

ETSI TS 132 450 V13.1.0 (2019-10)



**Universal Mobile Telecommunications System (UMTS);
LTE;
Telecommunication management;
Key Performance Indicators (KPI) for Evolved Universal
Terrestrial Radio Access Network (E-UTRAN): Definitions
(3GPP TS 32.450 version 13.1.0 Release 13)**



Reference

RTS/TSGS-0532450vd10

Keywords

LTE,UMTS

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 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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.

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/CommiteeSupportStaff.aspx>

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 2019.

All rights reserved.

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.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is 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 IPR Policy, no investigation, 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.

Legal Notice

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.....	4
Introduction	4
1 Scope	5
2 References	5
3 Definitions and abbreviations.....	6
3.1 Definitions	6
3.2 Abbreviations	6
4 KPI Overview.....	6
5 KPI Definitions Template	6
6 E-UTRAN KPI Definitions	8
6.1 KPI Category "Accessibility"	8
6.1.1 E-RAB Accessibility.....	8
6.1.1.1 Definition	8
6.1.1.2 Extended definition	8
6.2 KPI Category "Retainability"	9
6.2.1 E-RAB Retainability.....	9
6.2.1.1 Definition	9
6.2.1.2 Extended definition	10
6.3 KPI Category "Integrity"	11
6.3.1 E-UTRAN IP Throughput	11
6.3.1.1 Definition	11
6.3.1.2 Extended definition	11
6.3.2 E-UTRAN IP Latency	13
6.3.2.1 Definition	13
6.3.2.2 Extended definition	13
6.4 KPI Category "Availability"	14
6.4.1 E-UTRAN Cell Availability	14
6.4.1.1 Definition	14
6.4.1.2 Extended Definition	14
6.5 KPI Category "Mobility"	14
6.5.1 E-UTRAN Mobility.....	14
6.5.1.1 Definition	14
6.5.1.2 Extended Definition	15
Annex A (informative): Change history	16
History	17

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.

Introduction

The present document is part of a multi-part deliverable covering the 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; as identified below:

- 32.451: Key Performance Indicators (KPI) for E-UTRAN; Requirements;
- 32.450: Key Performance Indicators (KPI) for E-UTRAN; Definitions. Key Performance Indicators (KPI).

1 Scope

The present document specifies definitions of Key Performance Indicators (KPIs) for E-UTRAN.

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] ITU-T Recommendation E.800: "Terms and Definitions related to Quality of Service and Network Performance including Dependability".
- [2] 3GPP TS 21.905: "Vocabulary for 3GPP Specifications".
- [3] 3GPP TS 32.404: "Telecommunication management; Performance Management (PM); Performance measurements - Definitions and template".
- [4] 3GPP TS 32.405: "Telecommunication management; Performance Management (PM); Performance measurements Universal Terrestrial Radio Access Network (UTRAN) ".
- [5] 3GPP TS 32.406: "Telecommunication management; Performance Management (PM); Performance measurements Core Network (CN) Packet Switched (PS) domain".
- [6] 3GPP TS 32.407: "Telecommunication management; Performance Management (PM); Performance measurements Core Network (CN) Circuit Switched (CS) domain".
- [7] 3GPP TS 32.408: "Telecommunication management; Performance Management (PM); Performance measurements Teleservice".
- [8] 3GPP TS 32.409: "Telecommunication management; Performance Management (PM); Performance measurements IP Multimedia Subsystem (IMS)".
- [9] 3GPP TS 52.402: "Telecommunication management; Performance Management (PM); Performance measurements - GSM".
- [10] 3GPP TS 32.425: "Telecommunication management; Performance Management (PM); Performance measurements Evolved Universal Terrestrial Radio Access Network (E-UTRAN)"

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [2].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [2].

eNB	E-UTRAN Node B
EPS	Evolved Packet System
E-RAB	E-UTRAN Radio Access Bearer
E-UTRAN	Evolved UTRAN
kbit	kilobit (1000 bits)
KPI	Key Performance Indicator
KQI	Key Quality Indicator
LTE	Long Term Evolution
QoS	Quality of Service
RAT	Radio Access Technology
TTI	Transmission Time Interval
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Radio Access Network

4 KPI Overview

The following KPI categories are covered by the present document:

