**3GPP TSG-SA5 Meeting #132-e *S5-204115***

**Online, 17th Aug 2020 - 28th Aug 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  | **28.552** | **CR** | **0244** | **rev** | **-** | **Current version:** | **16.6.0** |  |
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| *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 |  | Radio Access Network | **x** | Core Network |  |

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| ***Title:***  | Rel-17 CR TS 28.552 Add PLMN granularity for UE throughput measurements |
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| ***Source to WG:*** | China Telecom Corporation Ltd. |
| ***Source to TSG:*** | S5 |
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| ***Work item code:*** | ePM\_KPI\_5G |  | ***Date:*** | 2020-08-06 |
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| ***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)* |
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| ***Reason for change:*** | Measurement and monitoring of throughput is necessary to improve the accuracy and efficiency of network optimization. For multi-operator RAN shareing sinario, the UL and DL UE throughput for each PLMN is then of importance to each operator to pinpoint their specific performance problem respectively. |
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| ***Summary of change:*** | Adding PLMN granularity for UE throughput measurements. |
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| ***Consequences if not approved:*** | Imcomplete granularity potentially affects the diagnosis of network problems. |
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| ***Clauses affected:*** | 5.1.1.3, A.9 |
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|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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| **1st change** |

#### 5.1.1.3 UE throughput

##### 5.1.1.3.1 Average DL UE throughput in gNB

a) This measurement provides the average UE throughput in downlink. This measurement is intended for data bursts that are large enough to require transmissions to be split across multiple slots. The UE data volume refers to the total volume scheduled for each UE regardless if using only primary- or also supplemental aggregated carriers. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per supported S-NSSAI, and subcounters per PLMN ID.

b) DER(N=1)

c) This measurement is obtained according to the following formula based on the "ThpVolDl" and "ThpTimeDl" defined below. Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI, and for each PLMN ID.

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeDl>0$, $\frac{\sum\_{UEs}^{}\sum\_{}^{}ThpVolDl}{\sum\_{UEs}^{}\sum\_{}^{}ThpTimeDl}$×1000 [kbit/s]

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeDl=0$, 0 [kbit/s]

For small data bursts, where all buffered data is included in one initial HARQ transmission, , otherwise 

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| ThpTimeDl | The time to transmit a data burst excluding the data transmitted in the slot when the buffer is emptied. A sample of "ThpTimeDl" for each time the DL buffer for one DataRadioBearer (DRB) is emptied. |
|  | The point in time after T2 when data up until the second last piece of data in the transmitted data burst which emptied the RLC SDU available for transmission for the particular DRB was successfully transmitted, as acknowledged by the UE.  |
|  | The point in time when the first transmission begins after a RLC SDU becomes available for transmission, where previously no RLC SDUs were available for transmission for the particular DRB. |
|  | The RLC level volume of a data burst, excluding the data transmitted in the slot when the buffer is emptied. A sample for ThpVolDl is the data volume, counted on RLC SDU level, in kbit successfully transmitted (acknowledged by UE) in DL for one DRB during a sample of ThpTimeDl. (It shall exclude the volume of the last piece of data emptying the buffer). |

d) Each measurement is a real value representing the throughput in kbit per second. The number of measurements is equal to one. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.

e) The measurement name has the form
DRB.UEThpDl, or optionally DRB.UEThpDl.*QOS,* where *QOS* identifies the target quality of service class, and DRB.UEThpDl.*SNSSAI,* where *SNSSAI* identifies the S-NSSAI, and DRB.UEThpDl.*PLMN,* where *PLMN* identifies the PLMN ID.

f) NRCellDU

g) Valid for packet switched traffic

h) 5GS

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

##### 5.1.1.3.2 Distribution of DL UE throughput in gNB

a) This measurement provides the distribution of the UE throughput in downlink. This measurement is intended for data bursts that are large enough to require transmissions to be split across multiple slots. The UE data volume refers to the total volume scheduled for each UE regardless if using only primary- or also supplemental aggregated carriers. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per supported S-NSSAI, and subcounters per PLMN ID.

b) CC

c) Considering there are n samples during measurement time T and each sample has the same time period tn, the measurement of one sample is obtained by the following formula for a measurement period tn:

