**3GPP TSG-RAN WG2 Meeting #116bis electronic R2-2xxxxx**

**Electronic Meeting, Jan 17-25, 2022**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.314** | **CR** | **draft** | **rev** | **-** | **Current version:** | **16.4.0** |  |
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| *For* [***HELP***](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:***  | Running CR for TS 38.314 |
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| ***Source to WG:*** | CMCC |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_ENDC\_SON\_MDT\_enh-Core |  | ***Date:*** | 2022-1-17 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | PRB usage for MIMO was specified in Rel-16 for actually reflect the PRB usage at the case of MU-MIMO and multiple MIMO layers. Alpha in the matrix was constant integer value. But in the real network, the integer value may not be suitable for some cases. Operator sometime need to configure Alpha with float value. It is also proposed to correct the error in the legacy matrix for PRB usage for MIMO. Since for each sampling occasion (i.e., OFDM symbol), the available PRB is not always the same, due to occupied by reference signalling, SSB, PDCCH etc. So using a constant value N(T) as the number of available PRB is not accurate. Therefore, the number of available PRB should be corrected as the sum of available PRB for each sampling occasion.In addition, configuring the same constant value Alpha for all the cells is not suitable, especially for cells in bad radio condition. And it is also difficult to manually configure Alpha for each cell, considering the large number of NR base stations. Therefore, from deployment and maintenance point of view, it is valuable to introduce a new PRB usage matrix with Alpha autonomously adjusted, e.g., based on statistical data of MIMO layer, the variable value can be named, e.g., β.PDCP excess packet delay is an enhancement of D1 measurement (UL PDCP Packet Average Delay per DRB per UE) and URLLC services are the main use cases. RAN2#116-e meeting, the agreements are as follows:1 Alpha in PRB Usage for MIMO is changed to float value 1.00~100.002 Introduce a new PRB usage matrix with Alpha autonomously adjusted based on statistical data of MIMO layer, the variable value can be called β.1 The new delay measurement can be called excess packet delay for NR.2 FFS: 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)3 The network can collect the measurement excess packet delay for NR from the UE.4 LTE excess packet delay reporting can be used as a baseline, and details can be further discussed.This CR is to implement the agreements. |
|  |  |
| ***Summary of change:*** | The following are added or corrected to support PRB usage for MIMO* Correct the metrics for PRB usage for MIMO
* Correct the granularity for Alpha
* Add the new metric for PDSCH PRB Usage based on statistical MIMO layer in the DL per cell
* Add the new metric for PUSCH PRB Usage based on statistical MIMO layer in the UL per cell
* Add the new metric for Enhanced PDSCH PRB Usage for MIMO in the DL per cell
* Add the new metric for Enhanced PUSCH PRB Usage for MIMO in the UL per cell
* Add the new metric for PDCP excess packet delay
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|  |  |
| ***Consequences if not approved:*** | It is not possible to support PRB usage for MIMO based on autonomous MIMO layer value and PDCP excess packet delay. |
|  |  |
| ***Clauses affected:*** | 4.2.1.7.1, 4.2.1.7.2, 4.2.1.7.a (new), 4.2.1.7.b (new), 4.2.1.7.c (new), 4.2.1.7.d (new), 4.3.1.e (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |

## << Start of changes >>

4 Layer 2 measurements

4.2.1 Measurements valid for all gNB deployment scenarios

## << Partially omitted >>

4.2.1.7 PRB Usage for MIMO

4.2.1.7.1 PDSCH PRB Usage for MIMO in the DL per cell

This measurement provides the total usage (in percentage) of PDSCH physical resource blocks (PRBs) for MIMO in the downlink per cell. The objective of the measurement is to measure usage of time and frequency resources. A use-case is OAM performance observability.

Protocol Layer: MAC, PHY

Table 4.2.1.7.1-1: Definition for PDSCH PRB Usage for MIMO in the DL per cell

|  |  |
| --- | --- |
| Definition | PDSCH PRB Usage for MIMO in the DL per cell is calculated in the time-frequency domain.Detailed Definition:whereexplanations can be found in the table 4.2.1.7.1-2 below. |

Table 4.2.1.7.1-2: Parameter description for PDSCH PRB Usage for MIMO in the DL per cell

|  |  |
| --- | --- |
|  | Total PDSCH PRB usage per cell which is percentage of PRBs used, averaged during time period with integer value range: 0-100 |
|  | A count of PDSCH PRBs used for traffic transmission for UE on single MIMO layer per cell at sampling occasion .Counting unit for PRB is 1 Resource Block x 1 symbol. (1 Resource Block = 12 sub-carrier) |
|  | The number of MIMO layers scheduled for UE at sampling occasion .  |
|  | A UE that is scheduled during time period 𝑇.  |
|  | Sampling occasion during time period T. A sampling occasion is 1 symbol. |
|  |  |
|  | Total number of PDSCH PRBs available for sampling occasion j on single MIMO layer per cell. |
|  | Time Period during which the measurement is performed. |
|  | Constant value configured by OAM with float value range: 1.00-100.00. With this parameter, should not be larger than 100. |

