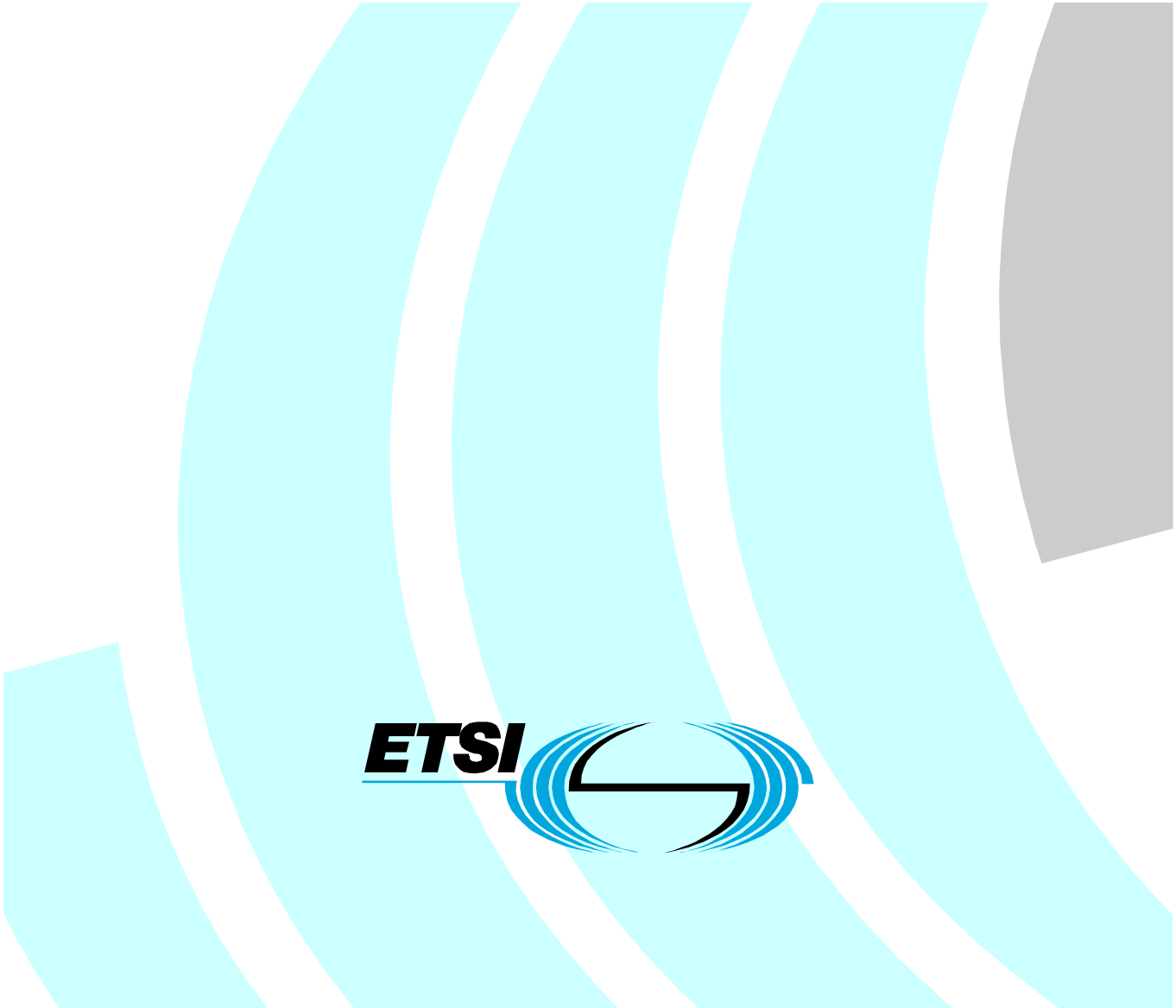
ETSI TS 102 250-2 V1.2.1 (2004-06)

Technical Specification

**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**



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Contents

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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 2 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 aspects";

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 7: "Sampling methodology".

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.

Part 7 describes the field measurement method procedures used for QoS measurements over GSM where the results are obtained applying inferential statistics.

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.

Speech quality values from completed speech quality samples measured should only be employed by calls ended successfully for statistical analysis if the parameter speech quality per call is reported.

However, measured values from calls ended unsuccessfully (e.g. dropped) should be available for additional evaluations (e.g. with the speech quality per sample parameter) and therefore, must be stored.

Further preconditions may apply when reasonable.

1 Scope

The present document defines QoS parameters and their computation for popular services in GSM and 3G networks.

The technical QoS indicators, listed in TS 102 250-1 [5], 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.

NOTE: Computation of certain parameters may depend in the vary cellular system, i.e. GSM or 3GPP specified 3G system. In this case respective notification is provided.

The harmonized definitions given in the present document are considered as the prerequisites for comparison of QoS measurements and measurement results.

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.

[1] ITU-T Recommendation P.862: "Perceptual evaluation of speech quality (PESQ), an objective method for end-to-end speech quality assessment of narrowband telephone networks and speech codecs".

[2] ETSI TS 123 107: "Universal Mobile Telecommunications System (UMTS); Quality of Service (QoS) concept and architecture (3GPP TS 23.107 Release 5)".

[3] WAP-206-MMSCTR-20020115-a: "Wireless Application Protocol; Multimedia Messaging Service; Client Transactions".

[4] PRD IR.43: "Typical procedures for QoS measurement equipment".

[5] ETSI TS 102 250-1: "Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 1: Identification of Quality of Service aspects".

[6] ETSI TS 102 250-3: "Speech processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 3: Typical procedures for Quality of Service measurement equipment".

[7] ITU-R Recommendation BS.1387-1: " Method for objective measurements of perceived audio quality".

[8] IETF RFC 1889 (1996): "RTP: A Transport Protocol for Real-Time Applications".

[9] IETF RFC 2326 (1998): "Real Time Streaming Protocol (RTSP)".

[10] ITU-T Recommendation P.862.1: " Mapping function for transforming P.862 raw result scores to MOS-LQO".

[11] ETSI EN 300 911: " Digital cellular telecommunications system (Phase 2+) (GSM); Radio subsystem link control; (GSM 05.08 Release 1999)".

[12] 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 Release 5)".

3 Abbreviations

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

APN	Access Point Names
3G	3rd Generation
3GPP	3rd Generation Partnership Project
AD	Access Delay
ATDT	ATtention Dial Tone
CCR	Call Completion Ratio
CR	Completion Ratio
CSD	Circuit Switched Data
DQ	Data Quality
DT	Delivery Time
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
MMS	Multimedia Messaging Service
MMSC	Multimedia Messaging Service Centre
MO	Mobile Originated
MOS	Mean Opinion Score
MS	Mobile Station
MT	Mobile Terminated
NA	Network Access
NA-CS	Network Accessibility Circuit switched
NA-PS	Network Accessibility Packet switched
NNA	Network Non Accessibility
PDP	Packet Data Protocol
PESQ	Perceptual Evaluation of Speech Quality
PSD	Packet Switched Data
QoS	Quality of Service
RT	Real Time
SA	Service Accessibility
SA-T	Service Accessibility-Telephony
SMC	Short Message Centre
SMS	Short Message Service
SMSC	Short Message Service Centre
SpQ	Speech Quality
SpQ-C	Speech Quality on Call basis
SpQ-S	Speech Quality on Sample basis
ST-T	Setup Time Telephony
ST	Setup Time
WAP	Wireless Application Protocol
WGR	WAP Get Request

4 QoS Parameter

4.1 Overview

Figure 1 shows a model for quality of service parameters. This model has three layers.

The first layer is the Network Access, the basic requirement for all the other QoS aspects and QoS parameters. The outcome of this layer is the QoS parameter Network Accessibility.

The second layer contains the other three QoS aspects Service Access, Service Integrity and Service Retainability.

The different services are located in the third layer. Their outcome are the QoS parameters.

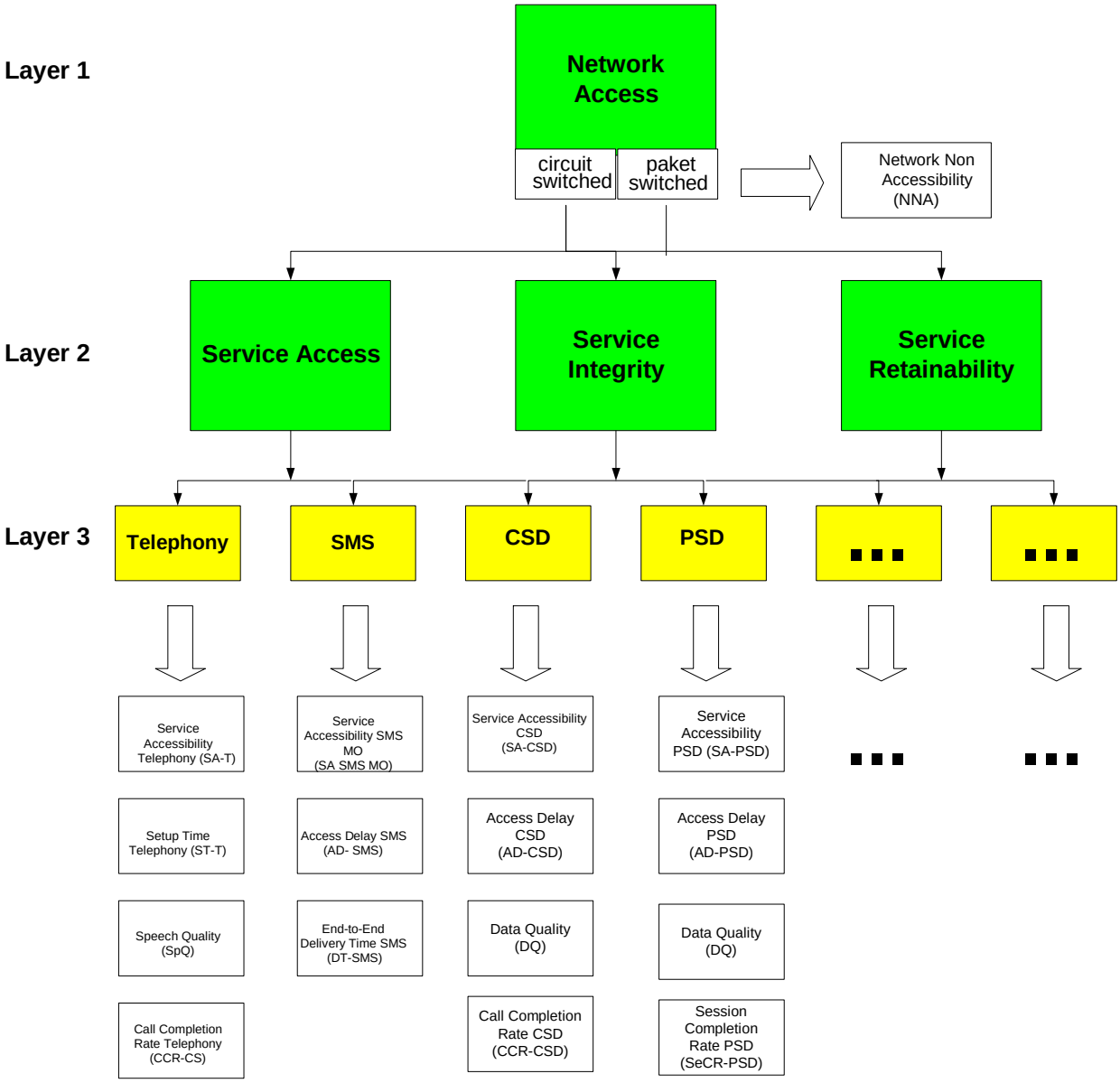

Figure 1: QoS aspects and the corresponding QoS parameters

4.2 Service independent

4.2.1 Network Accessibility Circuit Switched (NA - CS)

4.2.1.1 Abstract definition

To be specified.

