- | --- | --- |
| Company | Agree(Yes or No) | Comments |
| Qualcomm  | No | As pointed out in response to Q 1, we believe that it has very limited scope as it cannot be combined with existing RAN side delay.  |
| Huawei, HiSilicon | Yes | If the network can get both Rel-16 average delay measurements and also this new measurement, the following problem can be identified:Rel-16 average delay is ok (always less than a delay threshold), but at some time **excess packet delay for D1** is not ok (some “bad” packets occur). |
| Ericsson | Yes | As explained by Huawei, the advantage of this new measurement is to identify how often do we fail to meet certain delay budget requirement from D1 measurement point of view.  |
| CATT | No | See comments in Q1. |
| ZTE | Yes | For requirement part we think it is correct, and I think similar to delay measurement per 5QI, NW can based on its implementation to obtain excess delay per 5QI based on the per DRB measurement. |
| CMCC | Yes | We support the requirement. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary:**

4 companies agree with the requirement that the network can collect the per DRB excess packet delay information for D1 from the UE.

**Proposal 3: The network can collect the measurement excess packet delay for NR from the UE.**

**Q3: For configuration and reporting aspects for option 2, which of options do companies prefer?**

**(a) the network can indicate the delay threshold and the percentage threshold, and then the UE just indicates a bit flag to the network. The threshold values are FFS**

**(b) the network can indicate the delay threshold, and then the UE reports the excess delay results (like LTE excess packet delay reporting). The threshold values are FFS**

**(c) others**

|  |  |  |
| --- | --- | --- |
| Company | (a), (b), or others? | Comments |
| Qualcomm | (b) | We strongly prefer to have similar UE behaviour as LTE. We should follow the same UE behaviour, where UE reports the M6 measurements at the end of measurement collection period, therefore, we do not prefer option (a). We do not want to introduced event triggered reporting for M6.  |
| Huawei, HiSilicon | (b) | We think LTE excess packet delay mechanism can be referenced, but we also see the following differences:(1) this new measurement is for D1(2) LTE mechanism uses per QCI for reporting, and here per DRB can be considered. And this may also impact the configuration/reporting procedure (not much)(3) In LTE mechanism, the delayThreshold-r13 has the values ms30, ms40… In NR, we think these values can be re-designed, because it is expected that the UE will experience less transmission time in NR than in LTE, and the threshold values can be even smaller if considering toB cases, e.g. 0.25ms, 0.5ms, 1ms(4) In TS 36.314, **Table 4.2.1.1.1-1: EXCESS DELAY RATIO measurement report mapping** captures the mapping information between reported value and measured quantity value. We are generally fine with the table as the granularity is plentiful. However, for toB cases, it might need finer granularity, e.g. 99.999%, but we are open for it for now |
| Ericsson | (b) | Option-b provides more information compared to option-a and thus this is preferrable. |
| ZTE | (b) |  |
| CMCC | b |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary:**

5 companies agree with (b), which means the LTE excess packet delay mechanism can be used as a baseline. Details can be further discussed.

**Proposal 4:** **LTE excess packet delay mechanism can be used as a baseline, and details can be further discussed.**

# Conclusions

Based on email discussions, the following proposals seem agreeable:

**Proposal 1: The new delay measurement can be called excess packet delay for NR.**

**Proposal 2: the definition of the measurement of excess packet delay for NR is:**

* **it represents the ratio of packets in UL per DRB exceeding the configured delay threshold among the UL PDCP SDUs received. The delay for each packet is calculated from packet arrival at PDCP upper SAP until the UL grant to transmit the packet is available, which has included the delay the UE gets resources granted (from sending SR/RACH to get the first grant)**

**Proposal 3: The network can collect the measurement excess packet delay for NR from the UE.**

**Proposal 4: LTE excess packet delay reporting can be used as a baseline, and details can be further discussed.**

# Reference

[1] R2-116-e SONMDT HuNan 2021-11-03-1615 UTC

[2] R2-2110642 Discussion on L2M Huawei, CMCC, HiSilicon discussion

# Annex

## 5.1 LTE metric – Execess Packet Delay Ratio in TS 36.314 (definition)

#### 4.2.1.1 UL PDCP Packet Delay per QCI

The objective of this measurement performed by UE is to measure Excess Packet Delay Ratio in Layer PDCP for QoS verification of MDT.

