



**QUALITY OF SERVICE FOR VOICE, SHORT
MESSAGING SERVICE AND PACKET-SWITCHED
TRAFFIC FOR PUBLIC CELLULAR SERVICES**

MTSFB 009: 2005

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Committee representation

The IMT2000 and Beyond Working Group is supervised by the Malaysian Technical Standards Forum Bhd (MTSFB) which is authorized by Malaysian Communications and Multimedia Commission (MCMC). This amendment to the Determination No. 2 of 2002 (Public Cellular) was developed by various members whom are representatives from the following Telecommunications and Broadcast companies:

Celcom (Malaysia) Berhad
DiGi
Maxis Communications Berhad
Orbitage
Telekom Malaysia Berhad

FOREWORD

This document was developed by the IMT2000 and Beyond Working Group on the Quality of Service (QoS) for public cellular network in Malaysia. The development of this QoS was carried out by this working group under the supervision of the Malaysian Technical Standards Forum Bhd (MTSFB) which is authorized by Malaysian Communications and Multimedia Commission (MCMC).

This QoS document is an amendment to clauses 12 – 19 from the existing Determination no. 2 of 2002 (Public Cellular Service) of the Communication and Multimedia Act 1998.

This QoS document consists of 3 main parts as follows:

Part 1: Voice Telephony (Circuit Switch)

Part 2: Short Messaging Service (SMS)

Part 3: Packet Data (FTP, E-Mail, HTTP)

Part 1 consists of both intra and inter-network QoS-tests, where else Part 2 and Part 3 are only for intra-network QoS-tests.

QUALITY OF SERVICE FOR SHORT VOICE, SHORT MESSAGING SERVICE AND PACKET-SWITCHED TRAFFIC FOR PUBLIC CELLULAR SERVICES VERSION 7.0

1. INTRODUCTION

1.1 Objective

This document wishes to address Quality of Service concerns with regards to the circuit-switched voice traffic, Short Messaging Service (SMS) and Packet Data applications (FTP, E-Mail, HTTP). The test items are based on ETSI document TS 102 250.

The document also attempts to take into account perspectives from the service operators and the end-user themselves. This document describes mobility tests from the intra-network standpoint. Stationary tests (intra- and inter-network) will be developed in the next phase.

1.2 Scope

This QoS document covers the following areas of focus:

- a) Voice Telephony (Circuit Switch)
 - Service Accessibility – Telephony (SA-T)
 - Setup Time- Telephony (ST-T)
 - Call Completion Rate Circuit Switched Telephony (CCR-CS-T)
- b) Short Messaging Service (SMS)
 - Service Accessibility SMS MO (SA-SMS-MO)
 - Access Delay SMS MO (AD-SMS-MO)
 - Completion Rate SMS Circuit Switched (CR-SMS-CS)
- c) Packet Data
 - Service Accessibility Ratio (SA-PSD)
 - IP-Service Access Ratio (IPSA-PSD)
 - Completed Session Ratio (CoSeR-PSD)

2. DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

For the purposes of this standard, the following definitions apply.

2.1.1 A party

In direct transactions, the party initiating the transaction (calling party).

NOTE. In store-and-forward transactions, the party sending content.

2.1.2 B party

In direct transactions, the termination or counterpart of a transaction.

NOTE. In store-and-forward transactions, the party receiving content.

2.1.3 Content

Entirety of information transferred within a transaction, seen from the user's perspective.

NOTE. In case of services requiring entrance procedures (e.g. server login with FTP), information flow to achieve the state of being able to transfer actual user data is not counted as content.

EXAMPLE: Single SMS in SMS service; single multimedia message consisting of video, audio, and text components in MMS service.

2.1.4 Intra-network

It is the connection within the network service of one provider.

2.1.5 Inter-network

It is the connection between the network service of two providers.

2.1.6 Maximum expected delivery time.

Maximum expected delivery time for store-and-forward services, this defines the time span within which a message shall be received by the B party to rate the transaction successful from the user's perspective.

