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Technical Specification

**Speech and multimedia Transmission Quality (STQ);
QoS aspects for popular services in mobile networks;
Part 3: Typical procedures for Quality of Service
measurement equipment**



Reference

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Foreword

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

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

- Part 1: "Assessment of Quality of Service";
- 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: "Network based Quality of Service measurements".

Part 1 builds an umbrella document for this multi-part deliverable. It summarizes the basics of Quality of Service, always seen from the user's perspective. Differences to Quality of Experience (QoE) are also discussed. In extension to generic definitions, specific definitions for this multi-part deliverable are stated here. Furthermore, it gives guidance to assure that QoS assessments can be conducted in a meaningful way and proposes an according process.

Part 2 defines QoS parameters and their computation for popular services in mobile networks. The parameter definition is split into several parts. It contains an abstract definition which gives a generic description of the parameter, an abstract equation and the corresponding user and technical trigger points. The harmonized definitions given in part 2 are considered as prerequisites for the comparison of QoS measurements and measurement results.

The present document describes the measurement procedures needed to perform the measurements of QoS parameters in line with the definitions given in part 2, applying the test profiles defined in part 5.

Part 4 defines the minimum requirements of QoS measurement equipment for mobile 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 performing the proposed measurements in a reliable and reproducible way.

Part 5 specifies typical measurement profiles which are required to enable benchmarking of different mobile networks both within and outside national boundaries.

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

Part 7 describes how Quality of Service measurements should be done inside the network without direct access to the end point terminal.

Introduction

The present document describes the measurement procedures needed to perform the measurements of QoS parameters in line with the definitions given in part 2 [i.5], applying the test profiles defined in part 5 [3].

The aim of standardization of QoS measurements is to ensure that measurements done at different times and with different equipment produce comparable results. To reach this goal, not only computation rules have to be standardized. Since the result of measurements will depend on the way these measurements are performed, well-defined procedure definitions are also required to ensure comparable data.

1 Scope

The present document describes typical procedures used for QoS measurements on mobile communication networks, along with settings and parameters for such measurements.

Where possible, existing ITU-T or ETSI definitions are referenced. In some cases ITU-T or ETSI definitions do not exist or are considered too generic, then a more service and mobile network specific definition is chosen.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] ITU-T Recommendation P.56: "Objective measurement of active speech level".
- [2] 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 criteria".
- [3] ETSI TS 102 250-5: "Speech and multimedia Transmission Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 5: Definition of typical measurement profiles".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] IETF RFC 3501: "Internet message access protocol - version 4rev1".
- [i.2] IETF RFC 2177: "IMAP4 IDLE command".
- [i.3] IETF RFC 2821: "Simple Mail Transfer Protocol".
- [i.4] IETF RFC 1939: "Post Office Protocol - Version 3".
- [i.5] ETSI TS 102 250-2: "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in GSM and 3G networks; Part 2: Definition of Quality of Service parameters and their computation".

3 Definitions and abbreviations

3.1 Definitions

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

A-party: in direct transactions, the party initiating the transaction (calling party)

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

B-party: in direct transactions, the termination or counterpart of a transaction

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

content: entirety of information transferred within a transaction, seen from the user's perspective

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

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

direct transaction: real-time transaction between two entities

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

service family: group of services having main characteristics in common

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

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

transaction: single, complete, typical usage of a particular service

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

NOTE 2: Each type of transaction has parameters. The sum of all parameters describes the transaction completely. A parameter set is assumed to be complete if, under constant outer conditions, all transactions using this parameter set provide the same result.

transaction result: set (list) of possible outcomes for a particular transaction

NOTE: Services belonging to the same service family share the same set of transaction results.

3.2 Abbreviations

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

AOV	Angles Of View
APN	Access Point Name
CS	Circuit Switched
CSD	Circuit Switched Data
DNS	Domain Name Server
DRM	Digital Rights Management
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GW	Gateway
HTTP	Hyper Text Transfer Protocol

IP	Internet Protocol
MEDT	Maximum Expected Delivery Time
MMS	Multimedia Messaging Service
MO	Mobile Originated
MOF	Mobile Originated to Fixed
MOM	Mobile Originated to Mobile
MS	Mobile Station
MT	Mobile Terminated
MTM	Mobile Terminated, originator is also a Mobile unit
MTU	Maximum Transmission Unit
NAT	Network Address Translation
PC	Personal Computer
PDP	Packet Data Protocol
PDU	Packet Data Unit
POP3	Post Office Protocol Version 3
PS	Packet Switched
PSD	Packet Switched Data
QoS	Quality of Service
RTP	Realtime Transport Protocol
S&F	Store and Forward
SDS	Short Data Service
SMS	Short Message Service
SMSC	Short Message Service Centre
TCP/IP	Transmission Control Protocol/Internet Protocol
UDP	User Datagram Protocol
UE	User Equipment
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
WAP	Wireless Access Protocol
WAP	Wireless Application Protocol
XHTML	eXtensible Hyper Text Markup Language

4 Aim of measurement

The aim of measurements described in the present document is to assess the network under test for its Quality of Service (QoS) parameters as defined in TS 102 250-2 [i.5]. This is, to determine the network quality for the respective transactions from the user's view.

5 Classification of services

5.1 Classification guidelines

For the purpose of the present document, services are classified using what is considered to be their dominating property. The first distinction is made between direct and store-and-forward services:

- Direct-transaction services are services where there is - in the user's perception - a direct end-to-end connection.
- Store-and-forward services are services where content is stored in the network and delivered to the recipient at a later point in time.

As a technically usable differentiation, a service is considered to be direct if it is possible to decide on end-to-end content transfer success from the initiating party (A-party) of the connection within the scope of the transaction itself.

NOTE: e-Mail is a special case since it has both aspects of direct and of store and forward services. In the present document, it is, as in part 2 [i.5] of this multi-part deliverable, treated in the clause on store and forward services.

5.2 General structure of service descriptions

In the following, each service family description will contain the following structural elements:

- A general part defining:
 - the basic transaction definition and if applicable, transaction types;
 - a description of the transaction phase combined with a table of parameters governing transaction behaviour in this phase;
 - a description of all possible outcomes of a single transaction;
 - a description of content quality measurement definitions (if applicable).
- In case there are service-dependent differences, a service-dependent part having the same structure as above.

6 General aspects for all types of services

6.1 Set-up and control

Measurements should be conducted in a way that user behaviour is realistically modelled. Parameters and settings which have substantial influence on results need to be under control of the measurement equipment.

The testcase design (configuration and user profile) - to the degree necessary to fully reproduce the test - shall be part of the measurement documentation.

It is assumed that for all types of services under test, a testcase consists of a number of single identical transactions. The measurement equipment and control must ensure that the starting conditions are the same for each transaction. This includes, among other things, that pause times are sufficiently long that the equipment is in a stable (idle) state again. The parameter "guard time" sets a minimum value for the pause between transactions.

It is assumed that all QoS-relevant transaction parameters are recorded for proper post-processing and are kept constant during measurements. If a measurement contains more than one parameter set, evaluation shall be made for each parameter set separately.

6.2 Phase and result classification

In order to ensure common wording, the following clause defines terms and definitions for service measurements.

It is assumed that each transaction can be described at least by one seamless sequence of phases. There may exist several Angles Of View (AOV), each leading to a different phase description.

EXAMPLE: Internet services (as described by its QoS parameters defined in TS 102 250-2 [i.5] model A and B). AOV differ here by different assumptions on start of service usage. Each AOV, however, is a consistent description by seamlessly connected phases.

Phases may be further described having sub-phases.

Pauses between transactions are not explicitly mentioned in this picture, but are relevant with respect to parameter reporting. Typically, there is a minimum pause (guard time) ensuring that the system under test is in a stable starting condition for the next test. Values are technology-dependent.

6.2.1 Phase and result classification for direct services

A direct transaction consists of two top-level phases: service access and service usage.

Table 1: General phase definitions for direct services

Phase	Sub-phase	Definition
Service access		All steps leading to the technical ability to perform actual user-perspective content transport between A- and B-party. Service access may consist of different sub-phases, e.g. Network access, IP service access and Internet access. The availability of these sub-phases actually depends on the particular service.
	Network access	Basic access to the network under test. Successful network access is assumed when the UE is able to do as much basic communication with the network as is necessary to initiate the next phase in the service access procedure.
	IP service access	Basic access to the generic packet-data transfer capabilities the particular service is based upon.
	Internet access	Basic access to those internet services the service is meant to provide.
Service usage		Content transfer between A- and B-party.

A direct transaction may have one of the following overall results.

Table 2: General result classification for direct services

Result	Definition
Failed	Phase of service usage not reached. Successful or failed service access may be broken down into diagnostic sub-categories. The general name-forming rule is: <name of sub-phase>result. Example: Network access failed
Completed	Data-transfer transactions: All content intended to be transferred has been successfully transferred. Conversational transactions: The intended transaction duration has been reached.
Dropped/Cut-off	Service usage was ended before completion.
NOTE:	If a transaction being in the service usage phase is stopped due to some timeout or due to other criteria by the measurement system, e.g. to enhance test rate, this shall be treated as a dropped transaction. This behaviour has to be recorded by the measurement system.

6.2.2 Phase and result classification for store-and-forward services

A store-and-forward transaction consists of two top-level phases: content sending and content delivery.

Table 3: General phase definitions for store-and-forward services

Phase	Sub-phase	Definition
Content sending		All steps required to transfer the content to the network, up to the point where the network is able to start delivery. This phase is completed when there is nothing more the A-party can/needs to do to transfer content to the B-party. It is assumed that the A-party gets information sufficient to judge if sending has been successful or not.
Content delivery		All steps to transfer the content from the network to the B-party. Delivery may consist of two main sub-phases: notification and retrieval .
	Notification (optional)	Information to the B-party that content is ready for transfer.
	Retrieval/Delivery	Transport of content from network to B-party.

A Store-and-forward transaction may have one of the following overall results.