4.2.1.7.2 PUSCH PRB Usage for MIMO in the UL per cell

This measurement provides the total usage (in percentage) of PUSCH physical resource blocks (PRBs) for MIMO in the uplink per cell. The objective of the measurement is to measure usage of time and frequency resources. A use-case is OAM performance observability.

Protocol Layer: MAC, PHY

Table 4.2.1.7.2-1: Definition for PUSCH PRB Usage for MIMO in the UL per cell

|  |  |
| --- | --- |
| Definition | PUSCH PRB Usage for MIMO in the UL per cell is calculated in the time-frequency domain.Detailed Definition:whereexplanations can be found in the table 4.2.1.7.2-2 below. |

Table 4.2.1.7.2-2: Parameter description for PUSCH PRB Usage for MIMO in the UL per cell

|  |  |
| --- | --- |
|  | Total PUSCH PRB usage per cell which is percentage of PRBs used, averaged during time period with integer value range: 0-100 |
|  | A count of PUSCH PRBs scheduled for traffic transmission for UE on single MIMO layer per cell at sampling occasion .Counting unit for PRB is 1 Resource Block x 1 symbol. (1 Resource Block = 12 sub-carrier) |
|  | The number of MIMO layers scheduled for UE at sampling occasion .  |
|  | A UE that is scheduled during time period 𝑇.  |
|  | Sampling occasion during time period T. A sampling occasion is 1 symbol. |
|  |  |
|  | Total number of PUSCH PRBs available for sampling occasion j on single MIMO layer per cell. |
|  | Time Period during which the measurement is performed. |
|  | Constant value configured by OAM with float value range: 1.00-100.00. With this parameter, should not be larger than 100. |

4.2.1.7.a PDSCH PRB Usage based on statistical MIMO layer in the DL per cell

This measurement provides the total usage (in percentage) of PDSCH physical resource blocks (PRBs) for statistical MIMO layer per cell. The objective of the measurement is to measure usage of time and frequency resources. A use-case is OAM performance observability.

Protocol Layer: MAC, PHY**Table 4.2.1.7.a-1: Definition for PDSCH PRB Usage based on statistical MIMO layer in the DL per cell**

|  |  |
| --- | --- |
| Definition | PDSCH PRB Usage based on statistical MIMO layer in the DL per cell is calculated in the time-frequency domain.Detailed Definition:explanations can be found in the table 4.2.1.7.a-2 below. |

**Table 4.2.1.7.a-2: Parameter description for PDSCH PRB Usage based on statistical MIMO layer in the DL per cell**

|  |  |
| --- | --- |
|  | Total PDSCH PRB usage per cell which is percentage of PRBs used, averaged during time period with integer value. |
|  | A count of PDSCH PRBs used for traffic transmission for UE on single MIMO layer per cell at sampling occasion .Counting unit for PRB is 1 Resource Block x 1 symbol. (1 Resource Block = 12 sub-carrier) |
|  | The number of MIMO layers scheduled for UE at sampling occasion .  |
|  | A UE that is scheduled during time period 𝑇1.  |
|  | Sampling occasion during time period T1. A sampling occasion is 1 symbol. |
|  | Total number of PDSCH PRBs available for sampling occasion j on single MIMO layer per cell. |
|  | Time period during which the measurement is performed to calculate , e.g., 15min, 1 hour, etc. |
|  | A variable factor for MIMO layer assigned with the maximum during time period T2 with float value 1.00-100.00. |
|  | Average value of scheduled MIMO layers per PRB on the DL during time perior *T* with float value 1.00-100.00, as defined in TS 28.552 [2]. |
|  | Time period during which the measurement is performed to calculate , as defined in TS 28.552 [2]. |
|  | Time period during which the measurement is performed to calculate β, e.g., 1 week, etc. |

NOTE: For this measurement, same β value is used for the entire duration of T1.

4.2.1.7.b PUSCH PRB Usage based on statistical MIMO layer in the UL per cell

This measurement provides the total usage (in percentage) of PUSCH physical resource blocks (PRBs) for statistical MIMO layer in the uplink per cell. The objective of the measurement is to measure usage of time and frequency resources. A use-case is OAM performance observability.