2.1.7 Service family.

Group of services having main characteristics in common.

EXAMPLE: Speech and Video Telephony, as well as SMS and MMS, are assumed to form a service family.

2.1.8 Store-and forward transaction.

Transaction where information is sent from one party A to another party B using an entity C to store information sent from A and attempting to deliver it to B

2.1.9 Transaction.

Single, complete, typical usage of a particular service

NOTE 1: At the beginning of each clause describing a particular service or family of services, the typical transaction for this particular service is described.

NOTE 2: Each type of transaction has parameters. The sum of all parameters describes the transaction completely.

A parameter set is assumed to be complete if, under constant outer conditions, all transactions using this parameter set provide the same result.

2.1.10 Transaction result.

Set (list) of possible outcomes for a particular transaction

3.1. Abbreviation

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

3G	3 rd Generation
3GPP	3 rd Generation Partnership Project
ACK	ACKnowledgement
AD	Access Delay
CCR	Call Completion Ratio
CCR-CS	Call Completion Ratio Circuit Switched
CNCR	Call Non Completion Ratio
CR	Completion Ratio

CS	Circuit Switched
CSD	Circuit Switched Data
DNS	Domain Name Server
DQ	Data Quality
DT	Delivery Time
DTE	Data Terminal Equipment
FIN	Finish
FQDN	Fully Qualified Domain Name
FQT	Fixed QoS Test equipment
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GPS	General Positioning System
GR	GPRS Register
GSM	Global System for Mobile communications
HTTP	Hyper Text Transfer Protocol
IP	Internet Protocol
KPI	Key Performance Indicator
LAC	Location Area Code
MCC	Mobile Country Code
MEDT	Maximum Expected Delivery Time
MM	Multimedia Message
MMI	Man Machine Interface
MNC	Mobile Network Code
MO	Mobile Originated
MOC	Mobile Originated Call
MOF	Mobile Originated to Fixed
MOM	Mobile Originated to Mobile
MOS	Mean Opinion Score
MQT-LC	Mobile QoS Test equipment Local Control
MQT-RC	Mobile QoS Test equipment Remote Control
MS	Mobile Station
MSC	Mobile Switching Centre
MT	Mobile Terminated
MTC	Mobile Terminating Call
MTM	Mobile Terminated, originator is also a Mobile unit
MTSFB	Malaysian Technical Standard Forum Bhd
MTU	Maximum Transmission Unit
NA	Network Access
NA-CS	Network Accessibility Circuit switched
NA-PS	Network Accessibility Packet switched
NNA	Network Non Accessibility
NP	Network Performance
OS	Operating System
PC	Personal Computer
PDN	Packet Data Network
PDP	Packet Data Protocol
PDU	Packet Data Unit
PESQ	Perceptual Evaluation of Speech Quality
PLMN	Public Land Mobile Network
PMN	Public Mobile Network
PMTU	Path Maximum Transmission Unit
POP3	Post Office Protocol version 3
PS	Packet Switched