Table 4: General result classification for store-and-forward services

Result	Sub-category	Definition
Completed		Content was successfully transferred from A- to B-party.
Failed		Content was not successfully transferred from A- to B-party. Depending on particular services and available information, there may be a number of possible sub-categories for this result.
	Undelivered	Content was successfully sent to the network, but was never (or: not within a desired period of time, see note) delivered or retrieved.
	Send failed	Content was not successfully delivered to the network.
	Lost	Content was successfully sent to the network, but notification was never received by the B-party. Diagnostic sub-category in case notification can/shall be technically identified within the delivery process.
	Timeout	The transaction was completed, but the content delivery time was above a given threshold.

7 Telephony measurements

This clause deals with telephony services. In general, the term "content" will be used throughout this clause for the information flow exchanged between participating users during a call. Depending on the type of service, content can be audio or audio and video.

7.1 General aspects

7.1.1 Transaction definition and transaction types

The basic transaction for telephony testing is equivalent to a single call to a counterpart extension.

7.1.2 Parameter overview

Table 5: Parameter overview for telephony measurements

Phase	Parameters
Service Access	Call counterpart. This includes the type of equipment (dedicated unit, unique identifier (e.g. called party number), automatic answer with taped message, etc.).
	Call type.
	Time-out value
Service Usage	Call duration.
	Content flow direction: This is an inner parameter for a transaction. Basically, all combinations of uplink/downlink dynamics are possible: <ul style="list-style-type: none"> - Uplink only; - Downlink only; - Conversational (alternating uplink and downlink). This is the recommended standard testing mode. Other testing modes are considered to be used only for special purposes; - "Duplex" (uplink and downlink flow simultaneously).
	Codec settings.
	Algorithm and scale used for speech quality evaluation.
Call clear-down	Guard time.
Pause	Pause duration. For current UEs, a pause time of at least 15 seconds (guard time) is recommended. However, this duration may be adjusted to local conditions or special testing goals, but this must be reported. If the pause duration is too short, side effects may occur, resulting in all kinds of transient effects and distortions in measurement data. It should be made certain that all the QoS parameters to be measured are not affected by the pause time.

The last transaction within a measurement sequence does not require a pause.

7.1.3 Additional transaction result definitions

For call set-up assessment beyond QoS data acquisition, typically a state model driven by suitable trigger-events information combined with information from the call control engine is being used. This state model may also be used to determine timing information for each phase.

Service usability, i.e. presence of a usable two-way connection, shall be verified by a procedure based on content test transmissions within a given time window. If within this time window no connection can be verified, the setup attempt shall be considered as failed and the call attempt be terminated.

A call is active only as long as both sides consider it to be active. A call is therefore considered to be dropped if either side detects a dropped call.

Above definitions lead to the following decision tree for the outcome of a call (Figure 1 includes the end-of-call cases).

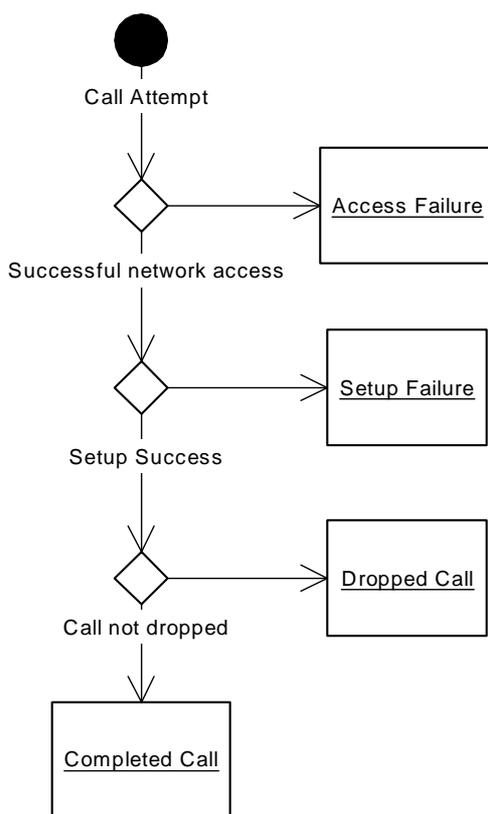


Figure 1: Telephony measurement outcome

7.1.4 Content quality

For content quality assessment, data is generated at the receiving end. For downlink content, data storage is therefore straightforward; quality-assessment data is simply included with other data items making up the result file. For uplink content, at some point in time results from the involved B-parties have to be combined with the data from the originating A-party.

For assessing content quality of complete transmitted speech samples, at least the following methods are possible:

- Real-time assessment (streaming mode), where the quality assessment algorithm continuously outputs the defined quality measures.
- "Offline" assessment, where content is first recorded in some way and later being processed.

Data processing must make sure that only such content quality data is used which lies inside the "connection active" time window and is in line with one of the defined content quality parameters.

7.1.5 Verification of usable two-way connection

Only calls with a valid two-way end-to-end information connection shall be considered for content quality assessment (valid calls).

A non-valid call shall be treated like a dropped call, with a modifier indicating this particular cause.

7.2 Speech telephony

7.2.1 Transaction definition and transaction types for speech telephony

See family definitions.

7.2.2 Parameter overview for speech telephony

See family definitions.

7.2.3 Additional transaction results for speech telephony

See family definitions.

7.2.4 Content quality for speech telephony

See family definitions.

7.2.5 Verification of usable two-way connection for speech telephony

This shall be verified by a procedure based on audio test transmissions within a given time window. If within this time window no audio connection can be verified, the setup attempt shall be considered to be failed and the call attempt be terminated.

NOTE: To make sure an audio connection is valid, it is assumed that an appropriate kind of data analysis on audio flow is performed (see ITU-T Recommendation P.56 [1]).

7.3 Video telephony

7.3.1 Transaction definition and transaction types for video telephony

The basic transaction for video telephony testing is equivalent to a single call to a counterpart extension.

Due to existing usage and hardware, typical video calls will be between UEs, so no further call types are distinguished.

Unlike other services, it is currently assumed that video-call testing will require a high degree of abstraction in the sense that testing-system architectures may differ quite thoroughly from those found in "real connections". At the time of writing, there are no known terminal-based protocol stacks delivering data necessary for testing or QoS assessment. Therefore, it is assumed that PC-based implementations of video protocol stacks will have to be used, where the UE serves only as the modem part of the connection.

It is further assumed that typical tests will use data which serve as load and carry diagnostic data at the same time.

7.3.2 Parameter overview for video telephony

NOTE: Content flow will typically be governed by the video protocol and is assumed to involve simultaneous data flow in both directions.

Table 6: Parameter overview for video telephony measurements

Phase	Parameters
Service access	Connection type (CSD bearer type).
	Video-telephony protocol used.
	Call counterpart technology and architecture. This includes the type of test being made (e.g. "transparent" test of modem connection).
	Time-out value.
Service usage	Call duration.
Call clear-down	Guard time.
Pause	Pause duration.

The last transaction within a measurement sequence does not require a pause.

7.3.3 Additional transaction result definitions for video telephony

It is assumed that the A and B party video-telephony protocol stacks are compatible, and given a usable end-to-end connection of proper type, a video-telephony connection can be established. It is assumed that if the network cannot provide a connection with the required bearer properties, this will either result in failure to provide a usable end-to-end connection, or the video-telephony protocol stack will detect this by indicating connection failure.

It is conceivable that the network provides the wrong bearer type. Due to limited "decision power" determining the usability of an end-to-end connection, this could go undetected at first, but lead to quality deficiencies due to inappropriate bearer properties.

7.3.4 Content quality for video telephony

Currently no stable specification for video quality exists. It is assumed that the audio part of the connection will be tested essentially the same way as for speech telephony.

7.3.5 Verification of usable two-way connection for video telephony

It is assumed that the video telephony protocol being used implicitly checks for useful connection.

7.3.6 Call setup considerations for MTSI calls

When MTSI calls are setup, any Network Address Translation (NAT) devices present in the call path need to be opened. This can be done automatically by the network for managed NATs, or handled by the MTSI clients for unmanaged NATs. The call setup, as seen by the calling party, is assumed to be done when the first valid media packet is received from the called party. This should be interpreted as the first packet containing the negotiated media payload type.

The RTP standard has a number of fixed media payload types, but MTSI uses dynamic payload type assignments, which means that the media payload types are allocated from the range 96 to 127. The relation between the payload type and the actual codec and codec format used is then defined in the SDP during the call setup negotiation.

Thus the client needs to use the information in the SDP and the outcome of the negotiation, to identify which payload type is finally agreed, and use the first reception of that payload type as the end of the call setup phase.

7.4 Group Call

7.4.1 Transaction definition and transaction types for group calls

The basic transaction for group call testing is an extension to an individual telephony speech call with two parties involved (A-party and B-party). One Test UE (A-party) will call n counterparts (B_i -parties) having $1 \leq i \leq n$. The n counterparts are typically Test UEs.

Type is Group Call (GC) and it will not be distinguished between Mobile Originated (MO) and Mobile Terminated (MT).

In principle, two options for a typical measurement scenario are available. Either all group members may be connected to the same common measurement system at one location (not limiting that the measurement system might be in mobility) or each group member is connected to a separate measurement system and these might be distributed at various locations (again not limiting that all or some of the measurement systems might be in mobility).

7.4.2 Parameter overview for group calls

Table 6: Parameter overview for group call measurements

Phase	Parameters
Service Access	Call counterparts (group to call).
	Call type is Group Call.
	Time-out for failed-call condition.
Service Usage	Call duration.
	Content flow direction: Typically only one party can talk at one point in time. A pattern may be specified, which describes, at what point in time a certain party has to talk to the others.
Call clear-down	Guard time.
Pause	Pause duration. Depending on the used radio access technology the duration of required pauses may differ significantly. However, this duration may be adjusted to local conditions or special testing goals, but this must be reported. If the pause duration is too short, side effects may occur, resulting in all kinds of transient effects and distortions in measurement data. It should be made certain that all the QoS parameters to be measured are not affected by the pause time.

The last transaction within a test sequence does not require a pause.

7.4.3 Additional transaction result definitions for group calls

It is assumed that all members of the target group are known by the measurement system(s). All group members are controlled and called exclusively by the measurement system(s).

