ETSI TS 132 410 V16.0.0 (2020-08)

**Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
Telecommunication management;
Key Performance Indicators (KPI) for UMTS and GSM
(3GPP TS 32.410 version 16.0.0 Release 16)**

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GSM® GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

Reference
RTS/TSGS-0532410vg00

Keywords
GSM,UMTS

ETSI

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Foreword

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

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  - 3 or greater indicates TSG approved document under change control.
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- z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

Key Performance Indicators (KPI) emanate from strategic goals of enterprise, and cascade through the entire organization.
KPIs are specified through definition and measurement of key parameters of input/output of internal network system and/or maintenance & operation progress of an enterprise.
KPIs are primary metrics to evaluate process performance as indicators of quantitative management, and to measure progress towards the enterprise's goals.

Competition in the liberalized telecommunications markets and customer requirements for more complex services are leading to a greater emphasis on the provision of efficient customer service.
To achieve this goal, telecommunication operators have found the Service Level Agreement (SLA) solution.
In the Performance Management hierarchy, SLA is supported by KQI; KQI is supported by KPI; and KPI is supported by network performance data from Network Elements.
Performance measurements are specified in 3GPP TS 32.404 [1], TS 32.405 [2], TS 32.406 [3], TS 32.407 [4], TS 32.408 [5], TS 32.409 [6] and TS 52.402 [7].

KPI definitions include high level KPIs that are common across GSM and UMTS etc and KPIs that are related to specific network techniques.

1 Scope

The present document specifies Key Performance Indicators (KPIs) for GSM, UMTS, etc.
KPI definitions include high level KPIs that are:

a) **common** across GSM and UMTS networks; and

b) **specific** to network techniques such as GSM and UMTS networks.

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 TS 32.404: "Telecommunication management; Performance Management (PM); Performance measurements - Definitions and template".

[2] 3GPP TS 32.405: "Telecommunication management; Performance Management (PM); Performance measurements Universal Terrestrial Radio Access Network (UTRAN) ".

[3] 3GPP TS 32.406: "Telecommunication management; Performance Management (PM); Performance measurements Core Network (CN) Packet Switched (PS) domain".

[4] 3GPP TS 32.407: "Telecommunication management; Performance Management (PM); Performance measurements Core Network (CN) Circuit Switched (CS) domain".

[5] 3GPP TS 32.408: "Telecommunication management; Performance Management (PM); Performance measurements Teleservice".

[6] 3GPP TS 32.409: "Telecommunication management; Performance Management (PM); Performance measurements IP Multimedia Subsystem (IMS) ".

[7] 3GPP TS 52.402: "Telecommunication management; Performance Management (PM); Performance measurements - GSM".

[8] 3GPP TR 32.814: "Telecommunication management; UTRAN and GERAN Key Performance Indicators (KPI)".

[9] ITU-T Recommendation E.800: "Terms and definitions related to quality of service and network performance including dependability".

[10] TMF GB917: "SLA management handbook, release 2.5", July 2005.

[11] TMF GB923: "Wireless service measurements handbook", version 3.0, March 2004.

[12] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol specification".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

BLER Block Error Rate

CN	Core Network
CS	Circuit Switched
GERAN	GSM EDGE Radio Access Network
GSM	Global System for Mobile Communications
IMS	IP Multimedia Subsystem
KPI	Key Performance Indicator
KQI	Key Quality Indicator
PS	Packet Switched
RAB	Radio Access Bearer
SLA	Service Level Agreement
TMF	TeleManagement Forum
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Radio Access Network

4 KPI Overview

Key performance indicators (KPI) must emanate from the strategy goals of enterprise and cascade through the organization. KPIs are defined through the definition and measurement of key parameters of input and output of internal network system and/or maintenance & operation progress of enterprise. KPIs are considered to be primary metrics to evaluate process performance as indicators of quantitative management, and to measure progress toward enterprise goals.

For operators, competition in the liberalized telecommunications markets and the requirements of customers for more complex services are leading to a greater emphasis on the provision of efficient customer service. The efficiency of customer service is embodied by customer perception and good customer relations.

According to TMF (TeleManagement Forum) contributions, SLAs (Service Level Agreement, See in TMF GB917 [10]) can contribute to determining how customer care is perceived and aiding service providers in attracting customers and maintaining customer loyalty. A SLA is an element of a formal, negotiated contract between two parties, viz., a service provider and a customer. It documents the common understanding of all aspects of the service and the roles and responsibilities of both parties from service ordering to service termination. SLAs can include many aspects of a service, such as performance objectives, customer care procedures, billing arrangements, service provisioning requirements, etc.

SLAs are supported by service or product KQIs. Service KQIs are the key indicators of the service element performance, and used as the primary input for management of internal or supplier/partner SLAs that calculate actual service delivery quality against design targets or in the case of supplier/partner contractual agreements. Service KQIs provide the main source of data for the product KQIs that are required to manage product quality and support the contractual SLAs with the customer. (See in TMF GB923 [11])

KQIs are supported by KPIs that are an indication of service resource performance.

KPI is proved by aggregation of network performance data from network elements.

Performance hierarchy is shown as figure 1.

