

# ETSI TS 128 554 V16.9.0 (2022-03)



**5G;**  
**Management and orchestration;**  
**5G end to end Key Performance Indicators (KPI)**  
**(3GPP TS 28.554 version 16.9.0 Release 16)**

[ETSI TS 128 554 V16.9.0 \(2022-03\)](https://standards.iteh.ai/catalog/standards/sist/2adcf86-f604-4e9a-8f94-4a4f1b3982be/etsi-ts-128-554-v16-9-0-2022-03)

<https://standards.iteh.ai/catalog/standards/sist/2adcf86-f604-4e9a-8f94-4a4f1b3982be/etsi-ts-128-554-v16-9-0-2022-03>



---

Reference

---

RTS/TSGS-0528554vg90

---

Keywords

---

5G

**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

---

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° w061004871

---

**Important notice**

---

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at [www.etsi.org/deliver](http://www.etsi.org/deliver).

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our

Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

---

**Notice of disclaimer & limitation of liability**

---

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

---

**Copyright Notification**

---

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2022.

All rights reserved.

---

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

**DECT™**, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

---

## Legal Notice

(standards.iteh.ai)

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under <http://webapp.etsi.org/key/queryform.asp>.

---

## Modal verbs terminology

In the present document **"shall"**, **"shall not"**, **"should"**, **"should not"**, **"may"**, **"need not"**, **"will"**, **"will not"**, **"can"** and **"cannot"** are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

**"must"** and **"must not"** are **NOT** allowed in ETSI deliverables except when used in direct citation.

# Contents

Intellectual Property Rights .....	2
Legal Notice .....	2
Modal verbs terminology.....	2
Foreword.....	6
1 Scope .....	7
2 References .....	7
3 Definitions and abbreviations.....	7
3.1 Definitions .....	7
3.2 Abbreviations .....	7
4 End to end KPI concept and overview .....	8
5 KPI definitions template.....	8
6 End to end KPI definitions .....	8
6.1 KPI Overview.....	8
6.2 Accessibility KPI.....	9
6.2.1 Mean registered subscribers of network and network slice through AMF .....	9
6.2.2 Registered subscribers of network through UDM .....	9
6.2.3 Registration success rate of one single network slice .....	9
6.2.4 DRB Accessibility for UE services .....	9
6.2.5 PDU session Establishment success rate of one network slice (S-NSSAI).....	10
6.3 Integrity KPI.....	10
6.3.1 Latency and delay of 5G networks .....	10
6.3.1.0 Void.....	10
6.3.1.1 Downlink latency in gNB-DU.....	10
6.3.1.2 Integrated downlink delay in RAN .....	11
6.3.1.2.1 Downlink delay in NG-RAN for a sub-network .....	11
6.3.1.2.2 Downlink delay in NG-RAN for a network slice subnet .....	11
6.3.1.3 Downlink delay in gNB-DU .....	11
6.3.1.3.1 Downlink delay in gNB-DU for a NRCellDU.....	11
6.3.1.3.2 Downlink delay in gNB-DU for a sub-network.....	12
6.3.1.3.3 Downlink delay in gNB-DU for a network slice subnet.....	12
6.3.1.4 Downlink delay in gNB-CU-UP .....	13
6.3.1.4.1 Downlink delay in gNB-CU-UP.....	13
6.3.1.4.2 Downlink delay in gNB-CU-UP for a sub-network .....	13
6.3.1.4.3 Downlink delay in gNB-CU-UP for a network slice subnet.....	14
6.3.1.5 Uplink delay in gNB-DU .....	14
6.3.1.5.1 Uplink delay in gNB-DU for a NR cell .....	14
6.3.1.5.2 Uplink delay in gNB-DU for a sub-network .....	15
6.3.1.5.3 Uplink delay in gNB-DU for a network slice subnet.....	15
6.3.1.6 Uplink delay in gNB-CU-UP .....	16
6.3.1.6.1 Uplink delay in gNB-CU-UP .....	16
6.3.1.6.2 Uplink delay in gNB-CU-UP for a sub-network .....	16
6.3.1.6.3 Uplink delay in gNB-CU-UP for a network slice subnet .....	17
6.3.1.7 Integrated uplink delay in RAN .....	17
6.3.1.7.1 Uplink delay in NG-RAN for a sub-network.....	17
6.3.1.7.2 Uplink delay in NG-RAN for a network slice subnet.....	18
6.3.1.8 E2E delay for network slice .....	18
6.3.1.8.1 Average e2e uplink delay for a network slice.....	18
6.3.1.8.2 Average e2e downlink delay for a network slice.....	19
6.3.2 Upstream throughput for network and Network Slice Instance .....	19
6.3.3 Downstream throughput for Single Network Slice Instance.....	20
6.3.4 Upstream Throughput at N3 interface .....	20
6.3.5 Downstream Throughput at N3 interface.....	20