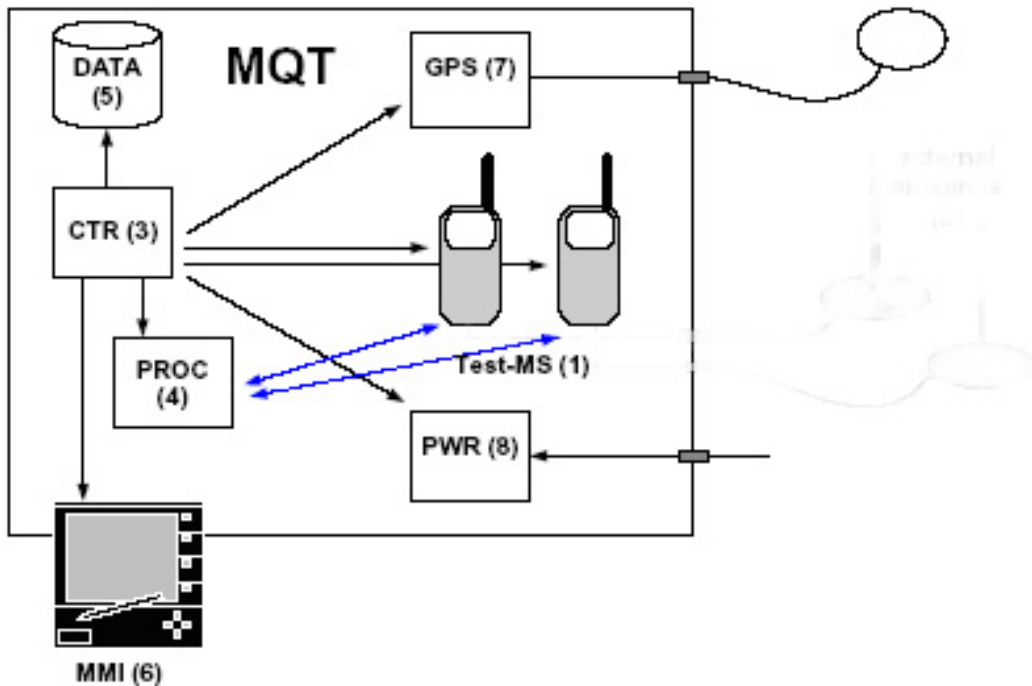
PSD	Packet Switched Data
PSTN	Public Switching Telephone Network
PWR	Power Supply
QoS	Quality of Service
RF	Radio Frequency
RT	Real Time
SA	Service Accessibility
SACK	Selective ACKnowledgement
SA-T	Service Accessibility-Telephony
SMS	Short Message Service
SMSC	Short Message Service Centre
SMTP	Simple Mail Transfer Protocol
SNAT	Service Non Accessibility Telephony
SpQ	Speech Quality
SpQ-C	Speech Quality on Call basis
SpQ-S	Speech Quality on Sample basis
ST	Setup Time
ST-T	Setup Time Telephony
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TS	Timeslot
UDP	User Datagram Protocol
UE	User Equipment (terminal, mobile station)
UMTS	Universal Mobile Telecommunication System
URL	Uniform Resource Locator
WGR	WAP Get Request
WGS-84	World Geodetic System 1984

3. Public cellular Quality of service categories

3.1 Mobile QoS Test Equipment (MQT)

3.1.7 Overview

The typical components of the Mobile QoS Test-equipment (MQT) will be as illustrated in figure 1.



- | | | |
|----|------------|--|
| 1) | Test-MS | Mobile Station emulating the typical customer MS (1...n). |
| 2) | Antenna | Test-MS antenna or external antenna. |
| 3) | Controller | Controls all the active parts in MQT. |
| 4) | Processor | Preprocessing of measurement data. |
| 5) | Storage | Storage of measurement data and programs. |
| 6) | MMI | Man Machine Interface for control of a MQT-LC or for diagnostics in case of MQT-RC |
| 7) | GPS | Geographical Positioning System. |
| 8) | PWR | Power Supply. |

Figure 1. Mobile QoS Test Equipment

3.1.2 Test-MS

Basic requirements on the Test-MS:

- 1) Compliant to 3GPP specifications (minimum Release 99) for UMTS network. Compliant to GSM specifications for EDGE network.
- 2) To initiate and measure the QoS tests, the Test-MS must be able to execute scripts automatically with the required parameter settings.
- 3) Delivering all data required for QoS tests.
- 4) The Test-MS should be able to use the features available on the service provider's network. For example, the device should be able to select the proper bearer when moving across a GSM / GPRS / EDGE / WCDMA coverage area.
- 5) Electrical interface for audio input and output.

- 6) Test-MS must be able to be powered / charged by the vehicle's battery or power supply.