- Accessibility (see the definition in [1]).
- Retainability (see the definition in [1]).
- Integrity (see the definition in [1]).
- Availability
- Mobility

5 KPI Definitions Template

- a) Long name (Mandatory): This field shall contain the long and descriptive name of the KPI.
- b) Description (Mandatory): This field shall contain the description of the KPI.
Within this field it should be given if the KPI is focusing on network or user view.
- c) Logical formula definition (Mandatory):
The logical formula should describe what the KPI formula is in logical way. The description of the formula is given in a written textual format without any measurement or counter names. E.g. a success rate KPI's logical formula is the successful event divided by all event.
- d) Physical formula definition (Optional):
This field should contain the KPI formula description using the 3GPP defined counter names.
This field can be used only if the counters needed for the KPI formula is defined in any of the 3GPP TS for

performance measurements (TS 32.404 [3], TS 32.405 [4], TS 32.406 [5], TS 32.407 [6], TS 32.408 [7], TS 32.409 [8], TS 52.402 [9], TS 32.425 [10])

e) Measurement names used for the KPI (Optional):

This section should list the measurement names used for the KPI.

This section can be filled out only when the underlying measurements for the KPI formula can be defined, i.e. physical formula definition is available.

f) KPI Object (mandatory)

This section shall describe the object of the KPI. The object of the KPI is one or some of the following:

- UTRAN;
- GERAN;
- CS core;
- PS core;
- IMS;
- E-UTRAN.

The field can have multiple selection, e.g. for a network level end to end KPI the selection can be UTRAN+PS core network.

g) KPI category (mandatory)

This section contains the classification of the KPI into one of the KPI categories listed in section 4

h) Unit of the KPI (mandatory)

This section describes the unit of the KPI. The unit can be one of the following:

- percentage;
- time interval (second or millisecond);
- Erlang;
- kbit/s.

i) Type of the KPI (Mandatory)

This section describes the type of the KPI. The KPI type can be one of the following:

- MEAN: This KPI is produced to reflect a mean measurement value based on a number of sample results.
- RATIO: KPI is produced to reflect the percentage of a specific case occurrence to all the cases.
- CUM: This KPI is produced to reflect a cumulative measurement which is always increasing.

j) Remark: (Optional)

This field is for any further information that is needed for the KPI definition.

Here it is proposed to define any additional information that would be needed for the KPI definition; e.g. the definition of a call in UTRAN.

6 E-UTRAN KPI Definitions

6.1 KPI Category "Accessibility"

6.1.1 E-RAB Accessibility

6.1.1.1 Definition

- a) E-RAB Accessibility.
- b) A KPI that shows probability for an end-user to be provided with an E-RAB at request.
- c) Probability success rate for E-RABs establishment. Successful attempts compared with total number of attempts for the different parts of the E-RAB establishment.
- d)

$$A1 = \text{InitialEPSBEstabSR} = \frac{\sum_{\text{cause}} \text{RRC.ConnEstabSucc.[Cause]}}{\sum_{\text{cause}} \text{RRC.ConnEstabAtt.[Cause]}} \times \frac{\sum \text{S1SIG.ConnEstabSucc}}{\sum \text{S1SIG.ConnEstabAtt}} \times \frac{\sum_{\text{QCI}} \text{ERAB.EstabInitSuccNbr.[QCI]}}{\sum_{\text{QCI}} \text{ERAB.EstabInitAttNbr.[QCI]}} \times 100$$

$$A2 = \text{AddedEPSBEstabSR} = \frac{\sum_{\text{QCI}} \text{ERAB.EstabAddSuccNbr[QCI]}}{\sum_{\text{QCI}} \text{ERAB.EstabAddAttNbr[QCI]}} \times 100$$

- e) RRC.ConnEstabAtt.Cause
RRC.ConnEstabSucc.Cause
S1SIG.ConnEstabAtt
S1SIG.ConnEstabSucc
ERAB.EstabInitAttNbr.QCI
ERAB.EstabInitSuccNbr.QCI
ERAB.EstabAddAttNbr.QCI
ERAB.EstabAddSuccNbr.QCI
- f) E-UTRAN
- g) Accessibility
- h) Percentage
- i) RATIO
- j) The definition of the service provided by E-UTRAN is E-RABs.

