**3GPP TSG-SA5 Meeting #141-e *S5-221452rev1*e-meeting, 17th Jan 2022 - 26th Jan 2022**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **28.554** | **CR** | **0362** | **rev** | **-** | **Current version:** | **17.5.0** |  |
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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 |  | Radio Access Network | **X** | Core Network | **X** |

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| ***Title:***  | Rel-17 CR TS 28.554 Define Reliability KPI in 5G Network |
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| ***Source to WG:*** | Harman GmbH |
| ***Source to TSG:*** | SA5 |
|  |  |
| ***Work item code:*** | ePM\_KPI\_5G |  | ***Date:*** | 2022-01-07 |
|  |  |  |  |  |
| ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | In addition to increased flexibility and optimization, a 5G system needs to support stringent KPIs for latency, **reliability**, throughput, etc. These KPIs are driven by support for both commercial and public safety services. On the commercial side, industrial control, industrial automation, UAV control, and AR are examples of those services. The 5G system also aims to enhance its capability to meet KPIs that emerging V2X applications require. For such advanced applications, the requirements, such as data rate, **reliability**, latency, communication range and speed, are made more stringent. If something can affect the customer’s experience, it has to be monitored. So like latency and throughput , in 5G and advanced cellular systems **“Reliability”** is also very important performance factor that should be monitored for number of such advanced services some of which are mentioned above.Furthermore, in TS 28.541, **reliability** is defined as an attribute of ServiceProfile, which means a NS consumer can request some particular reliability to be offered by the network slice provider. Hence reliability has to be monitored and for this a KPI has to be defined. One of it’s prominent usage and requirement is in URLLC use cases where an operator network’s slices particularly cater to such service requirements. Furthermore,TS 22.261 & TS 22.289 already define Reliability as “in the context of network layer packet transmissions, percentage value of the amount of sent network layer packets successfully delivered to a given system entity within the time constraint required by the targeted service, divided by the total number of sent network layer packets”. Same principle is considered in current proposal to define Reliability KPI |
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| ***Summary of change:*** | Reliability KPI is introduced in a 5G network in both downlink and uplink and is defined for RAN domain i.e. for Uu interface and for Core domain i.e. N3 interface. Annex explains how E2E reliability can be derived in a network |
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| ***Consequences if not approved:*** | Insufficent and limited set of KPIs continue for a 5G network as far as reliability is considered which is a very important performance factor in 5G and future networks with advanced use cases. Reliability as performance cannot be monitored in an operator’s network and any deragadation in end user experience due to poor reliability in network can not be checked and improvised. |
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| ***Clauses affected:*** | 6.X (new) |
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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 28.552 CR ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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| **1st change** |

## 6.X Reliability KPI

### 6.X.1 Reliability KPI in 5G networks

#### 6.X.1.1 Definition

In the context of network layer packet transmissions, Reliability is defined as the percentage value of the packets successfully delivered to a given system entity within the time constraint required by the targeted service out of all the packets transmitted.

#### 6.X.1.2 Packet transmission reliability KPI in DL on Uu

a) DLRelPSR\_Uu

b) This KPI describes the Reliability based on Packet Success Rate(PSR) Percentage between gNB and UE. It is used to evaluate the Uu interface reliability contribution to the total network downlink reliability. It is the percentage of RLC SDU packets which are successfully received in UE out of the total RLC SDU packets transmitted by gNB. It is a measure of the DL packet delivery success i.e. PSR% over Uu interface. It is a percentage value (%). This KPI can optionally be split into KPIs per QoS level (mapped 5QI or QCI in NR option 3) and per S-NSSAI.

c) Below is the equation for downlink Reliability in RAN based on PSR percentage between gNB and UE.

 DLRelPSR\_Uu = × 100 , where N(T1,drbid) & Dloss(T1,drbid) are as defined in TS 38.314.

 or optionally DLRelPSR\_Uu.QoS = × 100, where QoS identifies the target QoS quality of service class.

 or optionally DLRelPSR\_Uu.SNSSAI = × 100,

 where SNSSAI identifies the S-NSSAI.

 d) NRCellDU

#### 6.X.1.3 Packet transmission reliability KPI in UL on Uu

a) ULRelPSR\_Uu

b) This KPI describes the Reliability based on Packet Success Rate Percentage between UE and gNB. It is used to evaluate the Uu interface reliability contribution to the total network uplink reliability. It is the percentage of PDCP SDU packets which are successfully received in gNB out of the total PDCP SDU packets transmitted by UE. It is a measure of the UL packet delivery success i.e. PSR% over Uu interface. It is a percentage value (%). This KPI can optionally be split into KPIs per QoS level (mapped 5QI or QCI in NR option 3) and per S-NSSAI.

c) ULRelPSR\_Uu = DRB.PacketSuccessRateUlgNBUu × 100 , where DRB\_PacketSuccessRateUlgNBUu is as defined in TS 28.552

or optionally ULRelPSR\_Uu.QoS = DRB.PacketSuccessRateUlgNBUu.QOS × 100, where QoS identifies the target QoS quality of service class.

or optionally ULRelPSR\_Uu.SNSSAI = DRB.PacketSuccessRateUlgNBUu.SNSSAI × 100, where SNSSAI identifies the S-NSSAI.

