**3GPP TSG-RAN WG2 Meeting #109 electronic R2-2001993**

24th Feb – 6th Mar 2020

**Agenda Item: 6.12.3 L2 measurements**

**Source: CMCC**

**Title: Report for [AT109e][805][SON/MDT]L2 open issues (CMCC)**

**Document for: Discussion and decision**

# 1 Introduction

This email discussion is based on the summary of L2 measurement in R2-2000909, mainly focus on cat b open issues.

* [AT109e][805][SON/MDT]L2 open issues (CMCC)

 Intended outcome: email discussion report in R2-2001993

 Deadline: CET 23:00, 2020/02/28

During RAN2#109e first week online, RAN2 achieve the following agreements:

Agreements:

1 Granularity for per UE measurement performed by UE (i.e. D1 queueing delay) is per DRB per UE for non-split case.

2 Granularity for per UE measurement performed by network (i.e D2 delay, loss rate) is per DRB per UE.

4 Capture in TS 38.314 that for PRB usage measurements that have been defined in TS 28.552, i.e. DL/UL Total PRB Usage, Distribution of DL/UL Total PRB Usage, M(T), M1(T), P(T) are measured per cell level. P(T) is the total available PRBs for this cell. M1(T) is the PRBs used for traffic transmission in this cell.

5 For EN-DC UL D1 delay measurement configuration for non-split bearer,

- D1 measurement of MN terminated bearer(including non-split bearer) can be configured by MN,

- D1 measurement of SN terminated bearer(including non-split bearer) can be configured by SN via RRC message (SRB3 or SRB1).

- For the SN terminated bearers, it is the SN to configure and calculate the UL/DL delay.

6 Capture a general definition of DL measurement in TS 38.314:

Packet delay includes RAN part of delay and CN part of delay. For RAN part, the DL delay comprises:

- D1 (the DL delay in gNB-DU), referring to 5.1.1.1.1 Average delay DL air-interface in TS 28.552

- D2 (the DL delay on F1-U), referring to 5.1.3.3.2 Average delay on F1-U in TS 28.552

- D3 (the DL delay in CU-UP), referring to 5.1.3.3.1 Average delay DL in CU-UP in TS 28.552

7 The flooring operation associated to the definition of mean number of active UEs is removed.

As guided by session chairman, the discussion will focus on only the critical issues, without which the SON/MDT feature won't work. All the others things which make SON/MDT work better should be postponed to R17.

**Therefore, for all the cat b/c issues, rapporteur suppose that if it is not a critical issue and no quick consensus reached, we would better postpone it to next release.**

# 2 Discussion on open issues

## 2.1 Per DRB granularity

In the agreement above, the original proposal 3 is not captured and can be clarified further as follows:

**Proposal 3.1: ‘Granularity for per cell measurement performed by network (only for number of active UE) is per DRB per cell.’**

**Proposal 3.2: ‘And add a clarification in 38.314 that all the per DRB per cell measurements and per DRB per UE measurements can be aggregated into per QoS level per cell by network implementation.’.**

**Q1.1: Do companies agree with above Proposal 3.1 and 3.2?**

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| Company | Yes/No | Comments |
| CMCC | Yes | The clarification in Proposal 3.2 can be added in the front of ‘chapter 4 Layer 2 measurement’ in 38.314, to indicate it apply to all the per DRB per cell and per DRB per UE measurements. |
| QUALCOMM | yes |  |
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**Q1.2: Regarding to how to reflect per DRB measurement in 38.314, can we use ‘*drbid*’ in the matrix for each measurement?**

Here are 3 examples:

Number of active UE per DRB per cell:

$$M(T,drbid,p)=\left⌊\frac{\sum\_{∀i}^{}N(i,drbid)}{I(T,p)}\right⌋$$

D2.1 delay per DRB per UE:

$$M(T,drbid)=\left⌊\frac{\sum\_{∀i}^{}tSucc(i)-tSched(i)}{I(T)}\right⌋$$

D1 delay per DRB per UE:

$$M\left(T,drbid\right)=\left⌊\frac{\sum\_{∀i}^{}tDeliv\left(i\right)-tArrival\left(i\right)}{I\left(T\right)}\right⌋$$

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| Company | Yes/No | Comments |
| CMCC | Yes |  |
| QUALCOMM | yes |  |
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## 2.2 PRB usage

It has been agreed that PRB usage defined by SA5 should be measured at per cell level.