For quality measurements the following rules apply: As a first measurement option, all parties may talk the same amount of time. The sequence of the talking party shall be A-Party, B_1 -Party, B_2 -Party, ..., B_n -Party. A group call always ends after the B_n -Party finished its last talking period. In this case, $N \times (N+1)$ quality values are measured per group call. A quality value per group call should apply statistical means (e.g. a simple approach would be the arithmetic average) with respect to aggregation and is for further study.

As a second measurement option, only the initiating A-Party will generate a talk burst and the group call is ended after the speech phase of the A-Party. In this case, N quality values are measured per group call.

In both cases, the roles of the participating group members might change, e.g. a former B-Party can cyclically take the role of the initiating A-party whereas the former A-party gets the role of a B-Party.

If a B_i -Party is disconnected during the group call, the quality values of this B_i -Party will be excluded from the overall quality value.

7.4.4 Content quality for group calls

See family definitions.

7.4.5 Verification of usable connection for group calls

The usability of the connection will be tested implicitly by the content quality algorithm.

8 Store-and-forward services measurement

8.1 General aspects

The basic transaction for store-and-forward services testing is equivalent to transmission of a single unit of content (which may, however, contain several parts such as audio, video and text) between two parties.

Typically, content is, in the end-to-end perspective, being sent either from some fixed-network source to a UE (mobile terminated, MT) or from one UE to another (mobile originated to mobile, MOM). However, MOM testing with a two-UE setup may cause additional uncertainty due to coverage and signalling effects in the destination UE.

Basically, there are two recommended methods of testing:

- a) using a destination UE in a fixed location with virtually 100 % transfer probability. Part of the measurement procedure should be cyclical reference checks to assure reception quality respectively to create baseline data; or
- b) using a fixed-network destination such as a Large Account server which is accessed by suitable means from a fixed-network location.

In all cases, testing methodology requires that measurement data are being collected in at least two locations and need to be integrated before the final QoS evaluation can be made.

For practical reasons, measurements are typically limited to a certain time window. Technically it is possible that content being sent in previous test session arrive at the system after the session has been finalized. Technical provisions are needed to ensure proper handling of such content, either by ignoring it or by correctly assigning it in post-processing.

Content used by the measurement system shall carry appropriate signature to identify it as belonging to the measurement, to identify the test session within it was sent, and to enable unambiguous correlation between sent and received content.

8.1.1 Transaction phase and parameter overview

Table 7: Transaction phase and parameter overview for store-and-forward services

Phase	Parameters
Sending	Destination equipment type.
Notification	Time-out for notification.
Retrieval	
Pause	Pause duration.

8.1.2 Additional transaction result definitions

The nature of store and forward services implies that loss rates need precise definition. From the user's point of view, there is expectation that content is delivered within the Maximum Expected Delivery Time (MEDT). Even if technically an outstanding content item may be delivered later, it should be considered lost anyway. This leads, in turn, to the problem of over-aged content items which may disturb subsequent measurements. Suitable means of eliminating such effects should be taken, e.g. if the service allows for it, setting a reasonable lifetime for the content item, and using unique sequence numbering in a way to prevent aforementioned effects.

Post-processing must ensure that, if the measurement system is shut down before a given maximum waiting time has expired, all pending units of content, i.e. those with an age less than MEDT are completely removed from QoS evaluation since there is no way to predict if these elements will arrive within MEDT or not.

The influence of over-aged content should be reduced to a minimum by using a selective retrieval. Only the content delivered within the MEDT should be downloaded when possible.

8.1.3 Content quality for Store-and-Forward Services

For these service types, no family definitions exist. See the respective service-related subsections.

8.2 SMS measurements

8.2.1 General aspects of SMS measurements

There are two modes for SMS transmission:

- text mode;
- PDU mode.

Basically, these modes should be equivalent including options available. In practice, mode support is mobile-dependent.

For each SMS, a "lifetime" can be set after which a SMS is deleted in the SMSC. While in PDU mode, this parameter is part of the parameter structure, in text mode it is set in the mobile, which may not be supported by all mobile types. This leads to the recommendation that PDU mode should be used.

8.2.2 Transaction definitions and transaction types for SMS

The basic transaction for SMS testing is equivalent to transmission of a single SMS.

Typically, user SMS are being sent either from some fixed-network source to a mobile (SMS mobile terminated, SMS-MT), or from one mobile to another (SMS mobile originated, SMS MO, with regard to mobile-based testing). However, uplink SMS testing with a two-mobile setup may cause additional uncertainty due to coverage and signalling effects at the destination UE. Basically, there are two recommended methods of testing:

- using a destination mobile in a fixed location with virtually 100 % transfer probability. Part of the measurement procedure should be cyclical reference checks to assure reception quality respectively to create baseline data; or
- using a fixed-network destination such as a Large Account SMS server which is accessed by suitable means from a fixed-network location.

In all cases, testing methodology requires that measurement data is being collected in at least two locations and needs to be integrated before the final QoS evaluation can be made.

To ensure comparability and statistical validity of transactions, the following outer conditions need to be constant throughout a testcase:

- SMS mode.
- Call counterpart.
- SMSC being used.
- Call timing including behaviour in case of delivery failure to the network.

For reasons of comparability in density, it is required that all SMS sending attempts which form part of the statistics must follow a constant time pattern. Additional SMS sending attempts e.g. in the case of failure of delivery to the network must not affect the pattern of the statistically relevant call attempts.

SMS being sent from either side should contain information enabling validity and integrity checking during evaluation. The recommended minimum set includes:

- signature assuring that only test system SMS are being considered;
- sequence number for SMS delivery timing.

If required, a test SMS may contain additional data (padding) to obtain SMS with a length assumed to be typical for a particular network.

If required, more powerful means of ensuring that only SMS generated by the test system can be added. For example, the SMS may contain a code which is created from checksum content and a seed value delivered by the receiving side. This ensures that even if a static signature is duplicated by operational errors or malfunction of other test systems, the system will be robust against it.

Further for general design of SMS testing, communication between the mobile testing system and its stationary counterpart is required to ensure certain starting conditions:

- Prior to actual testing, the SMS storage of the UE should be cleared to exclude SMS delivery failure due to memory shortage.
- The stationary side should start sending SMS only after a "go" from the mobile side, ensuring that no transient effects occur.

8.2.3 Testing mode for SMS-MT

For this type of testing, SMS are being generated at a constant rate by the stationary side.

All SMS received which have not been generated by the stationary side shall be ignored for quality assessment.

For reception behaviour, two modes exist; it is mobile-dependent which modes are supported.

- On SMS reception, the mobile generates an indication message (CMTI message) on its data connection to the PC. The actual SMS can then be requested by a command.
- The mobile outputs the SMS directly on its data connection to the PC.

From control and trigger point accuracy considerations, mode a) is preferred.

8.2.4 Testing mode for SMS-MO

For this type of testing, SMS are being generated at a constant rate by the mobile side, plus eventual extra SMS in case of failure of delivery to the network.

8.2.5 Transaction phase and parameter overview for SMS

Table 8: Transaction phase and parameter overview for SMS

Phase	Parameters
Sending	Type and Destination equipment type (depends on type, e.g. To Mobile, to Large Account, etc.)
	SMSC used
	Content size
Notification	Time-out for notification
	Notification mode for incoming SMS
Retrieval	
Pause	Pause duration. For current GSM equipment, a pause time of at least 15 s (guard time) is recommended

8.2.6 Possible transaction results for SMS

See family definitions.

8.2.7 Content quality for SMS

It is assumed that the SMS service protect its payload sufficiently so it can be assumed that no distortions in content will occur.

8.3 MMS

8.3.1 General aspects of MMS measurements

With respect to general aspects of store-and-forward systems, in MMS testing special care has to be taken for proper handling of incoming notification SMS not belonging to the active session. They shall be treated as follows:

- Incoming SMS not being a valid push SMS shall be ignored.
- Incoming valid push SMS identified as been sent by the testing system but not belonging to the current test session may be ignored (see general remarks).
- For all other push SMS, it is optional to download the MMS and to check if it belongs to the measurement.

NOTE: If the network under test may modify push SMS content in a way that it cannot be detected if the push SMS belongs to the measurement, ignoring the push SMS contains the risk that a MMS successful from the user's perspective is reported as unsuccessful by the measurement system.

8.3.2 Transaction definitions and transaction types for MMS

The basic transaction for MMS testing is equivalent to transmission of a single MMS, which may however contain several parts such as picture or video, audio and text.

Typically, user MMS are being sent either from a mobile to another mobile (MOM or MTM depending on measurement setup), or from a mobile to a fixed-network location (MOF). In the case of MMS the destination is typically one or more e-mail addresses.

In case a destination mobile is classified by the network as not capable of MMS reception, a "legacy SMS" is transmitted instead. This SMS will contain an information that and how MMS content can be downloaded via internet. The format of such legacy SMS is not standardized.

In mobile-to-mobile scenarios there is always the risk of ambiguity with respect to end to end quality assessment. In the case of store and forward measurements, this is less critical due to the definition of QoS parameters which allow to distinguish uplink and downlink components. Nevertheless, QoS parameters expression end-to-end performance will be affected. Therefore, two methods of testing are recommended:

- a) using a B party mobile in a fixed location with very good network coverage. Part of the measurement procedure should be appropriate cyclical reference checks to obtain baseline data; or
- b) using an e-mail destination.

To ensure comparability and statistical validity of transactions, the following outer conditions need to be constant throughout a testcase:

- MMS content;
- call counterpart;
- MMS Proxy being used;
- send timing including behaviour in case of delivery failure to the network.

For reasons of comparability in density, it is required that all MMS sending attempts which form part of the statistics must follow a constant time pattern. Additional MMS sending attempts e.g. in the case of failure of delivery to the network must not affect the pattern of the statistically relevant call attempts.

MMS being sent from either side should contain information enabling validity and integrity checking during evaluation. The recommended minimum set includes:

- signature assuring that only test system MMS are being considered;
- sequence number for MMS delivery timing.