Protocol Layer: MAC, PHY

**Table 4.2.1.7.b-1: Definition for PUSCH PRB Usage based on statistical MIMO layer in the UL per cell**

|  |  |
| --- | --- |
| Definition | PUSCH PRB Usage based on statistical MIMO layer in the UL per cell is calculated in the time-frequency domain.Detailed Definition:explanations can be found in the table 4.2.1.7.b-2 below. |

**Table 4.2.1.7.b-2: Parameter description for PUSCH PRB Usage based on statistical MIMO layer in the UL per cell**

|  |  |
| --- | --- |
|  | Total PUSCH PRB usage per cell which is percentage of PRBs used, averaged during time period with integer value. |
|  | A count of PUSCH PRBs used for traffic transmission for UE on single MIMO layer per cell at sampling occasion .Counting unit for PRB is 1 Resource Block x 1 symbol. (1 Resource Block = 12 sub-carrier) |
|  | The number of MIMO layers scheduled for UE at sampling occasion .  |
|  | A UE that is scheduled during time period 𝑇1.  |
|  | Sampling occasion during time period T1. A sampling occasion is 1 symbol. |
|  | Total number of PUSCH PRBs available for sampling occasion j on single MIMO layer per cell. |
|  | Time period during which the measurement is performed to calculate M(T1), e.g., 15min, 1 hour, etc. |
|  | A variable factor for MIMO layer assigned with the maximum during time period T2 with float value 1.00-100.00. |
|  | Average value of scheduled MIMO layers per PRB on the UL during time perior *T* with float value 1.00-100.00, as defined in TS 28.552 [2]. |
|  | Time period during which the measurement is performed to calculate , as defined in TS 28.552 [2]. |
|  | Time period during which the measurement is performed to calculate β, e.g., 1 week, etc. |

NOTE: For this measurement, same β value is used for the entire duration of T1.

4.2.1.7.c Enhanced PDSCH PRB Usage for MIMO in the DL per cell

This measurement provides the total usage (in percentage) of PDSCH physical resource blocks (PRBs) for MIMO in the downlink per cell. The objective of the measurement is to measure usage of time, frequency and spatial resources. A use-case is OAM performance observability.

Protocol Layer: MAC, PHY

Table 4.2.1.7.c-1: Definition for enhanced PDSCH PRB Usage for MIMO in the DL per cell

|  |  |
| --- | --- |
| Definition | PDSCH PRB Usage for MIMO in the DL per cell is calculated in the time-frequency and spatial domain.Detailed Definition:whereexplanations can be found in the table 4.2.1.7.c-2 below. |

Table 4.2.1.7.c-2: Parameter description for enhanced PDSCH PRB Usage for MIMO in the DL per cell

|  |  |
| --- | --- |
|  | Total PDSCH PRB usage per cell which is percentage of PRBs used, averaged during time period with integer value range: 0-100 |
|  | A count of PDSCH PRBs used for traffic transmission for UE on single MIMO layer per cell at sampling occasion .Counting unit for PRB is 1 Resource Block x 1 symbol. (1 Resource Block = 12 sub-carrier) |
|  | The number of MIMO layers scheduled for UE at sampling occasion .  |
|  | A UE that is scheduled during time period 𝑇.  |
|  | Sampling occasion during time period T. A sampling occasion is 1 symbol. |
|  | Time period during which the measurement is performed. |
|  | Total number of PDSCH PRBs available for sampling occasion j on single MIMO layer per cell. |
|  | PDSCH Time-domain average of the Maximum Scheduled Layer Number of the cell for MIMO scenario during time period T, defined in TS 28.552 [2]. |
|  | The maximum number of scheduling layer of PDSCH at sampling occasion *j*; |
|  | The number of sampling occasions at which is not 0. |

4.2.1.7.d Enhanced PUSCH PRB Usage for MIMO in the UL per cell

This measurement provides the total usage (in percentage) of PUSCH physical resource blocks (PRBs) for MIMO in the uplink per cell. The objective of the measurement is to measure usage of time, frequency and spatial resources. A use-case is OAM performance observability.