Protocol Layer: RLC, PDCP

|  |  |
| --- | --- |
| **Definition** | PDCP Packet Delay in the UL per QCI. This measurement refers to packet delay for DRBs, which captures the delay from packet arrival at PDCP upper SAP until the packet starts to be delivered to RLC. The measurement is done separately per QCI.Detailed Definition:,whereexplanations can be found in the table 4.2.1.1-1 below. |

Table 4.2.1.1-1

|  |  |
| --- | --- |
|  | Ratio of packets in UL per QCI exceeding the configured delay threshold among the UL PDCP SDUs transmitted. |
|  | Number of PDCP SDUs of a data radio bearer with QCI = ,for which ULdelay exceeded the configured *delayThreshold* as defined in TS 36.331 [5] during the time period T. |
|  | Number of PDCP SDUs of a data radio bearer with QCI = , for which at least a part of SDU was transmitted during the time period T. |
|  | Queuing delay observed at the UE PDCP layer from packet arrival at PDCP upper SAP until the packet starts to be delivered to RLC, the packet belongs to a data radio bearer with QCI = . |
|  | The point in time when the PDCP SDU *I* of a data radio bearer with QCI =was delivered to lower layers.  |
|  | The point in the time when the PDCP SDU I of a data radio bearer with QCI =  arrives at PDCP upper SAP. |
|  | Index of PDCP SDU that arrives at the PDCP upper SAP during time period .  |
|  | Time period during which the measurement is performed. |

##### 4.2.1.1.1 Measurement report mapping for PDCP SDU queuing delay

UL PDCP SDU queuing delay shall be measured according to configuration as defined in TS 36.331 [5].

The UE shall report UL PDCP SDU queuing delay as the ratio of SDUs exceeding the configured delay threshold and the total number of SDUs received by the UE during the measurement period.

The reported excess PDCP queuing delay ratio is mapped to 32 levels with the quantities in the range of 0 < nExcess 100% with uniform quantization in the log domain.

The mapping of measured quantity is defined in Table 4.2.1.1.1-1.

Table 4.2.1.1.1-1: EXCESS DELAY RATIO measurement report mapping (5 –bit value)

|  |  |  |
| --- | --- | --- |
| Reported value | Measured quantity value | Unit |
| EXCESS DELAY RATIO\_00 | 0 < EXCESS DELAY RATIO  0,079 | % |
| EXCESS DELAY RATIO\_01 | 0,079 < EXCESS DELAY RATIO  0,100 | % |
| EXCESS DELAY RATIO\_02 | 0,100 < EXCESS DELAY RATIO 0,126 | % |
| EXCESS DELAY RATIO\_03 | 0,126 < EXCESS DELAY RATIO  0,158 | % |
| EXCESS DELAY RATIO\_04 | 0,158 < EXCESS DELAY RATIO  0,199 | % |
| EXCESS DELAY RATIO\_05 | 0,199 < EXCESS DELAY RATIO  0,251 | % |
| EXCESS DELAY RATIO\_06 | 0,251 < EXCESS DELAY RATIO  0,316 | % |
| EXCESS DELAY RATIO\_07 | 0,316 < EXCESS DELAY RATIO  0,398 | % |
| EXCESS DELAY RATIO\_08 | 0,398 < EXCESS DELAY RATIO  0,501 | % |
| EXCESS DELAY RATIO\_09 | 0,501 < EXCESS DELAY RATIO  0,631 | % |
| EXCESS DELAY RATIO\_10 | 0,631 < EXCESS DELAY RATIO  0,794 | % |
| EXCESS DELAY RATIO\_11 | 0,794 < EXCESS DELAY RATIO  1,000 | % |
| EXCESS DELAY RATIO\_12 | 1,000 < EXCESS DELAY RATIO  1,259 | % |
| EXCESS DELAY RATIO\_13 | 1,259 < EXCESS DELAY RATIO  1,585 | % |
| EXCESS DELAY RATIO\_14 | 1,585 < EXCESS DELAY RATIO  1,995 | % |
| EXCESS DELAY RATIO\_15 | 1,995 < EXCESS DELAY RATIO  2,511 | % |
| EXCESS DELAY RATIO\_16 | 2,511 < EXCESS DELAY RATIO  3,161 | % |
| EXCESS DELAY RATIO\_17 | 3,161 < EXCESS DELAY RATIO  3,980 | % |
| EXCESS DELAY RATIO\_18 | 3,980 < EXCESS DELAY RATIO  5,011 | % |
| EXCESS DELAY RATIO\_19 | 5,011 < EXCESS DELAY RATIO  6,309 | % |
| EXCESS DELAY RATIO\_20 | 6,309 < EXCESS DELAY RATIO  7,943 | % |
| EXCESS DELAY RATIO\_21 | 7,943 < EXCESS DELAY RATIO  10,00 | % |
| EXCESS DELAY RATIO\_22 | 10,00 < EXCESS DELAY RATIO  12,589 | % |
| EXCESS DELAY RATIO\_23 | 12,589 < EXCESS DELAY RATIO  15,849 | % |
| EXCESS DELAY RATIO\_24 | 15,849 < EXCESS DELAY RATIO  19,953 | % |
| EXCESS DELAY RATIO\_25 | 19,953 < EXCESS DELAY RATIO  25,119 | % |
| EXCESS DELAY RATIO\_26 | 25,119 < EXCESS DELAY RATIO  31,623 | % |
| EXCESS DELAY RATIO\_27 | 31,623 < EXCESS DELAY RATIO  39,811 | % |
| EXCESS DELAY RATIO\_28 | 39,811 < EXCESS DELAY RATIO  50,119 | % |
| EXCESS DELAY RATIO\_29 | 50,119 < EXCESS DELAY RATIO  63,096 | % |
| EXCESS DELAY RATIO\_30 | 63,096 < EXCESS DELAY RATIO  79,433 | % |
| EXCESS DELAY RATIO\_31 | 79,433 < EXCESS DELAY RATIO  100 | % |