Another open points is that, different from the EUTRA PRB, the NR PRB is defined in frequency but not in time. So the PRB term may not be a suitable unit for counting PRB usage.

In TS 38.211, RB is defined as “A resource block is defined as $N\_{sc}^{RB}=12$ consecutive subcarriers in the frequency domain. ” So it would be better to utilize 1 RB x 1 symbol to calculate PRB usage measurement.

**Proposal 5(Cat b): Capture in TS 38.314 that the counting unit for PRB usage measurement is 1 RB x 1 symbol. (1 RB=12 sub-carrier)**

Q2: Do you agree with above proposal 5?

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| Company | Yes/No | Comments |
| CMCC | Yes |  |
| QUALCOMM | Yes |  |
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## 2.3 Delay measurement

For UL D1 delay measurement configuration in EN-DC, RAN2 has achieved following agreements

5 For EN-DC UL D1 delay measurement configuration for non-split bearer,

- D1 measurement of MN terminated bearer(including non-split bearer) can be configured by MN,

- D1 measurement of SN terminated bearer(including non-split bearer) can be configured by SN via RRC message (SRB3 or SRB1).

- For the SN terminated bearers, it is the SN to configure and calculate the UL/DL delay.

###### Issue 3.2: For split bearer, does UE perform a single D1 measurement or 2 independent D1 measurements?

Qualcomm[1] thought there is no need to report the single D1 value to both MN and SN respectively which costs unnecessary signalling overhead. While Ericsson[8] thought that two different D1 measurements needs to be performed by the UE, independently one each for MN associated D1 delay and SN associated D1 delay in the split bearer configurations. Huawei, HiSilicon[16] share same view with Ericsson that the scheduling latency are different in the two paths, but prefer the UE to report two D1s to the RAN node where it receives the measurement configuration.

**Proposal 7(Cat b): RAN2 is kindly asked to make decision among following options:**

**Option 1:**

* **For the UL PDCP packet average queuing delay measurement for split bearer, UE reports a single D1 value to the node where it receives the measurement configuration.**

**Option 2:**

* **MN and SN can independently configure the UE with D1 measurements in the split bearer configurations.**
* **The UE shall perform two independent D1 delay measurements in the split bearer configuration, one for MN associated D1 delay measurement and the other for SN associated D1 delay measurement.**
* **The UE shall report the MN configured D1 delay measurement to the MN and the SN configured D1 delay measurement to the SN.**

**Option 3:**

* **the UE should report two D1s in MR-DC to the RAN node where it receives the measurement configuration.**

**Question 3.2: For split bearer case for EN-DC, which node can configure UE with D1 measurement? And does UE report 1 single D1 or 2 separate D1?**

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| Company | Which node can configure D1 for split bearer? | UE report 1 single D1 or 2 separate D1? |
| CMCC | No strong view, we slightly prefer Option 2 or 3.  | Option 2 or 3 |
| QUALCOMM | Option 1  | For the Split bearer, there is only one PDCP buffer, thus for the UL PDCP packet queuing delay measurement, UE can only report single D1 value for the split bearer for both MCG and SCG. |
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###### Issue 3.3: How to derive final delay for split bearer considering with or without PDCP duplication?

Huawei, HiSilicon[16] thought that for the split bearer configured with PDCP duplication, the packets of these two paths are the same. Therefore the node hosting the PDCP entity can use the min value of these two paths. For the split bearer configured without PDCP duplication, the packets of these two paths are not the same. Therefore the node hosting the PDCP entity can use the average value of these two paths.