If required, a test MMS may contain additional data (padding) to obtain content with structure and size assumed to be typical for QoS measurement purposes.

Further for general design of MMS testing, communication between the mobile testing system and its stationary counterpart is required to ensure that prior to actual testing, the MMS and SMS storage of the UE should be cleared to exclude failures due to memory shortage or other limitation.

8.3.3 Transaction phase and parameter overview for MMS

Unlike SMS, posting and retrieving MMS is handled via a network service (WAP) rather than embedded in low-level functionality of the network. Also, uploading or downloading MMS is a process taking considerable time. Therefore, the simple phase scheme - and, consequently, the possible-result definitions, have been extended by inserting subphases.

Table 9: Transaction phase and parameter overview for MMS

Phase	Subphase	Parameters
Sending	Network access	Equipment Types and Capabilities
	MMS gateway access	MMS gateway address (Proxy used)
	Upload	Content composition Content size User Agent String (identification of receiving UE)
Notification		Time-out for notification
Retrieval	Network access	Equipment Type and Capabilities
	MMS gateway access	MMS gateway address (Proxy used)
	Download	
Pause		Time between MMS postings

8.3.4 Additional transaction result definitions for MMS

The following definitions are based on the assumption that, from technical feedback during his service usage, the user notices (and cares about) different ways a MMS transaction can fail. The following definitions are to be seen in conjunction with family result definitions:

- Service access failed: The MMS transaction could not be started due to inability to access the network or the service.
- Dropped while posting: Content could not be uploaded successfully.
- Lost: The content package was successfully uploaded, but the recipient did not get notification within the MEDT.
- Dropped while retrieving: The recipient received a notification, but was unable to retrieve the MMS.

NOTE: Unlike for upload, this includes network or service access failure.

- Completed: Content has been successfully delivered to the B-party (which includes completeness of the package).

8.3.5 Content quality for MMS

In MMS transmission, transcoding may be used by the MMS infrastructure to adapt content from the format of the sending UE to a format supported by the receiving UE. Due to the fact that transcoding is integral part of MMS which is an explicit change of content, no direct comparison of content sent and received is possible.

For the time being, it is assumed that correct transcoding is validated by other means than QoS measurements. Therefore, it is not subject of the present document.

8.4 E-Mail

8.4.1 Transaction definitions for E-Mail

E-mails are sent from one e-mail client to another one via one or more e-mail servers. Both clients can independently use a wireless or wired connection to their respective server.

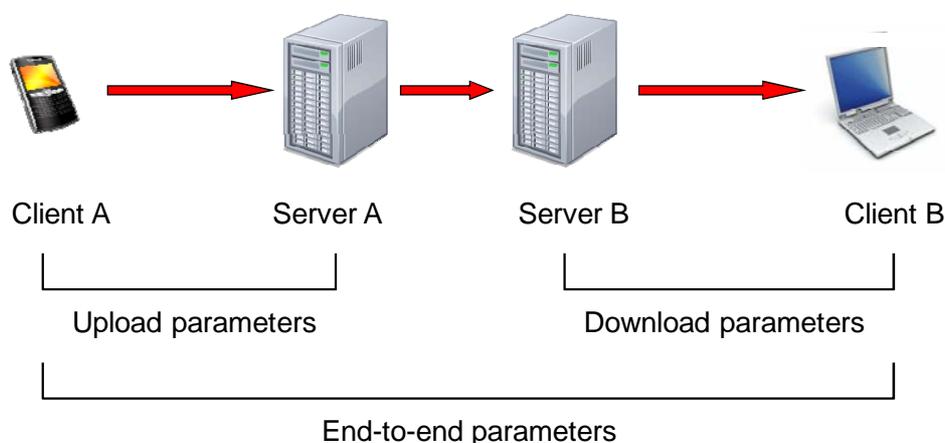


Figure 2

8.4.1.1 Protocols

The following protocols by the present procedure:

- For upload:
 - SMTP (Simple Mail Transfer Protocol), see [i.3].
- For download:
 - IMAP4 (Internet Message Access Protocol, version 4), see [i.1];
 - POP3 (Post Office Protocol, version 3), see [i.4].

NOTE: The POP3 protocol does not follow the store-and-forward approach because it is not capable to push (i.e. forward) e-mails to the receiver side. When using the POP3 protocol the client has to poll the e-mail server for new e-mails.

8.4.1.2 Reference content

An e-mail consists of a header and a body. The body may contain text (e.g. plain text or HTML) or attachments (e.g. archives, music, documents, etc.).

For the download tests it must be assured that the required reference content is present on the server. For upload tests it must be assured that successful upload is not prevented due to storage size limitations.

In addition the measurements should not be influenced by additional (unwanted) or old e-mails. Appropriate measures should be taken (e.g. junk filter, cleanup of e-mail accounts).

Each e-mail uploaded shall have a unique identifier inside the e-mail header for unambiguous identification. Each e-mail downloaded shall have a unique identifier inside the e-mail header and the e-mail body for unambiguous identification. This unique identifier can be used for the aggregation of test results using the same setup (e.g. e-mails of the same size).

Each e-mail uploaded shall have a unique test probe identifier inside the e-mail header to identify the uploading system. This is needed when different systems are uploading e-mails to a commonly used receiving account.

Please refer to Part 5 [3] for more details on the reference content to be used for e-mail testing.

8.4.1.3 Content integrity

After each e-mail transfer it should be checked if the transferred reference content is received completely and is identical to the original data (including attachments).

For e-mail upload additional procedures are necessary to guarantee the integrity of the transferred content.

The measured values of all QoS parameters except for the access related QoS parameters depend on the e-mail content used. Therefore it is only allowed to aggregate test results which used the same e-mail content setup, except for the access-related QoS parameters.

8.4.1.4 Push functionality

Both the client and the server shall support push functionality ("idle" feature) for tests using the IMAP4 protocol. Please refer to [i.2].

8.4.1.5 Header only download

The e-mail client used shall support the feature of downloading only the header of an e-mail contained within the inbox.

8.4.1.6 Timeouts

Every QoS parameter has its own configurable timeout setting which depends on the reference content and the technology used.

Please refer to Part 5 for timeout settings.

8.4.1.7 General requirements and limitations

The used e-mail client should be comparable to popular e-mail clients used by customers in respect of behaviour and performance. The performance of the used server should be comparable to commercially used systems.

The following information shall be logged:

- Type of e-mail client used (including version number, build, maximum number of parallel sockets).
- Authentication mode used.
- In case that a commercial client is used for testing not all of the pauses defined in clause 8.4.2 may be user configurable.

8.4.2 Transaction scenarios for e-mail

The following transaction scenarios are possible to test the service from an end customer perspective:

- 1) Upload scenario;
- 2) Download scenario;
- 3) End-to-end scenario.

The first scenario only considers uploading an e-mail, while the second one only examines the download path. The third scenario tests the complete service chain, from the sending an e-mail by the A-party to the reception of the e-mail by the B-party.

8.4.2.1 Upload scenario

The upload test cycle is defined as follows:

- 1) Connect to the mobile network (set up IP connectivity);
- 2) Configurable pause (default 15 s);
- 3) Login client A to server A;
- 4) Configurable pause (default 15 s);
- 5) Attempt to upload up to e.g. ten e-mails to server A, with a configurable pause (default 15 s) after each upload;
- 6) Disconnect from the mobile network;
- 7) Configurable pause (default 15 s) before starting the next test sequence.

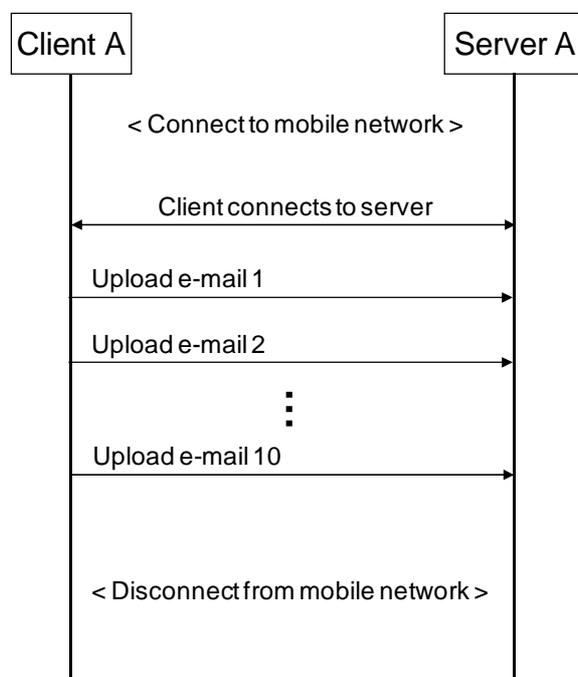


Figure 3

8.4.2.2 Download scenario

The download test cycle is defined as follows:

- 1) Connect to the mobile network (set up IP connectivity);
- 2) Configurable pause (default 15 s);
- 3) Login client A to server A;
- 4) Configurable pause (default 15 s);
- 5) Attempt to download all e.g. ten e-mail header from server A, with a configurable pause (default 15 s) after each download;
- 6) Configurable pause (default 15 s);
- 7) Attempt to download up to e.g. ten e-mails from server A, with a configurable pause (default 15 s) after each download;
- 8) Disconnect from the mobile network;
- 9) Configurable pause (default 15 s) before starting the next test sequence.