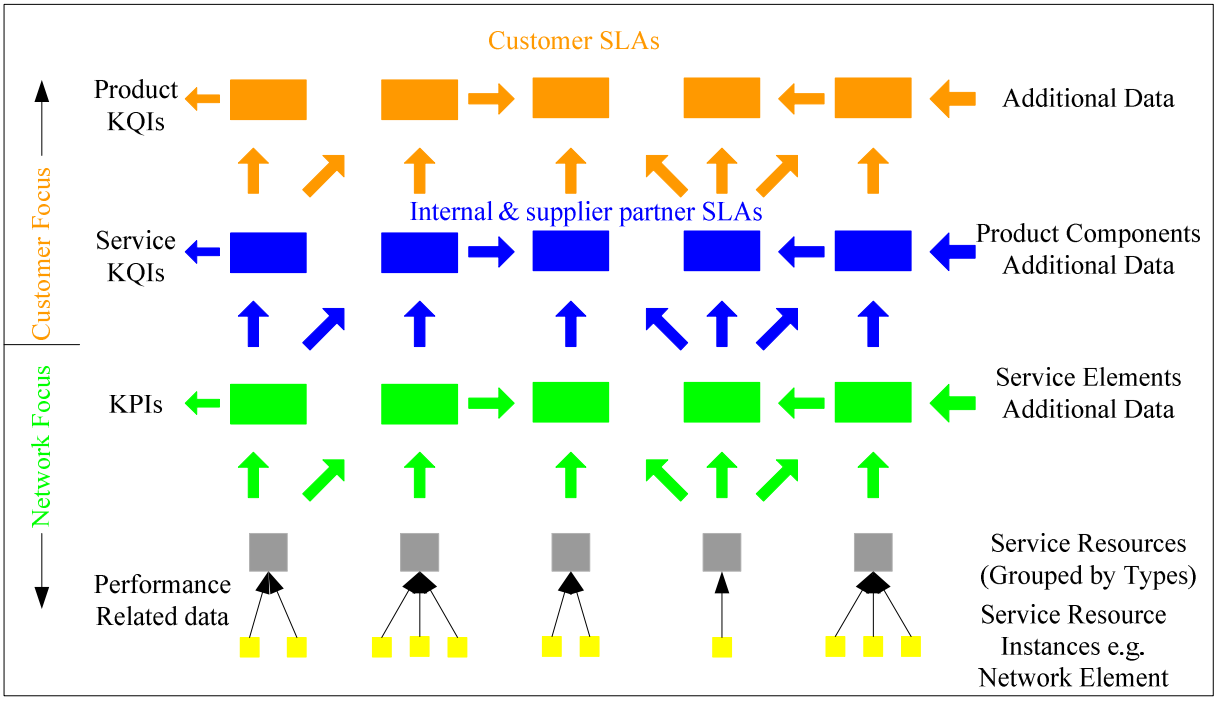

Figure 1: Key Indicator Hierarchy (see in TMF GB917 [10])

In detail to support customer SLAs, KPI should be used to evaluate user's degree of satisfaction with the service provided. The user's degree of satisfaction depends on quality of service that is on the user's perception of the service performance: the support, the operability, the serveability and the security (See in ITU-T Recommendation E.800 [9]). In the present document, KPI is only used to evaluate the service serveability performance. The service serveability performance is further subdivided into three terms: service accessibility, retainability and integrity performance.

From network performance point of view, serveability performance depends on trafficability performance that is the combined aspects of availability, reliability, maintainability and maintenance support performance. So that KPIs defined in the present document are widely used for network performance monitoring and quality benchmarking, such as hand-off success rate, call drop-rate, hold time, and congestion are continuously monitored to provide indicators of areas that might require tuning.

KPI is only valid when performance related data is non-zero or non-null.

5 KPI definitions and template

When defining KPIs the following information needs to be considered:

Type of the KPI: The different KPI types are already define in 3GPP TR 32.814 [8] (RATIO, MEAN, CUM). When a KPI is defined the KPI should be classified as one of the KPI types defined in TR 32.814 [8].

KPI Category: The following KPI categories should be defined:

- serveability: See the definition in ITU-T Recommendation E.800 [9].
  - Accessibility: See the definition in ITU-T Recommendation E.800 [9].
  - Retainability: See the definition in ITU-T Recommendation E.800 [9].
  - Integrity: See the definition in ITU-T Recommendation E.800 [9].
- Availability: See the definition in ITU-T Recommendation E.800 [9].
  - Reliability: See the definition in ITU-T Recommendation E.800 [9].

- Maintainability: See the definition in ITU-T Recommendation E.800 [9].
- Utilization: it indicates the utilization of network resource, such as throughput on specific interface.
- Mobility: it contains the Handover related KPIs.

When a KPI is defined, the KPI should be classified into one of the above defined KPI category.

Object of the KPI: The KPI can be calculated on network level (GSM network or UMTS network,). This field of the template should indicate whether the KPI is applicable for which types of network. The field can have one or more of the following network types:

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

It is important that the KPI defined should be calculated always on network level and not on Network Element level.

If a KPI uses a term that is not clearly defined, that term shall be added to the terms section of present document.

6 Header: KPI name

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 [1], TS 32.405 [2], TS 32.406 [3], TS 32.407 [4], TS 32.408 [5], TS 32.409 [6], TS 52.402 [7])

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.

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 following defined KPI categories:

- Accessibility: See the definition in ITU-T Recommendation E.800 [9].
- Retainability: See the definition in ITU-T Recommendation E.800 [9].
- Integrity: See the definition in ITU-T Recommendation E.800 [9].
  Basically Integrity KPI category is the connection quality related KPIs, like BLER.
- Mobility: This KPI category contains the Handover and Location Update related KPIs.
- Resource: This KPI category should contain the traffic utilisation of the interfaces and throughput measurements on network level.

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.

7 Accessibility KPI

7.1 RAB Establishment Success Rate

a) RAB establishment success rate.

b) This KPI describes the ratio of all successful RAB establishments to RAB establishment attempts for UTRAN network and is used to evaluate service accessibility across UTRAN.

c) This KPI is obtained by the number of all successful RAB establishments divided by the total number of attempted RAB establishments.

d) $$RabEstabSR = \frac{\sum_{type} \left\{ \begin{array}{l} RAB.SuccEstabCSNoQueuing.[type] + \\ RAB.SuccEstabCSQueuing.[type] + \\ RAB.SuccEstabPSNoQueuing.[type] + \\ RAB.SuccEstabPSQueuing.[type] \end{array} \right\}}{\sum_{type} RAB.AttEstabCS.[type] + RAB.AttEstabPS.[type]}$$

type $\in$ {Conv, Strm, Intact, Bgrd}

e) CS:
RAB.AttEstabCS.Conv, RAB.AttEstabCS.Strm, RAB.AttEstabCS.Intact, RAB.AttEstabCS.Bgrd,
RAB.SuccEstabCSNoQueuing.Conv, RAB.SuccEstabCSQueuing.Conv,
RAB.SuccEstabCSNoQueuing.Strm, RAB.SuccEstabCSQueuing.Strm,
RAB.SuccEstabCSNoQueuing.Intact, RAB.SuccEstabCSQueuing.Intact,
RAB.SuccEstabCSNoQueuing.Bgrd, RAB.SuccEstabCSQueuing.Bgrd (See in TS 32.405 [2])

