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Speech and Multimedia Transmission Quality (STQ); Guidelines on OTT Video Streaming; Service Quality Evaluation Procedures

Reference

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Foreword

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

Modal verbs terminology

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Executive summary

The fast increase of the variety, technology complexity, and dynamic changes of the OTT video streaming services' delivery, as well as their consumptions by the users on a wide range of smart devices, suggests a consistent and robust testing approach that can allow an application transparent and meaningful evaluation of these services' quality management and control. The present document offers guidance for such a testing approach, while aligning the content with all other ETSI WG STQ Mobile documents as well as work related to the topic ongoing in other organizations.

Introduction

Several published STQM TSs and TRs cover the area of the video streaming end to end QoS/QoE evaluation. ETSI TS 102 250-2 [i.1] covers video streaming session performance evaluation in the case of real time streaming (e.g. RTP, RTSP, RTCP). ETSI TR 101 578 [i.2] complements ETSI TS 102 250-2 [i.1] with QoS/QoE for the specific case of TCP based streaming (YouTube™ application), which is the de-facto delivery technique for the OTT video streaming applications. Last, but not least, ETSI TR 102 493 [i.3] provides guidance on available QoE algorithms that can be used in various video streaming testing scenarios.

However, the OTT video streaming services' arena has seen video technology evolution (e.g. H.265 codec, 1440 resolution, new protocols such as QUIC), as well as dynamic technology changes (e.g. encryption schemes, encoding schemes of various profiles, adaptations schemes at the server and/or client side within the context of various throttling techniques and policies). Last, but not least, the variety of devices, namely operation system based video clients, do see the same dynamic change. Therefore, guidance for a transparent and flexible testing approach is required by today's OTT video streaming sessions' quality evaluation. And, consequently, a set of the most meaningful QoE centric QoS parameters is also necessary, which can complement MOS estimators (QoE algorithms/models; Recommendations ITU-T J series [i.4] to [i.9], P series [i.10] and [i.11]) whenever these are available, but also go beyond a single quality score.

1 Scope

The present document's scope is to provide guidance on OTT video streaming testing approach with a set of minimum desired and most meaningful QoE centric QoS parameters along with recommendations to create a figure of merit quantifying the OTT video streaming session quality, where possible. In addition, the set of introduced QoE centric QoS parameters aim to help with the identification of the possible roots of video quality degradation. The present document also offers means to understand aspects related with network and services optimization and troubleshooting, such as the trade-off between bandwidth usage or controlled throttling and end-to-end video quality.

The scope of the present document complements ETSI TS 102 250-2 [i.1] and ETSI TR 101 578 [i.2] while not being as exhaustive, but rather focused on QoE centric characterization and an end-to-end view on the video streaming session as a whole. Furthermore, the present document takes into consideration QoE centric evaluation by means of passive, non-intrusive network monitoring of SSL/QUIC OTT Video Services bitstreams. In addition, the present document aims to complement the scope of ETSI TR 102 493 [i.3] with respect to QoE models for video streaming integrity as perceived by users.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative 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 referenced document (including any amendments) applies.

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

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 TR 101 578: "Speech and multimedia Transmission Quality (STQ); QoS aspects of TCP-based video services like YouTube™".

[i.3] ETSI TR 102 493: "Speech and multimedia Transmission Quality (STQ); Guidelines for the use of Video Quality Algorithms for Mobile Applications".

[i.4] Recommendation ITU-T P.1201: "Parametric non-intrusive assessment of audiovisual media streaming quality".

[i.5] Recommendation ITU-T P.1202: "Parametric non-intrusive bitstream assessment of video media streaming quality".

[i.6] Recommendation ITU-T P.1203: "Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport".

[i.7] Recommendation ITU-T P.343: "Hybrid perceptual bitstream models for objective video quality measurements".

[i.8] Recommendation ITU-T P.341: "Objective perceptual multimedia video quality measurement of HDTV for digital cable television in the presence of a full reference".

[i.9] Recommendation ITU-T P.342: "Objective multimedia video quality measurement of HDTV for digital cable television in the presence of a reduced reference signal".

[i.10] Recommendation ITU-T J.247: "Objective perceptual multimedia video quality measurement in the presence of a full reference".

[i.11] Recommendation ITU-T J.246: "Perceptual visual quality measurement techniques for multimedia services over digital cable television networks in the presence of a reduced bandwidth reference".