4.2.1.2 Computation

To be specified.

4.2.2 Network Accessibility Packet Switched (NA - PS)

4.2.2.1 Abstract definition

To be specified.

4.2.2.2 Computation

To be specified.

The sampling rate should be the same or a multiple of the Service Accessibility sampling rate. In order to compare the Network Accessibility with the Service Accessibility the sampling rate must be the same.

4.3 Telephony

4.3.1 Service Accessibility-Telephony (SA-T)

4.3.1.1 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.

4.3.1.2 Computation

There are two possibilities for a successful call attempt:

- the customer hears the alerting;
- B-party is busy.

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).

4.3.2 Setup Time Telephony (ST-T)

4.3.2.1 Abstract definition

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

4.3.2.2 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), see note.

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

NOTE: If you do not establish an end-to-end connection afterwards you must ignore this measurement. It is assumed that early traffic channel assignment is used.

Trigger points:

Beginning of the Setup Time measurement:	Successful pressing send button (it is important to check, if coverage has been given, otherwise this Call Attempt counts to Network Non Accessibility (NNA)).
Successful connection:	Connect measurement (e.g. alerting or busy heard by A-party).

4.3.3 Speech Quality on Call basis (SpQ-C)

4.3.3.1 Abstract definition

Indicator representing the quantification of the end-to-end speech transmission quality of the Mobile Telephony Service. This parameter computes the speech quality on the basis of completed calls.

4.3.3.2 Computation

The validation of the end-to-end quality is made using the $MOS\__{LQO}$ scale. This scale describes the opinion of customers with voice transmission and its troubles (noise, robot voice, echo, dropouts etc). The speech quality measurement is taken per call. An aggregation should be made on one value for speech quality per call.

Reference: ITU-T Recommendation P.862 (PESQ Algorithm) [1] in conjunction with ITU-T Recommendation P.862.1 [10].

Abstract formula:

$$\text{SpQ - C(received A - side)} = f(MOS\__{LQO})$$
$$\text{SpQ - C(received B - side)} = f(MOS\__{LQO})$$

Optionally it might be useful to aggregate both speech quality values into one. In this case the worst of both shall be used. This aggregated speech quality value shall be called SpQ (min).

Trigger points:

Beginning of connection:	interchange speech samples between a-party and b-party.
End of connection:	release of connection.

NOTE: The acoustic behaviour of terminals is not part of this speech quality measurement.

4.3.4 Speech Quality on Sample basis (SpQ-S)

4.3.4.1 Abstract definition

Indicator representing the quantification of the end-to-end speech transmission quality of the Mobile Telephony Service. This parameter computes the speech quality on a sample basis.

4.3.4.2 Computation

The validation of the end-to-end quality is made using the MOS scale. This scale describes the opinion of customers with voice transmission and its troubles (noise, robot voice, echo, dropouts etc). The speech quality measurement is taken per sample. An aggregation for measurement campaigns or parts of it should be made on speech sample basis.

Reference: ITU-T Recommendation P.862 (PESQ Algorithm) [1] in conjunction with ITU-T Recommendation P.862.1 [10].

Abstract formula:

$$\boxed{\begin{aligned}\mathrm{SpQ\text{-}S(received\ A\text{-}side)} &= \mathrm{f(MOS\__{LQO})}\\ \mathrm{SpQ\text{-}S(received\ B\text{-}side)} &= \mathrm{f(MOS\__{LQO})}\end{aligned}}$$

Optionally it might be useful to aggregate both speech quality values into one. In this case the worst of both shall be used. This aggregated speech quality value shall be called SpQ (min).

Trigger points:

Beginning of connection: interchange speech samples between a-party and b-party.

End of connection: release of connection.

NOTE: The acoustic behaviour of terminals is not part of this speech quality measurement.

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

4.3.5.1 Abstract definition

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

4.3.5.2 Computation

Abstract formula:

$$\boxed{\mathrm{CCR\text{-}CS\text{-}T\,[\%]} = \frac{\mathrm{Number\ of\ intentionally\ terminated\ telephony\ calls}}{\mathrm{Number\ of\ successful\ telephony\ call\ attempts}} \times 100\ \%}$$

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 Short Message Service (SMS)

4.4.1 Service Accessibility SMS MO (SA-SMS-MO)

4.4.1.1 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.

4.4.1.2 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:

$$\text{Service Accessibility SMS MO}[\%] = \frac{\text{Number of successful SMS service attempts}}{\text{Number of all SMS service attempts}} \times 100\%$$

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

Start SMS service attempt: Initiate sending a SMS.

Successful SMS service attempt: Receiving acknowledgement of the SMSC.

4.4.2 Access Delay SMS MO (AD SMS-MO)

4.4.2.1 Abstract definition

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

4.4.2.2 Computation

Abstract formula:

$$\text{Access Delay SMS MO}[s] = t_{\text{receive}}[s] - t_{\text{send SMS}}[s]$$

$t_{receive}$: 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.

4.4.3 End-to-end Delivery Time SMS (DT-SMS)

4.4.3.1 Abstract definition

Time between sending a Short Message to a Short Message Centre and receiving the very same Short Message on another mobile equipment.

4.4.3.2 Computation

Abstract formula:

$$\text{End - to - End Delivery Time SMS}[s] = t_{\text{receive SMS}}[s] - t_{\text{send SMS}}[s]$$

$t_{\text{receive SMS}}$: point of time the mobile equipment 2 receives the Short Message from mobile equipment 1.

$t_{\text{send SMS}}$: point of time the customer sends his Short Message to the SMS Centre.

Trigger points:

Start SMS service attempt: Initiate sending a SMS.

End SMS service attempt: Receiving SMS on Mobile Equipment 2.

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

4.4.4.1 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 [4]).

4.4.4.2 Computation

Abstract formula:

$$\text{CR SMS CS } [\%] = \frac{\text{successful received Test SMS - duplicate received Test SMS - corrupted Test SMS}}{\text{Number of all send Test SMS}} \times 100\%$$

Trigger points:

Successfully send and received SMS via SMSC.

Time window of measurements according to customer profile.

4.5 Circuit Switched Data (CSD) Service

4.5.1 Service Accessibility, Circuit Switched Data (SA - CSD)

4.5.1.1 Abstract definition

Probability that the end-customer's DTE can access the Mobile Data Service when requested. This will be indicated by the DTE receiving the valid connect message from the distant DTE.

Probability that the end-customer's DTE can access the Mobile Data Service when requested.

There are 2 layers of accessibility for CSD:

- access to the target network DCE;
- access to the required data service provided by a data server.

To a customer, these 2 events would be seamless and therefore the calculation for the service access should be a composite of these 2 activities. The field test system therefore must automate and combine the two layers to provide a single SA-CSD metric.

To combine the 2 layers should involve calculation of the success of the following actions:

- ATDT command including target number;
- receive Connect from target network DCE;
- send relevant command to target Data Server;
- receive valid response from Data Server.

The specific commands and responses from data servers will be detailed in TS 102 250-3 [6].

4.5.1.2 Computation

A successful call attempt is when the A-party DTE receives valid response from test server. This can either be a dedicated data test server or a data server accessed when testing functionality via the public internet.

Abstract formula:

$$\text{Service Accessibility CSD}[\%] = \frac{\text{Number of successful call attempts}}{\text{Number of call attempts}} \times 100\%$$

Trigger points:

Beginning of the call attempt: ATDT command with dialled number sent by A-party DTE.

Successful call attempt: Valid response received from Data Server.

4.5.2 Set-up Time (ST - CSD)

4.5.2.1 Abstract definition

Time between sending of complete address information in ATDT command by A-party and receipt of valid response from data server.

4.5.2.2 Computation

Abstract formula:

$$\text{Set - up Time Circuit Switched Data } [s] = t_2[s] - t_1[s]$$

t_1: point of time where A-party DTE sends ATDT command.

t_2: point of time where connect is established (valid response received by A-party from data server).

Trigger points:

Beginning of the Set-up time measurement: Sending of ATDT command by A-party.

Successful connection: Valid response received from Data Server.

4.5.3 Data Quality Circuit Switched Data (DQ-CSD)

For definitions of Data Quality Parameters refer to clause 4.7.

4.5.4 Completion Rate Circuit Switched Data (CR-CSD)

4.5.4.1 Abstract definition

Probability that a successful call attempt is not released except when intended by any of the parties involved in the call.

4.5.4.2 Computation

Abstract formula:

$$\text{Call completion Ratio CSD}[\%] = \frac{\text{Number of calls terminated by end users}}{\text{Number of successful data call attempts}} \times 100\,\%$$

Trigger points:

Successful call attempt: Valid response received by A-party DTE.

Completed call: DTE "ready" only when call ended by either party intentionally.

4.6 Packet Switched Data Services

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

- Service Accessibility Ratio (SA-PSD);
- Setup Time (ST-PSD);
- IP-Service Access Ratio (IPSA-PSD);
- IP-Service Setup Time (IPST-PSD);
- Completed Session Ratio (CoSeR-PSD);
- Session Time (SeT-PSD);
- Mean Data Rate (DR-PSD);
- Data Transfer Cut-off Ratio (CoR-PSD);
- Round Trip Time (RTT-PSD).

Currently two main views about the best way to reflect the user's experience are in place: One preferring the payload throughput philosophy and the other preferring the transaction throughput philosophy:

- Method A, specified in clause 4.6.1, defines trigger points which are as independent as possible from the service used, therefore representing a more generic view (payload throughput).
- Method B, specified in clause 4.6.2, defines trigger points on application layer, therefore representing a more service oriented view (transaction throughput).

An example of the different trigger points defined for each set is illustrated in Figure 2 and Figure 3: The start trigger point for the Mean Data Transfer for Web browsing is either the reception of the first packet containing data content (Method A) or the sending of the HTTP GET command (Method B).

A field test system compliant to the present document shall measure both sets (Method A and B) of QoS indicators using commercial UEs.

In addition, a set of technical QoS indicators is defined, which is given in clause 4.6.3. Field test systems shall be able to measure these QoS indicators.