**Proposal 8(Cat b): For the split bearer, the node hosting the PDCP entity derives the delay of the split bearers based on the delay of two paths.**

**- For split bearer with PDCP duplication, the final delay is the min value of measured results of two paths**

**- For split bearer without PDCP duplication, the final delay is the average value of measured results of two paths**

Question 3.3: Are you agree with above proposal?

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| Company | Support or not | comments |
| QUALCOMM | No | The proposed split bearer with PDCP duplication UL delay measurement impacts UE a lot because it involves the PDCP duplication detection between PDCP and RLC, we prefer to reuse UL delay measurement w/o duplication method to support duplication cases for this release |
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###### Issue 3.4: Whether CA duplication has impact on the split bearer delay measurement?

Huawei, HiSilicon[16] thought that for CA, the packets are transmitted via multi-paths in the same node. Therefore there is no X2/Xn delay difference among these paths. We think the air delay of these paths are similar. Therefore the measurements performed by the UE and the measurements performed by the gNB does not need to distinguish the transmission in these paths. For the CA based duplication, the UE and gNB can measure the delay assuming the packets of these paths are different.

**Proposal 9(Cat b): For the CA duplication bearer, the UE and gNB measure the UL/DL delay assuming the packets of multi-paths are different.**

Question 3.4: Are you agree with above proposal?

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| Company | Support or not | comments |
| QUALCOMM | Yes |  |
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###### Issue 3.5: Unit for delay measurement

CATT[2] observed that the unit RAN2 used for UL delay in 38.314 is “millisecond” (ms). The delay defined by SA5 is in “microsecond” (us). And D2.3(F1 delay) reuses the DL F1 delay which defined in TS28.552, the units is “microsecond” (us). CATT[2] thought that the different parts of the UL delay in RAN side use the different units, and cannot be added together.

**Proposal 10(Cat b): Confirm the unit of the UL PDCP queuing delay reported by UE is “ms” and add a section of “UL F1 delay” in TS38.314 with “ms” unit.**

**Proposal 11(Cat b): RAN2 to confirm the unit of UL PDCP queueing delay is 0.1ms (Current 38.331CR), instead of 1ms (last agreement).**

Question 3.5: Are you agree with above proposals?

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| Company | Support or not | comments |
| QUALCOMM | Proposal 10 is ok | For Proposal 11, we prefer to keep last RAN2 agareement |
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###### Issue 3.6: Value range for *ReportInterval*

The value range for *ReportInterval* in 38.331 CR is still open. CATT[2] propose to use the following values.

Proposal 12(Cat b): Set the value range of the *reportInterval* field for UL delay measurement to:

* For PDCP queuing excess delay measurement, use “ms1024, ms2048, ms5120 or ms10240” (if the measurement is maintained in NR);
* For average PDCP queuing delay measurement, use “ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120 or ms10240”.

Above proposal has already been discussed in MDT topic.

###### Issue 3.7: Introducing Min and max value for delay measurement

In addition to average delay measurement, Huawei, HiSilicon[13] see benefits to also have min and max value in the same period as the average delay.

**Proposal 13(Cat b): It is proposed to introduce min and max value for delay measurement in addition to the average delay.**

Question 3.7: Are you agree with above proposals?

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| Company | Support or not | comments |
| CMCC | Support  | The TP provided in R2-2001370 is fine for us.Question for clarification, does the proposal apply to both D1 and D2 delays? |
| QUALCOMM | No | UL PDCP packet delay measurement has been discussed in RAN2 for a long time, we think the average PDCP queuing delay measurement is sufficient. |
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###### Issue 3.8: Whether to introduce excess delay measurement in NR?

* **Support: Huawei, HiSilicon[11], ZTE[20]**
* **Not support: Qualcomm[1]**

During email discussion, companies have different understanding on the agreement 2 in last meeting, and no consensus is reached during the email discussion. Rapporteur suggests RAN2 to make final decision in the coming meeting.

Huawei, HiSilicon[11], ZTE[20] though that with the excess delay measurement, the network can know the delay distribution and thus some optimization means can be considered. Both delay measurements are useful and they are beneficial for monitoring delay status.