3.1.7 Antennas

The MS antenna must be located inside the vehicle. The antenna must be fixed at the head rest position of the vehicle.

The used antenna configuration is logged in the measurement data file.

The MS own antennas are typically used for pedestrian in- and out-door or stationary measurements in office environment.

The antennas have to be arranged in a well defined fixed way with a minimum distance to each other reducing RF-influence on an acceptable level in an equal radio environment. The coupling loss between 2 MS should be min. 40.5 dB (as specified in clause 2 of TS 100 910 [1]).

3.1.4 Geographical Positioning

For outdoor measurements the use of the Navstar Global Positioning System (GPS) is common standard. Depending on the required accuracy the GPS-receiver has to be supported with data of a differential GPS (DGPS) or by a dead-reckoning system.

3.1.5 Format of geographical coordinates

- a) Outdoor: WGS-84
- b) Indoor: Fixed reference points

3.1.6 Accuracy

The accuracy of the geographical positioning must be high enough for all outdoor measurements i.e. for drive test and pedestrian walk tests.

3.1.7 Environmental Conditions

The equipment should be supplied with sufficient information that the user can operate the equipment within the operating parameters ensuring accurate measurements.

3.1.8 Drive Test Criteria

Referring to Determination No. 2 of 2002 : Mandatory Standards for QoS (Public Cellular Service) as issued MCMC, the following additions to clause 19 as follows:

- Test vehicle speed for urban/city areas should not exceed 50kmh
- Test vehicle speed for major highways should not exceed 70kmh
- Test vehicle to exclude lorries.
- Test vehicle to have non-tinted windows

The test should be done during off-peak season periods (i.e. Hari Raya, Christmas, Deepavali, Chinese New Year etc.).

4. TELEPHONY

For all Telephony services it has to be stated, if the results were generated using MOC, MTC or a mix of both. The results for both types should be reported separately and should not be mixed. The default call duration used for telephony measurements should be 90 seconds.

To achieve comparable statistics when performing a benchmark, the fixed call window concept is to be used. A fixed call window is defined as a period when the call is setup, retained and disconnected. If the call fails or drops, the next call attempt shall only be made when the next call window arrives. The timeline is depicted in Figure 2.

The minimum pause interval between two call attempts should be 15 seconds to prevent network related problems between connection release and the next establishment (e.g. signaling in the PSD or mobility management).

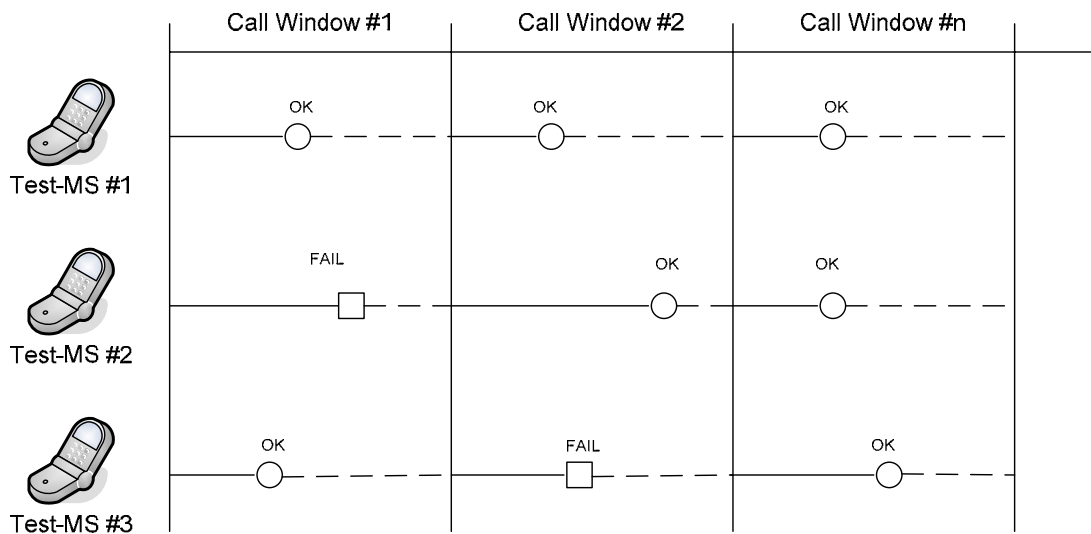


Figure 2. Fix Window samples (dotted lines indicate waiting period to the next call window)