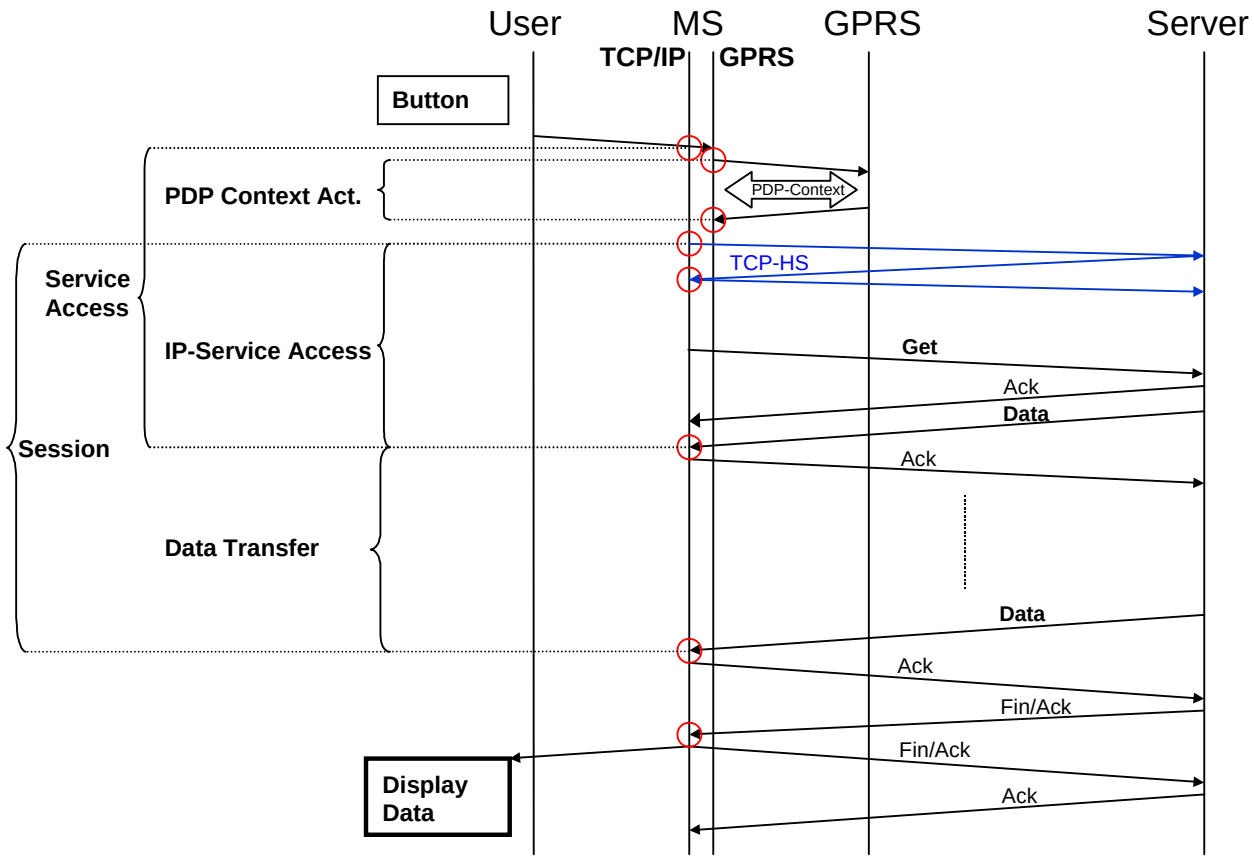

Figure 2: Key Performance Indicators Version A (Example: HTTP via GPRS)

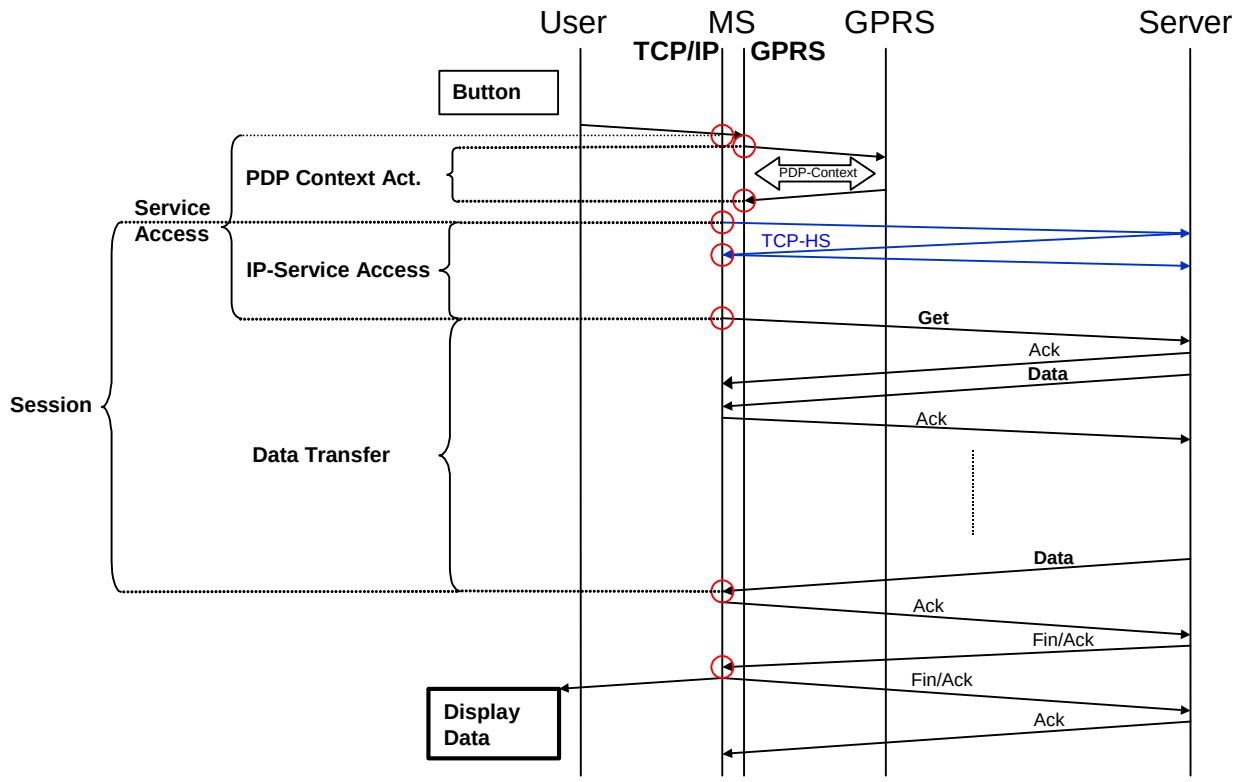

Figure 3: Key Performance Indicators Version B (Example: HTTP via GPRS)

4.6.1 Key Performance Indicators Method A

4.6.1.1 {Service} Service Accessibility Ratio (SA-PSD) [%]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.1.1 Abstract definition

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

4.6.1.1.2 Computation

Abstract equation:

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

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).

4.6.1.2 {Service} Setup Time (ST-PSD) [seconds]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.2.1 Abstract definition

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Abstract equation:

$$ST-PSD[s] = t_{\text{Content sent or received}}[s] - t_{\text{Dial-up connection initiated}}[s]$$

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.

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).

4.6.1.3 {Service} IP-Service Access Ratio (IPSA-PSD)

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.3.1 Abstract definition

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

4.6.1.3.2 Computation

Abstract equation:

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

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).

4.6.1.4 {Service} IP-Service Setup Time (IPST-PSD)

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.4.1 Abstract definition

The IP-service setup time is the time period needed to establish an TCP/IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

4.6.1.4.2 Computation

Abstract equation:

$$IPST - PSD[s] = t_{\text{Content sent or received}}[s] - t_{\text{Query sent}}[s]$$

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).

4.6.1.5 {Service} Completed Session Ratio (CoSeR-PSD) [%]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.5.1 Abstract definition

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

4.6.1.5.2 Computation

Abstract equation:

$$CoSeR[\%] = \frac{Number\ of\ completed\ sessions}{Number\ of\ successfully\ started\ sessions} \times 100\,\%$$

Trigger points:

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

- Start: First [SYN] sent.
- Stop: Reception of the 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).

4.6.1.6 {Service} Session Time (SeT-PSD)

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.6.1 Abstract definition

The session time is the time period needed to successfully complete a PS data session.

4.6.1.6.2 Computation

Abstract equation:

$$SeT - PSD\,[s] = t_{\text{Session end}}\,[s] - t_{\text{Session start}}\,[s]$$

Trigger points:

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

- Start: First [SYN] sent.
- Stop: Reception of the 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).

4.6.1.7 {Service} Mean Data Rate (MDR-PSD) [kBit/s]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.7.1 Abstract definition

After a data link has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

4.6.1.7.2 Computation

Abstract equation:

$$Mean\ Data\ Rate[kBit/s] = \frac{User\ data\ transferred\ [kBit]}{End\ of\ data\ transfer\ [s] - Start\ of\ data\ transfer\ [s]}$$

Trigger points: The average throughput is measured from opening the data connection to the end of the successful transfer of the content (file, e-mail or web page).

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

- Start: Reception of the first data packet containing content.
- Stop: Reception of the last data packet containing content.

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

- Start: Sending of the first data packet containing content.
- Stop: Reception of the [FIN, ACK] for the last data packet containing content.

Remark(s): The mobile station is already attached (cf. Attach Failure Ratio), a PDP context is activated (cf. PDP Context Activation Failure Ratio) and a service was accessed successfully (cf. Service Non-Accessibility).

4.6.1.8 {Service} Data Transfer Cut-off Ratio (DTCoR-PSD) [%]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.1.8.1 Abstract definition

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

4.6.1.8.2 Computation

Abstract equation:

$$DTCoR[\%] = \frac{Number\ of\ incomplete\ data\ transfers}{Number\ of\ successfully\ started\ data\ transfers} \times 100\,\%$$

Trigger points:

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

- Start: Reception of the first data packet containing content.
- Stop: Reception of the last data packet containing content.

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

- Start: Sending of the first data packet containing content.
- Stop: Reception of the [FIN, ACK] of the last data packet containing content.

Remark(s): The mobile station is already attached (cf. Attach Failure Ratio), a PDP context is activated (cf. PDP Context Activation Failure Ratio) and a service was accessed successfully (cf. Service Non-Accessibility).

4.6.2 Key Performance Indicators Method B

4.6.2.1 {Service} Service Accessibility Ratio (SA-PSD) [%]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.1.1 Abstract definition

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

4.6.2.1.2 Computation

Abstract equation:

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

Trigger points:

FTP (download), FTP (upload)

- Start: ATD command from the mobile to the network.
- Stop: Reception of the [ACK] from the [SYN, ACK].

E-Mail POP3 (receiving)

- Start: ATD command from the mobile to the network.
- Stop: Send RETR command.

E-Mail SMTP (sending)

- Start: ATD command from the mobile to the network.
- Stop: Reception of the positive acknowledgement (250) for the HELO command which was sent from the client before. This definition applies to the "none login procedure", for other login procedures the trigger point has to be defined.

HTTP

- Start: ATD command from the mobile to the network.
- Stop: Sending of the first GET command.

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).

4.6.2.2 {Service} Setup Time (ST-PSD) [seconds]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.2.1 Abstract definition

The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Abstract equation:

$$ST - PSD\,[s] \;=\; t_{\text{Content sent or received}}\,[s] \;-\; t_{\text{Dial-up connection initiated}}\,[s]$$

Trigger points:

FTP (download), FTP (upload)

- Start: ATD command from the mobile to the network.
- Stop: Reception of the [ACK] from the [SYN, ACK].

E-Mail POP3 (receiving)

- Start: ATD command from the mobile to the network.
- Stop: Send RETR command.

E-Mail SMTP (sending)

- Start: ATD command from the mobile to the network.
- Stop: Reception of the positive acknowledgement (250) for the HELO command which was sent from the client before. This definition applies to the "none login procedure", for other login procedures the trigger point has to be defined.

HTTP

- Start: ATD command from the mobile to the network.
- Stop: Sending of the first GET command.

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).

4.6.2.3 {Service} IP-Service Access Ratio (IPSA-PSD)

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.3.1 Abstract definition

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

4.6.2.3.2 Computation

Abstract equation:

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

Trigger points:

FTP (download), FTP (upload)

- Start: First [SYN] sent.
- Stop: Reception of the [ACK] from the [SYN, ACK].

E-Mail POP3 (receiving)

- Start: First [SYN] sent.
- Stop: Send RETR command.

E-Mail SMTP (sending)

- Start: First [SYN] sent.
- Stop: Reception of the positive acknowledgement (250) for the HELO command which was sent from the client before. This definition applies to the "none login procedure", for other login procedures the trigger point has to be defined.