d) NRCellCU

#### 6.X.1.4 Packet transmission reliability KPI in DL on N3

a) DLRelPSR\_N3

b) This KPI describes the Reliability based on Packet Success Rate(PSR) Percentage between UPF and gNB. It is used to evaluate the N3 interface reliability contribution to the total network downlink reliability. It is the percentage of GTP data PDUs which are successfully received by gNB out of the total GTP data PDUs transmitted by UPF over N3 interface. It is a measure of the DL packet delivery success i.e. PSR% over N3 interface. It is a percentage value (%). This KPI can optionally be split into KPIs per QoS level (mapped 5QI or QCI in NR option 3) and per S-NSSAI.

c) DLRelPSR\_N3 =

 where GTP.OutDataPktN3UPF , GTP.InDataPktPacketLossN3gNB are as defined in TS 28.552

 or optionally,

 DLRelPSR\_N3.QoS =

 where QoS identifies the target QoS quality of service class.

 or optionally,

 DLRelPSR\_N3.SNSSAI =

 where SNSSAI identifies the S-NSSAI.

d) UPFFunction, NRCellCU

#### 6.X.1.5 Packet transmission reliability KPI in UL on N3

a) ULRelPSR\_N3

b) This KPI describes the Reliability based on Packet Success Rate(PSR) Percentage between gNB and UPF. It is used to evaluate the N3 interface reliability contribution to the total network uplink reliability. It is the percentage of GTP data PDUs which are successfully received by UPF out of the total GTP data PDUs transmitted by gNB over N3 interface. It is a measure of the UL packet delivery success i.e. PSR% over N3 interface. It is a percentage value (%). This KPI can optionally be split into KPIs per QoS level (mapped 5QI or QCI in NR option 3) and per S-NSSAI.

c) ULRelPSR\_N3 =

 where GTP.InDataPktN3UPF , GTP.InDataPktPacketLossN3UPF are as defined in TS 28.552

 or optionally,

 ULRelPSR\_N3.QoS =

 where QoS identifies the target QoS quality of service class.

 or optionally,



 ULRelPSR\_N3.SNSSAI =

 where SNSSAI identifies the S-NSSAI.

d) UPFFunction

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| **Next change** |

# A.X Use case for end-to-end Reliability measurements of 5G network-related KPI

The end-to-end reliability is an important performance parameter for operating 5G network. In some scenarios (e.g. uRLLC), if end-to-end reliability is insufficient, the 5G network customer cannot obtain guaranteed network performance provided by the network operator. So it is necessary to assess end-to-end reliability of network with the help of related measurements of packet delivery success to evaluate whether the end-to-end reliability that network customer requested has been satisfied. A procedure is invoked by network management system and is used:

- to update the CSMF/NSMF with the end-to-end reliability parameter for monitoring;

- to inform the network customer/network operator the end-to-end reliability;

- to make CSMF/NSMF aware if the end-to-end reliability can meet network customer’s service requirement.

If low end-to-end reliability is measured, it is also of benefit to pinpoint where in the chain from UE to UPF (or vice-versa) that the lower reliability occurs.

Throughout the URLLC Network slice, same or different PSR% might exist on different interfaces. If it is same the reliability KPI of a slice can be calculated at any one segment of network i.e between UE and gNB or between gNB and UPF. In case, if it is not same the implementations may choose to calculate the PSR% of a URLLC slice at any interface deemed appropriate for the operator for its reliability KPI or it can calculate E2E reliability KPI as per the mechanism shown below :

Assume that in uplink, RAN slice subnet and Core slice subnet reliability i.e. ULRelPSR\_Uu.SNSSAI & ULRelPSR\_N3.SNSSAI is known to the operator. Now operator wants to know if in a given time frame, X number of packets are transmitted by UE then out of X, how many packets can be successfully received in UPF i.e. what is its End to End Reliability based on PSR percentage.This can be calculated as in equation below -

ULRelPSR\_E2E = [{(X× ULRelPSR\_Uu.SNSSAI) × (ULRelPSR\_N3.SNSSAI)} ÷ X] × 100

Suppose X = 1000000, ULRelPSR\_Uu.SNSSAI = 99.98% , ULRelPSR\_N3.SNSSAI = 99.99% , then

ULRelPSR\_E2E = [{(1000000 × .9998) × (.9999)} ÷ 1000000] × 100

 = [{(999800) × (.9999)} ÷ 1000000] × 100

 = [{999700} ÷ 1000000] × 100

 = [.999700] × 100

 = 99.97 %

Explanation of above calculation is that out of 1 million packets sent by UE, 999800 packets are successfully received in gNB because reliability over Uu interface is 99.98%. Now these 999800 packets will be sent over N3 interface as GTP-U packets towards UPF. Since PSR % between gNB and UPF is 99.99% so based on that, out of 999800 packets sent over N3 interface, 999700 packets are successfully received in UPF. So finally out of 1 million packets sent by UE, 999700 packets are received successfully in UPF, hence E2E Reliability KPI value is 99.97 %. So E2E reliability is the combination (multiplication) of RAN and Core interfaces reliabilities based on packet success rate.

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| **Next change** |

# 2 References

[12] 3GPP TS 38.314: "NR; layer 2 measurements".

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| **End of change** |