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Technical Specification

**Speech Processing, Transmission and Quality Aspects (STQ);
QoS aspects for popular services in GSM and 3G networks;
Part 5: Definition of typical measurement profiles**



Reference

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Speech Processing, Transmission and Quality Aspects (STQ).

The present document is part 5 of a multi-part deliverable covering the QoS aspects for popular services in GSM and 3G networks, as identified below:

- Part 1: "Identification of Quality of Service criteria";
- Part 2: "Definition of Quality of Service parameters and their computation";
- Part 3: "Typical procedures for Quality of Service measurement equipment";
- Part 4: "Requirements for Quality of Service measurement equipment";
- Part 5: "Definition of typical measurement profiles";**
- Part 6: "Post processing and statistical methods".

Part 1 identifies QoS aspects for popular services in GSM and 3G networks. For each service chosen QoS indicators are listed. They are considered to be suitable for the quantitatively characterization of the dominant technical QoS aspects as experienced from the end-customer perspective.

Part 2 defines QoS parameters and their computation for popular services in GSM and 3G networks. The technical QoS indicators, listed in part 1, are the basis for the parameter set chosen. The parameter definition is split into two parts: the abstract definition and the generic description of the measurement method with the respective trigger points. Only measurement methods not dependent on any infrastructure provided are described in the present document. The harmonized definitions given in the present document are considered as the prerequisites for comparison of QoS measurements and measurement results.

Part 3 describes typical procedures used for QoS measurements over GSM, along with settings and parameters for such measurements.

Part 4 defines the minimum requirements of QoS measurement equipment for GSM and 3G networks in the way that the values and trigger-points needed to compute the QoS parameter as defined in part 2 can be measured following the procedures defined in part 3. Test-equipment fulfilling the specified minimum requirements, will allow to perform the proposed measurements in a reliable and reproducible way.

Part 5 specifies test profiles which are required to enable benchmarking of different GSM or 3G networks both within and outside national boundaries. It is necessary to have these profiles so that when a specific set of tests are carried out then customers are comparing "like for like" performance.

Part 6 describes procedures to be used for statistical calculations in the field of QoS measurement of GSM and 3G networks using probing systems.

Introduction

All the defined quality of service parameters and their computations are based on field measurements. That indicates that the measurements were made from customers point of view (full End-to-End perspective, taking into account the needs of testing).

It is assumed that the end customer can handle his mobile and the services he wants to use (operability is not evaluated at this time). For the purpose of measurement it is assumed:

- that the service is available and not barred for any reason;
- routing is defined correctly without errors; and
- the target subscriber equipment is ready to answer the call.

Further preconditions may apply when reasonable.

The present document describes a set of use cases which are precisely defined to allow for comparability between different measurements, possibly performed by different parties.

1 Scope

The present document specifies test profiles which are required to enable benchmarking of different digital wireless networks both within and outside national boundaries. It is necessary to have these profiles so that when a specific set of tests are carried out then customers are comparing "like for like" performance.

NOTE: All timeouts given in the present document are examples from proven experience. These examples are intended to provide guidelines for reasonable choice of timeout values for other access technologies, mixed scenarios and different characteristics of user equipment.

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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

- [1] ETSI TS 102 250-2: "Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 2: Definition of Quality of Service parameters and their computation".
- [2] ETSI TS 124 008: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008)".
- [3] IETF RFC 3481: "TCP over Second (2.5G) and Third (3G) Generation Wireless Networks".
- [4] IETF RFC 2616: "Hypertext Transfer Protocol -- HTTP/1.1".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

session: continuous usage of a given service, e.g. a voice call or a data session

NOTE: This may contain additional information.