HTTP

- Start: First [SYN] sent.
- Stop: Sending of the first GET command.

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).

4.6.2.4 {Service} IP-Service Setup Time (IPST-PSD)

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.4.1 Abstract definition

The IP-service setup time is the time period needed to establish an TCP/IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received.

4.6.2.4.2 Computation

Abstract equation:

$$IPST - PSD[s] = t_{\text{Content sent or received}}[s] - t_{\text{Query sent}}[s]$$

Trigger points:

FTP (download), FTP (upload)

- Start: First [SYN] sent.
- Stop: Reception of the [ACK] from the [SYN, ACK].

E-Mail POP3 (receiving)

- Start: First [SYN] sent.
- Stop: Send RETR command.

E-Mail SMTP (sending)

- Start: First [SYN] sent.
- Stop: Reception of the positive acknowledgement (250) for the HELO command which was sent from the client before. This definition applies to the "none login procedure", for other login procedures the trigger point has to be defined.

HTTP

- Start: First [SYN] sent.
- Stop: Sending of the first GET command.

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).

4.6.2.5 {Service} Completed Session Ratio (CoSeR-PSD) [%]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.5.1 Abstract definition

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

4.6.2.5.2 Computation

Abstract equation:

$$CoSeR[\%] = \frac{Number\ of\ completed\ sessions}{Number\ of\ successfully\ started\ sessions} \times 100\,\%$$

Trigger points:

FTP (download), HTTP

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

NOTE: For FTP download, the last data packet contains a set FIN flag bit.

FTP (upload)

- Start: First [SYN] sent.
- Stop: Reception of the [FIN, ACK] sent from the server.

E-Mail POP3 (receiving)

- Start: First [SYN] sent.
- Stop: Reception of the data packet containing the finish sequence (CRLF.CRLF).

E-Mail SMTP (sending)

- Start: First [SYN] sent.
- Stop: Reception of the positive acknowledgement (250) for the EOM command.

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).

4.6.2.6 {Service} Session Time (SeT-PSD)

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.6.1 Abstract definition

The session time is the time period needed to successfully complete a PS data session.

4.6.2.6.2 Computation

Abstract equation:

$$SeT - PSD\,[s] = t_{\text{Session end}}\,[s] - t_{\text{Session start}}\,[s]$$

Trigger points:

FTP (download), HTTP

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

NOTE: For FTP download, the last data packet contains a set FIN flag bit.

FTP (upload)

- Start: First [SYN] sent.
- Stop: Reception of the [FIN, ACK] sent from the server.

E-Mail POP3 (receiving)

- Start: First [SYN] sent.
- Stop: Reception of the data packet containing the finish sequence (CRLF.CRLF).

E-Mail SMTP (sending)

- Start: First [SYN] sent.
- Stop: Reception of the positive acknowledgement (250) for the EOM command.

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).

4.6.2.7 {Service} Mean Data Rate (MDR-PSD) [kBit/s]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.7.1 Abstract definition

After a data link has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. The prerequisite for this parameter is network and service access.

4.6.2.7.2 Computation

Abstract equation:

$$Mean\ Data\ Rate[kBit/s] = \frac{User\ data\ transferred\ [kBit]}{End\ of\ data\ transfer\ [s] - Start\ of\ data\ transfer\ [s]}$$

Trigger points: The average throughput is measured from opening the data connection to the end of the successful transfer of the content (file, e-mail or web page).

FTP (download)

- Start: Reception of the [ACK] from the [SYN, ACK].
- Stop: Reception of the last data packet containing content.

NOTE: For FTP download, the last data packet contains a set FIN flag bit.

FTP (upload)

- Start: Reception of the [ACK] from the [SYN, ACK].
- Stop: Reception of the [FIN, ACK] sent from the server.

E-Mail POP3 (receiving)

- Start: Send RETR command.
- Stop: Reception of the data packet containing the finish sequence(CRLF.CRLF).

E-Mail SMTP (sending)

- Start: Reception of the positive acknowledgement (250) for the HELO command which was sent from the client before. This definition applies to the "none login procedure", for other login procedures the trigger point has to be defined.
- Stop: Reception of the positive acknowledgement (250) for the EOM command.

HTTP

- Start: Sending of the first GET command.
- Stop: Reception of the last data packet containing content.

Remark(s): The mobile station is already attached (cf. Attach Failure Ratio), a PDP context is activated (cf. PDP Context Activation Failure Ratio) and a service was accessed successfully (cf. Service Non-Accessibility).

4.6.2.8 {Service} Data Transfer Cut-off Ratio (DTCoR-PSD) [%]

Service(s) defined: FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.2.8.1 Abstract definition

The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully.

4.6.2.8.2 Computation

Abstract equation:

$$DTCoR[\%] = \frac{Number\ of\ incomplete\ data\ transfers}{Number\ of\ successfully\ started\ data\ transfers} \times 100\,\%$$

Trigger points:

FTP (download)

- Start: Reception of the [ACK] from the [SYN, ACK].
- Stop: Reception of the last data packet containing content.

NOTE: For FTP download, the last data packet contains a set FIN flag bit.

FTP (upload)

- Start: Reception of the [ACK] from the [SYN, ACK].
- Stop: Reception of the [FIN, ACK] sent from the server.

E-Mail POP3 (receiving)

- Start: Send RETR command.
- Stop: Reception of the data packet containing the finish sequence (CRLF.CRLF).

E-Mail SMTP (sending)

- Start: Reception of the positive acknowledgement (250) for the HELO command which was sent from the client before. This definition applies to the "none login procedure", for other login procedures the trigger point has to be defined.
- Stop: Reception of the positive acknowledgement (250) for the EOM command.

HTTP

- Start: Sending of the first GET command.
- Stop: Reception of the last data packet containing content.

Remark(s): The mobile station is already attached (cf. Attach Failure Ratio), a PDP context is activated (cf. PDP Context Activation Failure Ratio) and a service was accessed successfully (cf. Service Non-Accessibility).

4.6.3 Performance Indicators

4.6.3.1 Unavailability [%]

4.6.3.1.1 Abstract definition

The unavailability describes the probability that the PS bearer is not active in the cell currently used by the customer.

4.6.3.1.2 Computation (GPRS)

Abstract equation:

$$GPRS\ Unavailability[\%] = \frac{No.\ of\ unsuccessful\ attempts\ to\ read\ SI13}{No.\ of\ all\ attempts\ to\ read\ SI13} \times 100\%$$

Trigger points:

- Check if GPRS specific signalling (SI13) exists on cell selection.
- Check if the signalling message can be read out and if the required signalling exists on BCCH or PBCCH.

Remark(s):

- The availability of the PS bearer is checked once at the start of a probing cycle.
- According to EN 300 911 (GSM 05.08) [11] the mobile station should decode Layer 3 message System Information type 13 (SI13) at least every 30 seconds. This "technical" timeout should be used when measuring the unavailability. Note that some mobile stations do not conform to this 30 seconds timer, and the timeout for this PI should be adjusted accordingly if these types of mobile stations are used (e.g. Sagem OT190 with s/w DY3,5E and DYE,5G; Sagem OT96MGPRS with s/w FY1,0J,0L and 0Q).

4.6.3.2 Attach Failure Ratio [%]

4.6.3.2.1 Abstract definition

The attach failure ratio describes the probability that a subscriber cannot attach to the PS network.

4.6.3.2.2 Computation

Abstract equation:

$$Attach\ Failure\ Ratio[\%] = \frac{No.\ of\ unsuccessful\ attach\ attempts}{No.\ of\ all\ attach\ attempts} \times 100\%$$

Connection to other parameters: Unavailability

Trigger points:

- Start: Mobile sends the attach request message.
- Stop: Mobile receives the attach accept message.

Remark(s):

1) GPRS: Indicator will only be updated by event (a loss of SI13 signalling or a coverage hole will not be detected if no attach, routing area update or TBF request is initiated).

2) 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 [12]). Therefore the timeout interval for the attach procedure is 75 seconds, i.e. if the attach procedure was not completed after 75 seconds it is considered as failure.

   These retries should not have impact on the attach failure ratio, since only one attach request message should be counted in the calculation.

3) The PS bearer has to be active in the cell used by a subscriber (cf. Unavailability).

The above timeouts are considered to be "technical" timeouts and do not necessarily reflect actual user behaviour. Users may not be prepared to wait as long as the "technical timeout" values before considering the transaction as failed.

The "technical timeouts" should be used for gathering the measurements, and then potentially shorter "user behaviour timeouts" can be used in post-processing of the results to calculate the actual KPI values. In this way, results will not be discarded that only just exceed the "user behaviour timeouts". This could be useful when producing distribution tables/graphs of results.

4.6.3.3 Attach Setup Time [seconds]

4.6.3.3.1 Abstract definition

This attach setup time describes the time period needed to attach to the PS network.

4.6.3.3.2 Computation

Abstract equation:

$$Attach\ Setup\ Time[s] = t_{attach\ complete}[s] - t_{attach\ request}[s]$$

Connection to other parameters: Unavailability

Remark(s):

1) The difference between an attach of a known subscriber and an unknown subscriber will be reflected in the time period indicating the attach setup time. In case of an unknown subscriber (meaning that the SGSN has changed since the detach, or if its the very first attach of the mobile to the network), the SGSN contacts the HLR in order to receive the subscriber data. The attach setup time of an unknown subscriber will be slightly longer than the one of a known subscriber.

2) While determining the average attach setup time only successful attach attempts are included in the calculations.

3) The PS bearer has to be active in the cell used by a subscriber (cf. Unavailability).

Trigger points:

- Start: Point of time when the mobile sends the attach request message.
- Stop: Point of time when the mobile receives the attach accept message.

4.6.3.4 {Service} PDP Context Activation Failure Ratio [%]

Service(s) defined: All

4.6.3.4.1 Abstract definition

The PDP context activation failure ratio denotes the probability that the PDP context cannot be activated. It is the proportion of unsuccessful PDP context activation attempts and the total number of PDP context activation attempts.

4.6.3.4.2 Computation

Abstract equation:

$$PDP\ Context\ Activation\ Failure\ Ratio[\%] = \frac{No.\ of\ unsuccessful\ PDP\ context\ activation\ attempts}{No.\ of\ all\ PDP\ context\ activation\ attempts} \times 100\%$$

Connection to other parameters:

- Unavailability.
- Attach Failure Ratio.

Trigger points:

- Start: Mobile sends the PDP context activation request message.
- Stop: Mobile receives the PDP context activation accept message.

Remark(s):

1) 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, cf. TS 124 008 [12]). Therefore the timeout interval for the PDP context activation procedure is 150 seconds, i.e. if the PDP context activation procedure was not completed after 150 seconds it is considered as failure.

   These retries should not have impact on the activation failure ratio, since only one PDP context activation request message should be counted in the calculation.

2) 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).

The above timeouts are considered to be "technical" timeouts and do not necessarily reflect actual user behaviour. Users may not be prepared to wait as long as the "technical timeout" values before considering the transaction as failed.

The "technical timeouts" should be used for gathering the measurements, and then potentially shorter "user behaviour timeouts" can be used in post-processing of the results to calculate the actual KPI values. In this way, results will not be discarded that only just exceed the "user behaviour timeouts". This could be useful when producing distribution tables/graphs of results.

4.6.3.5 {Service} PDP Context Activation Time [seconds]

Service(s) defined: All

4.6.3.5.1 Abstract definition

This parameter describes the time period needed for activating the PDP context.