While, Qualcomm[1] thought that all the information provided by UL PDCP packet excess delay ratio measurement can be provided by UL PDCP packet average queuing delay. And it doesn’t bring any benefit to the network by requiring UE to report D1 as UL PDCP packet excess delay ratio meanwhile at the RAN node side, the remaining part of RAN delay(D2) is measured as average delay.

It is clearly that 2 network vendor support to introduce excess delay to know more about delay distribution. While 1 chipset vendor thinks there is no benefit. **If consensus can not be made during email discussion, we will postpone it to next release.**

**Proposal 14(Cat b): RAN2 is kindly asked to decide whether to support excess delay or not.**

**Question 3.8: In addition to the opinions in the above contributions, is there anything else companies want to comment? Otherwise, rapporteur suggest to postpone.**

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| Company | Support or not | comments |
| QUALCOMM | NO | As we know, UL PDCP packet excess delay ratio measurement was introduced in LTE for the QoS verification in MDT as a compromised method of average queuing delay measurement. In NR, per SA2 requirements on E2E delay measurement, UL PDCP average queuing delay measurement is supported. All the information provided by UL PDCP packet excess delay ratio measurement can be provided by UL PDCP packet average queuing delay, there is no need to support two UL PDCP packet delay measurement methods in NR. Secondly, QoS verification is end to end, it doesn’t bring any benefit to the network by requiring UE to report D1 as UL PDCP packet excess delay ratio meanwhile at the RAN node side, the remaining part of RAN delay(D2) is measured as average delay.Thirdly, there is only a single UE capability introduced in NR for UL delay measurement (ulPDCP-Delay) in NR, we don’t think it can be extended implicitly to require UE to support two UL delay measurement methods.**It is unnecessary to support UL PDCP packet excess delay ratio measurement in NR.** |
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If excess delay is supported, RAN2 also needs to discuss on the capability for UL PDCP delay measurement.

Proposal 15(Cat b): If both excess delay and everage measurements are supported, RAN2 also needs to discuss on the capability for UL PDCP delay measurement.

* **Option 1: 1 capability for supporting both measurements.**
* **Option 2: 2 separate capability for average delay and excess delay.**

**Question 3.9: Only if there is consensus on excess delay, we can further share views on capability for excess delay. Otherwise, please ignore this question.**

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| Company | Option 1 or 2 | comments |
| QUALCOMM | Option 2 | We don’t think it is necessary to introduce excess delay ratio measurement in NR. And if we have to do it, separate capability for average delay and excess delay is needed. |
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If Excess delay is supported, Huawei[14] thought that the M6 measurement should be a general measurement that at least covering measurements that need UE reporting, and it will be easy for RAN3 on the specification work, e.g. RAN3 needs to capture M6 measurement configuration in their specs.

Proposal 16(Cat b): M6 measurement in NR in TS 37.320 should cover at least delay ratio and average delay measurements.

Rapporteur suggest to not discuss proposal 16 until there is consensus on excess delay.

###### Issue 3.9: Some further enhancement for UL queueing delay measurement

Huawei[14] propose to introduce histogram of PDCP queueing delay.

**Proposal 17(Cat c): It is proposed RAN2 to discuss reporting of the histogram of the PDCP queuing delay. Network can configure more than one delay thresholds for the ratio reporting.**

Another proposal from Huawei[14] is that for delay for all packets, operators may want to know the x% worst delay value, e.g. x could be 99%. The reason behind is that such values can reflect the QoS on some certain levels and it can avoid too much measuerment reports. Therefore, we think the network can configure the reporting of the x% worst delay value.

**Proposal 18(Cat c): It is proposed RAN2 to discuss reporting of the x% worst delay value.**

Question 3.9: Do you support proposal 17&18 in Rel-16 or postpone it to next release?