6.1.1.2 Extended definition

Mapping of end-user applications towards E-RABs can be different depending on operator strategy; hence the measurement shall be adjustable depending on operator E-RAB mapping strategy.

Table 1 Example of service mapping towards E-RABs

<i>Operator</i>	<i>Service</i>	<i>E-RAB mapping</i>
-----------------	----------------	----------------------

A	X	Initial E-RAB
A	Y	Initial E-RAB
B	X	Initial E-RAB
B	Y	Added E-RAB

To provide Accessibility measurement from E-UTRAN that can be mapped to a service for the operator the following measurements are defined:

A1: Initial E-RAB establishment success rate

A2: Added E-RAB establishment success rate

The establishment success rate is defined as:

$$\frac{\text{Number of successful E-RAB establishments}}{\text{Number of received E-RAB establishment attempts}}$$

Services can be mapped towards either Initial or Added E-RABs depending on operator strategy. If a different QoS characteristic is required compared with the QoS characteristic provided by an existing Initial E-RAB, an Added E-RAB can be requested. QoS characteristics can be defined on an E-RAB basis; hence both Initial E-RAB establishment success rate (A1) and Added E-RAB establishment success rate (A2) shall be available per QoS group.

With these two measures the operator can calculate the service accessibility depending on E-RAB mapping as follows:

Service mapped on Initial E-RAB = $A1 * 100$ [%]

Service mapped on Added E-RAB = $A1 * A2 * 100$ [%]

6.2 KPI Category "Retainability"

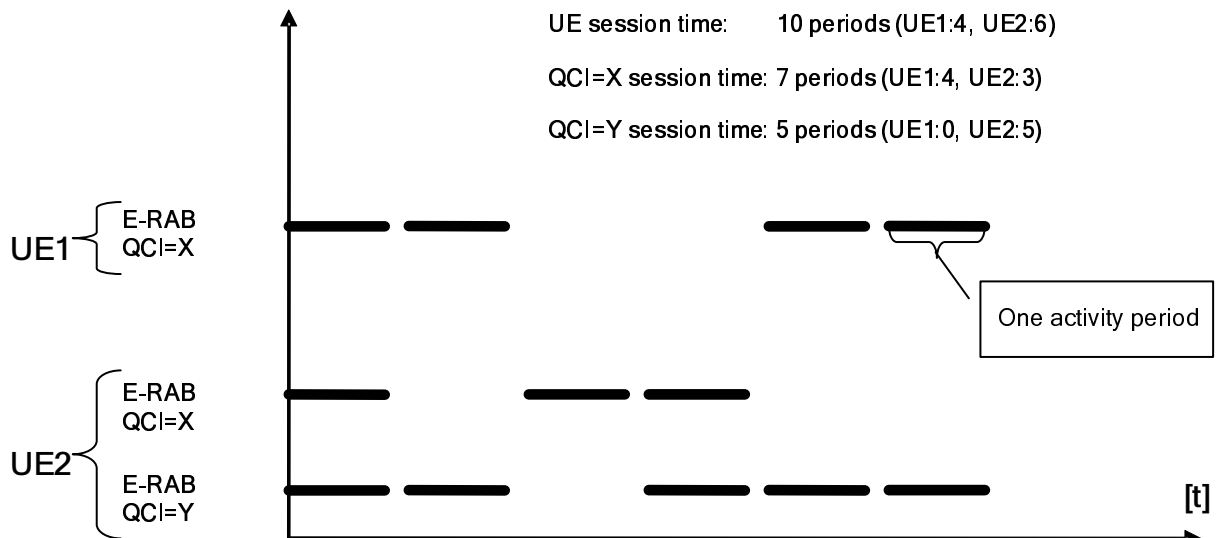
6.2.1 E-RAB Retainability

6.2.1.1 Definition

- a) E-RAB Retainability.
- b) A measurement that shows how often an end-user abnormally loses an E-RAB during the time the E-RAB is used.
- c) Number of E-RABs with data in a buffer that was abnormally released, normalized with number of data session time units.
- d) To measure E-RAB Retainability for a single QCI (R1) is fairly straight forward.

$$R1_{QCI=x} = \frac{ERAB.RelActNbr.QCI_{QCI=x}}{ERAB.SessionTimeQCI.QCI_{QCI=x}}$$

However to measure the E-RAB Retainability for UEs is not as straight forward. The measurement R1 is defined to look at the activity level of just one QCI at the time, so to use this formula and measurements in an aggregated way to get E-RAB Retainability on UE level will not be accurate (e.g. for an UE with multiple E-RABs, there might be E-RABs that are active at the same time, hence aggregating the QCI measurements for session time will give a larger session time than the total UE session time. See picture below).