## 5.2 LTE metric – Execess Packet Delay Ratio in TS 36.331 (configuration and report)

Note: the relevant definitions are in red.

### 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 E-UTRAN. 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 *measResultPCell* to include the quantities of the PCell;

*<Partially omitted>*

1> if uplink PDCP delay results are available:

2> set the *ul-PDCP-DelayResultList* to include the uplink PDCP delay results available;

### 6.3.5 Measurement information elements

*<Partially omitted>*

– *MeasResults*

The IE *MeasResults* covers measured results for intra-frequency, inter-frequency and inter- RAT mobility and for idle/inactive measurements.

***MeasResults* information element**

-- ASN1START

MeasResults ::= SEQUENCE {

 measId MeasId,

 measResultPCell SEQUENCE {

 rsrpResult RSRP-Range,

 rsrqResult RSRQ-Range

 },

 measResultNeighCells CHOICE {

 measResultListEUTRA MeasResultListEUTRA,

 measResultListUTRA MeasResultListUTRA,

 measResultListGERAN MeasResultListGERAN,

 measResultsCDMA2000 MeasResultsCDMA2000,

 ...,

 measResultNeighCellListNR-r15 MeasResultCellListNR-r15

 } OPTIONAL,

 ...,

 [[ measResultForECID-r9 MeasResultForECID-r9 OPTIONAL

 ]],

 [[ locationInfo-r10 LocationInfo-r10 OPTIONAL,

 measResultServFreqList-r10 MeasResultServFreqList-r10 OPTIONAL

 ]],

 [[ measId-v1250 MeasId-v1250 OPTIONAL,

 measResultPCell-v1250 RSRQ-Range-v1250 OPTIONAL,

 measResultCSI-RS-List-r12 MeasResultCSI-RS-List-r12 OPTIONAL

 ]],

 [[ measResultForRSSI-r13 MeasResultForRSSI-r13 OPTIONAL,

 measResultServFreqListExt-r13 MeasResultServFreqListExt-r13 OPTIONAL,

 measResultSSTD-r13 MeasResultSSTD-r13 OPTIONAL,

 measResultPCell-v1310 SEQUENCE {

 rs-sinr-Result-r13 RS-SINR-Range-r13

 } OPTIONAL,

 ul-PDCP-DelayResultList-r13 UL-PDCP-DelayResultList-r13 OPTIONAL,

 measResultListWLAN-r13 MeasResultListWLAN-r13 OPTIONAL

 ]],

 [[ measResultPCell-v1360 RSRP-Range-v1360 OPTIONAL

 ]],

 [[ measResultListCBR-r14 MeasResultListCBR-r14 OPTIONAL,

 measResultListWLAN-r14 MeasResultListWLAN-r14 OPTIONAL

 ]],

 [[ measResultServFreqListNR-r15 MeasResultServFreqListNR-r15 OPTIONAL,

 measResultCellListSFTD-r15 MeasResultCellListSFTD-r15 OPTIONAL

 ]],

 [[ logMeasResultListBT-r15 LogMeasResultListBT-r15 OPTIONAL,

 logMeasResultListWLAN-r15 LogMeasResultListWLAN-r15 OPTIONAL,

 measResultSensing-r15 MeasResultSensing-r15 OPTIONAL,

 heightUE-r15 INTEGER (-400..8880) OPTIONAL

 ]],

 [[ ul-PDCP-DelayValueResultList-r16 UL-PDCP-DelayValueResultList-r16 OPTIONAL,

 measResultForRSSI-NR-r16 MeasResultForRSSI-NR-r16 OPTIONAL

 ]]

}

UL-PDCP-DelayResultList-r13 ::= SEQUENCE (SIZE (1..maxQCI-r13)) OF UL-PDCP-DelayResult-r13

UL-PDCP-DelayResult-r13 ::= SEQUENCE {

 qci-Id-r13 ENUMERATED {qci1, qci2, qci3, qci4, spare4, spare3, spare2, spare1},

 excessDelay-r13 INTEGER (0..31),

 ...

