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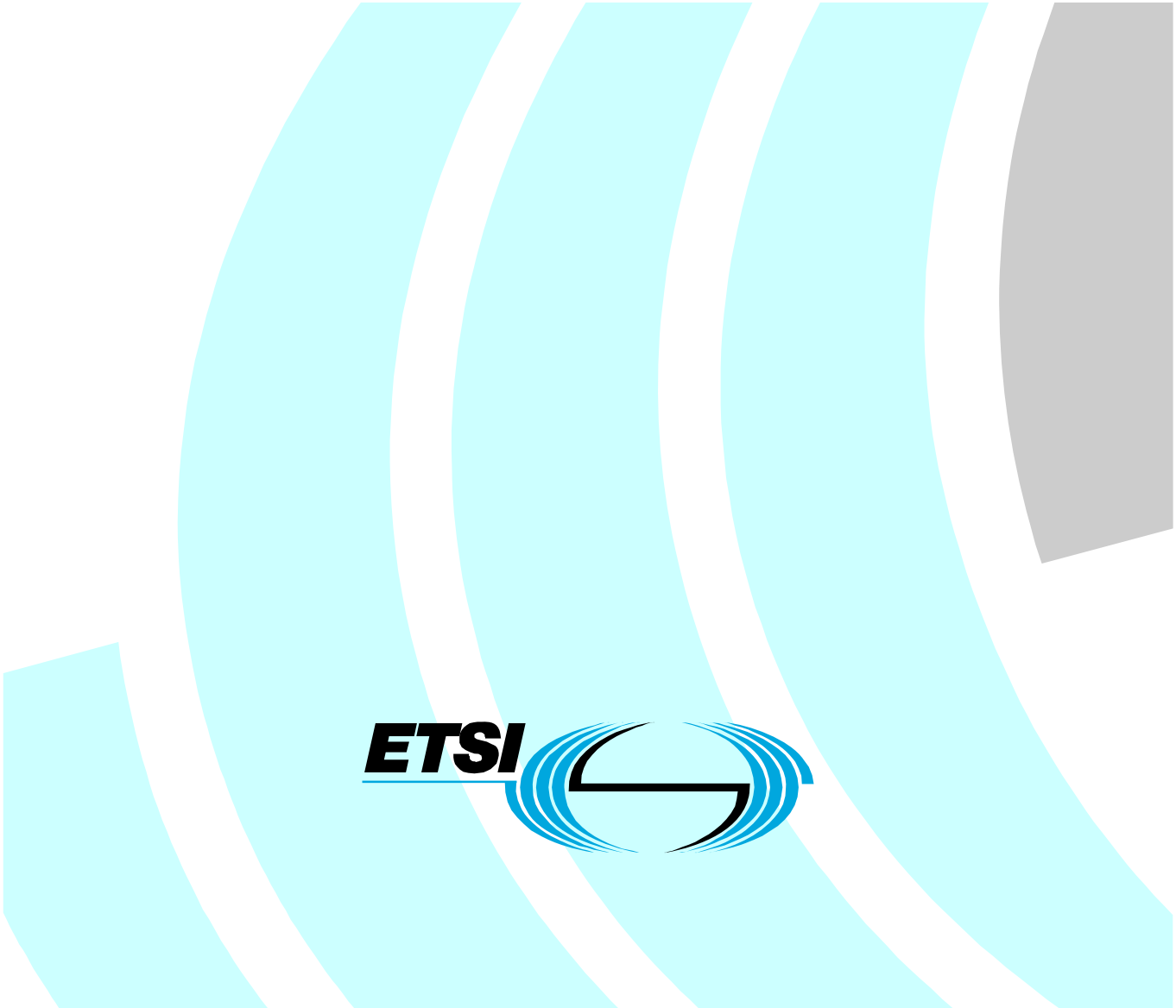
Technical Report

**Speech and multimedia Transmission Quality (STQ);
QoS Parameter Measurements
based on fixed Data Transfer Times**



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Contents

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Foreword

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

Introduction

The present document defines QoS parameters and the corresponding measurement and evaluation procedures as a supplement to the ones defined in TS 102 250-2 [i.1].