4.6.3.5.2 Computation

Abstract equation:

$$PDP\ Context\ Activation\ Time[s] = t_{\text{PDP context activation accept}}[s] - t_{\text{PDP context activation request}}[s]$$

Connection to other parameters:

- Unavailability.
- Attach Failure Ratio.

Remark(s):

1) While determining the average PDP context activation time only successful activation attempts are included in the calculations.

2) The PDP context activation time should be determined per service, since the service might have impact on the actual activation time, e.g. different Access Point Names (APNs) for WAP.

3) 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).

Trigger points:

- Start: Point of time when the mobile sends the PDP context activation request message.
- Stop: Point of time when the mobile receives the PDP context activation accept message.

4.6.3.6 {Service} PDP Context Cut-off Ratio [%]

Service(s) defined: All

4.6.3.6.1 Abstract definition

The PDP context cut-off ratio denotes the probability that a PDP context is deactivated without being initiated intentionally by the user.

4.6.3.6.2 Abstract equation

Abstract equation:

$$PDP\ Context\ Cut-off\ Ratio[\%] = \frac{No.\ of\ PDP\ context\ losses\ not\ initiated\ by\ the\ user}{No.\ of\ all\ successfully\ activated\ PDP\ contexts} \times 100\,\%$$

Trigger points: Different trigger points for a PDP context deactivation not initiated intentionally by the user are possible: SGSN failure or GGSN failure on which the PDP context will be deactivated by the SGSN or GGSN.

Remark(s): Precondition for measuring this parameter is that a PDP context was successfully established first.

4.6.3.7 {Service} Round Trip Time [milliseconds]

Service(s) defined: Ping
FTP (download / upload)
E-Mail POP3
E-Mail SMTP
HTTP

4.6.3.7.1 Abstract definition

The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. For this measurement the service must already be established.

4.6.3.7.2 Computation

Abstract equation:

$$Round\ Trip\ Time\,[ms] = t_{\text{Packet received}}[ms] - t_{\text{Packet sent}}[ms]$$

Trigger points: Ping

- Start: Point of time when the ICMP echo request is sent ($t_{ICMP\ echo\ request}$).
- Stop: Point of time when the ICMP echo reply is received by the sender ($t_{ICMP\ echo\ reply}$).

FTP, E-Mail, HTTP

The measurement of the round trip time is done by evaluating the TCP handshake:

- Start: Point of time when the [SYN] is sent.
- Stop: Point of time when the [SYN, ACK] is received.

4.7 Multimedia Messaging Service (MMS)

NOTE: It is important to keep in mind that measurement equipment and techniques used can affect the data collected. The measurement equipment and techniques should be defined and their effects documented for all tests. One example of this is the effect of Windows RAS on the setup of PDP Context. (See TS 102 250-3 [6]).

4.7.1 MMS send failure ratio (MO) [%]

4.7.1.1 Abstract definition

The parameter MMS Send Failure Ratio (MO) describes the probability that a MMS-message can not be send by the subscriber, although he has requested to do so by pushing the "send button".

4.7.1.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
MMS Send Attempt (MO)	Pushing of send button	The send button initiates the *PDP context activation* of the MS (MO), followed by a connection to the WAP Gateway, and to the MMSC. (See trigger 1 in Figure 4).
Unsuccessful MMS Send Attempt (MO)	Do not see "Message sent"	The *m-send.conf*(see [3]) (where Response Status: $80 = M_RS_OK) is not received by the MS(MO). (See trigger 18 in Figure 4). NOTE 1: The phase where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 2 : A forwarding of a MMS without reception of a positive m-send.conf (where Response Status: $80 = M_RS_OK) shall be counted as failure. NOTE 3: Only MMS sent within the timeouts will be considered. "MMS unsuccessful send attempt timeout" as specified in TS 102 250-5 (see bibliography).

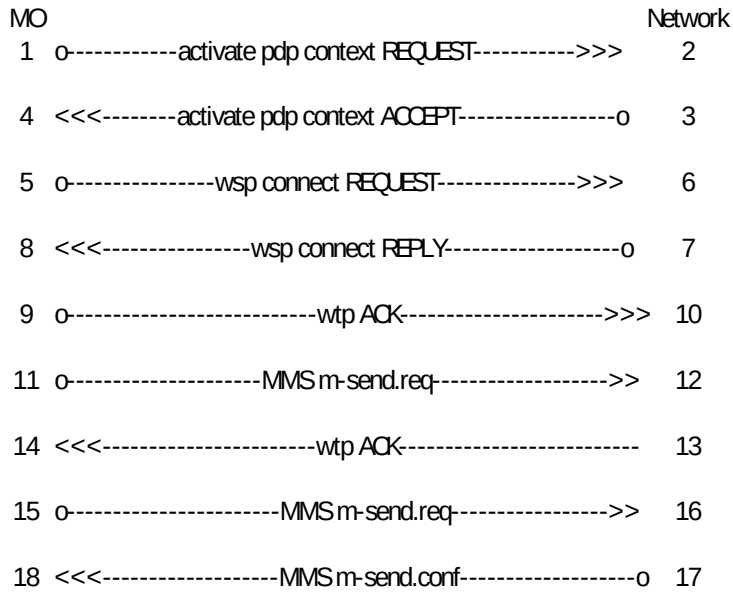

Figure 4: MMS Transaction flow

Abstract formula:

$$\text{MMS Send Failure Ratio (MO)}\,[\%] = \frac{\text{Number of unsuccessful l MMS Send Attempts (MO)}}{\text{Number of All MMS Send Attempts (MO)}} \times 100\,\%$$

4.7.2 MMS retrieval failure ratio (MT) [%]

4.7.2.1 Abstract definition

The parameter MMS Retrieval Failure Ratio (MT) describes the probability that the MMS-message can not be downloaded by the MT mobile, which received a MMS Notification before.

Remark: The MMS Notification is a push-message. This message either initiates the download of the MMS content by starting a "WAP Get Request" (when the mobile is switched to automatic mode) or enables the User to manually start this "Wap Get Request" (when the mobile is switched to manual mode). All the measurements will be done using the setting "Automatic Download".

4.7.2.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
MMS Retrieval Attempt (MT)	Initiation of the Wap Get Request MT	After the *m-Notification.ind*. (see [3]) has been sent to the MS (MT), this mobile activates a PDP-context and contacts the MMSC via the WAP Gateway (See trigger 29 in Figure 5).
Unsuccessful MMS Retrieval Attempt (MT)	No MMS-message is received	The *m-notifyResp.ind* (see [3]) is not sent by the MS (MT). (See trigger 49 in Figure 5). NOTE 1: The phase where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 2: Only MMS received within the timeouts will be considered. "MMS unsuccessful Retrieval timeout" as specified in TS 102 250-5 (see bibliography).

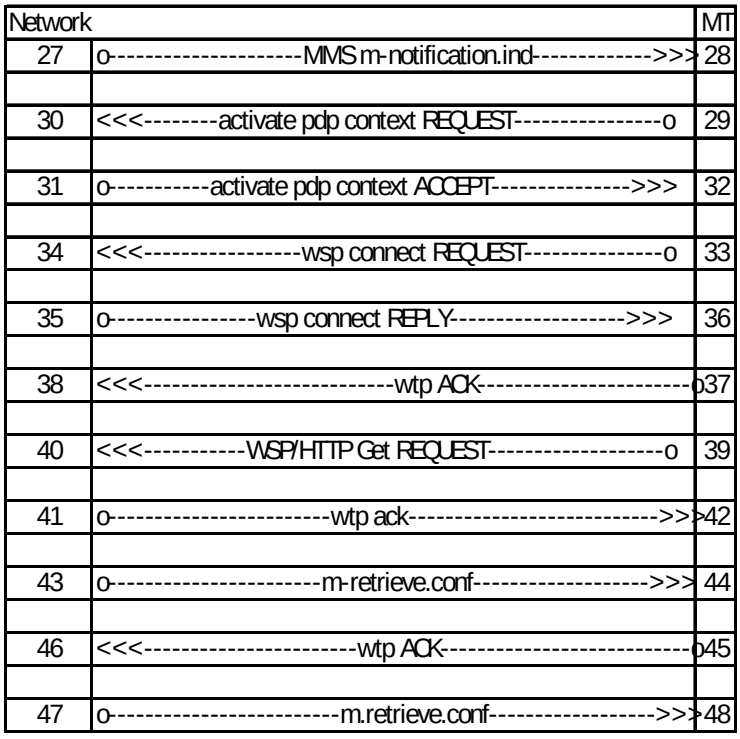

Figure 5: MMS Transaction flow

Abstract formula:

$$\text{MMS Delivery Failure Ratio (MT)}\,[\%] = \frac{\text{Number of unsuccessful MMS Delivery Attempts MT}}{\text{Number of All MMS Delivery Attempts (MT)}} \times 100\ \%$$

4.7.3 MMS send time (MO) [s]

4.7.3.1 Abstract definition

A subscriber uses the Multimedia Messaging Service (as indicated by the network ID in his mobile phone display). The time elapsing from pushing the send button after the editing of a MMS-message to the completion of the data transfer is described by this parameter.

NOTE: Possible measurement scenarios for time indicators of MMS may vary in the number of involved MMSCs. With increasing MMS-traffic or internetwork-traffic surveillance, the number of MMSCs involved will increase also. Number of MMSCs involved is therefore a measurement condition to be discussed.

4.7.3.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
$t_{MMStoMMSCcomplete}$	MMS-message is completely transmitted to MMS-C	The *m-send.conf* (see [3]) (where Response Status: $80 = M_RS_OK) is not received by the MS(MO). (See trigger 18 in Figure 6). NOTE 1: The phase, where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 2: Only MMS send within the timeouts will be considered.
$t_{sendbutton}$	Send button is pushed	The send button initiates the *PDP context activation* of the MS(MT), followed by a connection to the WAP Gateway (See trigger 1 in Figure 6). "MMS unsuccessful send transfer timeout" as specified in TS 102 250-5 (see bibliography).

MO		Network
1	o----------activate pdp context REQUEST----------->>>	2
4	<<<--------activate pdp context ACCEPT----------o	3
5	o----------wsp connect REQUEST---------->>>	6
8	<<<----------wsp connect REPLY----------o	7
9	o----------wtp ACK----------->>>	10
11	o----------MMS m-send.req----------->>	12
14	<<<----------wtp ACK----------	13
15	o----------MMS m-send.req----------->>	16
18	<<<----------MMS m-send.conf----------o	17

Figure 6: MMS Transaction flow

Abstract formula:

$$\text{MMS Send Time}[\text{s}] = t_{MMStoMMSCcomplete}[s] - t_{sendbutton}[s]$$

4.7.4 MMS retrieval time (MT) [s]

4.7.4.1 Abstract definition

The reception of a MMS-message works as follows: A push-sms is sent to the receiver's mobile. In automatic mode, the push sms initiates a WAP-connection to download the MMS from the MMS-C. The initiation of the WAP connection is called the WAP GET REQUEST (WGR). The time elapsing between the WGR and the completion of the download of the MMS will be described by the parameter MMS Retrieval Time (MT).

Possible measurement scenarios for time indicators of MMS may vary in the number of involved MMSCs. With increasing MMS-traffic or internetwork-traffic surveillance, the number of MMSCs involved will increase also. Number of MMSCs involved is therefore a measurement condition to be discussed.