Hence a measurement E-RAB Retainability on UE level is defined (R2) to provide a measurement for the overall E-RAB Retainability.

$$R2 = \frac{\sum_{QCI} ERAB.RelActNbr.[QCI]}{ERAB.SessionTimeUE}$$

- e) ERAB.RelActNbr.QCI
- ERAB.SessionTimeUE
- ERAB.SessionTimeQCI.QCI
- f) E-UTRAN.
- g) Retainability.
- h) Active release/second.
- i) MEAN.
- j) The definition of the service provided by E-UTRAN is E-RABs.

6.2.1.2 Extended definition

The retainability rate is defined as:

$$\frac{\text{Number of abnormally released E-RAB with data in any of the buffers}}{\text{Active E-RAB Time}} \quad [\text{Releases/Session time}]$$

As for defining an abnormal E-RAB release with end-user impact, it shall only be considered an abnormal release of the E-RABs if the eNodeB considers there to be data waiting for transfer in any of the buffers.

As for defining an E-RAB as active, an E-RAB shall be considered active if there recently has been any data transmission in any direction.

6.3 KPI Category "Integrity"

6.3.1 E-UTRAN IP Throughput

6.3.1.1 Definition

- a) E-UTRAN IP Throughput.
- b) A KPI that shows how E-UTRAN impacts the service quality provided to an end-user.
- c) Payload data volume on IP level per elapsed time unit on the Uu interface.
- d) IP Throughput for a single QCI:

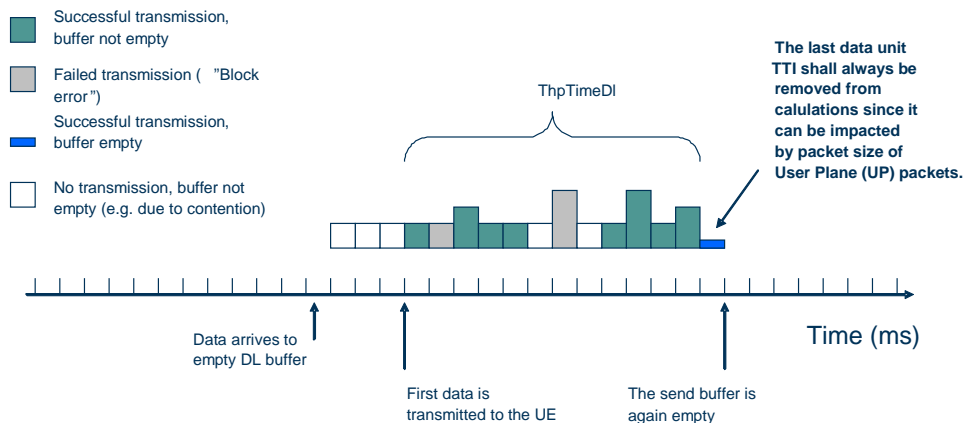
$$\text{Downlink } Thp_{QCI=x} = DRB.IPThpDl_{QCI=x}$$

$$\text{Uplink } Thp_{QCI=x} = DRB.IPThpUl_{QCI=x}$$

- e) DRB.IPThpDl.QCI
DRB.IPThpUl.QCI
- f) E-UTRAN
- g) Integrity
- h) kbit/s
- i) MEAN
- j) To make sure that only impacts from the RAN is included in this measurement, time units to be included in "elapsed time unit on the Uu interface" shall only be the ones where there is data in the buffer to be transmitted E.g.in application data flows such as a web session, there are times when there is no data to transmit by the eNodeB due to bursty traffic pattern, then this "eNodeB idle time" shall not be included in "elapsed time unit on the Uu interface".