3.2 Abbreviations

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

AMR	Adaptive Multi-Rate
BCP	Best Current Practise
DNS	Domain Name Server
FQDN	Fully Qualified Domain Name
FTP	File Transfer Protocol
GPRS	General Packet Radio Service
GR	GPRS Register
HLR	Home Location Register
HTTP	Hyper Text Transfer Protocol
ICMP	Internet Control Message Protocol
IMAP	Internet Messaging Access Protocol
MMS	Multimedia Messaging Service
MOC	Mobile Originated Call
MTC	Mobile Terminating Call
PDP	Pack Data Protocol
POP3	Post Office Protocol version 3
PSD	Packet Switched Data
QoS	Quality of Service
SGSN	Serving GPRS Support Node
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunication System
VT	Video Telephony
WAP	Wireless Application Protocol

4 Measurement profiles

Test profiles are required to enable benchmarking of different networks both within and outside national boundaries. It is necessary to have these profiles so that when a specific set of tests are carried out then customers are comparing "like for like" performance.

It is recognized that many factors will affect comparability:

- number of sessions;
- sessions duration;
- time between sessions;
- demanded QoS settings for data services;
- protocol settings (like TCP/IP settings for data services or AMR-settings for voice services);
- usage profile during the session;
- fixed network test equipment like test servers for data sessions;
- user profile stored in the HLR or the GR;
- geographic location;
- type of location (indoor, hotspot, city, suburban, rural, train, etc.);
- speed when mobile;

- type of vehicle;
- type of antenna;
- handset type;
- handset hardware and firmware version;
- service being tested and limitations of service;
- network configuration;
- mobile users population density.

For the points mentioned above where there is no recommendation or requirement in the present document, the settings experienced by a normal customer of the service under test in the network under test shall be used as a guideline.

As far as possible all particular values, e.g. timeout values, are named preserving the name of the respective quality of service parameters as defined in TS 102 250-2 [1].

4.1 Classification of measurement environments

For interpretation and comparability of test results it is important to know in which measurement environment the tests were performed. The environment classifications described below shall be used. Since the type of the measurement locations may be interpreted differently, the particular understanding of the location type determining a category shall be described in the results report.

Table 1: Stationary Tests

Category	Location Type	Additional information
S10:	airports / railway stations / shopping centres and malls business districts and exhibition areas	outdoor measurement
S11:	airports / railway stations / shopping centres and malls business districts and exhibition areas	indoor measurements

Table 2: Drive Tests / Walk Tests

Category	Location Type	Additional information
D1:	Train Measurements	
D2:	Urban Areas (medium cities)	
D3:	Highways	
D4:	Rural Areas (country roads)	
D5:	Large cities	
W1:	Walk Tests (indoor measurements)	
W2:	Walk Tests (outdoor measurements)	
NOTE:	Drive tests may be performed by incar using external antenna with an appropriate attenuation.	

4.2 Service profiles

This clause describes recommended service profiles used for testing.

4.2.1 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 120 seconds.

To achieve comparable statistics when performing a benchmark, there should be no fixed pause between calls. Instead, a fixed call window is defined in which the call has to be performed. If the call fails or drops, the next call attempt shall only be made when the next call window arrives.

The minimum pause interval between two call attempts should be 30 seconds to prevent network related problems between connection release and the next establishment (e.g. signalling in the PSD or mobility management).

4.2.1.1 Voice telephony

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

- CD1: 10 seconds for call setup testing;
- CD2: 120 seconds for typical tests, default call duration;
- CD3: 300 seconds for stability tests.

Call Window: Call Duration + 30 seconds, (for the setup and release phases) + 30 seconds (for the minimum pause interval), for the default call duration this results in 180 seconds.

Timeout values:

- Telephony Service Non-Accessibility Timeout: 20 seconds;
- Telephony Setup Time Timeout: 20 seconds.

NOTE: Since the Telephony Setup Time corresponds, with respect to the trigger point definition, to the Telephony Service Non-Accessibility, both of timeout values above need to be chosen identically.

4.2.1.2 Video Telephony

Video Telephony should be tested either in MOC or in MTC direction. The following call durations shall be used:

- CD1: 10 seconds for call setup testing;
- CD2: 120 seconds for typical tests, default call duration;
- CD3: 300 seconds for stability tests.