4.7.4.2 Computation

Trigger Points:

Event	Trigger Point	Technical description/protocol part
$t_{MMSfromMMSCcomplete}$	MMS-message is received completely	The *m-notifyResp.Ind* (see [3]) is sent by the MS (MT). (See trigger 49 in Figure 7). NOTE 1: The phase, where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 2: Only MMS received within the timeouts will be considered. "MMS successful retrieval timeout" as specified in TS 102 250-5 (see bibliography).
$t_{initWGR}$	Time when WAP Get Request is initiated	The *m-Notification.ind* (see [3] is delivered to the MS (MT). This initiates the *PDP context activation.* (See trigger 29 in Figure 7).

Network		MT
27	o----------MMS m-notification.ind----------->>>	28
30	<<<--------activate pdp context REQUEST----------o	29
31	o----------activate pdp context ACCEPT---------->>>	32
34	<<<----------wsp connect REQUEST----------o	33
35	o----------wsp connect REPLY----------->>>	36
38	<<<----------wtp ACK----------o	37
40	<<<----------WSP/HTTP Get REQUEST----------o	39
41	o----------wtp ack----------->>>	42
43	o----------m-retrieve.conf----------->>>	44
46	<<<----------wtp ACK----------o	45
47	o----------m.retrieve.conf----------->>>	48
50	<<<----------m-notifyResp.ind----------o	49

Figure 7: MMS Transaction flow

Abstract equation:

$$\text{MMS Delivery Time MT } [s] = t_{\text{MMSfromMMSCcomplete}}[s] - t_{\text{initWGR}}[s]$$

4.7.5 MMS notification failure ratio [%]

4.7.5.1 Abstract definition

The parameter MMS Notification Failure Ratio [%] describes the probability that the Multimedia Messaging Service (MMS) is not able to deliver the Notification of a MMS-message to the b-parties mobile.

4.7.5.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
Successful submitted MMS MO	Reception of the acknowledgement from the MMS-C MO (i.e. "Message sent")	The *m-send.conf* (see [3]) (where Response Status: $80 = M_RS_OK) is not received by the MS(MO). (See trigger 18 in Figure 8). NOTE 1: The phase where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 2: Only the accepted MMS has to be considered (see the response status = $80 in the sendconf) MMS with negative response but delivered can added alternatively.
Failed MMS-Notifications	Failure delivery (non-delivery) of the Notification - SMS.	*m- notification.ind* (see [3]) is not delivered to the MS(MT). (See trigger 28 in Figure 8). NOTE 3: Only Notifications received within the timeouts will be considered as successful "MMS successful notification timeout" as specified in TS 102 250-5 (see bibliography).

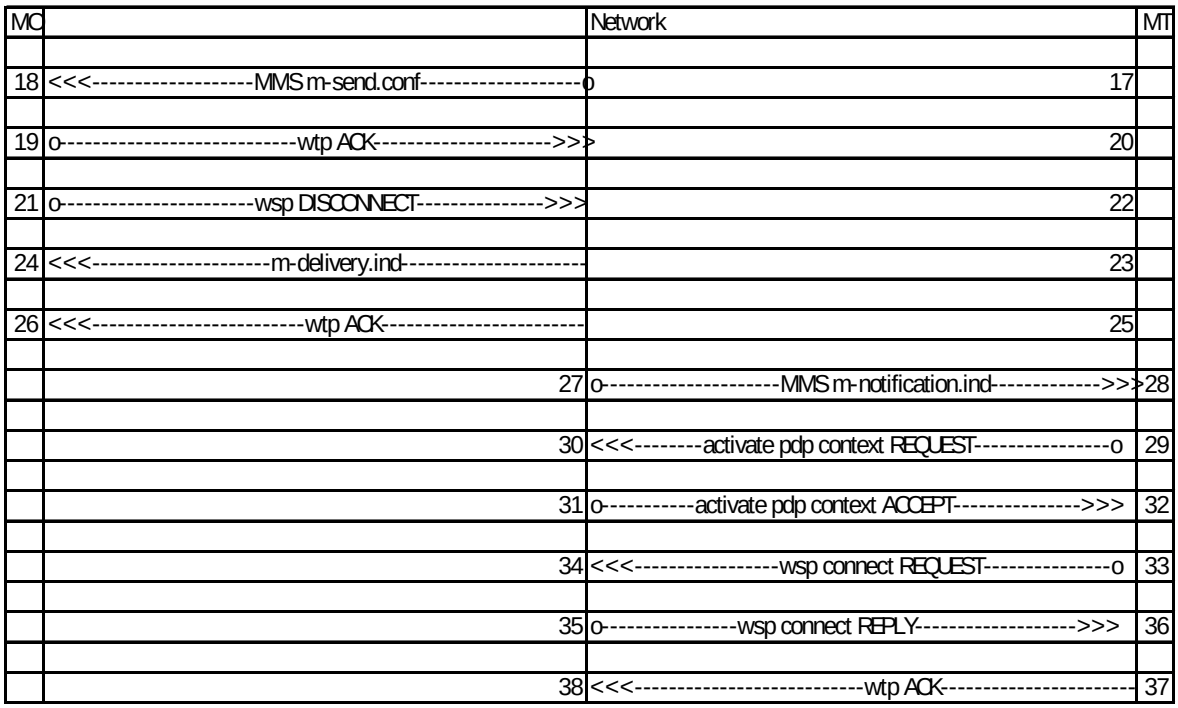

Figure 8: MMS Transaction flow

Abstract formula:

$$\text{MMS Notification Failure Ratio}\,[\%] = \frac{\text{Number of failed MMS - Notifications}}{\text{Number of successful submitted MMS (MO)}} \times 100\ \%$$

4.7.6 MMS notification time [s]

4.7.6.1 Abstract definition

A subscriber uses the Multimedia Messaging Service. The time elapsing from the complete submission of the Multimedia-Message to the MMSC to the reception of the Notification (MT) is the *MMS Notification Delay.*

Possible measurement scenarios for time indicators of MMS may vary in the number of involved MMSCs. With increasing MMS-traffic or internetwork-traffic surveillance, the number of MMSCs involved will increase also. Number of MMSCs involved is therefore a measurement condition to be discussed.

4.7.6.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
$t_{MMSsubmit}$	The MMS is submitted successfully	The *m-send.conf* (see [3]) , (where Response Status: $80 = M_RS_OK) is not received by the MS(MO). (See trigger 18 in Figure 9). NOTE 1: The phase, where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 2: The phase, where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly.
$t_{recNotif}$	Time when the Notification is received (MT)	*m-Notif.ind* (see [3]) is received by MS (MT) (See trigger 28 in Figure 9). NOTE 3: Only Notifications received within the timeouts will be considered as successful. "MMS successful notification timeout" as specified in TS 102 250-5 (see bibliography).

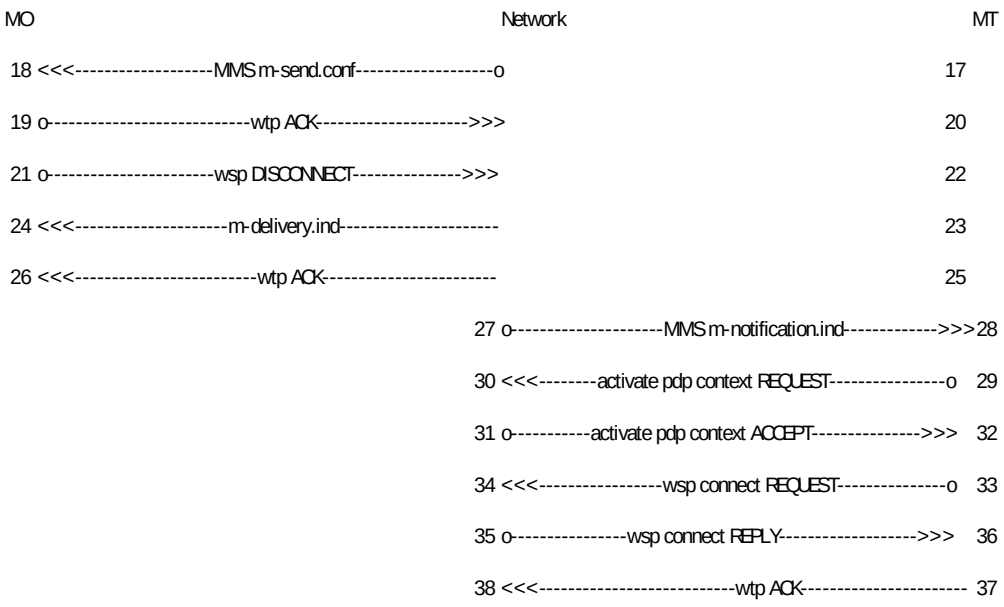

Figure 9: MMS Transaction flow

Abstract equation:

$$\text{MMS Notification Time MO/MT } [s] = t_{recNotif}[s] - t_{MMSsubmit}[s]$$

4.7.7 MMS end-to-end failure ratio [%]

4.7.7.1 Abstract definition

The parameter MMS end-to-end failure ratio describes the probability that the Multimedia Messaging Service (MMS) is not able to deliver a MMS-message after the "send button" has been pushed or the MO party has not received an acknowledgement of the successful transmission from the MMSC.

4.7.7.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
MMS Send Attempt by MS(MO)	Pushing of send button	The send button initiates the *PDP context activation* of the MS, followed by a connection to the WAP Gateway (See trigger 1 in Figure 10). NOTE 1: The forwarding of a MMS by the MMSC to the MS (MT) might be possible without the reception of the *m-send.conf* MS (MO) (see [3]), (where response status is $80=M RS OK)
Unsuccessful MMS Retrieval Attempt of MS(MT)	No MMS-message is received (MT) or no acknowledgement from the MMSC is received at MS (MO).	The *m-send.conf* (where Response Status: $80 = M_RS_OK) is not received by the MS(MO). (See trigger 18 in Figure 10) or the *m-notifyResp. ind* (see [3]) (see is not sent by the MS (MT)) (See trigger 18 and 49 in Figure 10). NOTE 2: The phase where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 3: Only MMS received within the timeouts will be considered. MMS unsuccessful End-to-End timeout as specified in TS 102 250-5 (see bibliography).