PS:
RAB.AttEstabPS.Conv, RAB.AttEstabPS.Strm, RAB.AttEstabPS.Intact, RAB.AttEstabPS.Bgrd,
RAB.SuccEstabPSNoQueuing.Conv, RAB.SuccEstabPSQueuing.Conv,
RAB.SuccEstabPSNoQueuing.Strm, RAB.SuccEstabPSQueuing.Strm,
RAB.SuccEstabPSNoQueuing.Intact, RAB.SuccEstabPSQueuing.Intact,
RAB.SuccEstabPSNoQueuing.Bgrd, RAB.SuccEstabPSQueuing.Bgrd. (See in TS 32.405 [2])

f) UTRAN.

g) Accessibility.

h) Percentage.

i) RATIO.

7.1.1 RAB Establishment Success Rate for Speech

a) RAB establishment success rate for speech.

b) This KPI describes the ratio of all successful conversational speech related RAB establishments to conversational speech related RAB establishment attempts for UTRAN network and is used to evaluate speech service accessibility across UTRAN.

c) This KPI is obtained by the number of all successful conversational speech related RAB establishments divided by the total number of attempted conversational speech related RAB establishments.

d) $$RabEstabSR = \frac{\sum_{type} \left\{ \begin{array}{l} RAB.SuccEstabCSNoQueuing.[type] + \\ RAB.SuccEstabCSQueuing.[type] + \end{array} \right\}}{\sum_{type} RAB.AttEstabCS.[type]}$$

type ∈ {Conv. <1><1> }

e) CS:
RAB.AttEstabCS.Conv Conv. <1><1>, RAB.SuccEstabCSNoQueuing. Conv. <1><1>,
RAB.SuccEstabCSQueuing. Conv. <1><1>
(See in TS 32.405 [2])

For conversational service Conv. <U><D>, the relevant measurement according to the data rates requested, see TS 25.993 [3] as follows:
uplink<U>:
1: AMR rate (12.2 10.2 7.95 7.4 6.7 5.9 5.15 4.75) kbps,
6: WB-AMR rate (12.65, 8.8, 6.65) kbps
downlink<D>:
1: AMR rate (12.2 10.2 7.95 7.4 6.7 5.9 5.15 4.75) kbps,
6: WB-AMR rate (12.65, 8.8, 6.65) kbps

f) UTRAN.

g) Accessibility.

h) Percentage.

i) RATIO.

j) Note:Emergency calls will also be covered by this KPI.

7.1.2 RAB Establishment Success Rate for Videotelephony

a) RAB establishment success rate for Videotelephony

b) This KPI describes the ratio of all successful conversational Videotelephony related RAB establishments to conversational Videotelephony related RAB establishment attempts for UTRAN network and is used to evaluate Videotelephony service accessibility across UTRAN.

c) This KPI is obtained by the number of all successful conversational Videotelephony related RAB establishments divided by the total number of attempted conversational Videotelephony related RAB establishments.

d) $$RabEstabSR = \frac{\sum_{type} \left\{ \begin{matrix} RAB.SuccEstabCSNoQueuing.[type] + \\ RAB.SuccEstabCSQueuing.[type] + \end{matrix} \right\}}{\sum_{type} RAB.AttEstabCS.[type]}$$

type ∈ {Conv. <5><5> }

CS:
RAB.AttEstabCS.Conv Conv. <5><5>, RAB.SuccEstabCSNoQueuing. Conv. <5><5>, RAB.SuccEstabCSQueuing. Conv. <5><5>
(See in TS 32.405 [2])

For conversational service Conv. <U><D>, the relevant measurement according to the data rates requested, see TS 25.993 [3] as follows:
uplink<U>:
5: 64 kbps
downlink<D>:
5: 64 kbps

e) UTRAN.

f) Accessibility.

g) Percentage.

h) RATIO.

7.2 RRC Connection Establishment Success Rate

a) RRC connection establishment success rate.

b) This KPI describes the ratio of all successful RRC establishments to RRC establishment attempts for UTRAN network, and is used to evaluate UTRAN and RNC or cell admission capacity for UE and/or system load.

c) This KPI is obtained by the number of all successful RRC establishments divided by the total number of attempted RRC establishments.

d) $$RrcEstabSR = \frac{\sum_{cause} RRC.SuccConnEstab.[cause]}{\sum_{cause} RRC.AttConnEstab.[cause]}$$

The respective causes are detailed in 3GPP TS 25.331 [12].

e) RRC.AttConnEstab.*Cause*
RRC.SuccConnEstab.*Cause* (See in TS 32.405 [2])

f) UTRAN.

g) Accessibility.

h) Percentage.

i) RATIO.

7.3 UTRAN Service Access Success Rate

a) UTRAN service access success rate for idle mode UEs.

b) This KPI describes the ratio of all successful UTRAN access to UTRAN access attempts for UTRAN network and is used to evaluate service accessibility provided by UTRAN. Successful RRC set up repetition and/or cell re-selections during RRC setup should be excluded, namely only service related RRC setup should be considered.

c) This KPI is obtained by the Successful RRC Connection Establishment Rate for UTRAN access purposes multiplied by the RAB Establishment Success Rate for all RAB types.

d) $$UASR = RabEstabSR * \left(\frac{\sum_{cause,\, cell/RNC} RRC.SuccConnEstab.[cause,\, cell/RNC]}{\sum_{cause,\, cell/RNC} RRC.AttConnEstab.[cause,\, cell/RNC]} \right)$$

Cause ∈ {Originating Conversational Call,
Originating Streaming Call,
Originating Interactive Call,
Originating Background Call,
Terminating Conversational Call,
Terminating Streaming Call,
Terminating Interactive Call,
Terminating Background Call}
only causes for call related are defined in 3GPP TS 25.331 [12].

e) Refer to e) part of KPI: RAB Establishment Success Rate and KPI: RRC Connection Establishment Success Rate.

f) UTRAN.

g) Accessibility.

h) Percentage.

i) RATIO.