Protocol Layer: MAC, PHY

Table 4.2.1.7.d-1: Definition for enhanced PUSCH PRB Usage for MIMO in the UL per cell

|  |  |
| --- | --- |
| Definition | PUSCH PRB Usage for MIMO in the UL per cell is calculated in the time-frequency and spatial domain.Detailed Definition:whereexplanations can be found in the table 4.2.1.7.d-2 below. |

Table 4.2.1.7.d-2: Parameter description for enhanced PUSCH PRB Usage for MIMO in the UL per cell

|  |  |
| --- | --- |
|  | Total PUSCH PRB usage per cell which is percentage of PRBs used, averaged during time period with integer value range: 0-100 |
|  | A count of PUSCH PRBs scheduled for traffic transmission for UE on single MIMO layer per cell at sampling occasion .Counting unit for PRB is 1 Resource Block x 1 symbol. (1 Resource Block = 12 sub-carrier) |
|  | The number of MIMO layers scheduled for UE at sampling occasion .  |
|  | A UE that is scheduled during time period 𝑇.  |
|  | Sampling occasion during time period T. A sampling occasion is 1 symbol. |
|  | Time period during which the measurement is performed. |
|  | Total number of PUSCH PRBs available for sampling occasion j on single MIMO layer per cell. |
|  | PUSCH Time-domain average of the Maximum Scheduled Layer Number of the cell for MIMO scenario during time period T, defined in TS 28.552 [2]. |
|  | The maximum number of scheduling layer of PUSCH at sampling occasion *j*; |
|  | The number of sampling occasions at which is not 0. |

## << Partially omitted >>

4.3 NR measurements performed by the UE

4.3.1 Packet delay

4.3.1.1 UL PDCP Packet Average Delay per DRB per UE

The objective of this measurement performed by UE is to measure Packet Delay in Layer PDCP for QoS verification of MDT or for the QoS monitoring as defined in TS 23.501 [4].

Protocol Layer: PDCP

**Table 4.3.1.1-1: Definition for UL PDCP Packet Average Delay per DRB per UE**

|  |  |
| --- | --- |
| 1. Definition
 | PDCP Packet Delay in the UL per DRB. This measurement refers to PDCP queuing delay for DRBs in the UE, which captures 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). The measurement is done separately per DRB.Detailed Definition:whereexplanations can be found in the table 4.3.1.1-2 below. |

NOTE: UE measures UL PDCP queueing delay at DRB level. It is up to gNB to convert DRB level delay to QoS level delay with the assumption that all QoS flows mapped to the same DRB get the same QoS treatment, and it is up to gNB to calculate QoS level delay if multiple DRBs mapped with the same QoS.

**Table 4.3.1.1-2: Parameter description for UL PDCP Packet Average Delay per DRB per UE**

|  |  |
| --- | --- |
|  | PDCP average delay in the UL per DRB, averaged during time period 𝑇. Unit: 0.1 ms.PDCP average delay in the UL per DRB is 1s if the actual value is larger than 1s. |
|  | The point in time when the UL PDCP SDU i arrivals at PDCP upper SAP. |
|  | The point in time when the UL MAC PDU k including the first part of UL PDCP SDU i is scheduled for transmission. |
|  | A UL PDCP SDU that is received by the PDCP during time period 𝑇.  |
|  | Total number of UL PDCP SDUs received during time period 𝑇. |
|  | Time Period during which the measurement is performed |
|  | The identity of the measured DRB. |

4.3.1.e UL PDCP Excess Packet Delay per DRB

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

Protocol Layer: PDCP

|  |  |
| --- | --- |
| **Definition** | PDCP Excess Packet Delay in the UL per DRB. 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). The measurement is done separately per DRB.Detailed Definition:,whereexplanations can be found in the table 4.3.1.e-1 below. |

**Table 4.3.1.e-1**

|  |  |
| --- | --- |
|  | Ratio of packets in UL per DRB exceeding the configured delay threshold among the UL PDCP SDUs for which the UL MAC PDU including the first part of UL PDCP SDU is scheduled for transmission during the time period T. |
|  | Number of PDCP SDUs of a data radio bearer with DRB Identity = ,for which ULdelay exceeded the configured *delayThreshold* as defined in TS 38.331 [3] during the time period T. (FFS on details in TS 38.331) |
|  | Number of PDCP SDUs of a data radio bearer with DRB Identity = , for which the UL MAC PDU including the first part of UL PDCP SDU is scheduled for transmission during the time period T. |
|  | Queuing delay observed at the UE PDCP layer from the UL PDCP SDU i belonging to a data radio bearer with DRB Identity = arrival at PDCP upper SAP until the UL MAC PDU k including the first part of UL PDCP SDU i is scheduled for transmission during the time period T. |
|  | The point in time when the UL MAC PDU k including the first part of UL PDCP SDU i is scheduled for transmission.  |
|  | The point in time when the UL PDCP SDU i arrivals 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. |

4.3.1.e.1 Measurement report mapping for PDCP Excess Packet Delay

UL PDCP excess packet delay shall be measured according to configuration as defined in TS 38.331 [3]. (FFS on details in TS 38.331)

The UE shall report UL PDCP excess packet 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 PDCP excess packet 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 4.3.1.e.1-1.

**Table 4.3.1.e.1-1: EXCESS DELAY 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 | % |

<< End of change >>