For the QoS parameters proposed in this document the term Fixed Data Transfer Time QoS (FDTT-QoS) parameters is used.

The main purpose of proposing the concept of FDTT-QoS parameters is to fulfil the common request for many QoS measurements to have a limited and regular run time for individual measurement tasks. Due to the wide range of uplink and downlink throughput in modern mobile communication networks, limited and regular run times cannot be provided when having e.g. fixed object (file) sizes for the measurements.

Limited runtime is required to ensure that all measurement tasks are finished before the data window ends, where the term data window is used to define the time period from the start of one data session (containing one or several measurement tasks) to the start of the next data session and the time duration of the data window is set to a constant value. For example a data session consists of 3 measurement tasks - FTP DL, FTP UL and HTTP. Limited time for each task (e.g. 30 s) ensures, that the data session will be completed in 3 × 30 s and all tasks (FTP DL, FTP UL and HTTP) will be performed.

Regular run time is required to ensure that a minimum percentage of the data window is used for measurements.

This document describes how the requirement of regular and limited runtime can be achieved by using these FDTT-QoS parameters for data measurements, especially for FTP and HTTP data transfers.

Advantages of the FDTT-QoS parameters and measurement method:

- Low variation between minimum and maximum measurement time. This is important if measurements are done in regular intervals.
- Required measurement time for slow connections is reduced while maintaining the accuracy for high speed connections.
- Better distribution of measurements in drive tests. Using FDTT-QoS measurements, the same number of tasks or job executions per time interval can be achieved regardless of the network access technology.
- Better resource utilization. To determine the throughput a certain time is required as several processes in the network are time dependent. Thus, a time based measurement concept for throughput measurements has the advantage of providing reliable measurement values for fast connections while not wasting network capacity for slow connections.

List of QoS parameters from TS 102 250-2 [i.1] for which supplement definitions in terms of FDTT-QoS parameters are provided within this document:

- FTP {Download|Upload} Mean Data Rate [kbit/s];
- FTP {Download|Upload} Data Transfer Cut-Off Ratio [%];
- HTTP Mean Data Rate [kbit/s];
- HTTP Data Transfer Cut-Off Ratio [%].

1 Scope

The present document defines QoS parameters and the corresponding measurement and evaluation procedures as a supplement to the ones defined in TS 102 250-2 [i.1].

This document discusses the concept of Fixed Data Transfer Time QoS (FDTT-QoS) parameters, their methods and validity rules and describes how the requirement of regular and limited runtime can be achieved by using the FDTT-QoS parameters for data measurements, especially for FTP and HTTP data transfers.

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.

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

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

2.1 Normative references

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

Not applicable.

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] ETSI TS 102 250-2: "Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 2: Definition of Quality of Service parameters and their computation".

[i.2] ETSI TS 102 250-5: "Speech and multimedia Transmission Quality Aspects (STQ); QoS aspects for popular services in mobile networks; Part 5: Definition of typical measurement profiles".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the ETSI Directives and the following apply:

Fixed Data Transfer Time QoS (FDTT-QoS) parameters: QoS parameters which are defined as supplement to selected QoS parameters from TS 102 250-2 [i.1] related to FTP and HTTP

NOTE: Under special circumstances FDTT-QoS parameters have some benefits compared to QoS from TS 102 250-2 [i.1].

3.2 Symbols

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

Δt_d	Predefined, fixed period of time used for data transfer measurement in the FDTT-QoS concept

3.3 Abbreviations

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

FDTT-QoS	Fixed Data Transfer Time QoS
FTP DL	File Transfer Protocol - Downlink Direction
FTP UL	File Transfer Protocol - Uplink Direction
FTP	File Transfer Protocol
HTTP	Hyper Text Transfer Protocol
QoS	Quality of Service
RAT	Radio Access Channel
TCP	Transmission Control Protocol

4 FDTT-QoS General Concept

4.1 Concept of FDTT-QoS

The concept of the FDTT-QoS family performance indicators is based on measurements of the performance for a predefined time period (Δt_d) instead of measurements with defined objects (measurement files)

EXAMPLE: For the measurements of FTP DL not a file with a defined size is used but the duration for downloading data via FTP is defined. After reaching the end of the transfer period (Δt_d elapsed), the amount of transferred data and the average throughput is calculated.