7.4 GERAN Service Access Success Rate for CS Domain

a) GERAN service access success rate for CS domain.

b) This KPI describes the ratio of all successful GERAN access to GERAN access attempts for GERAN network and is used to evaluate service accessibility provided by GERAN. Successful SDCCH set up repetition during SDCCH setup should be excluded, namely only service related SDCCH setup for CS domain should be considered.

c) This KPI is obtained by the TCH seizures success rate multiplied by the SDCCH setup success rate.

d) $$GASRCS = \frac{succTCHSeizures}{attTCHSeizures} \cdot \frac{succImmediateAssingProcs}{attImmediateAssingProcs}$$

e) succTCHSeizures, attTCHSeizures, attImmediateAssingProcs, succImmediateAssingProcs, (See in TS 52.402).

f) GERAN.

g) Accessibility.

h) Percentage.

i) RATIO.

7.5 GSM PDP Context Activation Success Rate

a) GERAN PDP context activation success rate.

b) This KPI describes the ratio of all successful PDP context activation to PDP context activation attempts for GSM PS core network and is used to evaluate service accessibility provided by GSM and network performance to provide GPRS. This KPI is only valid for Release 6 MS with capability of PDP context.

c) This KPI is obtained by the successful PDP context activation procedures initiated by MS divided by the attempted PDP context activation procedures initiated by MS.

d) $$GPDPCASR = \frac{\sum_{sgsn} succActPdpContextMSPerSgsn}{\sum_{sgsn} attActPdpContextMSPerSgsn}$$

e) attActPdpContextMSPerSgsn, succActPdpContextMSPerSgsn, (See in TS 52.402).

f) PS core.

g) Accessibility.

h) Percentage.

i) RATIO.

7.6 UMTS PDP Context Activation Success Rate

a) UMTS PDP context activation success rate.

b) This KPI describes the ratio of the number of successfully performed PDP context activation procedures to the number of attempted PDP context activation procedures for UMTS PS core network and is used to evaluate service accessibility provided by UMTS and network performance to provide GPRS.

c) This KPI is obtained by successful PDP context activation procedures initiated by MS divided by attempted PDP context activation procedures initiated by MS.

d) $$UPDPCASR = \frac{\sum_{sgsn} SM.SuccActPdpContext}{\sum_{sgsn} SM.AttActPdpContext}$$

e) SM.AttActPdpContext, SM.SuccActPdpContext (See in TS 32.406).

f) PS core.

g) Accessibility.

h) Percentage.

i) RATIO.

7.7 UMTS Switched Call Success Rate

a) MSC-S switched call success rate.

b) This KPI describes the ratio of the number of successful calls for MSC-S originating traffic and successful incoming calls from a given MSC-S to the number of attempted calls for MSC-S acknowledged for originating traffic and incoming calls from MSC-S. It is used to evaluate switched call performance.

c) This KPI is obtained by successful calls for MSC-S originating and incoming traffic from a given MSC-S divided by attempted calls for MSC-S originating calls and incoming calls.

d) $$USASR = \frac{\sum_{MSC-S} (CC.SuccmobileOrigiCalls + CC.SuccIncCalls)}{\sum_{MSC-S} (CC.AttmobileOrigiCalls + CC.AttIncCalls)}$$

Note: it is combined for UMTS and GSM.

e) CC.AttmobileOrigiCalls, CC.SuccmobileOrigiCalls ,CC.AttIncCalls, CC.SuccIncCalls (See in TS 32.407).

f) CS core.

g) Accessibility.

h) Percentage.

i) RATIO.

8 Retainability KPI

8.1 RAB Abnormal Release Rate

a) RAB abnormal release rate

b) This KPI describes the ratio of number of RAB release requests to number of the successful RAB establishments. This KPI reflects service retainability across UTRAN.

c) This KPI is obtained by the number of RAB release requests divided by the number of successful RAB establishments.

d) $$RARR = 1 - \frac{\begin{array}{l} RAB.RelReqCS.sum + \sum_{cell/RNC} RAB.NbrIuRelReqCS.sum + \\ RAB.RelReqPS.sum + \sum_{cell/RNC} RAB.NbrIuRelReqPS.sum \end{array}}{\sum_{type} \left\{ \begin{array}{l} RAB.SuccEstabCSNoQueuing.[type] + \\ RAB.SuccEstabCSQueuing.[type] + \\ RAB.SuccEstabPSNoQueuing.[type] + \\ RAB.SuccEstabPSQueuing.[type] \end{array} \right\}}$$

type ∈ {Conv, Strm, Intact, Bgrd}

e) CS:
RAB.SuccEstabCSNoQueuing.Conv, RAB.SuccEstabCSNoQueuing.Strm
RAB.SuccEstabCSNoQueuing.Intact, RAB.SuccEstabCSNoQueuing.Bgrd
RAB.SuccEstabCSQueuing.Conv, RAB.SuccEstabCSQueuing.Strm
RAB.SuccEstabCSQueuing.Intact, RAB.SuccEstabCSQueuing.Bgrd
RAB.RelReqCS.*sum*, RAB.NbrIuRelReqCS.*sum*

PS:
RAB.SuccEstabPSNoQueuing.Conv, RAB.SuccEstabPSNoQueuing.Strm
RAB.SuccEstabPSNoQueuing.Intact, RAB.SuccEstabPSNoQueuing.Bgrd
RAB.SuccEstabPSQueuing.Conv, RAB.SuccEstabPSQueuing.Strm
RAB.SuccEstabPSQueuing.Intact, RAB.SuccEstabPSQueuing.Bgrd
RAB.RelReqPS.*sum*, RAB.NbrIuRelReqPS.*sum* (See in TS 32.405)
Note: "*.sum*" means that sum of possible normal causes for measurements RAB.RelReqCS.*sum*, RAB.NbrIuRelReqCS.*sum*, RAB.RelReqPS.*sum* and RAB.NbrIuRelReqPS.*sum*.

f) UTRAN.

g) Retainability.

h) Percentage.

i) RATIO.