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeDl>0$, $\frac{\sum\_{UEs}^{}\sum\_{}^{}ThpVolDl}{\sum\_{UEs}^{}\sum\_{}^{}ThpTimeDl}$×1000 [kbit/s]

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeDl=0$, 0 [kbit/s]

For small data bursts, where all buffered data is included in one initial HARQ transmission, , otherwise 

|  |  |
| --- | --- |
| ThpTimeDl | The time to transmit a data burst excluding the data transmitted in the slot when the buffer is emptied. A sample of "ThpTimeDl" for each time the DL buffer for one DataRadioBearer (DRB) is emptied. |
|  | The point in time after T2 when data up until the second last piece of data in the transmitted data burst which emptied the RLC SDU available for transmission for the particular DRB was successfully transmitted, as acknowledged by the UE.  |
|  | The point in time when the first transmission begins after a RLC SDU becomes available for transmission, where previously no RLC SDUs were available for transmission for the particular DRB. |
|  | The RLC level volume of a data burst, excluding the data transmitted in the slot when the buffer is emptied. A sample for ThpVolDl is the data volume, counted on RLC SDU level, in kbit successfully transmitted (acknowledged by UE) in DL for one DRB during a sample of ThpTimeDl. (It shall exclude the volume of the last piece of data emptying the buffer). |

Alternatively, for small data bursts, that are successfully transmitted in any given slot (i.e. the requirement that data bursts need to span across several slots excluding transmission of the last piece of the data in a data burst does not apply). where all buffered data is included in one initial HARQ transmission, fraction of the slot time ($ThpTimeDL)$$ThpTimeUL)$ may be counted and obtained by the formula:



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| *slot* | Duration of the slot |
| *TBVol* | Volume of the TB related to one slot burst |
| *PaddingVol* | Volume of padding bits added into Transport Block related to one slot burst. |

For each measurement sample, the bin corresponding to the DL throughput experienced by the UE is incremented by one. Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI, and for each PLMN ID.

d) A set of integers, each representing the (integer) number of samples with a DL UE throughput in the range represented by that bin. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.

e) The measurement name has the form
DRB.UEThpDlDist.Bin where Bin represents the bin, or optionally DRB.UEThpDlDist.Bin.*QOS,* where *QOS* identifies the target quality of service class, and DRB.UEThpDlDist.Bin*.SNSSAI,* where *SNSSAI* identifies the S-NSSAI, and DRB.UEThpDlDist.Bin.*PLMN,* where *PLMN* identifies the PLMN ID.

NOTE: Number of bins and the range for each bin is left to implementation

f) NRCellDU

g) Valid for packet switched traffic

h) 5GS

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

##### 5.1.1.3.3 Average UL UE throughput in gNB

a) This measurement provides the average UE throughput in uplink. This measurement is intended for data bursts that are large enough to require transmissions to be split across multiple slots. The UE data volume refers to the total volume scheduled for each UE regardless if using only primary- or also supplemental aggregated carriers. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per supported S-NSSAI, and subcounters per PLMN ID.

B) DER(N=1)

c) This measurement is obtained according to the following formula based on the "ThpVolUl" and "ThpTimeUl" defined below. Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI, and for each PLMN ID.

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeUl>0$, $\frac{\sum\_{UEs}^{}\sum\_{}^{}ThpVolUl}{\sum\_{UEs}^{}\sum\_{}^{}ThpTimeUl}$×1000 [kbit/s]

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeUl=0$, 0 [kbit/s]

For small data bursts, where all buffered data is included in one initial HARQ transmission otherwise:



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| ThpTimeUl | The time to transmit a data burst excluding the data transmitted in the slot when the buffer is emptied. A sample of "ThpTimeUl" for each time the UL buffer for one DataRadioBearer (DRB) is emptied. |
|  | The point in time when the data up until the second last piece of data in data burst has been successfully received for a particular DRB  |
|  | The point in time when transmission is started for the first data in data burst for a particular DRB. |
|  | The RLC level volume of a data burst, excluding the data transmitted in the slot when the buffer is emptied. A sample for ThpVolUl is the data volume counted on RLC SDU level in kbit received in UL for one DRB during a sample of ThpTimeUl, (It shall exclude the volume of the last piece of data emptying the buffer). |

d) Each measurement is a real value representing the throughput in kbit per second. The number of measurements is equal to one. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.