- The family of FDTT-QoS parameters is defined for FTP DL, FTP UL and HTTP.
- The end of the measurement is defined by reaching the end of the transfer period Δt_d.
- Throughput is calculated as the total number of bytes received at the application level (FTP or HTTP level) during the time interval Δt_d.
- For FTP measurements, files should be used with a size big enough not to be completely downloaded/uploaded before reaching the end of the transfer period Δt_d.
- For HTTP measurements a measurement web page (e.g. Copernicus) should be downloaded repeatedly until the end of the transfer period Δt_d is reached or alternatively, a file should be downloaded with a size big enough not to be completely downloaded before reaching the end of the transfer period Δt_d.
- With respect to HTTP measurements, the specification given in TS 102 250-5 [i.2] should be taken into account.
- It is recommended to set Δt_d to a value appropriate for the purpose of the measurement, e.g. to take into consideration the influence of TCP slow start mechanism.
- When the end of the transfer period Δt_d is reached the connection should be ended gracefully, e.g. using a close command on socket level producing TCP message FIN.
- The connection should be checked to be still alive at the end of the transfer period Δt_d. The reception of any data packet sent by the server on the data connection after the end of the transfer period is a valid indicator that the data connection is still alive. An appropriate timeout of e.g. 3 to 5 multiples of typical RTT in the measured network might be used while waiting for the desired packet.

- When the desired packet has been received or the timeout occurred, the connection should be ended gracefully by using a close command on socket level producing TCP message FIN.
- A successfully terminated data transfer is considered as a data transfer which is ended within the connection which is checked as alive at the end of the transfer period Δt_d.
- A measurement task where the connection is not alive at the end of the transfer period Δt_d should not be used for calculating of data transfer rate statistics.

For different types of services (FTP DL, FTP UL and HTTP) the start triggers for data transfer are adopted from TS 102 250-2 [i.1]. However, the amount of transferred data is counted only until the predefined time period Δt_d has elapsed since the respective start event. A QoS parameter (download or upload throughput) is then calculated as this amount of data (received or sent on application level) divided by the time period Δt_d.

Diagrams for FTP DL, FTP UL and HTTP are shown within clauses 4.2.1 to 4.2.3.