8.2 GERAN Service Abnormal Release Rate

a) GERAN service abnormal release rate.

b) This KPI describes the ratio of mobiles which having successfully accessed the TCH, subsequently suffer an abnormal release, caused by loss of the radio link. This figure is comprised of RF losses on the TCH plus losses during handover.

c) This KPI is obtained by the number of lost radio links while using a TCH, unsuccessful internal handovers intra-cell, unsuccessful internal handovers with reconnection to old channels and with loss of connection divided by the total number of successful TCH/PDTCH seizures, successful internal handovers intra-cell and successful incoming Internal inter cell handovers.

d) $$GAbnormalRelRate = \frac{\begin{pmatrix} nbrOfLostRadioLinksTCH + \\ unsuccInternalHDOsIntraCell + \\ unsuccHDOsWithReconnection + \\ unsuccHDOsWithLossOfConnection \end{pmatrix}}{\begin{pmatrix} succTCHSeizures + succInternalHDOsIntraCell \\ + succIncomingInternalInterCellHDOs \end{pmatrix}}$$

e) nbrOfLostRadioLinksTCH
unsuccInternalHDOsIntraCell
unsuccHDOsWithReconnection
unsuccHDOsWithLossOfConnection
succTCHseizures
succInternalHDOsIntraCell
succIncomingInternalInterCellHDOs (See in TS 52.402).

f) GERAN.

g) Retainability.

h) Percentage.

i) RATIO.

8.3 Combined 2G 3G Call Drop Ratio

a) Combined 2G 3G Call Drop Ratio

b) This KPI can give a global indication of drop calls when an important part of 2G traffic comes from 3G network via handover.

c) This KPI is obtained by the number of calls in 2G and 3G related to the total number of establishment calls.

$$23CDR = \frac{\left(\begin{array}{l}\text{nbrOfLostRadioLinksTCH} + \\ \text{unsuccInternalHDOsIntraCell} + \\ \text{unsuccHDOsWithReconnection} + \\ \text{unsuccHDOsWithLossOfConnection}\end{array}\right) + \left(\begin{array}{l}\sum_{\text{type}} \text{RAB.SuccEstabCSNoQueuing.[type]} + \\ \text{RAb.SuccEstabCSQueuing.[type]} \\ - \\ \text{RAB.RelReqCS.sum} \\ - \\ \sum_{\text{Cell/RNC}} \text{RAB.NbrIuRelReqCS.sum}\end{array}\right)}{\left(\begin{array}{l}\text{succTCHseizures} + \\ \text{succInternalHDOsIntraCell} + \\ \text{succIncomingInternalInterCellHDOs}\end{array}\right) + \left(\sum_{type} \text{RAB.SuccEstabCSNoQueuing.[type]} + \text{RAB.SuccEstabCSQueuing.[type]}\right)}$$

type $\in$ {Conv, Strm, Intact, Bgrd}

d) nbrOfLostRadioLinksTCH
unsuccInternalHDOsIntraCell
unsuccHDOsWithReconnection
unsuccHDOsWithLossOfConnection
succTCHseizures
succInternalHDOsIntraCell
succIncomingInternalInterCellHDOs (See in TS 52.402).
CS:
RAB.SuccEstabCSNoQueuing.Conv, RAB.SuccEstabCSNoQueuing.Strm
RAB.SuccEstabCSNoQueuing.Intact, RAB.SuccEstabCSNoQueuing.Bgrd
RAB.SuccEstabCSQueuing.Conv, RAB.SuccEstabCSQueuing.Strm
RAB.SuccEstabCSQueuing.Intact, RAB.SuccEstabCSQueuing.Bgrd
RAB.RelReqCS.*sum*, RAB.NbrIuRelReqCS.*sum*

Note: "*.sum*" means that sum of possible normal causes for measurements RAB.RelReqCS.*sum*, RAB.NbrIuRelReqCS.*sum*

e) GERAN, UTRAN

f) Retainability.

g) Percentage.

h) RATIO.

9 Mobility KPI

9.1 Soft Handover Success Rate

a) Radio link addition success rate.

b) This KPI describes the ratio of number of successful radio link additions to the total number of radio link addition attempts.

c) This KPI is obtained by the number of successful radio link additions divided by the total number of radio link addition attempts.

d) $$SHOSR = \frac{SHO.SuccRLAddUESide}{SHO.AttRLAddUESide}$$

e) SHO.SuccRLAddUESide
SHO.AttRLAddUESide. (See in TS 32.405 [2])

f) UTRAN.

g) Mobility.

h) Percentage.

i) RATIO.

j) This KPI could be sum of radio link addition success rate based on UTRAN cell. the measured object cell should have been added to the active link (set).

9.2 Outgoing Intra-system Hard Handover Success Rate

a) Outgoing Hard Handover success rate.

b) This KPI describes the ratio of number of successful outgoing hard handover to the total number of the attempted outgoing hard handover.

c) This KPI is obtained by the number of successful outgoing hard handover divided by the total number of the attempted outgoing hard handover.

d) $$HHOSR = \frac{\left\{\begin{array}{l} HHO.SuccOutIntraNodeB + \\ HHO.SuccOutInterNodeBIntraRNC + \\ HHO.SuccOutInterRNCIur + \\ HHO.SuccOutInterRNCCN \end{array}\right\}}{\left\{\begin{array}{l} HHO.AttOutIntraNodeB + \\ HHO.AttOutInterNodeBIntraRNC + \\ HHO.AttOutInterRNCIur + \\ HHO.AttOutInterRNCCN \end{array}\right\}}$$

e) HHO.AttOutIntraNodeB, HHO.SuccOutIntraNodeB
HHO.AttOutInterNodeBIntraRNC, HHO.SuccOutInterNodeBIntraRNC
HHO.AttOutInterRNCIur, HHO.SuccOutInterRNCIur
HHO.AttOutInterRNCCN, HHO.SuccOutInterRNCCN. (See in TS 32.405 [2])

f) UTRAN.

g) Mobility.

h) Percentage.

i) RATIO.

j) HHOSR.InterRNCIur and HHOSR.InterRNCCN is collected in the SRNC.