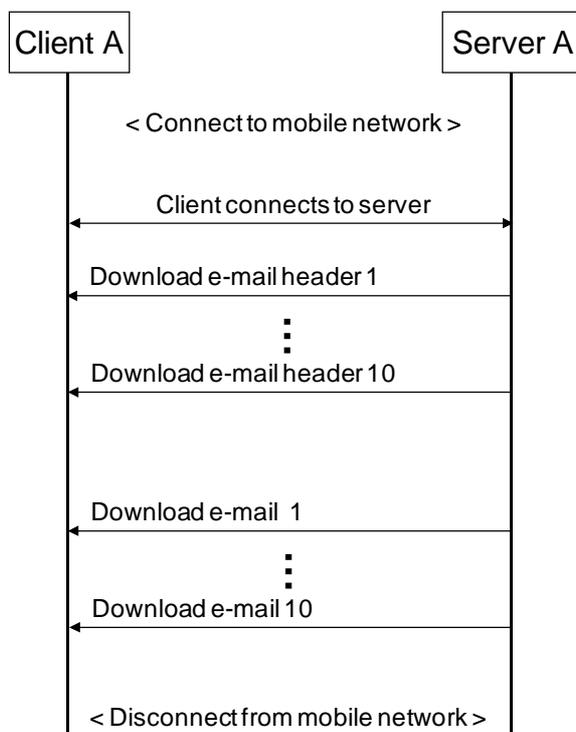


Figure 4

8.4.2.3 End-to-end scenario with IMAP4

For the end-to-end scenario it is necessary to point out the dependency of the measurement of the download parameters from the e-mail upload: Only in case of a successful upload by the A-party will the B-party be able to download the incoming e-mail (either by polling the inbox or after having received a notification from the e-mail server).

The end-to-end test cycle is defined as follows:

Initialisation phase:

- 1) A-party and B-party connect to the mobile network (set up IP connectivity);
- 2) Configurable pause (default 15 s);
- 3) Login client B to server B logs; client B then waits for incoming notifications;

Upload phase:

- 1) Client A connects to server A;
- 2) Configurable pause (default 15 s);
- 3) Upload up to ten e-mails to the server, with a configurable (default 15 s) pause after each upload;
- 4) Disconnect from the mobile network;
- 5) Configurable pause (default 15 s) before starting the next test sequence;

Notification-Phase

This phase runs in parallel to the upload phase.

- 1) Client B is notified of incoming e-mails by server B and initiates the header download.
- 2) Server B notifies client B of a new incoming e-mail;

Download phase:

This phase runs in parallel to the notification phase.

- 1) Attempt to download all notified e-mails;

Disconnect phase:

- 1) A-party and B-party disconnect from the mobile network;
- 2) Configurable pause (default 15 s) before starting the next test sequence.

8.5 SDS

Definitions for SDS are for further study.

9 Data measurements

In the following clauses, data measurements for internet-related services are described. While the process of obtaining a connection is different between circuit-switched and packet-switched access, there are many similarities for the actual data transfer phase.

9.1 Common aspects

9.1.1 Transaction definition and transaction types for data measurements

A transaction consists of access to a server to obtain content which is a closed unit from the user's perspective, e.g. a single downloaded file, or a web-site viewing access which may consist of several single objects which form the desired web page to be viewed.

9.1.2 Server types

The following categories of servers are distinguished, it is assumed that data service access is made to a server or entity within the general internet domain:

- Third-party content in the public internet. We will term this type of counterpart A-Servers.
- Accounts on internet servers which are under control of the testing system or under control of testing personnel (e.g. web domains assigned for testing purposes). This type of counterpart shall be termed B-Servers.
- Special servers not reachable via public internet (e.g. in the GGSN domain), or equipped with additional instrumentation e.g. for IP-level tracing or non-internet capabilities (e.g. UDP testing). This type of counterpart shall be termed C-Servers.

Access to a particular type of server will be termed using the same letter, e.g. A-access for access to an A-server.

It is assumed that A-servers are generally outside the sphere of control of testing systems, in particular, no baseline information for load or other conditions is obtainable. In case of B-servers and C-servers, such control may exist, but will typically be limited in some way due to IP-security reasons, in particular if IP access occurs intra-network.

Typically, when testing internet services, availability may depend on influences other than those under test, and performance will be affected by third-party traffic. Meaningful tests therefore shall contain appropriate measures to exclude such effects from QoS assessment, or make sure that all networks under test are affected the same way. It is assumed that such tests are performed by fixed network units. Suggested methods are:

- Cyclical availability checks on target servers or domains.
- Cyclical access-time tests.

It is assumed that for services where login is required, accounts used by the test system are valid, give positive login, and are good for full access to all activities forming the test.

NOTE: This covers read/write privileges and directory-access rights e.g. for FTP).

User's point of view typically includes assumptions of a time the user is ready to wait before an action is considered to be failed. At the same time, IP service access typically goes with timeout windows at several levels, e.g. for in activity over a certain period of time. Test design must combine these two aspects to a reasonable, technically feasible set of parameters.

9.1.3 Test data content

When using web content (web sites or single pages) for testing, it must be taken into account that such content will typically change frequently (e.g. content of popular web portals) and therefore performance tests may give varying results over time. Test design must ensure that such effects are excluded from QoS assessment. Preferably, standardized and constant web content shall be used.

The degree of control a testing system has further depends on the type of service.

With E-mail and FTP (assuming appropriate access privileges), data content can be determined exactly (e.g. by uploading files to be downloaded as part of subsequent tests).

9.1.4 Transaction phase and parameter overview

9.1.4.1 General

To ensure comparability and statistical validity of transactions, the following outer conditions need to be constant throughout a testcase:

- Access timing including behaviour in case of failure to obtain IP access. For reasons of comparability in density, it is required that all access attempts which form part of the statistics must follow a constant time pattern. Additional attempts e.g. in the case of network or service unavailability must not affect the pattern of the statistically relevant access attempts.

For services using buffering, such as video streaming, there may be the situation that while actual data transfer is already running, the visual appearance is that of still waiting. This period of time shall be considered part of service usage.

Typically, in IP services periods of inactivity can occur with the session still intact. On the other hand, it must be taken into account that a useful PDP context is indicated by the system, which is in fact not useful. Therefore, testing shall include cyclical "lifecheck" measures. A possible method is ICMP pings to the DNS, not if such pings are blocked by the network, DNS accesses with dummy URL. Due to possible URL/IP address storage, it must be assured that actual DNS access takes place.

Independently of the type of access, the following general information elements need to be logged in order to ensure reproducibility and comparability of tests:

- Operating system (type and version).
- MTU size.
- Logical location of server (public internet, GGSN, etc.) with respect to effects possibly created by other traffic.
- Maximum server throughput inbound and outbound, per session response per connection.

9.1.4.2 Packet-switched access

Table 10: Transaction phase and parameter overview for packet-switched access

Phase	Subphase	Parameters
Internet access	Network access	Equipment Types and Capabilities Type of access used (CSD/PSD. UE initialization) APN and other initial settings
	Session access	Access and authentication parameters for basic internet access
	DNS access	DNS (in case of non-automatic DNS assignment during session access procedure)
	Domain access	Target URL, or server IP address Account being used (where appropriate)
Data transfer		Content composition and size
Cleardown		Pause between access attempts

9.1.4.3 Circuit-switched access

Table 11: Transaction phase and parameter overview for circuit-switched access

Phase	Subphase	Parameters
Internet access	Connection set-up	Equipment Types and Capabilities Parameters for dial-up connection
	Session access	Access and authentication parameters for basic internet access
	DNS access	DNS (in case of non-automatic DNS assignment during session access procedure)
	Domain access	Target URL, or server IP address Account being used (where appropriate)
Data transfer		Content composition and size
Cleardown		Pause between access attempts

9.1.5 Possible transaction results

Commonly, a data transaction is termed "session" in contrast to "call" regardless of the type of connection (CS or PS). However, the general result term "dropped" shall be used, leading to "dropped session" for non-completed service usage.

In case of dropped sessions, the testing system shall indicate which of the possible principal causes occurred for the purpose of deciding of the network under test is to be blamed or not:

- Loss of radio connection.
- Loss of basic IP connection. If DNS access is still possible after a session loss, it is assumed that the basic IP connection is still intact.
- Loss of internet access: If access to another domain or server is still possible, it shall be assumed that basic internet services are still available.
- Loss of connection to the server.

For the single phases of internet access (as part of general service access), the following additional definitions are given:

- **Session access:** Access and authentication procedure for basic internet access. Successful access is assumed when a temporary IP address good for data transactions has been assigned to the testing system.
- **DNS access:** Obtaining an IP address from a URL (web site name, server name). Successful DNS access is assumed when an IP address has been obtained from a given, valid URL.
- **Domain access:** This is the actual internet access as seen from the user's perspective. For testing purposes, a successful domain access can be assumed when communication with the target server has been proved. The respective action will depend on the service under test.

9.1.6 Content quality

Content quality relates to the quality as perceived by the user.

9.1.7 Content integrity

Content integrity is correctness and completeness.

Technical precautions should be taken to make sure that the content received is the one expected.

9.2 FTP

9.2.1 Transaction definition and transaction types for FTP

The basic transaction for FTP testing consists of internet access to a FTP server followed by either downloading or uploading a single file of given size.

It is understood that basic access procedures such as server login shall not be considered as part of a transaction.

For download tests, it must be assured that the file to be downloaded is actually available on the server. For upload tests, it must be assured that no storage-size limitations prevent successful upload.

9.2.2 Transaction phase and parameter overview for FTP

Same as family definitions.

In addition, the following parameters shall be logged:

- type of FTP client used;
- protocol used (TCP/IP or UDP);
- type used (active or passive).

9.2.3 Possible transaction results for FTP

Same as family definitions.

9.2.4 Content quality for FTP

Same as family definitions.

9.2.5 Content integrity for FTP

Same as family definitions. It is recommended to use file size and checksum comparison.

9.3 HTTP

9.3.1 Transaction definition and transaction types for HTTP

The basic transaction for HTTP testing consists of internet access followed by downloading a web site for a given URL response of given structure.

9.3.2 Transaction phase and parameter overview for HTTP

Same as family definitions.

In addition, the following parameters shall be logged:

- Type of browser used (including version number/build). For test-system browsers, maximum number of parallel socket connections.
- Reference web site used (structure, size of documents, etc.).

9.3.3 Possible transaction results for HTTP

Same as family definitions.

9.3.4 Content quality for HTTP

Same as family definitions.

9.3.5 Content integrity for HTTP

It is assumed that a typical HTTP downloaded page consists of a main page and a number of sub-elements contained in this page (web elements). Based on the family definition, recommended method for content integrity checking is to verify that the expected main page has been loaded, and to verify the expected number of web elements and their respective type, size and content. (see also the Annex of part 5 [3]).