4.2 Event diagrams

4.2.1 Diagram of Events for FTP download, active mode

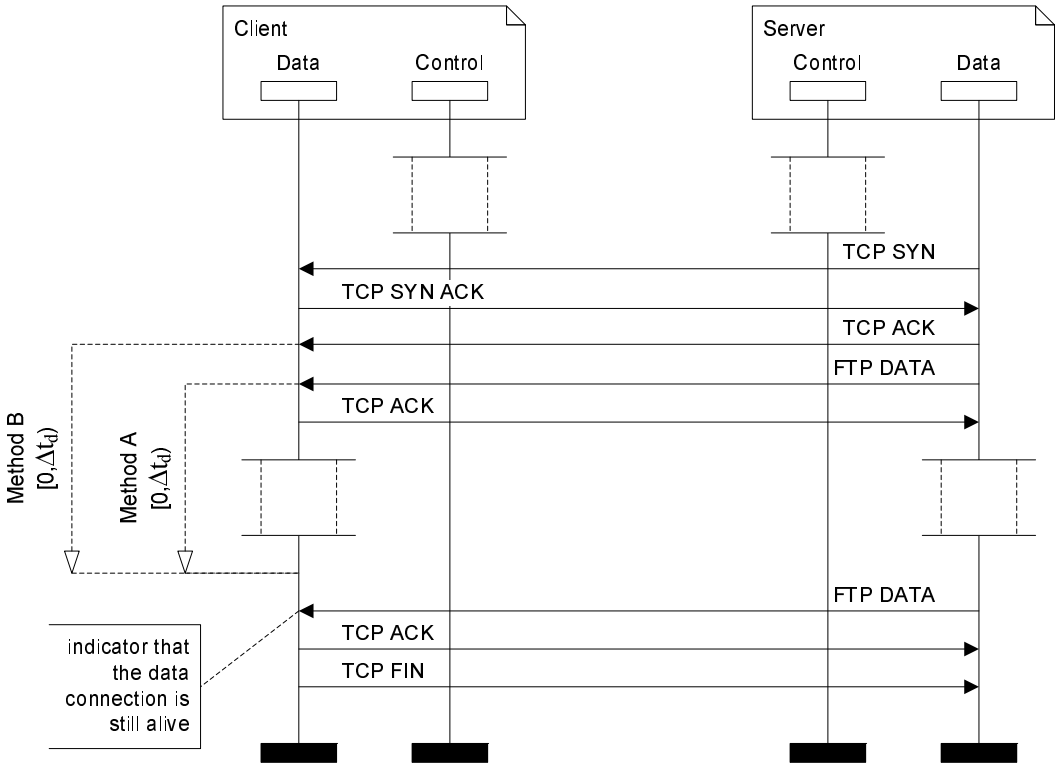

Figure 1: Diagram of Events for FTP download, active mode, includes both Data transfer start methods A and B

4.2.2 Diagram of Events for FTP download, passive mode

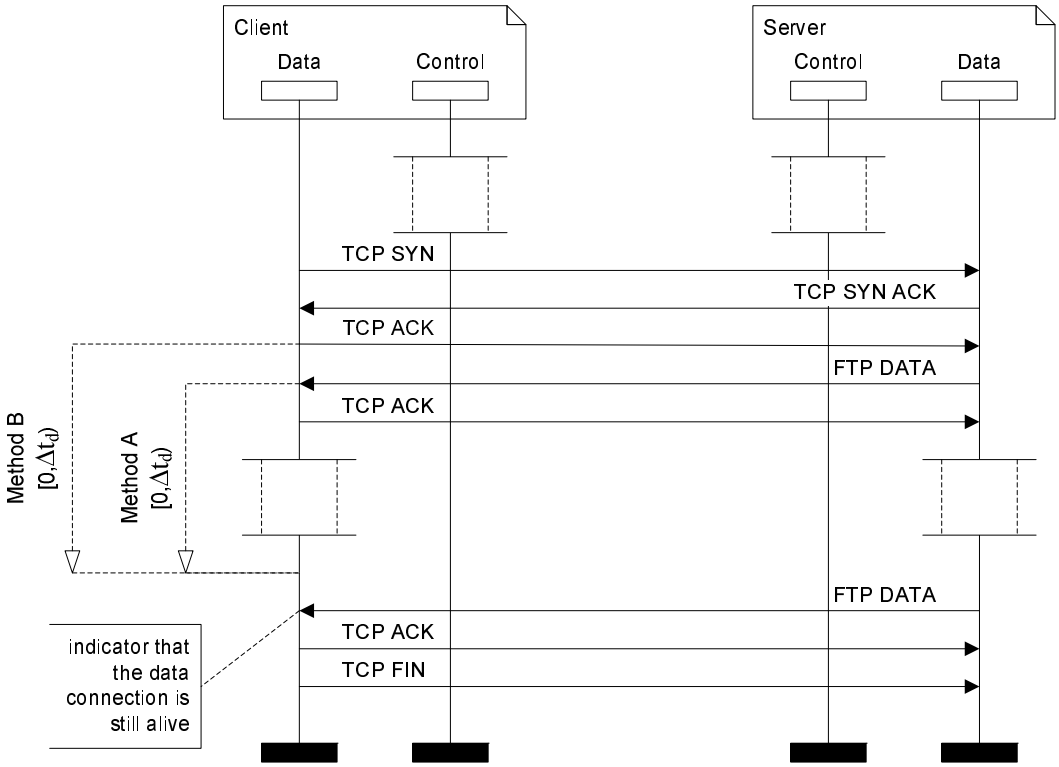

Figure 2: Diagram of Events for FTP download, passive mode, includes both Data transfer start methods A and B