6.3.6	RAN UE Throughput.....	20
6.3.6.1	Void.....	20
6.3.6.2	RAN UE Throughput definition.....	20
6.3.6.3	DL RAN UE throughput .....	21
6.3.6.3.1	DL RAN UE throughput for a NRCellIDU .....	21
6.3.6.3.2	DL RAN UE throughput for a sub-network .....	21
6.3.6.3.3	DL RAN UE throughput for a network slice subnet.....	22
6.3.6.4	UL RAN UE throughput .....	22
6.3.6.4.1	UL RAN UE throughput for a NRCellIDU .....	22
6.3.6.4.2	UL RAN UE throughput for a sub-network .....	23
6.3.6.4.3	UL RAN UE throughput for a network slice subnet.....	23
6.4	Utilization KPI .....	24
6.4.1	Mean number of PDU sessions of network and network Slice Instance.....	24
6.4.2	Virtualised Resource Utilization of Network Slice Instance .....	24
6.4.3	PDU session establishment time of network slice .....	24
6.4.4	Mean number of successful periodic registration updates of Single Network Slice .....	25
6.5	Retainability KPI.....	25
6.5.1	QoS flow Retainability .....	25
6.5.1.1	Definition .....	25
6.5.1.2	Extended definition .....	26
6.5.2	DRB Retainability .....	26
6.5.2.1	Definition .....	26
6.5.2.2	Extended definition .....	27
6.6	Mobility KPI .....	27
6.6.1	NG-RAN handover success rate .....	27
6.6.2	Mean Time of Inter-gNB handover Execution of Network Slice .....	27
6.6.3	Successful rate of mobility registration updates of Single Network Slice .....	27
6.6.4	5GS to EPS handover success rate.....	27
6.7	Energy Efficiency (EE) KPI.....	28
6.7.1	NG-RAN data Energy Efficiency (EE) .....	28
6.7.1.1	Definition .....	28

## **Annex A (informative): Use cases for end to end KPIs.....29**

A.1	Use case for end-to-end latency measurements of 5G network-related KPI.....	29
A.2	Use case for number of registered subscribers of single network-slice related KPI .....	29
A.3	Use case for upstream/downstream throughput for one-single-network-slice-related KPI.....	29
A.4	Use case for mean PDU sessions number in network slice.....	29
A.5	Use case for virtualised resource utilization of network-slice-related KPI .....	30
A.6	Use case for 5GS registration success rate of one single-network-slice-related KPI.....	30
A.7	Use case for RAN UE throughput-related KPI .....	30
A.8	Use case for QoS flow retainability-related KPI.....	30
A.9	Use case for DRB accessibility-related KPI.....	30
A.10	Use case for mobility KPIs.....	31
A.11	Use case for DRB retainability related KPI .....	31
A.12	Use case for PDU session establishment success rate of one network slice (S-NSSAI) related KPI ....	31
A.13	Use case for integrated downlink latency in RAN .....	31
A.14	Use case for PDU session Establishment success rate of one single-network-slice instance-related KPI .....	32
A.15	Use case for QoS flow retainability-related KPI.....	32
A.16	Use case for 5G Energy Efficiency (EE) KPI .....	32

## **Annex B (informative): Change history .....34**

History .....36

iTeh STANDARD

PREVIEW

(standards.iteh.ai)

ETSI TS 128 554 V16.9.0 (2022-03)