9.3 Outgoing Inter RAT Handover Success Rate for CS Domain

a) Outgoing Inter RAT Handover success rate (CS).

b) This KPI describes the ratio of number of successful inter RAT handover to the total number of the attempted inter RAT handover from UMTS to GSM for CS domain.

c) This KPI is obtained by the number of successful inter RAT handover divided by the total number of the attempted inter RAT handover from UMTS to GSM for CS domain.

d) $$IRATHOSR\_CS = \frac{IRATHO.SuccOutCS}{IRATHO.AttRelocPrepOutCS}$$

e) IRATHO.AttRelocPrepOutCS, IRATHO.SuccOutCS. (See in TS 32.405 [2])

f) UTRAN.

g) Mobility.

h) Percentage.

i) RATIO.

j) Measurements are collected in the SRNC.
Inter RAT handover for CS calls (UMTS -> GSM) starts from the relocation attempt.

9.4 Outgoing Inter RAT Handover Success Rate for PS Domain

a) Outgoing Inter RAT Handover success rate (PS).

b) This KPI describes the ratio of number of successful inter RAT handover to the total number of the attempted inter RAT handover from UMTS to GSM for PS domain.

c) This KPI is obtained by the number of successful inter RAT handover divided by the total number of the attempted inter RAT handover from UMTS to GSM for PS domain respectively.

d) $$IRATHOSR\_PS = \frac{IRATHO.SuccOutPSUTRAN}{IRATHO.AttOutPSUTRAN}$$

e) IRATHO.AttOutPSUTRAN, IRATHO.SuccOutPSUTRAN. (See in TS 32.405 [2])

f) UTRAN.

g) Mobility.

h) Percentage.

i) RATIO.

j) Measurements are collected in the SRNC.
Inter RAT handover for PS call (UMTS -> GPRS Cell Reselection, Network Initiated) considers only the UTRAN controlled handover.

9.5 Handover Success Rate (BSC and Cell)

a) Handover success rate.

b) This KPI describes the ratio of successful handover to the attempted handover from the sourece cell (measurement object) to the destination cell.

c) KPI handover success rate per BSC is obtained by the successful internal handovers per BSC divided by the successful internal handovers per BSC, unsuccessful internal handovers with reconnection to old channels and with loss of connection per BSC.
KPI handover success rate per cell is obtained by the successful outgoing Internal inter cell handovers divided by attempted outgoing Internal inter cell handovers per cell.

d)
$$HandoverSuccessRateBsc = \left(\frac{succInternalHDOsPerBSC}{\left(succInternalHDOsPerBSC + unsuccInternalHDOsWith\,\mathrm{Re}\,connectionPerBSC + unsuccInternalHDOsWithLossOfConnectionPerBSC \right)} \times 100\% \right)$$

$$HandoverSuccessRateCell = \left(\frac{succOutgoingInternalInterCellHDOs}{attOutgoingInternalInterCellHDOs} \right).$$

e) BSC Handover Success Rate
succInternalHDOsPerBSC
unsuccInternalHDOsWithReconnectionPerBSC
unsuccInternalHDOsWithLossOfConnectionPerBSC

Cell Handover Success Rate
succOutgoingInternalInterCellHDOs
attOutgoingInternalInterCellHDOs.
(See in TS 52.402).

f) GERAN.

g) Mobility.

h) Percentage.

i) RATIO.

10 Utilization KPI

10.1 Percentage of Established RABs, CS Speech.

a) Percentage of Established RABs, CS Speech.

b) This KPI describes the percentage contribution of successfully established CS Speech RABs to the total of RABs of all types successfully established.

c) This KPI is obtained by dividing the number of successfully established CS Speech RABs by the total number of RABs established, over a given time period (i.e one working day) and multiplying by 100.

d)
$$\%RabEstabCSConv = \frac{\sum_{RNC} \left\{ \begin{matrix} RAB.SuccEstabCSNoQueuing.conv.<U><D> + \\ RAB.SuccEstabCSQueuing.conv.<U><D> \end{matrix} \right\}}{\sum_{RNC} \sum_{type} \left\{ \begin{matrix} RAB.SuccEstabCSNoQueuing.[type] + \\ RAB.SuccEstabCSQueuing.[type] \\ + RAB.SuccEstabPSNoQueuing.[type] + \\ RAB.SuccEstabPSQueuing.[type] \end{matrix} \right\}}.100$$

type∈ {Conv, Strm, Intact, Bgrd}

For conversational service Conv. <U><D>, the relevant measurement according to the data rates requested, see TS 25.993 [3] as follows:
uplink<U>:
1: AMR rate (12.2 10.2 7.95 7.4 6.7 5.9 5.15 4.75) kbps

6: AMR -WB-rate (12.65, 8.8, 6.65) kbps

downlink<D>:
1: AMR rate (12.2 10.2 7.95 7.4 6.7 5.9 5.15 4.75) kbps

6: AMR -WB-rate (12.65, 8.8, 6.65) kbps

e) CS:
RAB.SuccEstabCSNoQueuing. Conv. <1><1>, RAB.SuccEstabCSQueuing. Conv. <1><1>
RAB.SuccEstabCSNoQueuing. Conv. <6><6>, RAB.SuccEstabCSQueuing. Conv. <6><6>
(See in TS 32.405 [2])
RAB.SuccEstabCSNoQueuing.Conv, RAB.SuccEstabCSNoQueuing.Strm
RAB.SuccEstabCSNoQueuing.Intact, RAB.SuccEstabCSNoQueuing.Bgrd
RAB.SuccEstabCSQueuing.Conv, RAB.SuccEstabCSQueuing.Strm
RAB.SuccEstabCSQueuing.Intact, RAB.SuccEstabCSQueuing.Bgrd (See in TS 32.405 [2])

PS:
RAB.SuccEstabPSNoQueuing.Conv, RAB.SuccEstabPSQueuing.Conv,
RAB.SuccEstabPSNoQueuing.Strm, RAB.SuccEstabPSQueuing.Strm,
RAB.SuccEstabPSNoQueuing.Intact, RAB.SuccEstabPSQueuing.Intact,
RAB.SuccEstabPSNoQueuing.Bgrd, RAB.SuccEstabPSQueuing.Bgrd. (See in TS 32.405 [2])

f) UTRAN

g) Utilization.

h) Percentage.

i) RATIO.