4.2.3 Diagram of Events for FTP upload, active mode

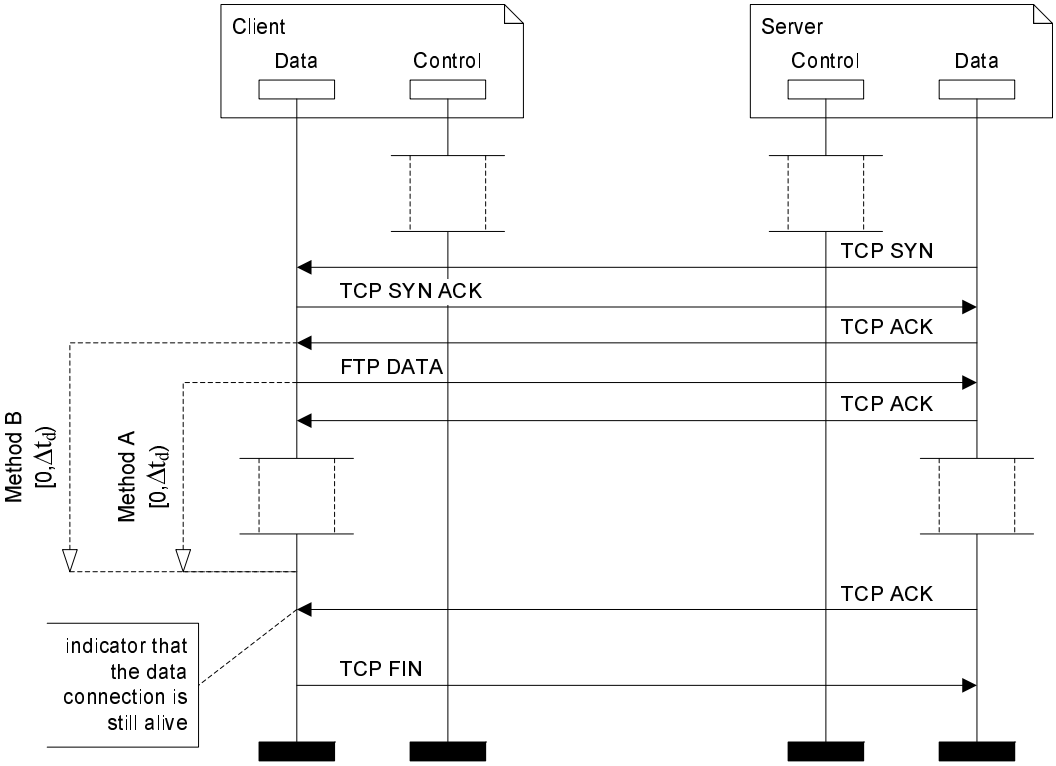

Figure 3: Diagram of Events for FTP upload, active mode, includes both Data transfer start methods A and B