QoS parameters shall only be compared directly (e.g. in benchmarks) if they are obtained without accelerators (performance enhancement proxies) or with the same accelerator behaviour for all networks involved. In practice, since the exact working of such accelerators is not known, this leads to the requirement that download times shall only be compared directly if such accelerators are not in the chain. Otherwise, when reporting such values the fact that different accelerator operation was in effect and that values are not to be compared shall be explicitly emphasized.

9.4 E-mail

Please refer to clause 8.4, as the procedures described there are usable for direct services as well if notification is disabled on the e-mail server.

9.5 WAP

9.5.1 Transaction definition and transaction types for WAP

The basic transaction for WAP testing consists of WAP access and download of a WAP page.

To guarantee comparability and statistical validity of transactions, the following parameters have to be logged:

- Protocol (WAP1.x or WAP2.0).
- Access-Point (Gateway).
- Type of mobile used / emulated (user-agent string, accept-header).
- Mobile browser (version number, build).
- Depending on the test goal one of the following clauses should be used:
 - A given reference WAP page (static WAP content)
Picture count and text size has to be stable.
 - A static url e.g. main page of the WAP-portal (variable WAP content)
Picture count and text size have to fulfil minimum requirements depending on the url.

NOTE 1: It is required that the WAP page has a size greater than one packet.

- It is required that all WAP session attempts follow a constant time pattern.

NOTE 2: The size of the mobile cache can be neglected, because all tests should be performed with an empty mobile cache.

The mobile specific effects (rendering) are not represented in case of non application level testing.

9.5.2 Transaction phase and parameter overview for WAP

Same as family definitions.

In addition, the following parameters shall be logged:

- Protocol (WAP1.x or WAP2.0).
- Access-Point (Gateway).
- mobile used (user-agent string, accept-header, browser type).
- Structure of the WAP page (size of content, number of pictures, etc.).
- URL of the WAP page.

When measuring the parameter using drive tests or field tests, it is recommended that the following general method should be used.

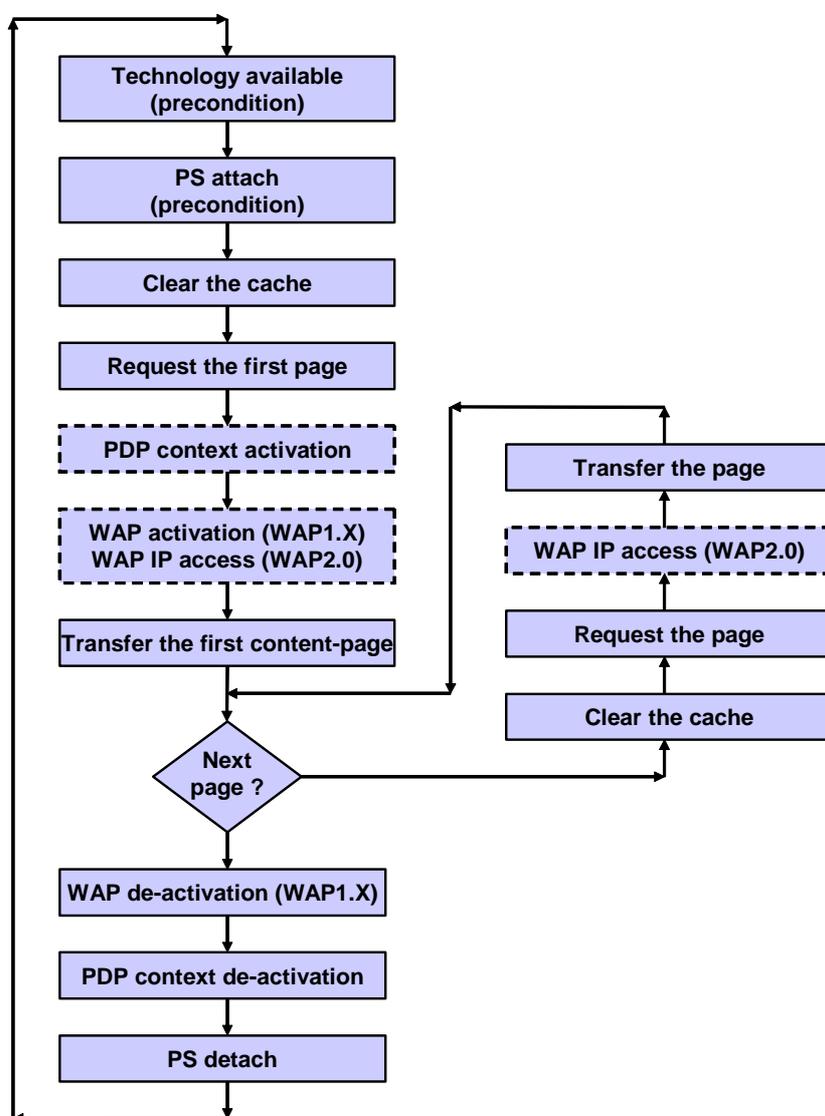


Figure 5

9.5.3 Possible transaction results for WAP

Same as family definitions.

9.5.4 Content quality for WAP

Same as family definitions.

9.5.5 Content integrity for WAP

The following is to verify that the received page is not an "error message" page and that the requested page is downloaded.

It is assumed that a typical WAP downloaded page consists of a main page and a number of sub-elements contained in this page, which may have sub-elements themselves. Based on the family definition, recommended method for content integrity checking is to verify that all elements of the expected main page have been completely loaded.

- In case of testing a given reference WAP page (static WAP content) the whole (known) content should be verified.

In case of testing public WAP pages with variable WAP content it is necessary to define and check the page regarding minimum criteria (e.g. five pictures and text size greater than 150 Byte). For identifying the content of the requested page it is necessary to check static page content (logo, keyword).

9.6 Streaming Video

9.6.1 Transaction definition and transaction types for streaming video

The basic transaction for Streaming Video testing consists of internet access to a Streaming server followed by replay access to a given content from this server.

9.6.2 Transaction phase and parameter overview for streaming video

Same as family definitions.

In addition, the following parameters shall be logged:

- streaming Server and Client versions used;
- OS and relevant configuration of streaming server;
- streaming protocol used.

9.6.3 Possible transaction results for Streaming Video

Same as family definitions.

9.6.4 Content quality for Streaming Video

To be decided.

9.6.5 Content integrity for Streaming video

To be decided.

9.7 Media Download

9.7.1 Transaction definition and types for Media Download

There is a need for content providers and operators to control the usage of downloaded media objects. Download is the means by which a media object is delivered to the UE. Digital Rights Management (DRM) is the means to control the usage of the media object once it has been downloaded.

DRM enables content providers to define rules (rights) for how the media object should be used. It is possible to associate different rights with a single media object. Different rights may have different prices. A content provider can grant a user the rights to preview media objects for free and charge the user only for the full usage rights. Since the value lies in the rights and not in the media object itself, DRM makes it possible to sell the rights to use the media object, rather than selling the media object itself. The rights can be delivered to the consuming UE by downloading them together with the content or by sending the rights object separately from content. The former case (combined delivery) is simpler whereas the latter case (separate delivery) provides more security by making it more difficult to steal the content. However, a complete DRM technology, including strong security between the consumer UEs and content providers is not in the scope of OMA Download. The OMA Digital Rights Management follows common DRM practices taking into account the special requirements and characteristics of the mobile domain in order to support basic functionality with some level of security. This specification defines also a "forward-lock" special case of combined delivery where the DRM message does not contain a rights object. In that case a set of default rights apply for the media object.

9.7.1.1 OMA network elements

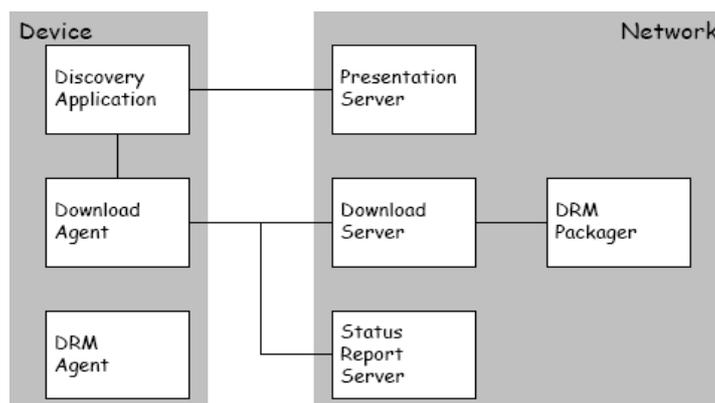


Figure 6

Download descriptor can be located on either the presentation server or the download server.

Discovery application: The user discovers media objects on the Web by using a WAP browser or applications specifically created for one type of media.

Download agent: Launched after the discovery application downloaded the download descriptor and handles the remaining part of the download.

DRM Agent: Handles DRM media objects.

Presentation server: May be a Web or WAP "portal".

Download server: Is responsible for the download transaction, moving the actual media object from the server to the download agent.

Status Report Server: Receives the posted status reports.

DRM packager: Is wrapping media objects into DRM containers and is also responsible for generating the rights.