Call Window: Call Duration + 30 seconds, (for the setup and release phases) + 30 seconds (for minimum pause interval), for the default call duration this results in 180 seconds.

Timeout values:

- VT Service Non-Accessibility Timeout: 20 seconds;
- VT Service Access Time Timeout: 20 seconds;
- VT Audio/Video Setup Time Timeout: 30 seconds.

NOTE: Since the VT Service Access Time corresponds, with respect to the trigger point definition, to the VT Service Non-Accessibility, both of timeout values above need to be chosen identically.

4.2.2 Messaging Services

For all messaging services it is important that the recipient of a message is not interrupted by the next message while retrieving the previous one. For this reason it is important that the interval between sending two messages is larger than the 95 % percentile of the end-to-end duration, unless measures are taken to avoid this kind of interference.

It should be noted, that mobility of either the sender or the receiver or both of a message can have an impact on the results. Therefore it is recommended that measurements are not only performed stationary, but also with mobility of one or both participants. In all cases the used scenario has to be stated.

4.2.2.1 SMS

SMS should be tested either in MO or in MT direction with respect to the mobiles used as measurement probes. The SMS should be 120 characters long and use different characters to test content integrity. The interval between two consecutive SMS shall be 70 seconds.

The time window of measurements for calculating the Completion Rate SMS shall be 175 seconds.

Timeout-values:

- Service Accessibility SMS MO Timeout: 65 seconds;
- Access Delay SMS MO Timeout: 65 seconds;
- End-to-end Delivery Time SMS Timeout: 175 seconds.

4.2.2.2 MMS

MMS should be tested end to end. That means a MMS send by A-Party should be received by B-Party using also a mobile phone. The advantage of this testing is, that the MO direction at A-Party and the MT direction at B-Party can be measured. Both directions together are the end-to-end Parameters described in TS 102 250-2 [1].

The following MMS sizes shall be used:

- MMS1: 2 kByte;
- MMS2: 28 kByte;
- MMS3: 90 kByte.

If the MMS is not delivered at the destination mobile after the MMS End-to-end Failure Ratio Timeout, the MMS delivery is considered failed. MMS delivered after this time is not taken into account for end-to-end delay, but into end-to-end failure ratio.

Timeouts for MMS over GPRS:

The timeouts for MMS Send, Retrieval and End-to-end Failure are dependent on the MMS size. For GPRS all MMS uploads with less than 5 kbit/s and all MMS downloads with less than 10 kbit/s are considered to be cut-off.

MMS Send Failure Ratio (MO) Timeout and MMS Send Time (MO) Timeout:

$$(195 + \text{Size[kByte]} \times 8/5) \text{ [seconds].}$$

MMS Retrieval Failure Ratio (MT) Timeout and MMS Retrieval Time (MT) Timeout:

$$(195 + \text{Size[kByte]} \times 8/10) \text{ [seconds].}$$

The fixed part of 195 seconds incorporate the time for PDP context activation and WAP activation and shall be used as a whole, i.e. the single timeouts for PDP context and WAP activation shall not be considered.

MMS end-to-end Delivery Failure Ratio Timeout and MMS End-to-end Delivery Time Timeout:

$$(590 + \text{Size[kByte]} \times 8/5 + \text{Size[kByte]} \times 8/10) \text{ [seconds].}$$

The fixed part of 590 seconds incorporate the time for PDP context activations, WAP activations and notification and a security margin. It shall be regarded as a whole, i.e. the single timeouts shall not be considered.

MMS Notification Failure Ratio Timeout and MMS Notification Time Timeout: 120 seconds.