4.2.4 Diagram of Events for FTP upload, passive mode

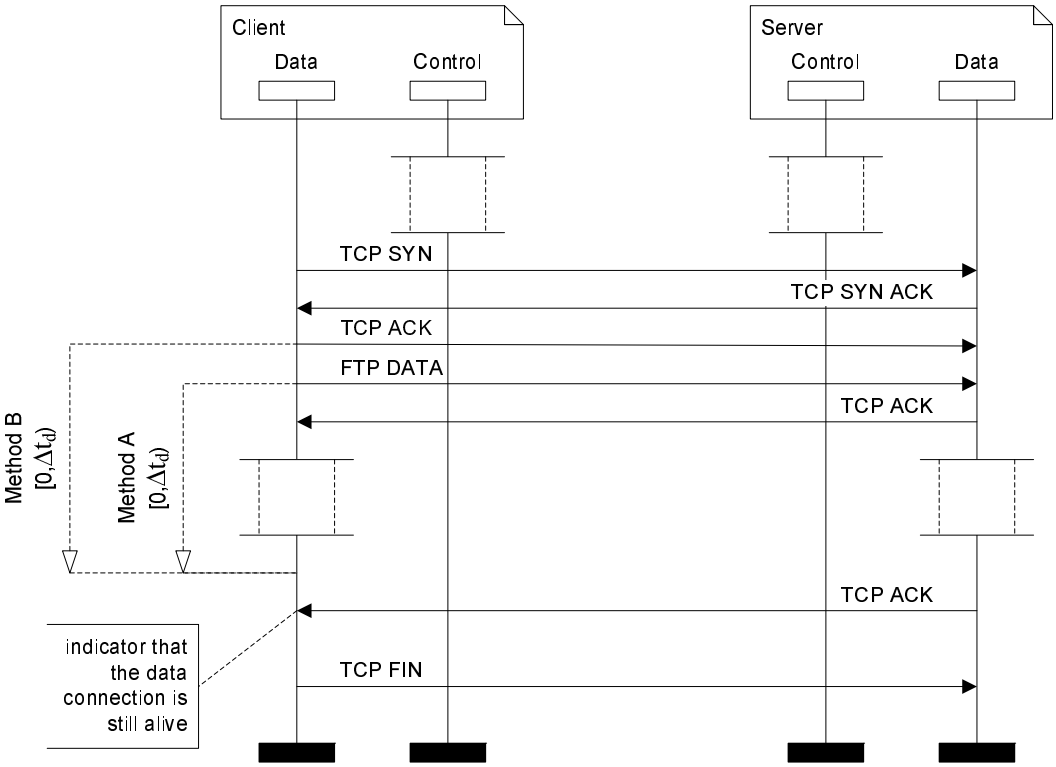

Figure 4: Diagram of Events for FTP upload, passive mode, includes both Data transfer start methods A and B

4.2.5 Diagram of Events for HTTP download

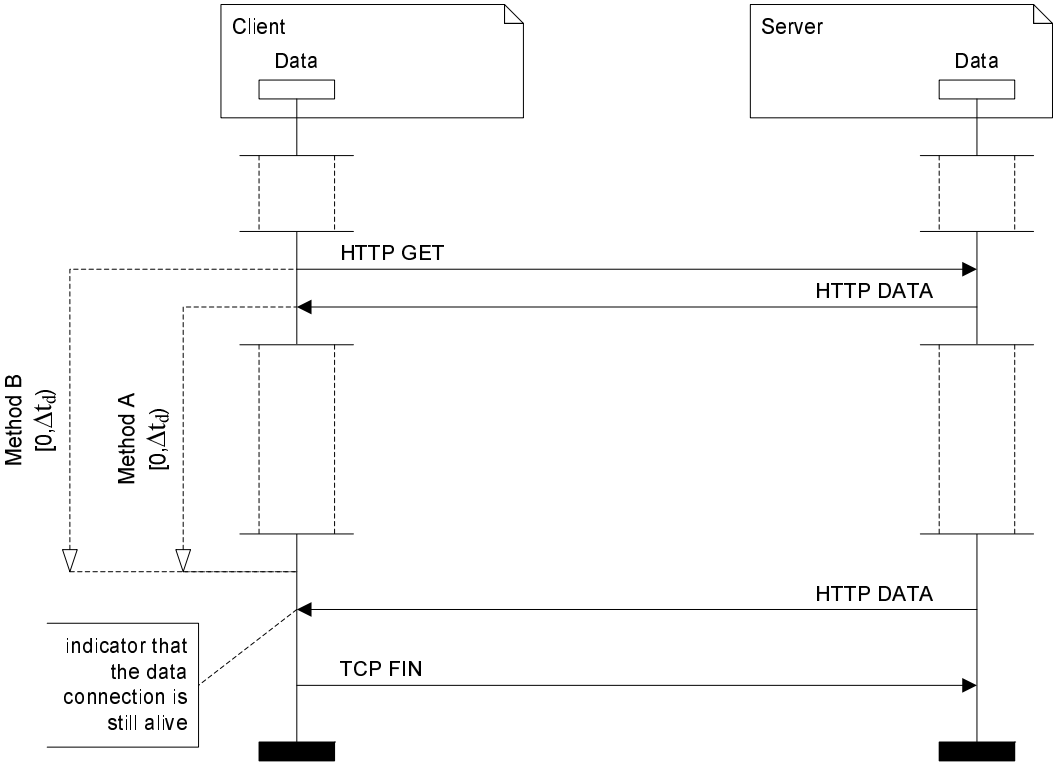

Figure 5: Diagram of Events for HTTP download, includes both Data transfer start methods A and B