}

***excessDelay***

Indicates excess queueing delay ratio in UL, according to excess delay ratio measurement report mapping table, as defined in TS 36.314 [71], Table 4.2.1.1.1-1.

***qci-Id***

Indicates QCI value for which *excessDelay* is provided, according to TS 36.314 [71].

*<Next relevant specification text>*

#### – *ReportConfigEUTRA*

The IE *ReportConfigEUTRA* specifies criteria for triggering of an E‑UTRA measurement reporting or conditional reconfiguration (i.e. conditional handover) event. The E‑UTRA measurement reporting events concerning CRS are labelled A*N* 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.

The E‑UTRA measurement reporting events concerning CRS for conditional reconfigurations are labelled A*N* with *N* equal to 3 or 5.

CondEvent A3: Conditional reconfiguration candidate becomes amount of offset better than PCell;

CondEvent A5: PCell becomes worse than absolute threshold1 AND conditional reconfiguration candidate becomes better than another absolute threshold2;

The E‑UTRA measurement reporting events concerning CSI-RS are labelled C*N* with *N* equal to 1 and 2.

Event C1: CSI-RS resource becomes better than absolute threshold;

Event C2: CSI-RS resource becomes amount of offset better than reference CSI-RS resource.

The E-UTRA measurement reporting events concerning CBR are labelled VN with N equal to 1 and 2.

Event V1: CBR becomes larger than absolute threshold;

Event V2: CBR becomes smaller than absolute threshold.

The E-UTRA reporting events concerning Aerial UE height are labelled H*N* with *N* equal to 1 and 2.

Event H1: Aerial UE height becomes higher than absolute threshold;

Event H2: Aerial UE height becomes lower than absolute threshold.

*ReportConfigEUTRA* information element

-- ASN1START

ReportConfigEUTRA ::= SEQUENCE {

 triggerType CHOICE {

 event SEQUENCE {

 eventId CHOICE {

 eventA1 SEQUENCE {

 a1-Threshold ThresholdEUTRA

 },

 eventA2 SEQUENCE {

 a2-Threshold ThresholdEUTRA

 },

 eventA3 SEQUENCE {

 a3-Offset INTEGER (-30..30),

 reportOnLeave BOOLEAN

 },

 eventA4 SEQUENCE {

 a4-Threshold ThresholdEUTRA

 },

 eventA5 SEQUENCE {

 a5-Threshold1 ThresholdEUTRA,

 a5-Threshold2 ThresholdEUTRA

 },

 ...,

 eventA6-r10 SEQUENCE {

 a6-Offset-r10 INTEGER (-30..30),

 a6-ReportOnLeave-r10 BOOLEAN

 },

 eventC1-r12 SEQUENCE {

 c1-Threshold-r12 ThresholdEUTRA-v1250,

 c1-ReportOnLeave-r12 BOOLEAN

 },

 eventC2-r12 SEQUENCE {

 c2-RefCSI-RS-r12 MeasCSI-RS-Id-r12,

 c2-Offset-r12 INTEGER (-30..30),

 c2-ReportOnLeave-r12 BOOLEAN

 },

 eventV1-r14 SEQUENCE {

 v1-Threshold-r14 SL-CBR-r14

 },

 eventV2-r14 SEQUENCE {

 v2-Threshold-r14 SL-CBR-r14

 },

 eventH1-r15 SEQUENCE {

 h1-ThresholdOffset-r15 INTEGER (0..300),

 h1-Hysteresis-r15 INTEGER (1..16)

 },

 eventH2-r15 SEQUENCE {

 h2-ThresholdOffset-r15 INTEGER (0..300),

 h2-Hysteresis-r15 INTEGER (1..16)