10.2 Percentage of Established RABs, CS 64kbps (Videotelephony)

a) Percentage of Established RABs, CS 64kbps (Videotelephony).

b) This KPI describes the percentage contribution of successfully established CS 64kbps RABs to the total of RABs of all types successfully established. This RAB type is often used to identify the CS Video Telephony service.

c) This KPI is obtained by dividing the number of successfully established CS 64kbps RABs by the total number of CS RABs established, over a given time period (i.e one working day) and multiplying by 100.

d)

$$\%RabEstabCS64 = \frac{\sum_{RNC}\left\{\begin{array}{l} RAB.SuccEstabCSNoQueuing.Conv<U><D>+ \\ RAB.SuccEstabCSQueuing.Conv<U><D> \end{array}\right\}}{\sum_{RNC}\sum_{type}\left\{\begin{array}{l} RAB.SuccEstabCSNoQueuing.[type]+ \\ RAB.SuccEstabCSQueuing.[type]+ \\ RAB.SuccEstabPSNoQueuing.[type]+ \\ RAB.SuccEstabPSQueuing.[type] \end{array}\right\}}.100$$

For streaming service Conv. <U><D>, the relevant measurement according to the data rates requested, see TS 25.993 [3] as follows:
uplink<U>:
5: 64kbps
downlink<D>:
5: 64kbps (See in TS 32.405 [2])

type∈ {Conv, Strm, Intact, Bgrd}

e) CS:
RAB.SuccEstabCSNoQueuing. Conv<5><5>, RAB.SuccEstabCSQueuing.Conv<5><5>
RAB.SuccEstabCSNoQueuing.Conv, RAB.SuccEstabCSNoQueuing.Strm
RAB.SuccEstabCSNoQueuing.Intact, RAB.SuccEstabCSNoQueuing.Bgrd
RAB.SuccEstabCSQueuing.Conv, RAB.SuccEstabCSQueuing.Strm
RAB.SuccEstabCSQueuing.Intact, RAB.SuccEstabCSQueuing.Bgrd (See in TS 32.405 [2])

PS:
RAB.SuccEstabPSNoQueuing.Conv, RAB.SuccEstabPSQueuing.Conv,
RAB.SuccEstabPSNoQueuing.Strm, RAB.SuccEstabPSQueuing.Strm,
RAB.SuccEstabPSNoQueuing.Intact, RAB.SuccEstabPSQueuing.Intact,
RAB.SuccEstabPSNoQueuing.Bgrd, RAB.SuccEstabPSQueuing.Bgrd. (See in TS 32.405 [2])

f) UTRAN

g) Utilization.

h) Percentage.

i) RATIO.

10.3 Percentage of Established RABs, TotalPS

a) Percentage of Established RABs, TotalPS.

b) This KPI describes the percentage contribution of all successfully established PS RABs to the total of RABs of all types successfully established.

c) This KPI is obtained by dividing the total number of successfully established PS RABs by the total number of all RABs established, over a given time period (i.e one working day) and multiplying by 100.

d)

$$\%RabEstabTotalPS = \frac{\sum_{RNC}\sum_{type}\left\{\begin{array}{l} RAB.SuccEstabPSNoQueuing.[type]+ \\ RAB.SuccEstabPSQueuing.[type] \end{array}\right\}}{\sum_{RNC}\sum_{type}\left\{\begin{array}{l} RAB.SuccEstabCSNoQueuing.[type]+ \\ RAB.SuccEstabCSQueuing.[type]+ \\ RAB.SuccEstabPSNoQueuing.[type]+ \\ RAB.SuccEstabPSQueuing.[type] \end{array}\right\}}.100$$

type $\in$ {Conv, Strm, Intact, Bgrd}

e) CS:
RAB.SuccEstabCSNoQueuing.Conv, RAB.SuccEstabCSNoQueuing.Strm
RAB.SuccEstabCSNoQueuing.Intact, RAB.SuccEstabCSNoQueuing.Bgrd
RAB.SuccEstabCSQueuing.Conv, RAB.SuccEstabCSQueuing.Strm
RAB.SuccEstabCSQueuing.Intact, RAB.SuccEstabCSQueuing.Bgrd (See in TS 32.405 [2])

PS:
RAB.SuccEstabPSNoQueuing.Conv, RAB.SuccEstabPSQueuing.Conv,
RAB.SuccEstabPSNoQueuing.Strm, RAB.SuccEstabPSQueuing.Strm,
RAB.SuccEstabPSNoQueuing.Intact, RAB.SuccEstabPSQueuing.Intact,
RAB.SuccEstabPSNoQueuing.Bgrd, RAB.SuccEstabPSQueuing.Bgrd. (See in TS 32.405 [2])

f) UTRAN

g) Utilization.

h) Percentage.

i) RATIO.

11 Availability KPI

11.1 UTRAN Cell Availability

a) UTRAN Cell Availability.

b) A KPI that shows Availability of UTRAN Cell.

c) Percentage of time that the cell is considered available.

d) $$CellAvailability = \frac{\text{measurement\_period} - \sum_{\text{cause}} \text{RRU.UTRANCellUnavailableTime.[cause]}}{measurement\_period} \times 100$$

e) RRU.UTRANCellUnavailableTime.cause

f) UTRAN

g) Availability

h) Percentage

i) RATIO

Annex A (informative): Use case for KPI

A.1 Use Case for RAB Establishment Success Rate

Because RAB provides service such as CS voice call and PS web service. When CS and/or PS RAB establishment is successful, it means that UTRAN is ready for a CS and/or PS service access. It is important to evaluate CS and/or PS service accessibility across UTRAN. This KPI is focusing on network view.