e) The measurement name has the form
DRB.UEThpUl, or optionally DRB.UEThpUl.*QOS,* where *QOS* identifies the target quality of service class and DRB.UEThpUl.*SNSSAI,* where *SNSSAI* identifies the S-NSSAI, and DRB.UEThpUl.*PLMN,* where *PLMN* identifies the PLMN ID.

f) NRCellDU

g) Valid for packet switched traffic

h) 5GS

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

##### 5.1.1.3.4 Distribution of UL UE throughput in gNB

a) This measurement provides the distribution of the UE throughput in uplink. This measurement is intended for data bursts that are large enough to require transmissions to be split across multiple slots. The UE data volume refers to the total volume scheduled for each UE regardless if using only primary- or also supplemental aggregated carriers. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per supported S-NSSAI, and subcounters per PLMN ID.

b) CC

c) Considering there are n samples during measurement time T and each sample has the same time period tn, the measurement of one sample is obtained by the following formula for a measurement period tn:

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeUl>0$, $\frac{\sum\_{UEs}^{}\sum\_{}^{}ThpVolUl}{\sum\_{UEs}^{}\sum\_{}^{}ThpTimeUl}$×1000 [kbit/s]

If $\sum\_{UEs}^{}\sum\_{}^{}ThpTimeUl=0$, 0 [kbit/s]

For small data bursts, where all buffered data is included in one initial HARQ transmission otherwise:



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| ThpTimeUl | The time to transmit a data burst excluding the data transmitted in the slot when the buffer is emptied. A sample of "ThpTimeUl" for each time the UL buffer for one DataRadioBearer (DRB) is emptied. |
| T1 | The point in time when the data up until the second last piece of data in data burst has been successfully received for a particular DRB  |
| T2 | The point in time when transmission is started for the first data in data burst for a particular DRB. |
| ThpVolUL | The RLC level volume of a data burst, excluding the data transmitted in the slot when the buffer is emptied. A sample for ThpVolUl is the data volume counted on RLC SDU level in kbit received in UL for one DRB during a sample of ThpTimeUl, (It shall exclude the volume of the last piece of data emptying the buffer). |

Alternatively, for small data bursts, that are successfully transmitted in any given slot (i.e. the requirement that data bursts need to span across several slots excluding transmission of the last piece of the data in a data burst does not apply). where all buffered data is included in one initial HARQ transmission, fraction of the slot time ($ThpTimeUL)$ may be counted and obtained by the formula:



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| --- | --- |
| *slot* | Duration of the slot |
| *TBVol* | Volume of the TB related to one slot burst |
| *PaddingVol* | Volume of padding bits added into Transport Block related to one slot burst. |

For each measurement sample, the bin corresponding to the UL throughput experienced by the UE is incremented by one. Separate counters are maintained for each mapped 5QI (or QCI for option 3) and for each supported S-NSSAI, and for each PLMN ID.

d) A set of integers, each representing the (integer) number of samples with a UL UE throughput in the range represented by that bin. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.

e) The measurement name has the form
DRB.UEThpUlDist.Bin where Bin represents the bin, or optionally DRB.UEThpDlDist.Bin.*QOS,* where *QOS* identifies the target quality of service class, and DRB.UEThpDlDist.Bin.*SNSSAI,* where *SNSSAI* identifies the S-NSSAI, and DRB.UEThpDlDist.Bin.*PLMN,* where *PLMN* identifies the PLMN ID.