<https://standards.iteh.ai/catalog/standards/sist/2adcf86-f604-4e9a-8f94-4a4f1b3982be/etsi-ts-128-554-v16-9-0-2022-03>

---

# Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

**iTeh STANDARD  
PREVIEW  
(standards.iteh.ai)**

ETSI TS 128 554 V16.9.0 (2022-03)  
<https://standards.iteh.ai/catalog/standards/sist/2adcfd86-f604-4e9a-8f94-4a4f1b3982be/etsi-ts-128-554-v16-9-0-2022-03>

---

# 1 Scope

The present document specifies end-to-end Key Performance Indicators (KPIs) for the 5G network and network slicing.

---

## 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] Void.
- [3] ITU-T Recommendation E.800: "Definitions of terms related to quality of service".
- [4] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [5] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [6] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".
- [7] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [8] ETSI ES 203 228 V1.2.1 (2017-04): "Environmental Engineering (EE); Assessment of mobile network energy efficiency"  
<https://standards.iteh.ai/catalog/standards/sist/2adcfd86-f604-4e9a-8694-4a4f1b3982be/etsi-es-203-228-v1-2-1-2017-04>
- [9] 3GPP TS 28.310: "Management and orchestration; Energy efficiency of 5G".

---

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

### 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

EE	Energy Efficiency
kbit	kilobit (1000 bits)
RTT	Round Trip Time



## 4 End to end KPI concept and overview

The following KPI categories are included in the present document:

- Accessibility (see the definition in [3]).
- Integrity (see the definition in [3]).
- Utilization.
- Retainability (see the definition in [3]).
- Mobility.
- Energy Efficiency.

## 5 KPI definitions template

- a) Name (Mandatory): This field shall contain the name of the KPI.
- b) Description (Mandatory): This field shall contain the description of the KPI.  
Within this field it should describe if the KPI is focusing on network or user view. This field should also describe the logical KPI formula to derive the KPI. For example, a success rate KPI's logical formula is the number of successful events divided by all events. This field should also show the KPI unit (e.g., kbit/s, millisecond) and the KPI type (e.g., mean, ratio).
- c) Formula definition (Optional):  
This field should contain the KPI formula using the 3GPP defined measurement names.  
This field can be used only when the measurement(s) needed for the KPI formula are defined in 3GPP TS for performance measurements (TS 28.552 [6]). This field shall clarify how the aggregation shall be done, for the KPI object level(s) defined in d).
- d) KPI Object (Mandatory):  
This field shall contain the DN of the object instance where the KPI is applicable, including the object where the measurement is made. The DN identifies one object instance of the following IOC:
  - NetworkSliceSubnet
  - SubNetwork
  - NetworkSlice
  - NRCell1DU
  - NRCell1CU
- e) Remark (Optional):  
This field is for additional information required for the KPI definition, e.g. the definition of a call in UTRAN.

## 6 End to end KPI definitions

### 6.1 KPI Overview

The KPI categories defined in [2] will be reused by the present document.

## 6.2 Accessibility KPI

### 6.2.1 Mean registered subscribers of network and network slice through AMF

- a) AMFMeanRegNbr.
- b) This KPI describe the mean number of subscribers that are registered to a network slice instance. It is obtained by counting the subscribers in AMF that are registered to a network slice instance. It is an Interger. The KPI type is CUM.

$$AMFMeanRegNbr = \sum_{AMF} RegisteredSubNbrMean.SNSSAI$$

- c)
- d) SubNetwork, NetworkSlice

### 6.2.2 Registered subscribers of network through UDM

- a) UDMRegNbr.
- b) This KPI describes the total number of subscribers that are registered to a network through UDM. It is corresponding to the measurement RM.RegisteredSubUDMNbrMean that counts subscribers registered in UDM. It is an Integer. The KPI type is CUM.

$$c) \text{ UDMRegNbr} = \sum_{UDM} RegisteredSubUDMNbrMean$$

- d) SubNetwork

### 6.2.3 Registration success rate of one single network slice

- a) RSR.
- b) This KPI describes the ratio of the number of successfully performed registration procedures to the number of attempted registration procedures for the AMF set which related to one single network slice and is used to evaluate accessibility provided by the end-to-end network slice and network performance. It is obtained by successful registration procedures divided by attempted registration procedures. It is a percentage. The KPI type is RATIO.