9.7.1.2 OMA download use cases

9.7.1.2.1 Combined OMA download use case

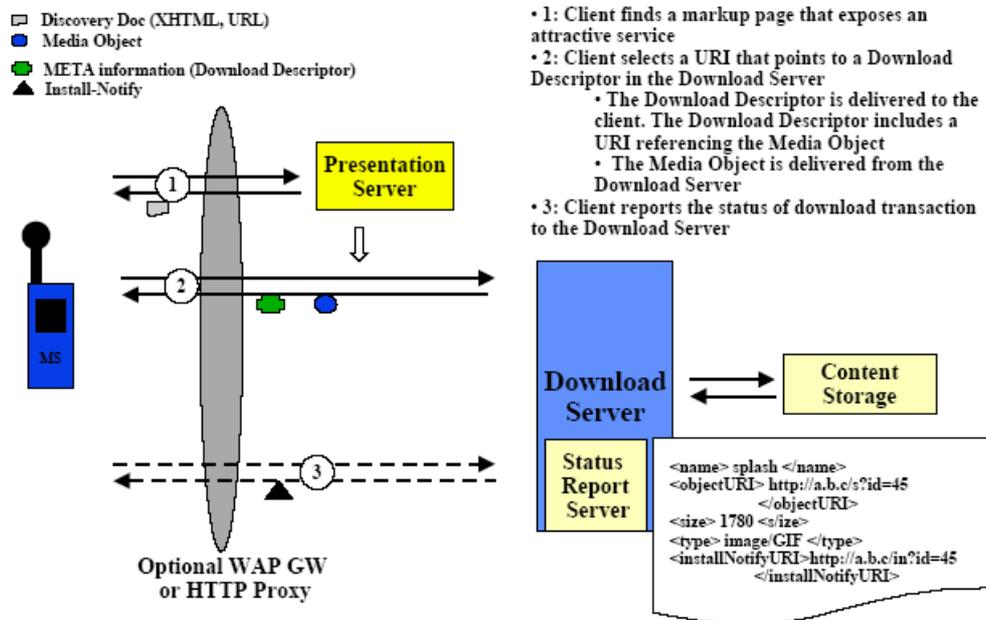


Figure 7

The OMA download use cases extend the basic HTTP download use case by using a download descriptor. In the combined OMA download use case a media object and a download descriptor is downloaded from an HTTP server by using one GET request and response. Because the media object and the download descriptor are both delivered together, the user is unable to confirm the download before the delivery of the media object. Optionally, a status report is posted to a URL specified in the download descriptor.

When this use case starts, the media object and the corresponding download descriptor is packaged into one multipart entity available on an HTTP URL, the URL must also be available on the device to the user (e.g. as a link in a WAP page). When this case ends, if the main scenario is completed, the media object is available on the device.

Main scenario:

- 1) User initiates a GET request to the URL - by selecting a link in a Web page, for example.
- 2) Client sends GET request to the server and waits for a response.
- 3) Server serves up the requested resource, the multipart with the media object and the download descriptor, and sends a GET response back to client.
- 4) Client accepts GET response, with the HTTP headers and the data, from the server.
- 5) The information in the download descriptor is presented to the user.
- 6) If the download descriptor indicates that a status report shall be posted, a status report is posted to the specified URL.
- 7) The media object is made available to the user (e.g. saved on the file system).

9.7.1.2.2 Separate OMA download use case

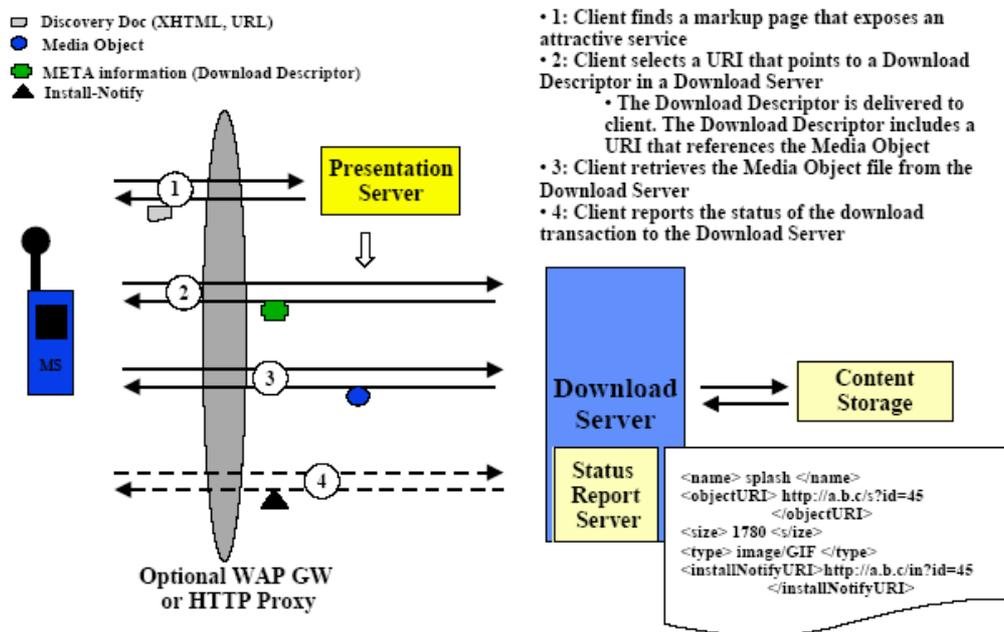


Figure 8

In the Separate OMA download use case a media object and a download descriptor is downloaded from an HTTP server by using two GET request and response. The user is able to confirm the download based on pre-download capability checks in the device, and via a device specific download user interface. Optionally, a status report is posted to a URL specified in the download descriptor.

When this use case starts, the media object and download descriptor are available on two separate HTTP URLs, the download descriptor URL must also be available on the device to the user (e.g. as a link in a WAP page). The media object URL is available on the download descriptor. When this case ends, if the main scenario is completed, the media object is available on the device.

Main scenario:

- 1) User initiates a GET request to the URL - by selecting a link in a Web page, for example.
- 2) Client sends GET request to the server and waits for a response.
- 3) Server serves up the requested resource, the download descriptor, and sends GET response back to client.
- 4) Client accepts GET response, with the HTTP headers and the data, from the server.
- 5) The information in the download descriptor is analysed by the UE (capability checks) and user is given a chance to confirm the download.
- 6) HTTP download is used to deliver the media object.
- 7) If the download descriptor indicates that a status report shall be posted, a status report is posted to the specified URL.
- 8) The media object is made available to the user (e.g. saved on the file system).

9.7.1.3 DRM use cases

9.7.1.3.1 Combined delivery DRM use case

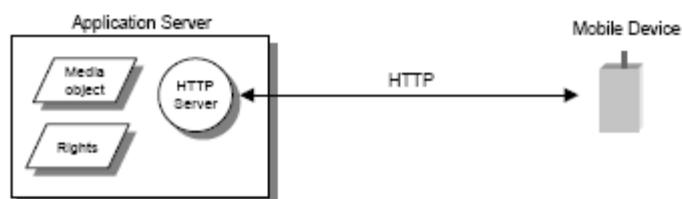


Figure 9

A protected media object, together with the corresponding rights object, is downloaded from an HTTP server. When this case ends, if the main scenario is completed, the media object is available on the UE. It can be used only according to the granted usage rights.

Main scenario: The content provider, using a DRM packager, packages the media object and the rights object into one DRM message. The DRM message is made available to the UE (e.g. by publishing it on a Web page). HTTP Download or OMA Download is used to download the DRM message (media and rights object). The user is using the media object and the DRM agent ensures that it is used according to the rights.

9.7.1.3.2 Separate delivery DRM use case

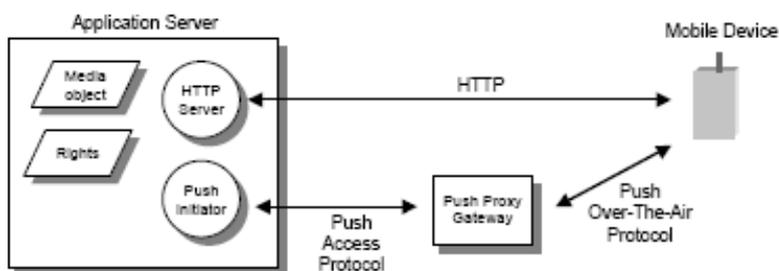


Figure 10

A protected media object is downloaded from an HTTP server. Later, the corresponding rights object is delivered to the UE via WAP Push (e.g. over SMS). When this case ends, if the main scenario is completed, the media object is available on the UE. It can be used only according to the granted usage rights.

Main scenario: The content provider, using a DRM packager, packages the encrypted media object into a DRM content format. The key to decrypt the media object is put into the rights object. The DRM content format URL is made available to the UE (e.g. by publishing it on a Web page). The rights object is not available to the UE. HTTP download or OMA download is used to deliver the DRM content format. The user waits for the rights object to be delivered via a WAP Push message from the content provider. (If OMA download was used, the status report could be used as a "trigger" in the network to push the rights object to the UE, after a successful download of the encrypted media object). The media object is decrypted using the key from the rights. The user is using the media object and the DRM agent ensures that it is used according to the rights.

9.7.2 Transaction phase and parameter overview for Media Download

9.7.2.1 Overview of basic parameters for Media Download

Charts in Figure 11 (taken from [3]) show on which basic parameters the Media Download service sequence is based.