Timeouts for MMS over UMTS:

- The timeouts for MMS Send, Retrieval and End-to-end Failure are dependent on the MMS size.
- The respective required minimum upload and download data rate is for further study.
- MMS send failure ratio (MO) Timeout and MMS Send Time (MO) Timeout: for further study.
- MMS Retrieval Failure Ratio (MT) Timeout and MMS Retrieval Time (MT) Timeout: for further study.
- MMS end-to-end Delivery Failure Ratio Timeout and MMS End-to-end Delivery Time Timeout: for further study.
- MMS Notification Failure Ratio Timeout and MMS Notification Time Timeout: 120 seconds.

4.2.3 Data services

4.2.3.1 Circuit switched

Circuit switched data services shall be tested for 100 % MOC. Call duration shall be either 300 seconds or is defined by the usage profile used during the data session. The pause interval between call attempts shall be 30 seconds. The usage profile used during the data session is defined in clause 4.3.

4.2.3.2 Packet switched

Packet switched data services shall be tested for 100 % MOC sessions. Session duration shall be either 300 seconds or is defined by the usage profile used during the data session. The pause interval between session setup attempts shall be 30 seconds. The usage profile used during the data session is defined in clause 4.3.

Timeout values:

- Service Accessibility Timeout: 150 seconds + IP-Service Access Timeout.
- Setup Time Timeout: 150 seconds + IP-Service Access Timeout.
- IP-Service Access Timeout (and IP-Service Setup Time Timeout):
 - FTP (ULandDL): 30 seconds;
 - HTTP: 30 seconds;
 - E-mail (IMAP, POP3 and SMTP): 60 seconds.
- Data Transfer Cut-off Timeout:
 - Over GPRS:
 - UL: $\text{File size[kByte]} \times 8/5$;
 - DL: $\text{File size[kByte]} \times 8/10$.
 - Over UMTS:
 - ULandDL: $\text{File size[kByte]} \times 8/50$.
 - Dual mode: The average between the timeout over GPRS and UMTS shall be considered.
- Attach Timeout: 75 seconds.

It might occur that the mobile station sends more than one attach request towards the SGSN, since retries are necessary. A maximum of four retries are possible (timer T3310 expires after 15 seconds for each attempt, see TS 124 008 [2]).

- PDP Context Activation Timeout: 150 seconds.

It might occur that the mobile station sends more than one PDP context activation request towards the SGSN, since retries are necessary. A maximum of four retries are possible (timer T3380 expires after 30 seconds for each attempt, see TS 124 008 [2]).

4.2.3.3 Streaming

For further study.

4.3 Usage Profiles for Data Sessions

For data session measurements, the client application, e.g. web browser, FTP client or mail client, as well as the server application, e.g. web server, FTP server or mail server, should behave similar to the majority of client applications used by the customer and server application used by the data service providers.

Also, the operating system on both sides, namely the client- and the server side, should be chosen with respect to the operating system commonly used by the customer and the data service provider, respectively.

In case a network operating company whose network is to be measured provides the customer with some client application, it should be ensured that any change introduced by such application to the client operating system should have been applied prior to the measurement, as well. This is especially true for changes which would have an impacting on the measurement results, for example changes to the operating system's TCP stack. Such client applications are for example provided in order to allow the customer a single point of access to network related configurations and to data service clients, e.g. web browser, mail client, etc. Furthermore, such client application might optimize operating system parameters, including tuning of e.g. TCP settings, with respect to the connection type and technology to be used.

NOTE 1: In some cases it is desirable not to install such client application itself since this might have some unwanted impact on the measurement. For example, if such application would generate unwanted network traffic in order to check for updates or if the application would continuously try to connect to the mobile device preventing some measurement application from controlling the device.

NOTE 2: The use of different operating systems as well as the use of operating systems with different TCP parameter settings in general might have a large impact on the results obtained. With respect to the operating systems, this is due to the different implementations of the TCP/IP stack. This needs to be considered in case of benchmarking exercises where the client and/or server operating systems and/or the changes applied on the client sides of the compared networks are not the same. In any case, the settings of the TCP stack of both, the client and the server operating system should be recorded in order to allow for better interpretation and in-depth evaluation of the measurement data.