4.1 Test Methodology

Voice Telephony should be tested in MOC direction. The following call durations shall be used:

- 15 seconds for idle time
- 90 second for call holding time
- Number of samples should be more than 200 (MOC).

4.2 Service Accessibility – Telephony (SA-T)

4.2.1 Abstract Definition

Probability that the end-customer can access the Mobile Telephony Service when requested if it is offered by display of the network indicator on the Mobile Equipment.

4.2.2 Computation

A successful call attempt may happen when:

- the customer hears the alerting;

It is assumed that the routing to the destination is successful (without any failures).

Abstract formula:

$$\text{Service Accessibility Telephony [\%]} = \frac{\text{Number of Successful Call Attempts}}{\text{Number of Call Attempts}} \times 100\%$$

Trigger points:

Beginning of the call attempt: successful pressing send button (it is important to check, if coverage has been given when send button is pressed, otherwise this Call Attempt counts to Network Non Accessibility (NNA)).

Successful call attempt: connect measurement (e.g. alerting or busy heard by A-party).

4.2.3 Recommendation

Service accessibility Telephony should be more than 95%.

4.3 Setup Time – Telephony (ST-T)

4.3.1 Abstract Definition

Time between sending of complete address information and receipt of call set-up notification.

4.3.2 Computation

Abstract formula:

$$\text{Setup Time Telephony [s]} = t_2[s] - t_1[s]$$

t_2 : point of time where connect is established (e.g. alerting or subscriber busy is detected by test equipment)

t_1 : point of time where the customer presses the send button on mobile equipment

4.3.3 Recommendation

Time, on average, should be less than or equal to ten (10) seconds.

4.4 Call Completion Rate Circuit Switched Telephony (CCR-CS-T)

4.4.1 Abstract Definition

Probability that a successful call attempt is maintained for a predetermined time until it is released intentionally by A- or B-party.

4.4.2 Computation

Abstract formula:

$$\text{CCR - CS - T[\%]} = \frac{\text{Number of Intentionally Terminated Telephony Calls}}{\text{Number of Successful Telephony Call Attempts}} \times 100\%$$

Trigger points:

Successful call attempt: Connect measurement (e.g. "alerting" or "busy" detected by A-party).

Terminated call: Release of connection directly by A- or B-party.

4.4.3 Recommendation

Probability shall be more than 95%.

5. SHORT MESSAGING SERVICE (SMS)

From the ETSI QoS definitions, there are three criteria defined for the assessment of the quality of the Short Message Service. They are as follows:

- a) Service Accessibility SMS MO (SA-SMS-MO)
- b) Access Delay SMS MO (AD-SMS-MO)
- c) Completion Rate SMS Circuit Switched (CR-SMS-CS)

The first two concern the performance between a subscriber and their home network. The SA-SMS-MO gives a measure of success at being able to reach the SMS Centre (SMSC), while AD-SMS-MO give a measure of the delay between sending an SMS and receiving a notification from the SMSC.

The last one extends this to measure the performance of the service end-to-end. The DT-SMS provides a measure of the delay between sending an SMS and that SMS being received; the CR-SMS-CS provides a measure of the success rate of received SMS, taking into consideration message duplication and message error.

5.1 Test Methodology

The test methodology outlined here is in line with the recommendations for QoS testing from the GSMA Document "Typical procedures for QoS measurement equipment", PRD IR.43.