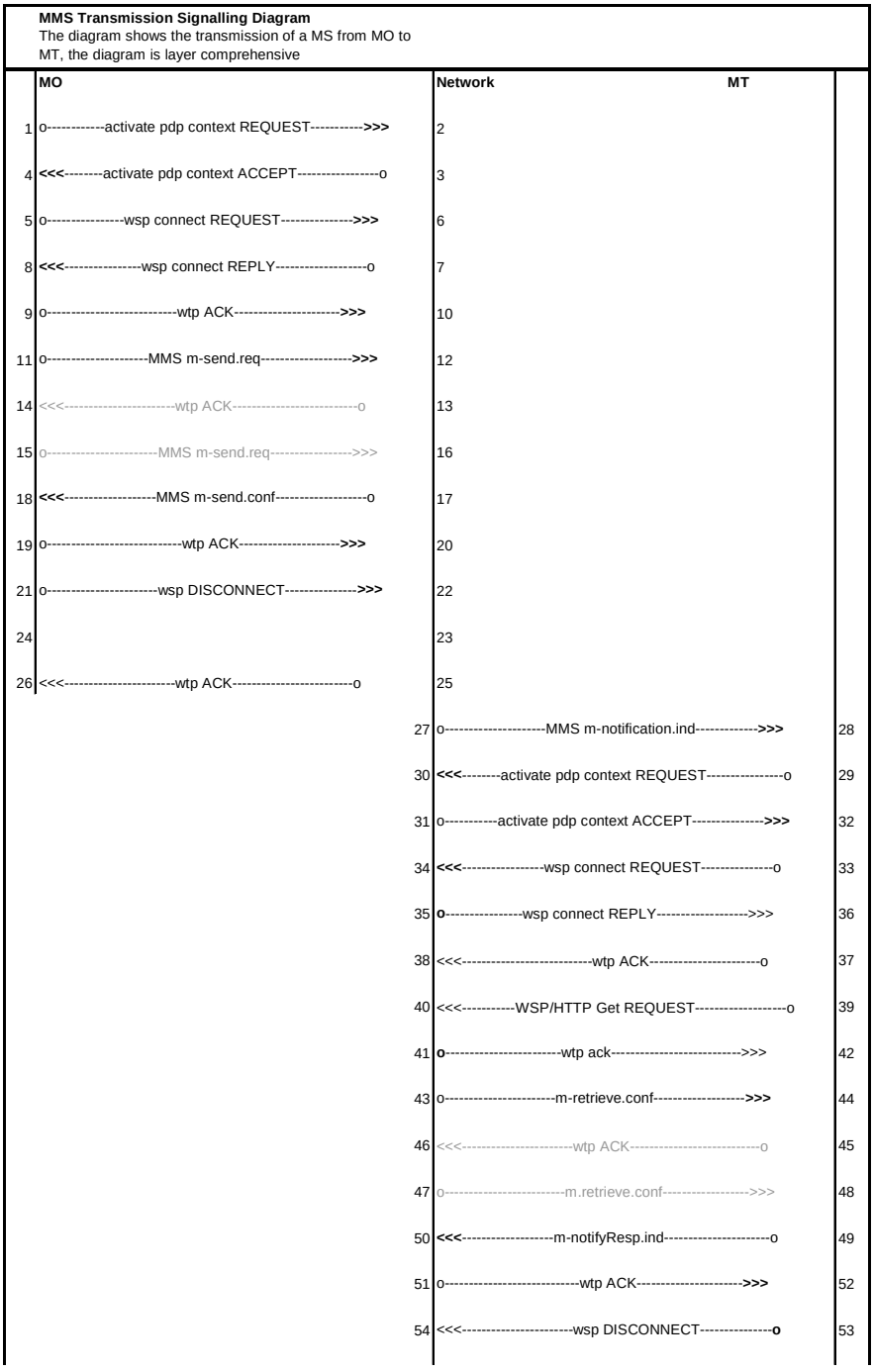

Figure 10: MMS transaction flow

Abstract equation:

$$\text{MMS End - to - end Failure Ratio}[\%] = \frac{\text{Number of unsuccessful delivered MMS - messages}}{\text{Number of all MMS send attempts}} \times 100\ \%$$

End-to-end parameter measurement may optionally be derived by concatenating the component measurements.

4.7.8 MMS End-to-end Delivery Time (MO/MT) [s]

4.7.8.1 Abstract definition

A subscriber uses the Multimedia Messaging Service (as indicated by the network ID in his mobile phone display). The time elapsing from pushing of the "send button" to the reception of the MMS by the b-parties mobile is the MMS End-to-end Delivery Time MO/MT.

This parameter is not calculated if the MO party has not received an acknowledgement of the successful transmission from the MMSC.

The size of a MMS varies. In comparison to SMS, the size has noticeable impact on the submission time. So, a typical sized MM is used for this measurement. See Auxiliary (Network Performance-) Parameter "MMS Average Size".

NOTE 1: Possible measurement scenarios for time indicators of MMS may vary in the number of involved MMSCs. With increasing MMS-traffic or internetwork-traffic surveillance, the number of MMSCs involved will increase also. Number of MMSCs involved is therefore a measurement condition to be discussed.

NOTE 2: End-to-end parameter measurement may optionally be derived by concatenating the component measurements.

4.7.8.2 Computation

Trigger Points:

Event	Trigger Point	Technical description / protocol part
$t_{sendattemot}$	Time when the "send button" is pushed	The send button initiates the *PDP context activation* of the MS (MO), followed by a connection to the WAP Gateway (See trigger 1 in Figure 11). NOTE 1: The forwarding of a MMS by the MMSC to the MS (MT) might be possible without the reception of the *m-send.conf* MS (MO).
t_{MMSrec}	Time when the MMS is received at the b-parties mobile	The M-resp.ind (see [3]) is received completely by the MS (MT), and the MS (MT) sends the m-notify-resp.ind (See trigger 49 in Figure 11). NOTE 2: Parameter not calculated if the m-send.conf (where Response Status: $80 = M_RS_OK) is not received by MS (MO) (See trigger 18 in Figure 11). NOTE 3: The phase where the WAP session will be deactivated is not covered by this indicator. Some mobiles might not support the sending/receiving of the next MMS unless the WAP session is disconnected properly. NOTE 4: Only MMS received within the timeouts will be considered. "MMS successful End-to-end timeout" as specified in TS 102 250-5 (see bibliography).

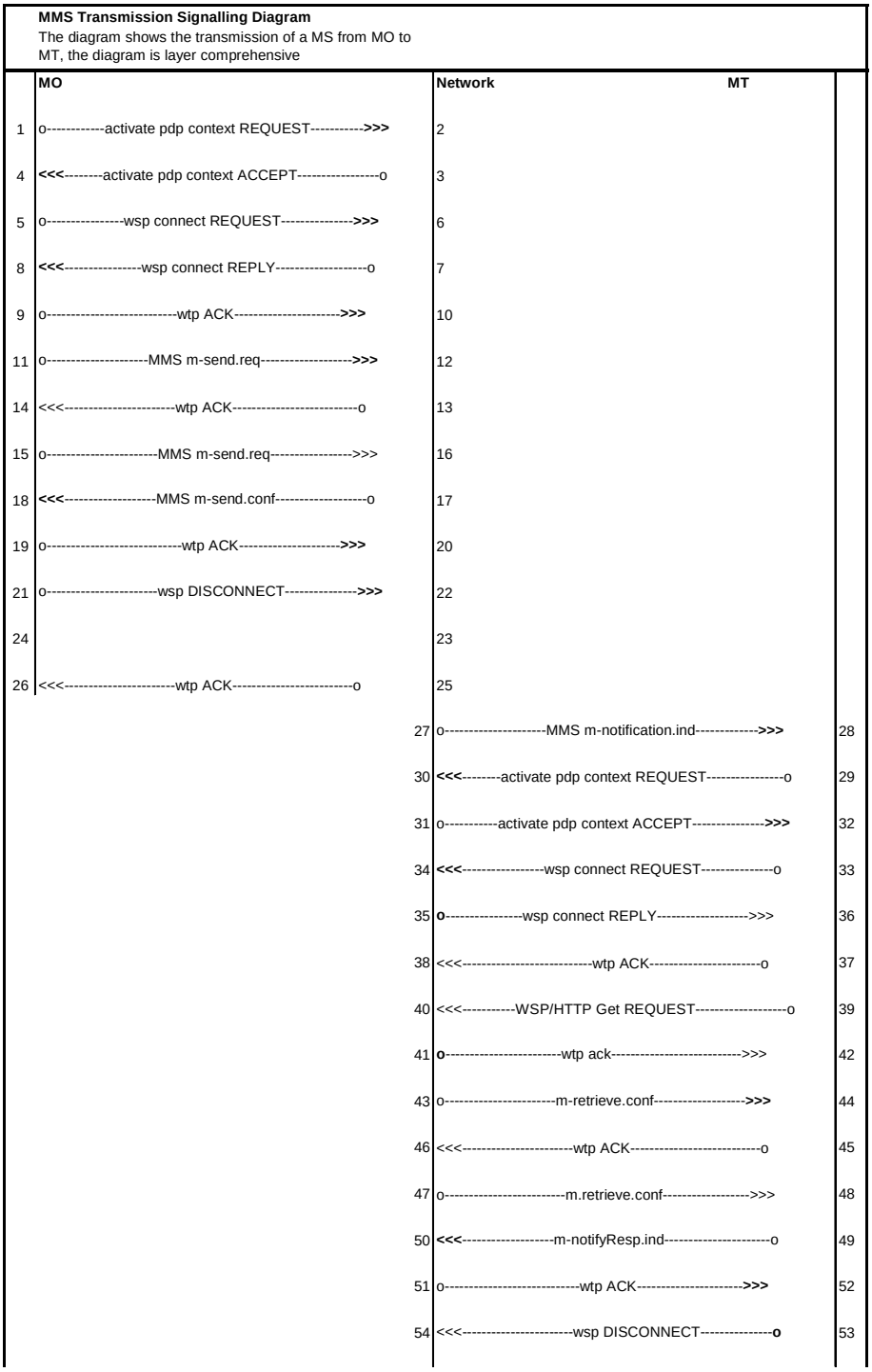

Figure 11: MMS Signalling Diagram

Abstract equation:

$$\text{MMS End - to - end Delivery Time (MO/MT)}\,[\text{s}] = t_{MMSrec}[s] - t_{sendAttempt}[s]$$

4.8 Streaming

4.8.1 Definitions

4.8.1.1 Streaming Session or Session

RFC 2326 [9] defines a session as "a complete RTSP "transaction", e.g. the viewing of a movie. A session typically consists of a client setting up a transport mechanism for the continuous media stream (SETUP), starting the stream with PLAY or RECORD, and closing the stream with TEARDOWN."

Referring to Figure 12 this means that the session starts at (B) and stops at (G).

4.8.2 Prerequisites

Precondition	Covered by	Reference document	Comment
Network Accessibility given	Network Accessibility Indicator		
PDP context activated			

4.8.3 Streaming Scenarios

The following two clauses describe different streaming scenarios. The first one is a generic approach in order to understand the main principles and identify the relevant protocols and communication procedures.

4.8.3.1 Generic Streaming Signalling Flow

A generic signal flow description for streaming is shown in Figure 12. The client communicates with the web server and media server entities and uses different protocols during the complete procedure, e.g. RTP, RTSP, RTCP, HTTP.

The next table gives a basic description of the protocols and their usage:

Protocol	Reference in Figure 12	Description
HTTP	A	Used for the retrieval of the streaming file description data
RTSP	B,C,F,G	RTSP is an application-level protocol. It provides different methods for the control of real-time data, e.g. audio/video. NOTE 1: RTSP is not responsible for the delivery of the data, this is done by RTP.
RTP	D	RTP is used for the transmission of real-time data, e.g. audio/video. NOTE 2: RTP is only used for the delivery of the data. No control and/or QoS are included.
RTCP	E	RTCP is the control protocol for RTP. Ist main function is the provision of a quality feedback.

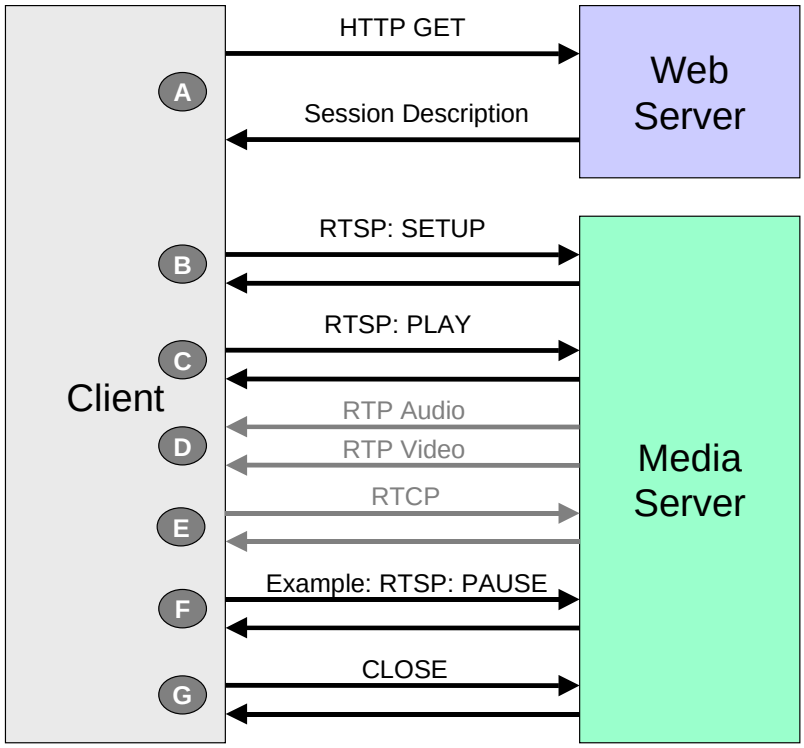

Figure 12: Generic session signalling flow, based on Schulzrinne

Referring to Figure 12 and the definition of a session in clause 4.8.1.1 it is possible to divide the communication of the client with the server side in two phases.