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| Company | Support or not | Comments |
| CMCC | R17 | We agree with the intention to have clear view on distribution of delay. But we prefer to have the same enhancement on matrix for both D1 delay and D2 delay. Probably we can work on it in R17. |
| QUALCOMM | Rel-17 |  |
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###### ~~Issue 3.10: A general definition of DL measurement is missing~~

~~Huawei, HiSilicon [15] observed that a general definition of DL measurement is missing, and it may lead to some ambiguity on the whole DL measurement. One option is to capture a simple sentence to illustrate the definition in TS 38.314~~

~~Proposal 19(Cat b): Capture a general definition of DL measurement in TS 38.314:~~

~~Packet delay includes RAN part of delay and CN part of delay. For RAN part, the DL delay comprises:~~

~~- D1 (the DL delay in gNB-DU), referring to 5.1.1.1.1 Average delay DL air-interface in TS 28.552~~

~~- D2 (the DL delay on F1-U), referring to 5.1.3.3.2 Average delay on F1-U in TS 28.552~~

~~- D3 (the DL delay in CU-UP), referring to 5.1.3.3.1 Average delay DL in CU-UP in TS 28.552~~

Rapporteur note: The proposal above has already been agreed. No need to discuss

## 2.4 Number of UEs

###### Issue 4.1: Flooring operation may results to zeroing for low load scenario

The flooring operation is used in the mean number of active UEs definition so that the result can be defined as an integer. Ericsson and CMCC[7] observed that flooring operation for the mean number of active UEs results in ‘zeroing’ the information in low load scenario. The following agreement has been achieved.

7 The flooring operation associated to the definition of mean number of active UEs is removed.

In the annex of R2-2001112[7], a TP is provided with the following matrix for mean number of active UE.

$$M(T,drbid,p)=\frac{\left⌊\frac{\sum\_{∀i}^{}N(i,drbid)}{I(T,p)}\*10\right⌋}{10}$$

**Question 4.1: Is the above matrix for mean number of active UE per DRB per cell acceptable for you? If not, please provide a suggestion as well.**

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| Company | Support or not | Comments |
| CMCC | Support |  |
| QUALCOMM | support |  |
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###### Issue 4.2: Introducing number of inactive context per RNA

ZTE, Sanechips[3] observes that since network is always aware of the RNA inactive UE belongs to, it is possible to count the number of inactive UE context (both mean and maximum number) stored per RNA, which can be used for the RAN node to know the resource consumption in granularity of RNA level, therefore to help for configuration of RNA at network’s side.

**Proposal 23(Cat c): The number of UE inactive context stored (both mean and maximum number) can be counted per RNA to help the network to optimize the configuration of RNA.**

**Question 4.2: Do you support proposal 23 for Rel-16 or postpone to further release?**

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| Company | Support or not | Comments |
| QUALCOMM | No strong view |  |
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###### Issue 4.3: New measurement on Counting number of UE whose duration time in RRC\_INACTIVE is below a configured threshold

ZTE, Sanechips[3] thinks that inappropriate determination of state transition will send UE to RRC\_INACTIVE mode in vain, e.g., UE initiates RRC connection resume procedure shortly after transition to RRC\_INACTIVE mode, which delays the data transmission unnecessarily while consumes more power at UE’s side. The number of users whose duration time in RRC\_INACTIVE state is below a configured threshold can be used to diagnose if the decision on state transition is appropriate.

**Proposal 24(Cat c): To optimize the determination on state transition, measurement on the number of users whose duration time in RRC\_INACTIVE is below a configured threshold, shall be supported.**

**Proposal 25(Cat c): The number of UE, whose duration time in RRC\_INACTIVE is below a configured threshold, shall be count per cell, where the INACTIVE UE is considered “belongs to” the cell in which the UE was released from RRC\_CONNECTED state to RRC\_INACTIVE state.**

**Question 4.3: Do you support proposal 24&25 for Rel-16 or postpone to further release?**

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| Company | Support or not | Comments |
| QUALCOMM | Rel-17 |  |
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## 2.5 Throughput

###### Issue 5.1: Whether to inform TCE that DC duplication is enabled for throughput measurement

The immediate MDT related throughput measurement is performed at the RLC level (in the DU). Ericsson[9] observes that, in the DC based DL PDCP duplication scenario, the MN RLC and SN RLC receive the same set of packets to be transmitted the UE (DL scenario). If an immediate MDT session associated to throughput measurement in both MCG and SCG is activated for a given UE by the OAM, then the MN and the SN sends the respective RLC throughput measurements to the TCE. In the DC scenario, the TCE is unaware of whether the DC based DL PDCP duplication is enabled or disabled to this UE.