 }

 },

 hysteresis Hysteresis,

 timeToTrigger TimeToTrigger

 },

 periodical SEQUENCE {

 purpose ENUMERATED {

 reportStrongestCells, reportCGI}

 }

 },

 triggerQuantity ENUMERATED {rsrp, rsrq},

 reportQuantity ENUMERATED {sameAsTriggerQuantity, both},

 maxReportCells INTEGER (1..maxCellReport),

 reportInterval ReportInterval,

 reportAmount ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},

 ...,

 [[ si-RequestForHO-r9 ENUMERATED {setup} OPTIONAL, -- Cond reportCGI

 ue-RxTxTimeDiffPeriodical-r9 ENUMERATED {setup} OPTIONAL -- Need OR

 ]],

 [[ includeLocationInfo-r10 ENUMERATED {true} OPTIONAL, -- Need OR

 reportAddNeighMeas-r10 ENUMERATED {setup} OPTIONAL -- Need OR

 ]],

 [[ alternativeTimeToTrigger-r12 CHOICE {

 release NULL,

 setup TimeToTrigger

 } OPTIONAL, -- Need ON

 useT312-r12 BOOLEAN OPTIONAL, -- Need ON

 usePSCell-r12 BOOLEAN OPTIONAL, -- Need ON

 aN-Threshold1-v1250 RSRQ-RangeConfig-r12 OPTIONAL, -- Need ON

 a5-Threshold2-v1250 RSRQ-RangeConfig-r12 OPTIONAL, -- Need ON

 reportStrongestCSI-RSs-r12 BOOLEAN OPTIONAL, -- Need ON

 reportCRS-Meas-r12 BOOLEAN OPTIONAL, -- Need ON

 triggerQuantityCSI-RS-r12 BOOLEAN OPTIONAL -- Need ON

 ]],

 [[ reportSSTD-Meas-r13 BOOLEAN OPTIONAL, -- Need ON

 rs-sinr-Config-r13 CHOICE {

 release NULL,

 setup SEQUENCE {

 triggerQuantity-v1310 ENUMERATED {sinr} OPTIONAL, -- Need ON

 aN-Threshold1-r13 RS-SINR-Range-r13 OPTIONAL, -- Need ON

 a5-Threshold2-r13 RS-SINR-Range-r13 OPTIONAL, -- Need ON

 reportQuantity-v1310 ENUMERATED {rsrpANDsinr, rsrqANDsinr, all}

 }

 } OPTIONAL, -- Need ON

 useWhiteCellList-r13 BOOLEAN OPTIONAL, -- Need ON

 measRSSI-ReportConfig-r13 MeasRSSI-ReportConfig-r13 OPTIONAL, -- Need ON

 includeMultiBandInfo-r13 ENUMERATED {true} OPTIONAL, -- Cond reportCGI

 ul-DelayConfig-r13 UL-DelayConfig-r13 OPTIONAL -- Need ON

 ]],

 [[ ue-RxTxTimeDiffPeriodicalTDD-r13 BOOLEAN OPTIONAL -- Need ON

 ]],

 [[

 purpose-v1430 ENUMERATED {reportLocation, sidelink, spare2, spare1}

 OPTIONAL -- Need ON

 ]],

 [[

 maxReportRS-Index-r15 INTEGER (0..maxRS-IndexReport-r15) OPTIONAL -- Need ON

 ]],

 [[ includeBT-Meas-r15 BT-NameListConfig-r15 OPTIONAL, -- Need ON

 includeWLAN-Meas-r15 WLAN-NameListConfig-r15 OPTIONAL, -- Need ON

 purpose-r15 ENUMERATED {sensing} OPTIONAL, -- Need ON

 numberOfTriggeringCells-r15 INTEGER (2..maxCellReport) OPTIONAL, -- Cond a3a4a5

 a4-a5-ReportOnLeave-r15 BOOLEAN OPTIONAL -- Cond a4a5

 ]],

 [[ condReconfigurationTriggerEUTRA-r16 CondReconfigurationTriggerEUTRA-r16 OPTIONAL,

-- Need ON

 ul-DelayValueConfig-r16 UL-DelayValueConfig-r16 OPTIONAL -- Need ON

 ]]

}

CondReconfigurationTriggerEUTRA-r16 ::= SEQUENCE {

 condEventId-r16 CHOICE {

 condEventA3-r16 SEQUENCE {

 a3-Offset-r16 INTEGER (-30..30),

 hysteresis-r16 Hysteresis,

 timeToTrigger-r16 TimeToTrigger

 },

 condEventA5-r16 SEQUENCE {

 a5-Threshold1-r16 ThresholdEUTRA,

 a5-Threshold2-r16 ThresholdEUTRA,

 hysteresis-r16 Hysteresis,

 timeToTrigger-r16 TimeToTrigger

 },

 ...