For the test, it is recommended to eliminate an uncertainty caused by the connection between the network and mobile terminal. Therefore for the test, the destination device used should either be kept in a fixed location with near-100% probability of successful transfer (for SA-SMS-MO and CR-SMS-CS) and at a fixed-destination SMS server (for AD-SMS-MO). B-party destination device should be able to store and provide the evidence/test results for at least 200 SMS received.

During the test, the following should be kept constant:

- a) SMS Message Format (recommend text); and
- b) SMS length (160 7-bit characters). The sample of a 97 character SMS is shown in Figure 3.

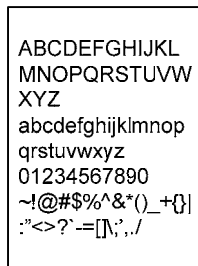


Figure 3. SMS sample

- SMS Centre in use;

- Destination of SMS;
- Interval between SMS (70s)
- Number of MO SMS should be 200
- All SMS should be received within 5 hours from the first MO SMS sent out. For example, SMS #1 is sent out at 1300hrs, and SMS#200 is expected to be received before 1800hrs. (i.e. 1300hrs + 5 hrs = 1800hrs)
- B-party should be at a static location with a minimum signal strength (RSSI) - 85 dBm

The test should be done with a separate Test-MS for SMS and voice at the test equipment site, i.e. one Test-MS for SMS and another Test-MS for voice. It is recommended to run voice and SMS test concurrently.

Before the test is performed, the SMS storage of the receiving Test-MS/device should be cleared to exclude errors and failures due to memory shortage.

It is recommended that the following test be performed:

- SMS from A-party Test-MS to B-party Test-MS (intra-operator).

5.2 Service Accessibility SMS Mobile Originating (SA-SMS-MO)

5.2.1 Abstract Definition

Probability that the end-customer can access the Short Message Service when requested while it is offered by display of the network indicator on the Mobile Equipment. In this case the customer wants to send a Short Message.

5.2.2 Computation

NOTE: For the trigger point explained here, the connection over the air interface must be measured (e.g. Layer-3) and the answers of the SMSC must be counted statistically. The protocol for every connection shows the deviation from the successful service access. Only the first try should be measured. If the Short Message is established with the second try this should not be counted.

Abstract formula:

$$SA-SMS-MO (\%) = \frac{\text{No. of successful SMS service attempts}}{\text{No. of all SMS service attempts}} \times 100\%$$

Trigger points [e.g. Layer-3 messages]:

Start SMS service attempt:	Initiate sending a SMS.
Successful SMS service attempt:	Receiving acknowledgement of the SMSC.

5.2.3 Recommendation

The recommended value is that SA-SMS-MO achieves at least 90%.

5.3 Access Delay SMS Mobile Originating (AD-SMS-MO)

5.3.2 Abstract Definition

Time between sending a Short Message to a Short Message Service Centre (SMSC) and receiving the notification from the Short Message Service Centre.

5.3.3 Computation

Abstract formula:

$$AD-SMS-MO (s) = t_{receive}(s) - t_{send_SMS}(s)$$

Where

$t_{receive}$ point of time the mobile equipment receives the confirmation from the SMS Centre.

t_{send_SMS} point of time the customer sends his SMS to the SMS Centre.

Trigger points [e.g. Layer-3 messages]:

Start SMS service attempt:	Initiate sending a SMS.
Successful SMS service attempt:	Receiving acknowledgement of the SMSC.

5.3.3 Recommendation

The recommended value is that AD-SMS-MO achieves ≤ 5 secs.

5.4 Completion Rate SMS Circuit Switched (CR-SMS-CS)

5.4.1 Abstract Definition

Ratio of received and send Test SMS from one mobile to another mobile part, excluding duplicate received and corrupted Test SMS. A corrupted Test SMS is a SMS with at least one bit error.

For test and measurement purposes a message is considered valid if it is delivered successfully within a time window defined (see PRD IR.43).