NOTE 3: Proxy servers installed in the networks IP core network may act as the TCP peer instead of the application server the tests are performed against. In benchmarking scenarios, the existence of different Proxy servers might have an additional impact on the results, which should be considered when comparing them.

NOTE 4: A reference for optimized TCP parameters over cellular networks like 2.5/3 G is the RFC 3481 [3] which is of the Best Current Practise (BCP) category in the IETF published on February of 2003.

NOTE 5: Some of the client applications referred to above might also change the way a data service is accessed from the client side, for example by introducing some client to the customer's operating system which changes the transport protocol between the customers operating system and some proxy server. In such case, the trigger points as defined in TS 102 250-2 [1] might not be measurable any more and should therefore be mapped to the application layer. Especially in case of benchmarking exercises where different operating systems are used on the client side, such mapping might have an additional influence on the measurements. The definition of such trigger point mappings for the different operations systems is not in the scope of the present document.

For all tests a dedicated test server should be used as a well defined reference. Under no circumstances should a commercial server be used, since the content on such a server may change over time. This makes later reproduction of the results impossible.

In order to avoid issues with DNS host name resolution like including effects of DNS caching strategies of the used operating system into the measurement, the test server should either be identified by an IP address and not by its FQDN or it shall be ensured that the local Resolver will contact a remote DNS name server in case a host name resolution is requested by an application. Furthermore, the DNS name server should be able to perform the resolution within its local zone, in case DNS lookup time is to be included into any quality of service parameter to get calculated. The later is needed in order to exclude effects of DNS caching strategies of the DNS name server(s) involved into the measurement.

The measurement of data services should take place against a reference server only used for testing purposes. The reference server should be connected to public the internet with a link capable of carrying the accumulated traffic of all mobiles testing against that server (e.g. if a benchmark with 4 networks is performed, the server should be able to deliver at least 4 times the maximum nominal speed of a single wireless link). There should be no bias concerning the IP connectivity to this server from a specific operator (e.g. bandwidth or hop-count).

The capabilities of the test UE shall be stated in the results report.

4.3.1 Web browsing using HTTP

For the measurement of data services the reference server should contain a static version of the Copernicus reference webpage.

The browser used for testing should behave similar to the browser used by most of the customers. It should be able to support the same HTTP capabilities and headers and open the same number of parallel download threads to download the content as the reference browser.

After one test cycle (one download of the reference page), the complete data representation of the reference page content shall be cleared from the local cache of the browser. Furthermore, it should be made sure, that all TCP connections between the server and the client are closed (no HTTP keep alive). There should be a pause of at least 6 seconds between the cycles.

NOTE: Any data related to Performance Enhancement Proxy (PEP) settings, like JavaScript scripts or Cookies need to be prevented from getting cleared from the browser's cache.

For the test, only HTTP download should be used. HTTP upload shall not be used.

Testing of content integrity is not mandatory for this test, but highly recommended.

4.3.2 E-Mail access

E-Mail Access should take place against a reference mail server.

A cycle should consist of mail upload using SMTP and mail download using IMAP or POP3. Both upload and download should represent typical user behaviour.

After a test cycle, all TCP connections to the server should be disconnected.

Testing of content integrity is mandatory for this test.

4.3.3 File Transfer using FTP

FTP testing should take place against a reference FTP server. The server should support the standard FTP commands and both active and passive mode transfer of data. There should be no bandwidth limitation on application level.

In case of multisession scenarios, the reader shall be aware of the resulting effects with respect to the QoS parameters measured for each single session. With that, any use of multisession scenarios shall be stated in the results report.

4.3.4 File Sharing using UDP

To be decided.

4.3.5 Synthetic tests

4.3.5.1 UDP

To be decided - Reference to iPerf.

4.3.5.2 ICMP

To be decided - Reference to TPING.

4.3.5.3 TCP

To be decided - Reference to TPING.

Annex A (informative): Reference SMS

For further study.