 }

}

RSRQ-RangeConfig-r12 ::= CHOICE {

 release NULL,

 setup RSRQ-Range-v1250

}

ThresholdEUTRA ::= CHOICE{

 threshold-RSRP RSRP-Range,

 threshold-RSRQ RSRQ-Range

}

ThresholdEUTRA-v1250 ::= CSI-RSRP-Range-r12

MeasRSSI-ReportConfig-r13 ::= SEQUENCE {

 channelOccupancyThreshold-r13 RSSI-Range-r13 OPTIONAL -- Need OR

}

-- ASN1STOP

| *ReportConfigEUTRA* field descriptions |
| --- |
| ***a3-Offset/ a6-Offset/ c2-Offset***Offset value to be used in EUTRA measurement report triggering condition for event a3/ a6/ c2, or to be used in conditional reconfiguration trigger condition for cond event a3. The actual value is field value \* 0.5 dB. |
| ***a5-Threshold1/ a5-Threshold2***Threshold value associated to the selected trigger quantity (e.g. RSRP, RSRQ, SINR) to be used in conditional reconfiguration trigger condition for cond event a5. In the same *condeventA5*, the network configures the same quantity for the *TriggerQuantity* of the *a5-Threshold1* and for the *MeasTriggerQuantity* of the *a5-Threshold2*. |
| ***alternativeTimeToTrigger***Indicates the time to trigger applicable for cells specified in *altTTT-CellsToAddModList* of the associated measurement object, if configured |
| ***aN-ThresholdM/ cN-ThresholdM***Threshold to be used in EUTRA measurement report triggering condition for event number aN/ cN. If multiple thresholds are defined for event number aN/ cN, the thresholds are differentiated by M. E-UTRAN configures *aN-Threshold1* only for events A1, A2, A4, A5 and *a5-Threshold2* only for event A5. |
| ***c1-ReportOnLeave/ c2-ReportOnLeave***Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a CSI-RS resource in *csi-RS-TriggeredList*, as specified in 5.5.4.1. |
| ***c2-RefCSI-RS***Identity of the CSI-RS resource from the *measCSI-RS-ToAddModList* of the associated *measObject*, to be used as the reference CSI-RS resource in EUTRA measurement report triggering condition for event c2. |
| ***channelOccupancyThreshold***RSSI threshold which is used for channel occupancy evaluation. |
| ***condEventId***Choice of conditional reconfiguration event triggered criteria. |
| ***condReconfigurationTriggerEUTRA***Event configured for conditional reconfiguration. If this field is configured, the UE shall ignore the configuration of *triggerType, reportQuantity, maxReportCells, reportInterval,* and *reportAmount.* |
| ***eventId***Choice of E‑UTRA event triggered reporting criteria. EUTRAN may set this field to *eventC1* or *eventC2* only if *measDS-Config* is configured in the associated *measObject* with one or more CSI-RS resources. The *eventC1* and *eventC2* are not applicable for the *eventId* if RS-SINR is configured as *triggerQuantity* or *reportQuantity*. |
| ***h1-Hysteresis, h2-Hysteresis***This parameter is used within the entry and leave condition of an event triggered reporting condition for event H1 and event H2. The actual value is field value. If this field is configured UE shall ignore parameter *hysteresis.* |
| ***h1-ThresholdOffset, h2-ThresholdOffset***An offset value to *heightThreshRef* to obtain the threshold to be used in EUTRA height report triggering condition for event H1 and event H2. The value for h1-ThresholdOffset and h2-ThresholdOffset is expressed in meters such that granularity is 2meters. Value 0 corresponds to offset value 0m, value 1 corresponds to offset value 2m, value 2 correspond to offset value 4m, and so on. |
| ***includeMultiBandInfo***If this field is present, the UE shall acquire and include multi band information in the measurement report. |
| ***maxReportCells***Max number of cells, excluding the serving cell, to include in the measurement report concerning CRS, and max number of CSI-RS resources to include in the measurement report concerning CSI-RS. |
| ***measRSSI-ReportConfig***If this field is present, the UE shall perform measurement reporting for RSSI and channel occupancy and ignore the *triggerQuantity*, *reportQuantity* and *maxReportCells* fields. E-UTRAN sets this field to *true* only when setting *triggerType* to *periodical* and *purpose* to *reportStrongestCells*. |
| ***numberOfTriggeringCells***Indicates the number of cells detected that are required to fulfill an event for a measurement report to be triggered. This field is set only for the events concerning neighbor cells, i.e. *eventA3*, *eventA4, eventA5*. |
| ***reportAmount***Number of measurement reports applicable for *triggerType* *event* as well as for *triggerType* *periodical*. In case *purpose* is set to *reportCGI* or *reportSSTD-Meas* is set to *true*, only value 1 applies. |
| ***reportCRS-Meas***If this field is set to *TRUE* the UE shall include rsrp, rsrq together with csi-rsrp in the measurement report, if possible. |
| ***reportOnLeave/ a6-ReportOnLeave/ a4-a5-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. |
| ***reportQuantity***The quantities to be included in the measurement report***.*** The value both means that both the rsrp and rsrq quantities are to be included in the measurement report. The value *rsrpANDsinr* and *rsrqANDsinr* mean that both *rsrp* and *rs-sinr* quantities, and both *rsrq* and *rs-sinr* quantities are to be included respectively in the measurement report. The value *all* means that *rsrp*, *rsrq* and *rs-sinr* are to be included in the measurement report. In case *triggerQuantityCSI-RS* is set to *TRUE*, only value *sameAsTriggerQuantity* applies. If *reportQuantity*-v*1310* is configured, the UE only considers this extension (and ignores *reportQuantity* i.e. without suffix). |