5.4.2 Computation

Abstract formula:

$$CR-SMS-CS (\%) = \frac{\text{No. of successfully received SMS} - \text{duplicated SMS} - \text{corrupted SMS}}{\text{No. of all sent SMS}} \times 100\%$$

Trigger points:

Successfully send and received SMS via SMSC.
Time window of measurements according to customer profile.

5.4.3 Recommendation

The recommended value is that CR-SMS-CS achieves at least 90%

6. PACKET-SWITCHED DATA

The main QoS indicators defined for packet switched data services are:

- Service Accessibility Ratio (SA-PSD);
- IP-Service Access Ratio (IPSA-PSD);
- Completed Session Ratio (CoSeR-PSD);

6.1 Test Methodology

QoS tests for packet-switched-data transactions are fairly new in the industry, with tried-and-true definition of packet data quality of service as the main obstacle to fair results. Location of the destination server plays a role in determining latency, routing efficiency and many other QoS parameters. The following test methodology recommendations are meant to be as objective and neutral as possible:

- a) All destination test servers (regardless of application type) must be in an IP network provided by a non-3G license holder. The MCMC and/or MTSFB network is an optimal base to locate these servers for the packet-switched-data tests. MCMC to also decide the website for the HTTP test.
- b) The file sizes, e-mail attachment sizes and number of samples shall be dependent upon the bearer type as listed below:

Bearer	Min. no. of samples and sizes for FTP and e-mail	Maximum duration after first sample sent out
GPRS	100 samples of 180 kbytes each	5 hours
EDGE	100 samples of 720 kbytes each	5 hours
UMTS	100 samples of 900 kbytes each	5 hours

Table 1. Minimum requirements for each service bearer

6.2 Service Accessibility Ratio – Packet Switched Data (SA-PSD)

6.2.1 Abstract definition

The service accessibility ratio denotes the probability that a subscriber can establish a PDP context and access the service successfully.

6.2.2 Computation

Abstract equation:

$$SA - PSD[\%] = \frac{\text{No. of successful attempts to reach the point when contents is sent or received}}{\text{No. of all attempts to reach the point when content is sent or received}} \times 100\%$$

Trigger points:

- FTP (download), E-Mail POP3 (receiving), http
- Start: ATD command from the mobile to the network.
 - Stop: Reception of the first data packet containing content.

NOTE:

The term "content" has a different meaning depending on the service that is accessed. In case of a FTP session content is a file, in case of a HTTP session it is a web page and the content of an E-Mail session is the text of the E-Mail.

FTP (upload), E-Mail SMTP (sending)

- Start: ATD command from the mobile to the network.
- Stop: Sending of the first data packet containing content.

Remark(s):

The PS bearer has to be active in the cell used by a subscriber (cf. Unavailability) and the mobile station has to be attached (cf. Attach Failure Ratio).

6.2.3 Recommendation

The recommended value for SA-PSD is greater than or equal to 90%.

6.3 IP-Service Access Ratio (IPSA-PSD)

6.3.1 Abstract definition

The IP-service access ratio denotes the probability that a subscriber can establish a TCP/IP connection to the server of a service successfully.

6.3.2 Computation

Abstract equation:

$$IPSA-PSD[\%] = \frac{\text{No. of successful attempts to establish an IP connection to the server}}{\text{No. of all attempts to establish an IP connection to the server}} \times 100\%$$

Trigger points:

FTP (download), E-Mail POP3 (receiving), http

- Start: First [SYN] sent.
- Stop: Reception of the first data packet containing content.

FTP (upload), E-Mail SMTP (sending)

- Start: First [SYN] sent.
- Stop: Sending of the first data packet containing content.

Remark(s):

The PS bearer has to be active in the cell used by a subscriber (cf. Unavailability) and the mobile station has to be attached (cf. Attach Failure Ratio) as well as the respective PDP context has to be activated (cf. PDP Context Activation Failure Ratio).

6.3.3 Recommendation

The recommended value for IPSA-PSD is greater than or equal to 90% success rate.