A.1.1 Use Case for RAB Establishment Success Rate for SPEECH

RAB Speech provides service such as CS voice call. When CS is successful, it means that UTRAN is ready for a CS speech service access. It is important to evaluate CS speech accessibility across UTRAN. This KPI is focusing on network view.

A.1.2 Use Case for RAB Establishment Success Rate for Videotelephony

RAB Videotelephony provides service such as CS voice call. When CS is successful, it means that UTRAN is ready for a CS Videotelephony service access. It is important to evaluate CS Videotelephony accessibility across UTRAN. This KPI is focusing on network view.

A.2 Use Case for RRC Connection Establishment Success Rate

There are two kinds of RRC connection. One kind is related to service access, the other kind is not related to service, such as related to location update, cell update, network registration etc. first kind of RRC connection can be used to evaluate service accessibility across UTRAN, second one can be used to evaluate RNC or cell admission capacity for UE and/or system load. This KPI is focusing on network view.

A.3 Use Case for UTRAN Service Access Success Rate

It is necessary to evaluate CS and PS service accessibility provided by UTRAN from control plane and user plane aspects. This KPI is focusing on user view.

A.4 Use Case for Soft Handover Success Rate

Soft handover is helpful to guarantee service QoS when UE is at the edge of cell coverage. It can be used to evaluate network performance, such as measurement control, handover decision and handover execution performance etc.This KPI indicates soft handover performance. This KPI is focusing on network view.

A.5 Use Case for Outgoing Intra-system Hard Handover Success Rate

If outgoing intra-system hard handover is failed, a call maybe drops that user can be perceived. So that it is helpful for network plan and optimization. It can be used to evaluate network performance, such as measurement control, handover decision and handover execution performance, etc. This KPI is focusing on network view.

A.6 Use Case for Outgoing Inter RAT Handover Success Rate for CS Domain

Inter RAT handover is an important function for operators with both GSM and UMTS networks. This KPI can be used to evaluate GSM and UMTS network coverage and stability and reliability performance of inter RAT handover for CS domain. User can perceive service QoS change if this KPI is too low. This KPI is focusing on network and user view.

A.7 Use Case for Outgoing Inter RAT Handover Success Rate for PS Domain

Inter RAT handover is an important function for operators with both GSM and UMTS networks. This KPI can be used to evaluate GSM and UMTS network coverage and stability and reliability performance of inter RAT handover for PS domain. User can perceive service QoS change if this KPI is too low. This KPI is focusing on network and user view.

A.8 Use Case GERAN Service Access Success Rate for CS Domain

It is necessary to evaluate service accessibility provided by GERAN. This KPI is focusing on user view.

A.9 Use Case for GSM PDP Context Activation Success Rate

It is necessary to evaluate PS service accessibility provided by GSM and network performance to support GPRS service. This KPI is focusing on network and user view.

A.10 Use Case for RAB Abnormal Release Rate

Since the user may complain about a connection released unexpectedly for CS service or unstable for PS service, it is necessary to evaluate CS and/or PS service retainability provided by UTRAN from user plane aspects, as well as UTRAN reliability and stability should be reflected. This KPI is focusing on network view.

A.11 GERAN Service Abnormal Release Rate

Since the user may complain about a connection released unexpectedly for CS service service, it is necessary to evaluate CS service retainability provided by GERAN from user plane aspects, as well as GERAN reliability and stability should be reflected. This KPI is focusing on user and network view.

A.12 Handover Success Rate (BSC and Cell)

Mobility management plays an important role in the GERAN in effectively delivering services to the mobile users on the move. Handover success rate calculated by measurements is an important performance indicator for network to indicate seamless coverage. This KPI is focusing on network view.

A.13 UMTS PDP Context Activation Success Rate

It is necessary to evaluate PS service accessibility provided by UMTS and network performance to support GPRS service. This KPI is focusing on network and user view.

A.14 UMTS Switched Call Success Rate

It is necessary to evaluate performance of switched call success rate. If switched call success rate is low, call drop rate will be increased. This KPI is focusing on network and user view.

A.15 UTRAN Cell Availability

It is necessary to evaluate the UTRAN Cell Availability. This KPI is focusing on user view.

A.16 Percentage of Established RABs

Availability of requested RABs is important for the operator to be able to effectively deliver requested services to the mobile user. Understanding the pattern of RAB usage for CS Speech, CS 64kbps Streaming and Total PS allows the operator to determine how the demand for services associated with them varies over time. It is a key input for planning and investment decisions that operators must take in order to match RAB availability to current and future demand for the associated services. These KPIs focus on the network view.

A.17 Combined 2G 3G Call Drop Ratio Ratio

This indicator can give a global indication of all drop calls including the important part of 2G traffic comes from 3G network via handover. If the call is successfully established in one network, e.g. 3G and it is handover to the other network, e.g. 2G and then the call drops the separated KPIs GERAN Service Abnormal Release Rate and RAB Abnormal Release Rate aren't a good measure of customer experience.

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
Dec 2008	SP-42	SP-080793			Presentation to SA for information	0.1.0	1.0.0
Mar 2009	SP-43	SP-090062	--	--	Presentation to SA for approval	2.0.0	8.0.0
Sep 2009	SP-45	SP-090627	001	--	Combined 2G3G Drop Call Rate	8.0.0	9.0.0
2011-03	-	-	-	-	Update to Rel-10 version (MCC)	9.0.0	10.0.0
2012-09	-	-	-	-	Update to Rel-11 version (MCC)	10.0.0	**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**
2017-04	SA#75	-	-	-	Promotion to Release 14 without technical change	13.0.0	**14.0.0**
2018-06	-	-	-	-	Update to Rel-15 version (MCC)	14.0.0	**15.0.0**
2020-07	-	-	-	-	Update to Rel-16 version (MCC)	15.0.0	**16.0.0**

History

Document history		
V16.0.0	August 2020	Publication