| ***reportSSTD-Meas***If this field is set to *true*, the UE shall measure SSTD between the PCell and the PSCell as specified in TS 36.214 [48] and ignore the *triggerQuantity*, *reportQuantity* and *maxReportCells* fields. E-UTRAN sets this field to *true* only when setting *triggerType* to *periodical* and *purpose* to *reportStrongestCells*. |
| ***reportStrongestCSI-RSs***Indicates that periodical CSI-RS measurement report is performed. EUTRAN configures value *TRUE* only if *measDS-Config* is configured in the associated *measObject* with one or more CSI-RS resources. |
| ***si-RequestForHO***The field applies to the *reportCGI* functionality, and when the field is included, the UE is allowed to use autonomous gaps in acquiring system information from the neighbour cell, applies a different value for T321, and includes different fields in the measurement report. |
| ***ThresholdEUTRA***For RSRP: RSRP based threshold for event evaluation. The actual value is field value – 140 dBm.For RSRQ: RSRQ based threshold for event evaluation. The actual value is (field value – 40)/2 dB.For RS-SINR: RS-SINR based threshold for event evaluation. The actual value is (field value -46)/2 dB.For CSI-RSRP: CSI-RSRP based threshold for event evaluation. The actual value is field value – 140 dBm.EUTRAN configures the same threshold quantity for all the thresholds of an event. |
| ***timeToTrigger***Time during which specific criteria for the event needs to be met in order to trigger a measurement report, or to execute the conditional reconfiguration evaluation. |
| ***triggerQuantity***The quantity used to evaluate the triggering condition for the event concerning CRS***.*** EUTRAN sets the value according to the quantity of the *ThresholdEUTRA* for this event. The values rsrp, rsrq and *sinr* correspond to Reference Signal Received Power (RSRP), Reference Signal Received Quality (RSRQ) and Reference Signal Signal to Noise and Interference Ratio (RS-SINR), see TS 36.214 [48]. If *triggerQuantity-v1310* is configured, the UE only considers this extension (and ignores *triggerQuantity* i.e. without suffix). |
| ***triggerQuantityCSI-RS***The quantity used to evaluate the triggering condition for the event concerning CSI-RS***.*** The value *TRUE* corresponds to CSI Reference Signal Received Power (CSI-RSRP), see TS 36.214 [48]. E-UTRAN configures value *TRUE* if and only if the measurement reporting event concerns CSI-RS. |
| ***ue-RxTxTimeDiffPeriodical***If this field is present, the UE shall perform UE Rx-Tx time difference measurement reporting and ignore the fields *triggerQuantity*, *reportQuantity* and *maxReportCells*. If the field is present, the only applicable values for the corresponding *triggerType* and *purpose* are periodical and reportStrongestCells respectively. |
| ***ue-RxTxTimeDiffPeriodicalTDD***If this field is set to *TRUE*, the UE shall performUE Rx-Tx time difference measurement reporting according to EUTRAN TDD UE Rx-Tx time difference report mapping in TS 36.133 [16]. If the field is configured, the *ue-RxTxTimeDiffPeriodical* shall be configured. The field is applicable for TDD only. |
| ***usePSCell***If this field is set to *TRUE* the UE shall use the PSCell instead of the PCell. E-UTRAN configures value *TRUE* only for events A3 and A5, see 5.5.4.4 and 5.5.4.6. |
| ***useT312***If value *TRUE* is configured, the UE shall use the timer T312 with the value *t312* as specified in the corresponding *measObject*. If the corresponding *measObject* does not include the timer T312 then the timer T312 is considered as not configured. E-UTRAN configures value *TRUE* only if *triggerType* is set to *event*. |
| ***useWhiteCellList***Indicates whether only the cells included in the white-list of the associated *measObject* are applicable as specified in 5.5.4.1. E-UTRAN does not configure the field for events A1, A2, C1 and C2. |
| ***ul-DelayConfig***If the field is present, E-UTRAN configures UL PDCP Packet Delay per QCI measurement and the UE shall ignore the fields *triggerQuantity* and *maxReportCells*. The applicable values for the corresponding *triggerType* and *reportInterval* are *periodical* and (one of the) ms1024, ms2048, ms5120 or ms10240respectively.The *reportInterval* indicates the periodicity for performing and reporting of UL PDCP Delay per QCI measurement as specified in TS 36.314 [71]. |
| ***ul-DelayValueConfig***If the field is present, the UE shall perform the UL PDCP Packet Delay measurement per DRB as specified in TS 38.314 [103] and the UE shall ignore the fields *reportQuantityCell* and *maxReportCells*. The applicable values for the corresponding *reportInterval* are (one of the) { ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, min1, min6, min12, min30, min60}. The *reportInterval* indicates the periodicity for performing and reporting of UL PDCP Packet Delay per DRB measurement as specified in TS 38.314 [103]. |