6.4 Completed Session Ratio – Packet Switched Data (CoSeR-PSD)

6.4.1 Abstract definition

The completed session ratio is the proportion of completed sessions and sessions that were started successfully.

6.4.2 Computation

Abstract equation:

$$\text{COSER-PSD}[\%] = \frac{\text{Number of successfully completed sessions}}{\text{Number of started sessions}} \times 100\%$$

Trigger points:

FTP (download), E-Mail POP3 (receiving), HTTP

- Start: First [SYN] sent.
- Stop: Reception of the [FIN, ACK] for last data packet containing content.

FTP (upload), E-Mail SMTP (sending)

- Start: First [SYN] sent.
- Stop: Reception of the [FIN, ACK] for the last data packet containing content.

Remark(s):

The PS bearer has to be active in the cell used by a subscriber (cf. Unavailability) and the mobile station has to be attached (cf. Attach Failure Ratio) as well as the respective PDP context has to be activated (cf. PDP Context Activation Failure Ratio).

6.4.3 Recommendation

The recommended value for CoSeR-PSD is greater than or equal to 90% success rate.

Acknowledgements

Listed below are the contributors who were involved directly in the process of developing this Technical Standard and Infrastructure Requirements document:

Rosilawati Ayub (Chairperson)	Telekom Malaysia Berhad
Koo Jenn Meng (Vice-Chairman)	DiGi Telecommunication Sdn Bhd
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Norehan Yahya	Maxis Broadband Sdn Bhd
Ravindran Ramesan	Maxis Broadband Sdn Bhd
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Alan Seah	Rohde & Schwarz (Malaysia) Sdn Bhd
Wilson Pee	Rohde & Schwarz (Malaysia) Sdn Bhd
Mohd Fazzil Mohd Salleh	Telekom Malaysia Berhad
Jaafar Hj Mohd Abu Bakar	Telekom Research & Development Malaysia
Jasmi Mohd Daron	TIME dotcom Berhad
Chua Tien Han	Universiti Teknologi Malaysia
Prof. Tharek Abdul Rahman	Universiti Teknologi Malaysia

Recommendation for Amendment of clause number 12 – 17 (Mandatory Standard for QoS of Endpoint Service Availability on Public Cellular Services)

The guidelines below are referring to the ETSI TS 102 250, which describes QoS criteria for GSM and 3G networks. Voice and SMS tests shall be applicable to all public cellular networks, whereas packet data tests are applicable for public cellular networks which offer data services. The tests which are relevant in the Malaysian context are listed below:

- **Voice Telephony (Circuit Switch)**
- **SMS**
- **Packet Data**

Full details of the test parameters and methodology is available in the document '**Quality of Service for Voice, Short Messaging Service and Packet-switched Traffic**' draft version 0.5 authored by the IMT2000 and Beyond Working Group under MTSFB.

13. To measure the performance of voice telephony services over public cellular networks in Malaysia, it is recommended that the following items will be measured:

- **Service Accessibility – Telephony (SA-T)**
Minimum 95 % SA-T
- **Setup Time – Telephony (ST-T)**
Less than 15 seconds
- **Call Completion Rate Circuit Switched Telephony (CCR-CS-T)**
Minimum 95 %

14. To measure the performance of SMS services over public cellular networks in Malaysia, it is recommended that the following items will be measured:

- **Service Accessibility SMS MO (SA-SMS-MO)**
Minimum 90%
- **Access Delay SMS MO (AD-SMS-MO)**
Less than or equals to 3 second
- **Completion Rate SMS Circuit Switched (CR-SMS-CS)**
Minimum 90%

15. To measure the performance of packet data services over public cellular networks where applicable in Malaysia, it is recommended that the following items will be measured:

- **Service Accessibility Ratio (SA-PSD)**
Minimum 90%
- **IP-Service Access Ratio (IPSA-PSD)**
Minimum 90%
- **Completed Session Ratio (CoSeR-PSD)**
Minimum 90%



Published by:

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