6.3.1.2 Extended definition

To achieve a Throughput measurement (below examples are given for DL) that is independent of file size it is important to remove the samples where one TTI on the radio interface is not utilized. (Successful transmission, buffer empty in figure below).



$$ThpVolDI = \sum \text{Green Bar} \text{ (kbit)}$$

$$\text{Total DL transferred volume} = \sum \text{Green Bar} + \text{Blue Bar} \text{ (kbit)}$$

$$\text{IP Throughput in DL} = ThpVolDI / ThpTimeDI \text{ (kbit/s)}$$

Figure 1

To achieve a throughput measurement that is independent of bursty traffic pattern, it is important to make sure that idle gaps between incoming data is not included in the measurements. That shall be done as considering each burst of data as one sample.

ThpVolDI is the volume on IP level and the ThpTimeDI is the time elapsed on Uu for transmission of the volume included in ThpVolDI.

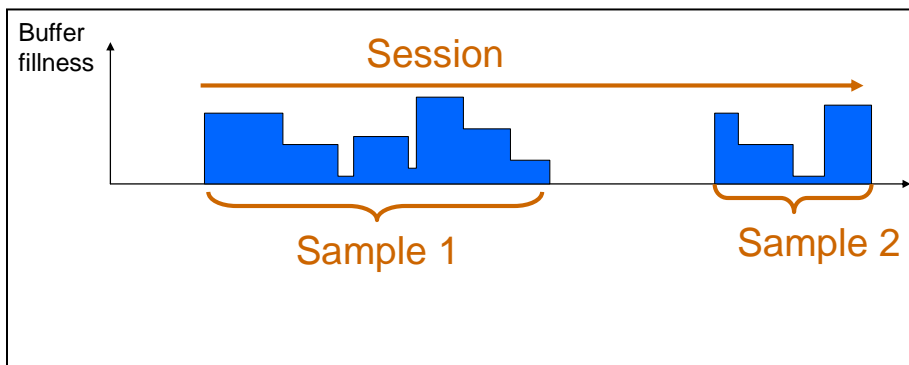


Figure 2

$$IP \text{ Throughput } DL = \frac{\sum_{Samples} ThpVolDI}{\sum_{Samples} ThpTimeDI}$$

Since services can be mapped towards different kind of E-RABs, the IP Throughput measurement shall be available per QoS group.

6.3.2 E-UTRAN IP Latency

6.3.2.1 Definition

- a) E-UTRAN IP Latency.

- b) A measurement that shows how E-UTRAN impacts on the delay experienced by an end-user.
- c) Time from reception of IP packet to transmission of first packet over the Uu.
- d) *Downlink* $Lat_{QCI=x} = DRB.IPLatDI_{QCI=x}$
- e) DRB.IPLatDI.QCI
- f) E-UTRAN.
- g) Integrity.
- h) Milliseconds.
- i) MEAN.
- j) To make sure only contribution from the RAN is included in this measurement, only delay of the first block to the Uu is counted.

6.3.2.2 Extended definition

To achieve a delay measurement that is independent of IP data block size only the first packet sent to Uu is measured.

To find the delay for a certain packet size the IP Throughput measure can be used together with IP Latency (after the first block on the Uu, the remaining time of the packet can be calculated with the IP Throughput measure).

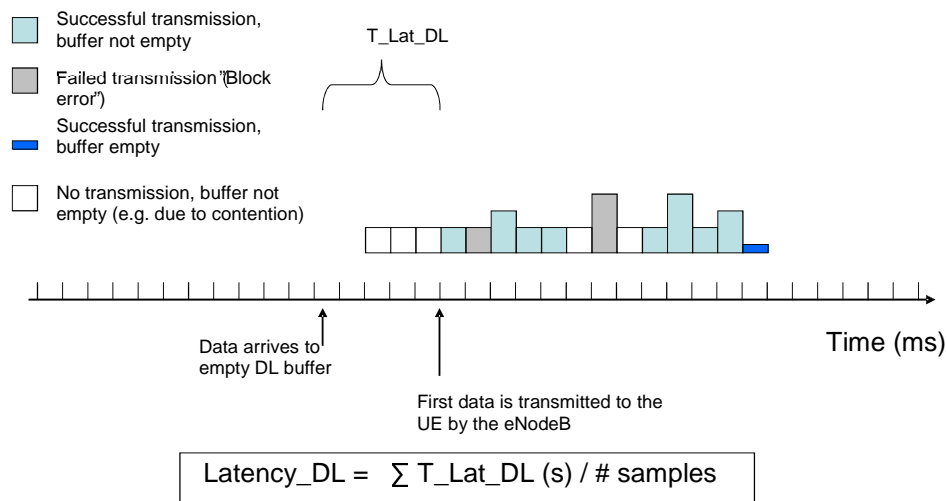


Figure 3

T_Lat is defined as the time between reception of IP packet and the time when the eNodeB transmits the first block to Uu.