| Conditional presence | Explanation |
| --- | --- |
| *reportCGI* | The field is optional, need OR, in case *purpose* is included and set to *reportCGI*; otherwise the field is not present and the UE shall delete any existing value for this field. |
| *a3a4a5* | This field is optional, need OR, in case eventId is set to eventA3 or eventA4 or eventA5; otherwise, this field is not present and the UE shall delete any existing value of this field. |
| *a4a5* | This field is optional, need OR, in case eventId is set to eventA4 or eventA5; otherwise, this field is not present and the UE shall delete any existing value of this field. |

– *UL-DelayConfig*

The IE *UL-DelayConfig* IE specifies the configuration of the UL PDCP Packet Delay per QCI measurement specified in TS 36.314 [71].

***UL-DelayConfig* information element**

-- ASN1START

UL-DelayConfig-r13 ::= CHOICE {

 release NULL,

 setup SEQUENCE {

 delayThreshold-r13 ENUMERATED {

 ms30, ms40, ms50, ms60, ms70, ms80,

 ms90,ms100, ms150, ms300, ms500, ms750, spare4,

 spare3, spare2, spare1}

 }

}

-- ASN1STOP

| ***UL-DelayConfig* field descriptions** |
| --- |
| ***delayThreshold***Indicates the delay threshold value used by UE to provide results of UL PDCP Packet Delay per QCI measurement as specified in TS 36.314 [71]. Value in milliseconds. Value ms30 means 30 ms and so on. |

## 5.3 LTE metric – Execess Packet Delay Ratio in TS 37.320 (UE capabilities)

*Note: the relevant definitions are in red.*

### 5.1.4 UE capabilities

MDT relevant UE capabilities are component of radio access UE capabilities. Thus, the procedures used for handling UE radio capabilities over (E-)UTRAN and NR apply.

For (E-)UTRAN:

- The UE indicates one capability bit for support for Logged MDT, which indicates that the UE supports logging of downlink pilot strength measurements. The UE may also indicate capability for stand-alone GNSS positioning.

- The E-UTRA UE may indicate a capability for RX-TX time difference measurement for E-CID positioning for MDT.

- The E-UTRA UE may indicate a capability for support of logging of MBSFN measurements.

- The E-UTRA UE may indicate a capability for support of UL PDCP delay measurement when the UE is not configured with MR-DC.

- The E-UTRA UE may indicate a capability for support of UL PDCP Packet Average Delay measurement when the UE is configured with EN-DC.

- The E-UTRA UE may indicate a capability for support of Bluetooth measurements in RRC idle mode.

- The E-UTRA UE may indicate a capability for support of WLAN measurements in RRC idle mode.

- The E-UTRA UE may indicate a capability for support of Bluetooth measurements in RRC connected mode.

- The E-UTRA UE may indicate a capability for support of WLAN measurements in RRC connected mode.

- For UMTS support of the Accessibility measurements is an optional UE feature.

For NR:

- The UE indicates one capability bit for support for Logged MDT in RRC idle and inactive mode, to indicate that the UE supports logging of downlink pilot strength measurements, periodical logging and event-triggered logging.

- The UE may indicate capability for stand-alone GNSS positioning.

- The NR UE may indicate a capability for support of UL PDCP delay measurement.

- The NR UE may indicate a capability for support of Bluetooth measurements in RRC idle and inactive mode.

- The NR UE may indicate a capability for support of WLAN measurements in RRC idle and inactive mode.

- The NR UE may indicate a capability for support of Bluetooth measurements in RRC connected state.

- The NR UE may indicate a capability for support of WLAN measurements in RRC connected state.

- The NR UE may indicate a capability for support of barometer measurements.

- The NR UE may indicate a capability for support of orientation measurements.

- The NR UE may indicate a capability for support of speed measurements.