4.3 Usage recommendation

It is recommended to use FDTT-QoS instead of normal QoS parameters in case there is expected a large variance of measured parameter values (e.g. FTP throughput) which therefore would result in a large variance in duration of the single measurement task. Therefore, it is recommended to use FDTT-QoS when it is required to measure a defined number of tasks within a predefined fixed time interval. Especially, it is recommended to use FDTT-QoS in case of drive tests for benchmarking several different operators' networks when it is required to combine measured results out of different RAT areas in a correct and fair way.

4.4 Relation to QoS parameters

In table 1 the mapping between the 'QoS parameters' as defined in TS 102 250-2 [i.1] and the 'FDTT-QoS parameters' as defined in the present document is given.

Table 1

QoS parameter name in TS 102 250-2 [i.1]	FDTT-QoS parameter name
FTP {Download|Upload} Mean Data Rate [kbit/s]	FDTT-QoS FTP {Download|Upload} Mean Data Rate [kbit/s]
FTP {Download|Upload} Data Transfer Cut-off Ratio [%]	FDTT-QoS FTP {Download|Upload} Data Transfer Non-Stability [%]
HTTP Mean Data Rate [kbit/s]	FDTT-QoS HTTP Mean Data Rate [kbit/s]
HTTP Data Transfer Cut-off Ratio [%]	FDTT-QoS HTTP Data Transfer Non-Stability [%]

5 Direct Services QoS Parameters

5.1 File Transfer (FTP)

5.1.1 FDTT-QoS FTP {Download|Upload} Mean Data Rate [kbit/s]

5.1.1.1 Abstract Definition

This parameter describes the average data transfer rate measured over a predefined time interval Δt_d starting when the data link has been established successfully (start methods A and B). The connection has to be alive at the end of the measurement interval. The prerequisite for this parameter is network and service access.

5.1.1.2 Abstract Equation

$$\text{FDTT - QoS FTP \{Download | Upload\} Mean Data Rate [kbit/s]} = \frac{\text{user data transferred between 'Data transfer start' and 'Data measurement end' [kbit]}}{\Delta t_d \text{ [s]}}$$

5.1.1.3 Trigger Points

The average throughput is measured over the time interval Δt_d starting from the successful establishment of the data connection.

Download:

Event from abstract equation	Trigger point from customer's point of view	Technical description/protocol part
"Datatransfer start": data transfer started successfully.	Start: File download starts.	Start Method A: Reception of the first data packet containing content. Start Method B: Reception of the [ACK] from the [SYN, ACK] for active mode connections, sending of the [ACK] for the [SYN, ACK] for passive mode connections on the data socket.
"Data measurement end": end of predefined data transfer interval Δt_d is reached.	End: End of measurement time interval reached.	Stop: time Δt_d elapsed since start trigger event.

Upload:

Event from abstract equation	Trigger point from customer's point of view	Technical description/protocol part
"Datatransfer start": data transfer started successfully.	Start: File upload starts.	Start Method A: Sending of the first data packet containing content. Start Method B: Reception of the [ACK] from the [SYN, ACK] for active mode connections, sending of the [ACK] for the [SYN, ACK] for passive mode connections on the data socket.
"Data measurement end": end of predefined data transfer interval Δt_d is reached.	End: End of measurement time interval reached.	Stop: time Δt_d elapsed since start trigger event.

5.1.2 FDTT-QoS FTP {Download|Upload} Data Transfer Non-Stability [%]

5.1.2.1 Abstract Definition

The data transfer non stability is the proportion of data transfers which cut-off within Δt_d and data transfers that were started successfully.