Annex B (informative): Content integrity checking

Content Integrity Checking can be achieved by placing meta-information about the expected content in the retrieved documents and check if the content description matches the received content. If the description is put in the text payload of the content, it should survive compression and transcoding of the content during transportation from the server to the client.

B.1 HTTP

The text of the main reference page shall contain the following description language in the main file of a test webpage (typically index.html). The text should substitute text present before in order to keep the length of the reference page constant. In order to avoid misinterpretation of the content description by common client software, established standards like XML or HTML must be avoided.

The structure of the reference description is as follows:

```
(% TAGNAME VALUE,[VALUE] %)
```

Before each IE, an opening mark shall be used, followed by a blank. The opening mark is a "(" (Bracket-Open, followed by a Percent-Sign). The IE itself is identified by a tag called TAGNAME. Below is a list of all valid TAGNAMES. Each IE has one more parameters, called VALUES, separated by a comma. After the IE and its parameters a closing mark shall be used. The closing mark is a "%)" (Percent-Sign, followed by a Bracket-Close). The opening and closing tags are separated from the TAGNAME and its parameters by a single blank space. The complete element should not be included within any HTML-format construct but shall be place in pure text payload.

TAGNAME PARAMETERS

NAME <RESOURCENAME>, <APPROVED>

This IE contains the name of the reference webpage. The first parameter <RESOURCENAME> describes the reference page. A full list of available pages is available in Appendix D.1. The second parameter <APPROVED> is set to 0 for a resource not approved by ETSI and set to 1 for an ETSI approved resource.

VERSION <VERSIONNUMBER>

This IE contains a unique version number of this specific resource.

TSIZE <TBYTES>

This IE contains the accumulated size of all objects of the complete resource in bytes.

OBJECTS <NUMBER>

This IE contains the accumulated number of objects belonging to this specific page.

OBJECT <OID>,<OFNAME>,<ONAME>,<OSIZE>,<OREQUIRED>

For each object of the resource (identified by a separate file) a OBJECT tag shall be available. Each OBJECT tag has 5 mandatory parameters:

- <OID> contains a unique identifier per object on this page, starting the count from 1 for the main index-file that includes the content description
- <OFNAME> contains the filename of the referenced object
- <ONAME> contains a description of the object
- <OSIZE> contains the original size of the object in bytes

- <OREQUIRED> is set to 1 if the object relevant for customer perception. If the object may be removed while in transit the value should be set to 0 (e.g. for advertisements).

INFO <TEXT>

This IE contains additional information about the resource.

B.2 FTP

Content integrity checking of a object transferred by FTP shall be done by the use of MD5 checksums (16 bytes long). Two methods are supported:

Method 1:

In the same directory of the FTP server where the reference file is located lays a second file containing the MD5 checksum of the reference file (identified by the same name, but a file name extension.MD5). By downloading both files, the test client can determine the content integrity of the reference file by calculating its MD5 checksum and comparing it to the value contained in the checksum file.

To identify that method 1 is used the filename of the reference file starts with the fragment "CIC_M1_" followed by the name of the file plus extension.

EXAMPLE 1:

DEMO.TXT becomes CIC_M1_DEMO.TXT and CIC_M1_DEMO.MD5.

Method 2:

The MD5 checksum of the file is appended to the original reference file, increasing its size by 16 bytes. For content integrity check, the test client cuts the last 16 bytes of the downloaded file and calculates the MD5 checksum of the remaining fragment. This checksum can be compared to the checksum received with the last 16 bytes of the file.

To identify that method 2 is used the filename of the reference file starts with the fragment "CIC_M2_" followed by the name of the file plus extension.

EXAMPLE 2:

DEMO.TXT becomes CIC_M2_DEMO.TXT.

B.3 MMS

For further study.

Annex C (informative): Bibliography

- ETSI EG 201 212: "Electrical safety; Classification of interfaces for equipment to be connected to telecommunication networks".
- ETSI EN 300 429: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems".

History

Document history		
V1.1.1	September 2004	Publication
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