- c)

$$RSR = \frac{\sum_{Type} AMF.5GSRegisSucc.Type}{\sum_{Type} AMF.5GSRegisAtt.Type} * 100\%$$

NOTE: Above measurements with subcounter .Type should be defined in 3GPP TS 24.501 [4].

- d) NetworkSlice

### 6.2.4 DRB Accessibility for UE services

- a) DRB Accessibility
- b) This KPI describes the DRBs setup success rate, including the success rate for setting up RRC connection and NG signalling connection. It is obtained as the success rate for RRC connection setup multiplied by the success rate for NG signalling connection setup multiplied by the success rate for DRB setup. The success rate for RRC connection setup and for NG signalling connection setup shall exclude setups with establishment cause mo-Signalling [5]. It is a percentage. The KPI type is RATIO.

- c)  $\text{DRBAccessibility}_{5\text{QI}} = \left( \frac{\sum \text{RRC.ConnEstabSucc.Cause}}{\sum \text{RRC.ConnEstabAtt.Cause}} * \frac{\sum \text{UECNTXT.ConnEstabSucc.Cause}}{\sum \text{UECNTXT.ConnEstabAtt.Cause}} \right) * \left( \frac{\text{DRB.EstabSucc.5QI}}{\text{DRB.EstabAtt.5QI}} \right) * 100$

$$\text{DRB Accessibility}_{\text{SNSSAI}} = \left( \frac{\sum \text{RRC.ConnEstabSucc.Cause}}{\sum \text{RRC.ConnEstabAtt.Cause}} * \frac{\sum \text{UECNTXT.ConnEstabSucc.Cause}}{\sum \text{UECNTXT.ConnEstabAtt.Cause}} \right) * \left( \frac{\text{DRB.EstabSucc.SNSSAI}}{\text{DRB.EstabAtt.SNSSAI}} \right) * 100.$$

The sum over causes shall exclude the establishment cause mo-Signalling [5].

For KPI on SubNetwork level the measurement shall be the averaged over all NRCellICUs in the SubNetwork

- d) SubNetwork, NRCellICU.

## 6.2.5 PDU session Establishment success rate of one network slice (S-NSSAI)

- a) PDUSessionEstSR.
- b) This KPI describes the ratio of the number of successful PDU session establishment request to the number of PDU session establishment request attempts for 5G network for the SMF which related to one network slice (S-NSSAI) and is used to evaluate accessibility provided by the end-to-end network slice and network performance. It is obtained by the number of successful PDU session requests divided by the number of attempted PDU session requests. It is a percentage. The KPI type is RATIO.

$$\text{PDUSessionEstSR} = \frac{\text{SM.PduSessionCreationSucc.SNSSAI}}{\text{SM.PduSessionCreationReq.SNSSAI}}$$

- c)
- d) NetworkSlice

## 6.3 Integrity KPI [ETSI TS 128 554 V16.9.0 \(2022-03\)](https://standards.iteh.ai/catalog/standards/sist/2adcf86-f604-4e9a-8f94-4e4f1b3982be/etsi-ts-128-554-v16-9-0-2022-03)

### 6.3.1 Latency and delay of 5G networks

#### 6.3.1.0 Void

#### 6.3.1.1 Downlink latency in gNB-DU

- a) DLLat\_gNB-DU.
- b) This KPI describes the gNB-DU part of the packet transmission latency experienced by an end-user. It is used to evaluate the gNB latency contribution to the total packet latency. It is the average (arithmetic mean) of the time from reception of IP packet to gNB-DU until transmission of first part of that packet over the air interface, for a packet arriving when there is no previous data in queue for transmission to the UE. It is a time interval (0.1 ms). The KPI type is MEAN. This KPI can optionally be split into KPIs per QoS level (mapped 5QI or QCI in NR option 3) and per S-NSSAI.
- c)  $\text{DLLat\_gNB-DU} = \text{DRB.RlcSduLatencyDI}$
- or optionally  $\text{DLLat\_gNB-DU.QoS} = \text{DRB.RlcSduLatencyDI.QoS}$  where QoS identifies the target QoS quality of service class.
- or optionally  $\text{DLLat\_gNB-DU.SNSSAI} = \text{DRB.RlcSduLatencyDI.SNSSAI}$  where SNSSAI identifies the S-NSSAI.
- d) NRCellIDU