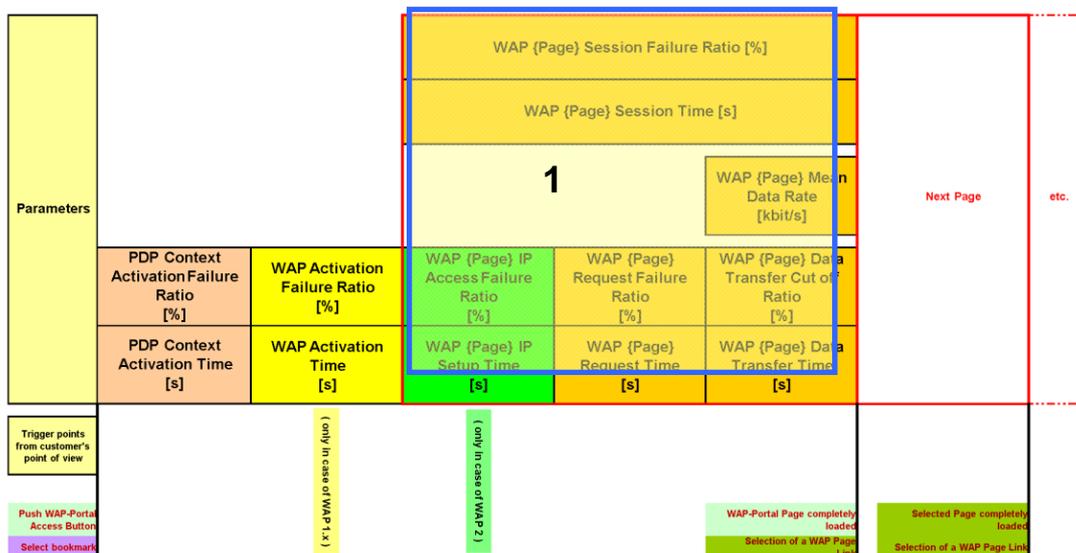
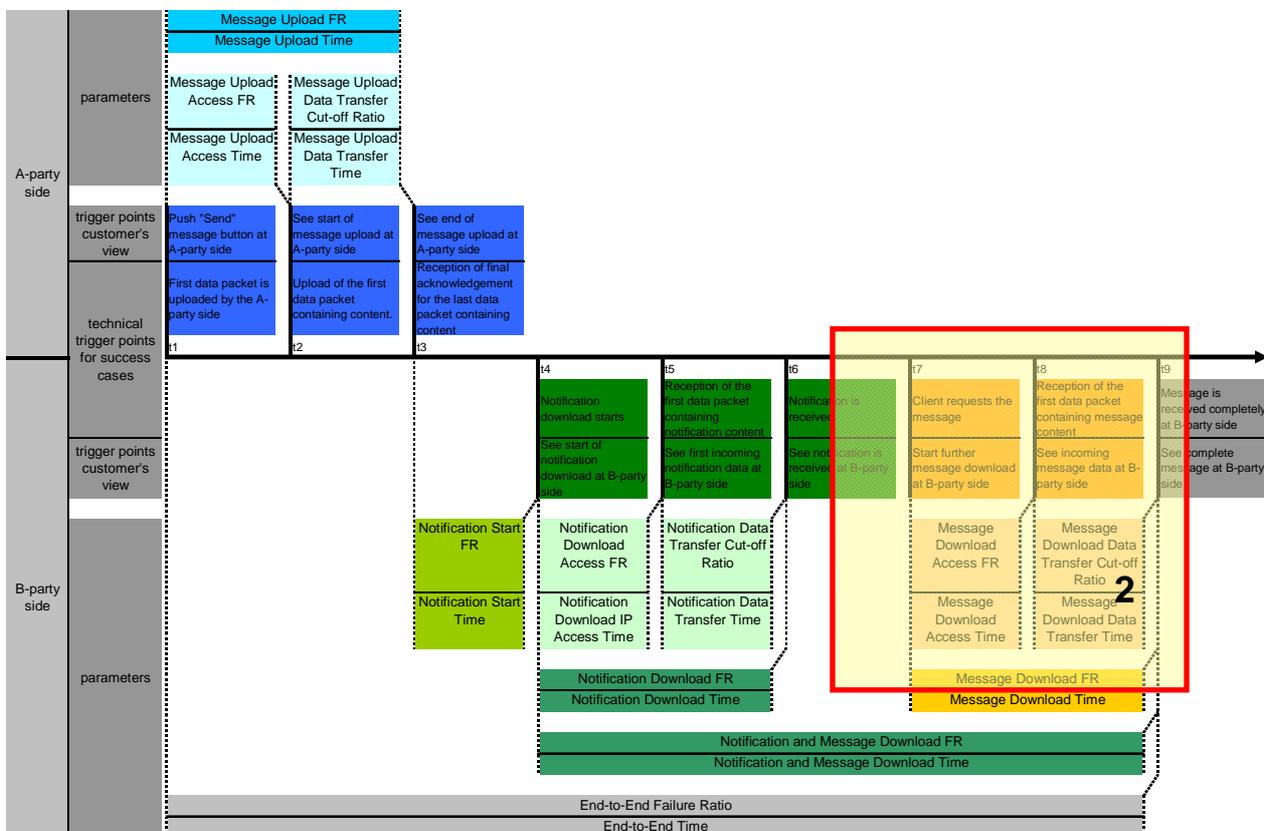


Figure 11

For the download part the marked WAP or equivalent HTTP parameters should be used.



NOTE: FR: Failure Rate

Figure 12

For the DRM separate delivery part, the marked Store and Forward (S&F) parameters should be used.

9.7.2.2 Media Download subphases

The following text boxes are providing subphase specific information about the whole Media Download service sequence. The information includes the basic parameters used and the trigger points they are based on.

A: Purchase Link

Trigger point from user's point of view	Technical description / protocol part
Start: Select download purchase link.	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP
Stop: Payment receipt page is successfully loaded within the specified time limit.	Stop: <ul style="list-style-type: none"> • Same as WAP/HTTP (content: payment receipt page)

B: Download Descriptor

Trigger point from user's point of view	Technical description / protocol part
Start: Appearance of the payment receipt page.	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP (Stop from A)
Stop: Media file data page is successfully loaded.	Stop: <ul style="list-style-type: none"> • Same as WAP/HTTP (content: Download Descriptor)

C: Media Object

Trigger point from user's point of view	Technical description / protocol part
Start: Push download button.	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP (Stop from B)
Stop: Media File download is completed.	Stop: <ul style="list-style-type: none"> • Same as WAP/HTTP (content: Media Object)

D: Media and DRM Object

Trigger point from user's point of view	Technical description / protocol part
Start: Push download button.	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP (Stop from B)
Stop: Media file download is completed.	Stop: <ul style="list-style-type: none"> • Same as WAP/HTTP (content: Media and DRM Object)

E: Media Object and Download Descriptor

Trigger point from user's point of view	Technical description / protocol part
Start: Appearance of the payment receipt page	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP (Stop from A)
Stop: Media file download is completed	Stop: <ul style="list-style-type: none"> • Same as WAP/HTTP (content: Media Object and Download Descriptor)

F: Media and DRM Object and Download Descriptor

Trigger point from user's point of view	Technical description / protocol part
Start: Appearance of the payment receipt page	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP (Stop from A)
Stop: Media file download is completed.	Stop: <ul style="list-style-type: none"> • Same as WAP/HTTP (content: Media and DRM Object and Download Descriptor)

G: Install Notify

Trigger point from user's point of view	Technical description / protocol part
Start: Push save or install button if content is not saved automatically.	Start: <ul style="list-style-type: none"> • Same as WAP/HTTP (Stop from C,D,E or F)
Stop: Downloaded file is successfully saved or installed within the specified time limit.	Stop: <ul style="list-style-type: none"> • Sending of the Install Notify message

H: DRM Object

Trigger point from user's point of view	Technical description / protocol part
Start: Downloaded file is successfully saved or installed within the specified time limit.	Start: <ul style="list-style-type: none"> • Sending of the Install Notify (Stop from G)
Stop: DRM Message is received	Stop: <ul style="list-style-type: none"> • Same as Store and Forward

9.7.2.3 Combined OMA download and combined delivery DRM use case

The following overview chart illustrates the minimum combination of subphases for a Media Download service sequence in case of combined OMA download and combined delivery DRM use case.

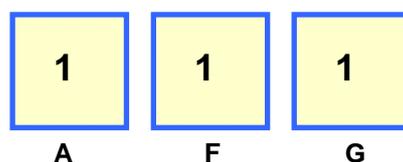


Figure 13

9.7.2.4 Separate OMA download and combined delivery DRM use case

The following overview chart illustrates the minimum combination of subphases for a Media Download service sequence in case of separate OMA download and combined delivery DRM use case.

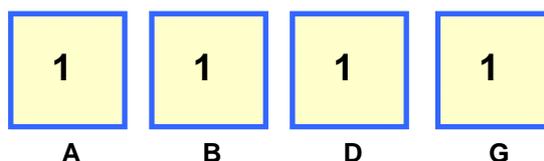


Figure 14

9.7.2.5 Combined OMA download and separate delivery DRM use case

The following overview chart illustrates the minimum combination of subphases for a Media Download service sequence in case of combined OMA download and separate delivery DRM use case.

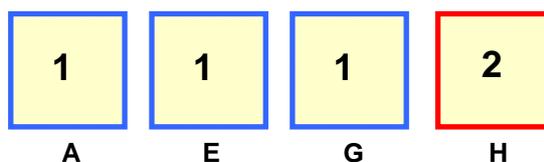


Figure 15

9.7.2.6 Separate OMA download and separate delivery DRM use case

The following overview chart illustrates the minimum combination of subphases for a Media Download service sequence in case of Separate OMA download and separate delivery DRM use case.

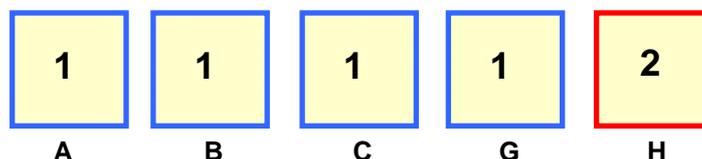


Figure 16

9.7.2.7 Additional information about parameters for Media Download

Same as family definitions (WAP/HTTP/Store and Forward).

Media Download Session Time as sum over all subphase times (whole sequence/session was successful).

Media Download Session Failure Ratio over all subphases.

In addition, the following information should be logged:

- Use case information.
- Media object information: Artist, title, format and size.

9.7.2.8 Recommended Testing Method for Media Download

NOTE: Frequently usage of public content can take influence on official chart rankings. Purchase of an already purchased song can change the service sequence.

Test objects for Media Download should not be reported to chart ranking agencies and billed with real costs. They should be endlessly purchasable without impact on service sequence.

When measuring the parameters using drive tests or field tests, it is recommended that for example the general WAP method should be used. In case of separate delivery DRM use case the SMS memory should be erased before sequence start and checked at the end of service sequence.

9.7.3 Possible transaction results for Media Download

Same as family definitions (WAP/HTTP/Store and Forward).

Media Download Session Time as sum over all subphase times (when whole sequence/session was successful).

Media Download Session Failure Ratio over all subphases.

9.7.4 Content quality for Media Download

Same as family definitions (WAP/HTTP/Store and Forward).

NOTE: On application layer the content quality for Media Download could be evaluated by playback of downloaded media.

9.7.5 Content integrity for Media Download

Same as family definitions (WAP/HTTP/Store and Forward).

NOTE: On application layer the content integrity for Media Download could be evaluated by playback of downloaded media.

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