Ericsson[9] thinks that, for the DC scenario, there is a benefit in knowing whether the PDCP duplication is enabled or not while including the UE specific throughput measurements as part of immediate MDT.

**Proposal 26(Cat c): If the UE is in DC scenario and if the RAN node receives the signaling based MDT request associated to UE throughput measurements, the RAN node shall notify the TCE whether the PDCP duplication is enabled or not at per DRB level. Draft LS is also provided in [6].**

**Question 5: Do you support proposal 26 for Rel-16 or postpone to further release?**

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| Company | Support or not | Comments |
| QUALCOMM | Support |  |
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# 3 Reference

1. R2-2000000 Remaining Issues of UL PDCP Packet Average Queuing Delay Measurement Qualcomm Incorporated discussion Rel-16 38.314 NR\_SON\_MDT-Core
2. R2-2000103 Correction and Open Issues of UL Delay Measurement CATT discussion Rel-16 NR\_SON\_MDT-Core
3. R2-2000806 Further consideration on INACTIVE UE counting ZTE Corporation, Sanechips discussion Rel-16 NR\_SON\_MDT-Core
4. R2-2000909 Summary of L2M open points and proposals CMCC discussion NR\_SON\_MDT-Core Late
5. R2-2000910 Clarification for per cell PRB usage CMCC, Ericsson, Huawei discussion NR\_SON\_MDT-Core Revised
6. R2-2001110 [DRAFT] LS on throughput measurement in DC based PDCP duplication scenario Ericsson LS out Rel-16 NR\_SON\_MDT-Core To:TSG RAN3, SA5
7. R2-2001112 Definition of number of active UEs Ericsson, CMCC discussion
8. R2-2001113 Handling PDCP queueing delay measurements in split bearer scenario Ericsson discussion
9. R2-2001119 Throughput measurement in duplication scenario Ericsson discussion
10. R2-2001147 Per DRB measurements in TS38.314 Nokia, Nokia Shanghai Bell discussion Rel-16 NR\_SON\_MDT Late
11. R2-2001368 Discussion on per DRB and excess delay measurement for L2M Huawei, HiSilicon discussion Rel-16 NR\_SON\_MDT-Core
12. R2-2001369 TP on per DRB measurements for L2M Huawei, HiSilicon pCR Rel-16 38.314 0.0.3 NR\_SON\_MDT-Core
13. R2-2001370 Discussion on min and max value for delay measurements for L2M Huawei, HiSilicon discussion Rel-16 NR\_SON\_MDT-Core
14. R2-2001371 Discussion on UL delay measurements in non MR-DC Huawei, HiSilicon discussion Rel-16 NR\_SON\_MDT-Core
15. R2-2001372 Discussion on DL delay measurements Huawei, HiSilicon discussion Rel-16 NR\_SON\_MDT-Core
16. R2-2001373 Discussion on delay measurements for MR-DC and CA Huawei, HiSilicon discussion Rel-16 NR\_SON\_MDT-Core R2-1915856
17. R2-2001419 Clarification on PRB usage ZTE Corporation, Sanechips discussion Rel-16 R2-1915418 Withdrawn
18. R2-2001440 On Mapping 5QI to DRB Mediatek Inc discussion
19. R2-2001603 Clarification for per cell PRB usage CMCC, Ericsson, Huawei, ZTE discussion NR\_SON\_MDT-Core R2-2000910
20. R2-2000907 Summary of open points in [108#91][NR/L2M] running 38.314 CR (CMCC) CMCC discussion Rel-16 NR\_SON\_MDT-Core