### 6.3.1.2 Integrated downlink delay in RAN

#### 6.3.1.2.1 Downlink delay in NG-RAN for a sub-network

- a)  $DLDelay\_NR\_SNw$ .
- b) This KPI describes the average packet transmission delay through the RAN part to the UE. It is used to evaluate delay performance of NG-RAN in downlink for a sub-network. It is the weighted average packets delay from reception of IP packet in gNB-CU-UP until the last part of an RLC SDU packet was received by the UE according to received HARQ feedback information for UM mode or until the last part of an RLC SDU packet was received by the UE according to received RLC ACK for AM mode. It is a time interval (0.1 ms). The KPI type is MEAN. 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 are the equations for average "Integrated downlink delay in RAN" for this KPI on SubNetwork level. The "Integrated downlink delay in RAN" is the sum of average DL delay in gNB-CU-UP of the sub-network ( $DLDelay\_gNBCUUP\_SNw$ ) and the average DL delay in gNB-DU of the sub-network ( $DLDelay\_gNBDU\_SNw$ ):

$$DLDelay\_NR\_SNw = DLDelay\_gNBCUUP\_SNw + DLDelay\_gNBDU\_SNw$$

or optionally  $DLDelay\_NR\_SNw.QOS = DLDelay\_gNBCUUP\_SNw.QOS + DLDelay\_gNBDU\_SNw.QOS$  where  $QOS$  identifies the target quality of service class.

or optionally  $DLDelay\_NR\_SNw.SNSSAI = DLDelay\_gNBCUUP\_SNw.SNSSAI + DLDelay\_gNBDU\_SNw.SNSSAI$  where  $SNSSAI$  identifies the S-NSSAI.

- d) SubNetwork

#### 6.3.1.2.2 Downlink delay in NG-RAN for a network slice subnet

- a)  $DLDelay\_NR\_Nss$ . <https://standards.iteh.ai/catalog/standards/sist/2adcfd86-f604-4e9a-8f94-4a4f1b3982be/etsi-ts-128-554-v16-9-0-2022-03>
- b) This KPI describes the average packet transmission delay through the RAN part to the UE. It is used to evaluate delay performance of NG-RAN in downlink for a network slice subnet. It is the weighted average packets delay from reception of IP packet in gNB-CU-UP until the last part of an RLC SDU packet was received by the UE according to received HARQ feedback information for UM mode or until the last part of an RLC SDU packet was received by the UE according to received RLC ACK for AM mode. It is a time interval (0.1 ms). The KPI type is MEAN.
- c) Below is the equation for average "Integrated downlink delay in RAN" for this KPI on NetworkSliceSubnet level. The "Integrated downlink delay in RAN" for network slice subnet is the sum of average DL delay in gNB-CU-UP of the network slice subnet ( $DLDelay\_gNBCUUP\_Nss$ ) and the average DL delay in gNB-DU of the network slice subnet ( $DLDelay\_gNBDU\_Nss$ ):

$DLDelay\_NR\_Nss.SNSSAI = DLDelay\_gNBCUUP\_Nss.SNSSAI + DLDelay\_gNBDU\_Nss.SNSSAI$  where  $SNSSAI$  identifies the S-NSSAI that the network slice subnet supports.

- d) NetworkSliceSubnet

### 6.3.1.3 Downlink delay in gNB-DU

#### 6.3.1.3.1 Downlink delay in gNB-DU for a NRCellDU

- a)  $DLDelay\_gNBDU\_Cell$ .
- b) This KPI describes the average packet transmission delay through the gNB-DU part to the UE. It is used to evaluate delay performance of gNB-DU in downlink. It is the average packets delay time from arrival of an RLC SDU at the RLC ingress F1-U termination until the last part of an RLC SDU packet was received by the UE