- In the first phase the client communicates with the web server in order to get a description of the file to be streamed. The used protocol is HTTP. Starting point is (A) and ending point is (B).
- In the second phase starts the communication with the media server which is finally delivering the stream. This means that the session starts at (B) and stops at (G). Different protocols are used in this phase (RTSP, RTP, RTCP).

4.8.3.2 Parameter Overview Chart

The following diagram gives an overview of the defined QoS parameters with their trigger points from customer's point of view.

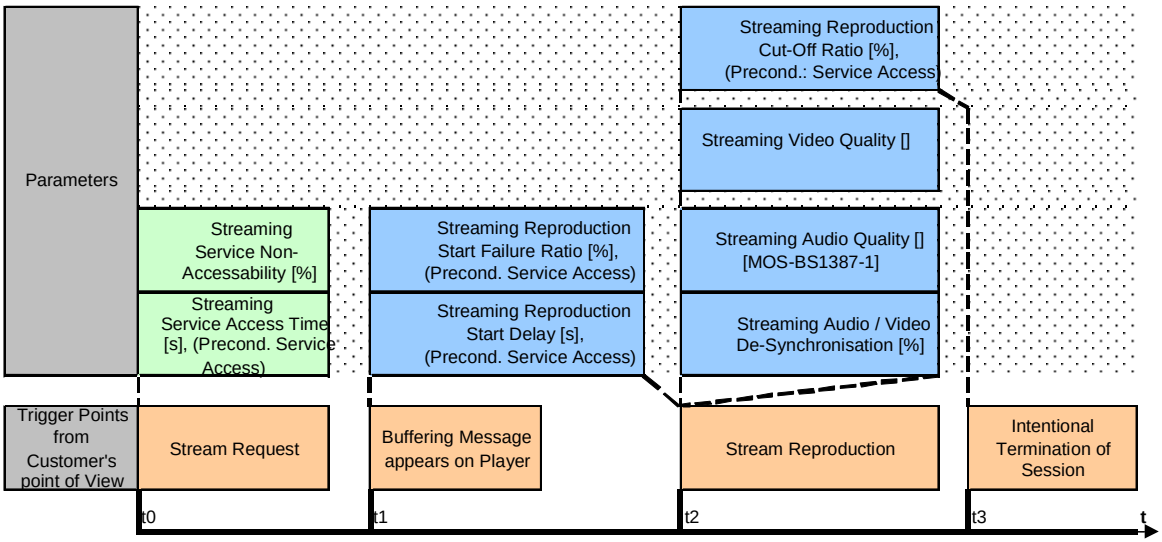

Figure 13: Parameter overview with trigger points

4.8.4 Streaming Service Non-Accessibility [%]

4.8.4.1 Abstract Definition

The parameter Streaming Service Non-Accessibility describes the probability that the first data packet of the stream cannot be received by the UE when requested by the user. The "packet reception" is completed by appearance of the "buffering" message on the player at user side.

The first data packet refers to RTP protocol.

4.8.4.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: Stream request	Start: RTSP: Setup
End: "Buffering" message	Stop: Receipt of first data packet

Abstract formula:

$$\text{Streaming Service Non - Accessibility}\,[\%] = \frac{\text{Number of unsucessful stream request attempts due to first data packet non - receipt}}{\text{Number of total stream request attempts}} \times 100\%$$

4.8.5 Streaming Service Access Time [s]

4.8.5.1 Abstract Definition

The parameter *Streaming Service Access Time* describes the duration of a service access from requesting the stream at the portal until the reception of the first stream data packet at the UE.

The first data packet refers to RTP protocol.

4.8.5.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: Stream request	Start: RTSP: Setup
End: "Buffering" message	Stop: Receipt of first data packet

Abstract Formula:

$$\text{StreamingServiceAccessTime}[s] = [\text{Timeof 1st data packet reception}][s] - [\text{Timeof streamrequest}][s]$$

4.8.6 Streaming Reproduction Cut-off Ratio [%]

4.8.6.1 Abstract Definition

The parameter *Streaming Reproduction Cut-off Ratio* describes the probability that a successfully started stream reproduction is ended by a cause other than the intentional termination by the user.

Causes for Reproduction Cut-off

The following list represents possible causes for session cut-off scenarios:

- radio bearer loss;
- synchronization errors;
- streaming server/system failure/errors;
- protocol errors;
- streaming player failure/errors.

4.8.6.2 Computation

Trigger points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: Appearance of the buffering information (after stream request) on the player screen	Start: Receipt of 1st data packet
End: unintentional stop of stream reproduction	Stop: if RTSP:TEARDOWN method is not received

Some players do not send this TEARDOWN command at the end of the stream but a PAUSE command or in some cases nothing at all. On the server side a logic can then identify the status of the streams/clients.

Used players should send the RTSP:TEARDOWN command in order to give a stable trigger point for measurements.

Abstract equation:

$$\text{Streaming Reproduction Cut - off Ratio}[\%] = \frac{\text{Number of lost media streaming reproductions}}{\text{Number of all media streaming reproductions successfully started}} \times 100\%$$

4.8.7 Streaming Audio Quality

4.8.7.1 Abstract Definition

The parameter Streaming Audio Quality describes the audio quality as perceived by the end-user. Since the streams can contain and not only speech information, an algorithm like PESQ is not suitable for all scenarios.

ITU-R has defined an algorithm defined for audio information. It can be found in [7].

4.8.7.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: Begin of audio stream reproduction	Start: Streaming players signal when the reproduction of the stream starts
End: End of audio stream reproduction	Stop: RTSP: TEARDOWN

4.8.8 Streaming Video Quality

4.8.8.1 Abstract Definition

The parameter *Streaming Video Quality* measures the quality of the video stream.

NOTE 1: Although there exist some evaluation algorithm, there are no validated solutions ready.

NOTE 2: The minimum necessary MOS value also depends on the scenario (e.g. news, movie trailer, sport).

NOTE 3: Video-MOS standardization process in ITU-T started in September 2003.

4.8.8.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: Begin of video stream reproduction	Start: Streaming players signal when the reproduction of the stream starts
End: End of video stream reproduction	Stop: RTSP: TEARDOWN

Abstract Formula:

No validated or standardized algorithm has been selected for the evaluation for video streaming content quality.

4.8.9 Streaming Audio/Video De-Synchronization

4.8.9.1 Abstract Definition

The parameter *Streaming Audio/Video De-Synchronization* describes the percentage of times that time difference of the audio and video signal at the user side exceeds a predefined threshold.

4.8.9.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: Begin of audio stream reproduction	Start: Streaming players signal when the reproduction of the stream starts
End: End of audio stream reproduction	Stop: RTSP: TEARDOWN

Abstract Formula:

No validated or standardized algorithm has been selected for the evaluation for video streaming content quality.

4.8.10 Streaming Reproduction Start Failure Ratio [%]

4.8.10.1 Abstract Definition

The parameter *Streaming Reproduction Start Failure Ratio* describes the probability of unsuccessful stream reproduction.

NOTE: This parameter can be affected:
- by the player;
- by the UE performance.

4.8.10.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: "buffering" message	Start: Receipt of 1st data packet
End: Stream reproduction	Stop: Streaming players signal when the reproduction of the stream starts

Abstract Formula:

$$\text{Streaming Reproduction Start Failure Ratio}[\%] = \frac{\text{No. of reproduction failures}}{\text{No of all successful service accesses}} \times 100\%$$

4.8.11 Streaming Reproduction Start Delay [s]

4.8.11.1 Abstract Definition

The parameter *Streaming Reproduction Delay* describes the duration between the reception at UE of the first stream data packet and the start of the reproduction of the stream on the UE.

NOTE: This parameter can be affected:
- by the player;
- by the UE performance.

4.8.11.2 Computation

Trigger Points:

Trigger Point from customer's point of view	Technical description / protocol part
Begin: "buffering" message	Start: Receipt of 1st data packet
End: Stream reproduction	Stop: Streaming players signal when the reproduction of the stream starts

Abstract Equation:

$$\text{Streaming Reproduction Delay}[s] = [\text{Time of stream reproduction start}][s] - [\text{Time of 1st data packet reception}][s]$$

Annex A (informative): Examples for measuring trigger points

SMS-Service:

Layer 3 Messages:

Start SMS Service Attempt:	generating random access (chan_request SDCCH) at mobile equipment
Successful SMS Service Attempt	receiving cp_data (rp_ack) at mobile equipment
Receiving SMS on Mobile Equipment 2:	receiving cp_data (rp_ack) at mobile equipment

Annex B (informative): Streaming explanations

RTP - Real Time Protocol

The Real Time Protocol is used for the transmission of real-time data, e.g. audio, video, simulation data over multicast or unicast network services. No QoS functionality is implemented.

RTP is designed to be independent from the underlying transport and network layers. For a complete description refer to [8].

RTCP - Real Time Control Protocol

The Real Time Control Protocol as control protocol for the RTP. It allows the monitoring of the data delivery and provides a minimal control and identification functionality. RTCP is designed to be independent from the underlying transport and network layers.

For a complete description of the RTCP refer to [8].

RTSP - Real Time Streaming Protocol

The Real Time Streaming Protocol is used for the overall control of the streaming session.

For a complete description of the RTSP refer to [9].

Most important methods of RTSP:

DESCRIBE:

> The DESCRIBE method retrieves the description of a presentation or media object identified by the request URL from a server. It may use the Accept header to specify the description formats that the client understands. The server responds with a *description* of the requested resource. The DESCRIBE reply-response pair constitutes the media initialization phase of RTSP [9].

SETUP:

> Causes the server to allocate resources for a stream and start an RTSP session [9].

PLAY:

> Play is send from the client to the server and informs the server to start the transmission of data as specified by the SETUP method [9].

PAUSE:

> Send from client to server. Temporarily halts the stream transmission without freeing server resources. These resources can only be freed after a specified time [9].

RECORD:

> This method initiates recording a range of media data according to the presentation description [9].

TEARDOWN:

> Frees resources associated with the stream. The RTSP session ceases to exist on the server [9].

B.1 Streaming Hyperlink Description

The following syntax for the hyperlink is used in order to access streaming content on the server:

protocol://address:port/path/file

Protocol	Used protocol. E.g. rtsp://
Address	Address of the used streaming server
Port	Port used by the server for answering request
Path	Path to the file to be streamed
File	The streaming file to be reproduced and its extension

Annex C (informative): Bibliography

ETSI TS 102 250-5: " Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 5: Definition of typical measurement profiles".

"Internet Media-on-Demand: The Real-Time Streaming Protocol", Schulzrinne, Henning, 2001.

History

Document history		
V1.1.1	October 2003	Publication
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