5.1.2.2 Abstract Equation

$$\text{FDTT - QoS FTP \{Download | Upload\} Data Transfer Non - Stability [\%]} = \frac{\text{data transfer cut - off within } \Delta t_d}{\text{successfully started data transfers}} \times 100$$

5.1.2.3 Trigger Points

Download:

Event from abstract equation	Trigger point from customer's point of view	Technical description/protocol part
Successfully started data transfer.	Start: File download starts.	Start Method A: Reception of the first data packet containing content. Start Method B: Reception of the [ACK] from the [SYN, ACK] for active mode connections, sending of the [ACK] for the [SYN, ACK] for passive mode connections on the data socket.
Successfully terminated data transfer.	Measurement time interval elapsed and connection alive.	FDTT-QoS time Δt_d elapsed and connection is alive according to clause 4.1.
Data transfer cut-off.	Data transfer stops (connection is inactive) before Δt_d elapsed.	FDTT-QoS time Δt_d elapsed but connection is not alive according to clause 4.1.

Upload:

Event from abstract equation	Trigger point from customer's point of view	Technical description/protocol part
Successfully started data transfer.	Start: File upload starts.	Start Method A: Sending of the first data packet containing content. Start Method B: Reception of the [ACK] from the [SYN, ACK] for active mode connections, sending of the [ACK] for the[SYN, ACK] for passive mode connections on the data socket.
Successfully terminated data transfer.	Measurement time interval elapsed and connection alive.	FDTT-QoS time Δt_d elapsed and connection is alive according to clause 4.1.
Data transfer cut-off within Δt_d.	Data transfer stops (connection is inactive) before Δt_d elapsed.	FDTT-QoS time Δt_d elapsed but connection is not alive according to clause 4.1.

5.2 Web Browsing (HTTP)

5.2.1 FDTT-QoS HTTP Mean Data Rate [kbit/s]

5.2.1.1 Abstract Definition

This parameter describes the average data transfer rate measured over a predefined time interval Δt_d starting when the data link has been established successfully (start methods A and B). The connection has to be alive at the end of the measurement interval. The prerequisite for this parameter is network and service access.

5.2.1.2 Abstract Equation

$$\text{FDTT - QoS HTTP Mean Data Rate}\,[\text{kbit/s}] = \frac{\text{user data transferred between 'Data transfer start' and 'Data measurement end'}\,[\text{kbit}]}{\Delta t_d\,[\text{s}]}$$

5.2.1.3 Trigger Points

The average throughput is measured over the time interval Δt_d starting from the successful establishment of the data connection.

Event from abstract equation	Trigger point from customer's point of view	Technical description/protocol part
"Datatransfer start": data transfer started successfully.	Start: File download starts.	Start Method A: Reception of the first data packet containing content. Start Method B: Sending of the first GET command.
'Data measurement end': end of predefined data transfer interval Δt_d reached.	End: End of measurement time interval reached.	Stop: time Δt_d elapsed since start trigger event.

5.2.2 FDTT-QoS HTTP Data Transfer Non-Stability [%]

5.2.2.1 Abstract Definition

The data transfer non stability is the proportion of data transfers which cut-off within Δt_d and data transfers that were started successfully.

5.2.2.2 Abstract Equation

$$\text{FDTT - QoS HTTP Data Transfer Non - Stability}[\%] = \frac{\text{data transfers cut - off within } \Delta t_d}{\text{successfully started data transfers}} \times 100$$

5.2.2.3 Trigger Points

Event from abstract equation	Trigger point from customer's point of view	Technical description/protocol part
Successfully started data transfer.	Start: Web page download starts.	Start Method A: Reception of the first data packet containing content. Start Method B: Sending of the first GET command.
Successfully terminated data transfer.	Measurement time interval elapsed and connection alive.	FDTT-QoS time Δt_d elapsed and connection is alive according to clause 4.1.
Data transfer cut-off within Δt_d.	Data transfer stops (connection is inactive) before Δt_d elapsed.	FDTT-QoS time Δt_d elapsed but connection is not alive according to clause 4.1.

6 Summary and conclusion

The concept of the FDTT-QoS family performance indicators is based on measurements of the performance for a defined time period (Δt_d) instead of measurements with defined objects (measurement files). There are benefits compared to normal QoSs (defined in TS 102 250-2 [i.1]) which can lead to saving of time and effort needed to monitor performance of measured mobile network. Benefits of FDTT-QoS concept can be proved especially in case of large variance of measured QoSs parameters.

History

Document history		
V1.1.1	November 2009	Publication
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