Since services can be mapped towards different kind of E-RABs, the Latency measure shall be available per QoS group.

6.4 KPI Category "Availability"

6.4.1 E-UTRAN Cell Availability

6.4.1.1 Definition

- a) E-UTRAN Cell Availability.
- b) A KPI that shows Availability of E-UTRAN Cell.
- c) Percentage of time that the cell is considered available.
- d)
$$CellAvailability = \frac{\text{measurement_period} - \sum_{\text{cause}} RRU.CellUnavailableTime.[\text{cause}]}{\text{measurement_period}} \times 100$$
- e) RRU.CellUnavailableTime.cause
- f) E-UTRAN
- g) Availability
- h) Percentage
- i) RATIO
- j) -

6.4.1.2 Extended Definition

$$Availability = \frac{\text{Time that cell is available}}{\text{Measurement Time}} * 100 [\%]$$

As for defining the cell as available, it shall be considered available when the eNodeB can provide E-RAB service in the cell.

6.5 KPI Category "Mobility"

6.5.1 E-UTRAN Mobility

6.5.1.1 Definition

- a) E-UTRAN Mobility.
- b) A KPI that shows how E-UTRAN Mobility functionality is working.
- c) Success rate of E-UTRAN Mobility.
- d)
$$\text{Mobility Success Rate}_{QCI=x} = \frac{HO.ExeSucc}{HO.ExeAtt} \times \frac{HO.PrepSucc.QCI_{QCI=x}}{HO.PrepAtt.QCI_{QCI=x}} \times 100 [\%]$$
- e) HO.ExeAtt
HO.ExeSucc

- HO.PrepAtt.*QCI*
- HO.PrepSucc.*QCI*
- f) E-UTRAN
- g) Mobility
- h) Percentage
- i) RATIO
- j) -

6.5.1.2 Extended Definition

The measurement shall include both Intra E-UTRAN and Inter RAT handovers.

The measurement shall include both the preparation and execution phase of the handover.

”Entering preparation phase” is defined as the point of time when the source eNB attempts to prepare resources for an UE in a neighboring cell.

”Success of execution phase” is defined as the point of time when the source eNB receives information that the UE successfully is connected to the target cell.

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
Dec 2008	SP-42	SP-080719			Presentation to SA for information		1.0.0
Mar 2009	SP-43	SP-090065	--	--	Presentation to SA for approval	2.0.0	8.0.0
Jun 2009	SP-44	SP-090289	001	--	Correction of extended definition for Mobility KPI	8.0.0	8.1.0
Sep 2009	SP-45	SP-090542	002	--	Correction on the IP latency KPI	8.1.0	8.2.0
Dec 2009	-	-	-	-	Update to Rel-9 version	8.2.0	9.0.0
Jun 2010	SP-48	SP-100412	003	-	Add formulas for IP Throughput KPI	9.0.0	9.1.0
Mar 2011	-	-	-	-	Update to Rel-10 version (MCC)	9.1.0	10.0.0
May 2011	SP-52	SP-110285	007	-	Correction of the measurement names in the KPI definition of E-RAB Accessibility	10.0.0	10.1.0
May 2011	SP-52	SP-110287	008	1	Correction of the measurement names in the KPI definition of E-RAB Retainability to align with 32.425	10.0.0	10.1.0
2012-09	-	-	-	-	Update to Rel-11 version (MCC)	10.1.0	11.0.0
2014-10	-	-	-	-	Update to Rel-12 version (MCC)	11.0.0	12.0.0
2016-01	-	-	-	-	Update to Rel-13 version (MCC)	12.0.0	13.0.0

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2019-09	SA#85	SP-190749	0019	-	F	Correction on kbits abbreviation	13.1.0

History

Document history		
V13.0.0	February 2016	Publication
V13.1.0	October 2019	Publication