NOTE: Number of bins and the range for each bin is left to implementation

f) NRCellDU

g) Valid for packet switched traffic

h) 5GS

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

##### 5.1.1.3.5 Percentage of unrestricted DL UE data volume in gNB

a) This measurement provides the percentage of DL data volume for UEs in the cell that is classified as unrestricted, i.e., when the volume is so low that all data can be transferred in one slot and no UE throughput sample could be calculated. The UE data volume refers to the total volume scheduled for each UE regardless if using only primary- or also supplemental aggregated carriers. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per supported S-NSSAI, and subcounters per PLMN ID.

b) SI.

c) For periods when no data is transferred at all *Percentage Unrestricted Volume DL = 0*, otherwise:

 

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| ThpUnresVolDl | The volume of a data burst that is transmitted in the slot when the buffer is emptied (which could be the only slot needed to transmit the data burst) and not included in the UE throughput measurement. A sample for ThpUnresVolDl is the data volume counted on RLC SDU level in kbits sent in DL for one DRB. |
| ThpVolDl | The volume of a data burst, excluding the data transmitted in the slot when the buffer is emptied. A sample for ThpVolDl is the data volume counted on RLC SDU level in kbits sent in DL for one DRB.  |

d) Each measurement is a single integer value from 0 to 100. The number of measurements is equal to one. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are perfomed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.

e) The measurement name has the form
DRB.UEUnresVolDl or optionally DRB.UEUnresVolDl.*QOS,* where *QOS* identifies the target quality of service class, or DRB.UEUnresVolDl.*SNSSAI,* where *SNSSAI* identifies the S-NSSAI, and DRB.UEUnresVolDl.*PLMN,* where *PLMN* identifies the PLMN ID.

f) NRCellDU

g) Valid for packet switched traffic

h) 5GS

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

##### 5.1.1.3.6 Percentage of unrestricted UL UE data volume in gNB

a) This measurement provides the percentage of UL data volume for UEs in the cell that is classified as unrestricted, i.e., when the volume is so low that all data can be transferred in one slot and no UE throughput sample could be calculated. The UE data volume refers to the total volume scheduled for each UE regardless if using only primary- or also supplemental aggregated carriers. The measurement is optionally split into subcounters per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per supported S-NSSAI, and subcounters per PLMN ID.

b) SI

c) For periods when no data is transferred at all *Percentage Unrestricted Volume UL = 0*, otherwise:



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| ThpUnresVolUl | The volume of a data burst that is transmitted in the slot when the buffer is emptied (which could be the only slot needed to transmit the data burst) and not included in the UE throughput measurement. A sample for ThpUnresVolUl is the data volume counted on RLC SDU level in kbits received in UL for one DRB. |
| ThpVolUl | The volume of a data burst, excluding the data transmitted in the slot when the buffer is emptied. A sample for ThpVolUl is the data volume counted on RLC SDU level in kbits received in UL for one DRB.  |

d) Each measurement is a single integer value from 0 to 100. The number of measurements is equal to one. If the optional QoS level subcounter and S-NSSAI subcounter and PLMN ID subcounter measurements are performed, the number of measurements is equal to the number of mapped 5QIs and the number of supported S-NSSAIs, and the number of PLMN IDs.

e) The measurement name has the form
DRB.UEUnresVolUl or optionally DRB.UEUnresVolUl.*QOS,* where *QOS* identifies the target quality of service class , and DRB.UEUnresVolUl.*SNSSAI,* where *SNSSAI* identifies the S-NSSAI, and DRB.UEUnresVolUl.*PLMN,* where *PLMN* identifies the PLMN ID.

f) NRCellDU.

g) Valid for packet switched traffic.

h) 5GS.

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

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| **Next change** |

# A.9 Monitoring of UE Throughput in NG-RAN

Keeping track of UL and DL UE throughput in the NG-RAN is essential, to ensure end user satisfaction and well-functioning and well configured cells and scheduling features.

The restricted UE throughput per mapped 5QI will show the scheduling efficiency and QoS priority handling in the gNB and the ratio between unrestricted and restricted volume will show the gNB ability to handle small data transfers efficiently.

To be able to monitor the spread of throughput within the cell, and estimate the ratio of satisfied users, the throughput distribution measurement can be used.

When network slicing is supported by the NG-RAN, multiple s S-NSSAIs may be supported. The UL and DL UE throughput for each S-NSSAI is then of importance to the operator to pinpoint a specific performance problem.

For RAN sharing scenarios, the UL and DL UE throughput in each PLMN is of importance to pinpoint performance problem in a specific PLMN.

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| **End of changes** |