[i.12] Recommendation ITU-T P.1401: "Methods, metrics and procedures for statistical evaluation, qualification and comparison of objective quality prediction models".

[i.13] Larry Stephens: "Schaum's Outline of Statistics" series, McGraw-Hill Trade, January 1989.

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

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

API	Application Programming Interface
CDN	Content Delivery Network
DASH	Dynamic Adaptive Streaming over HTTP
DL	DownLoad
FoM	Figure of Merit
IP	Internet Protocol
MOS	Mean Opinion Score
OS	Operating System
OTT	Over The Top
QoE	Quality of Experience
QoS	Quality of Services
QUIC	Quick UDP Internet Connections
RCA	Root Cause Analysis
RTCP	Real Time Control Protocol
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
SSL	Secure Sockets Layer
TCP	Transport Control Protocol
TH	THreshold
UDP	User Datagram Protocol
UE	User Equipment
WG	Working Group

4 Passive, non-intrusive network monitoring of SSL/QUIC OTT video services bitstreams

OTT Video payloads transported by SSL and QUIC, together with metadata encryption, reduce the applicability of QoE algorithms/models referred by ETSI TR 102 493 [i.3] and Recommendation ITU-T J series, P series [i.4], [i.5], [i.6], [i.7], [i.8], [i.9], [i.10] and [i.11] for non-intrusive network monitoring at mid-point solutions and prevent them to provide the MOS identified by such standards.

The approach described in the present document is based on the figure of merit and on identification of the possible causes of video quality degradation, complements the one depicted by ETSI TR 102 493 [i.3] for non-intrusive network monitoring solutions and provides a reference for them when payloads are transported by SSL and QUIC.

Note that such approach can be also extended to all the passive monitoring solutions, including any possible ones on the User Equipment, when only transported payloads by SSL and QUIC are available.

5 Categories of OTT video streaming session QoS parameters

5.1 Introduction

The whole end-to-end OTT video streaming session quality is determined and impacted by four categories of QoS parameters:

- Transport/delivery QoS parameters.
- Audio/video integrity QoS parameters.
- Streaming session QoS parameters.
- Service centric QoS parameters.

Each category can cover a set of QoS parameters which can be either measured and/or calculated directly, or can be estimated based on inferences (that are out of the scope of the present document) made on client's events, service's states and transport packet analysis. The latter is needed due to various types and levels of encryptions. At the time of publication of the present document, there are scenarios within which even these inferences techniques are challenged by fully encrypted streams, such as QUIC protocol, which leaves no metadata available. Work is going on in 3GPP, IETF and DASH Industry Forum in order to offer an open API interface which would allow access to minimum required metadata.

Table 1 provides a list of minimum required and most meaningful QoS parameters which can be used for end-to-end characterization (e.g. CDNs Id, CDN protocol, subscriber IP address, session id, video provider) and quantification (e.g. video-audio QoS parameters, streaming QoS parameters) of the OTT video streaming session' s quality.Ultimately, these QoS parameters can be further used to troubleshoot and identify more likely root causes of possible quality problems.

The columns in table 1 refer to:

- **Category:** Transport; audio/video; streaming session; Service centric.
- **Name:** It provides the parameter name.
- **Type:** It refers to QoS or Auxiliary (Aux) aspects.

Table 1: QoS parameters

Category	Name	Description	Type
Transport	Number of CDN Media Servers	Number of participating CDN Media Server inside a session.	Aux
	CDN Media ServerX Name	Name of the used CDN Media Server X. X is an integer number that ranges from 1 to Number of CDN Media Servers.	Aux
	CDN Media ServerX IP address	IP Address of the used CDN Media Server X. X is an integer number that ranges from 1 to Number of CDN Media Servers.	Aux
	CDN Media ServerX downloaded bytes	Bytes downloaded from CDN Media server X X is an integer number that ranges from 1 to Number of CDN Media Servers.	Aux
	CDN Media ServerX Average Time to first packet (CDN delay)	Average time between the last packet of the player request till the first packet of the related CDN Media server response for all the player requests with a response. X is an integer number that ranges from 1 to Number of CDN Media Servers.	QoS
	CDN Media ServerX Failure rate (%)	Rate of Player Requests with no answer towards CDN Media ServerX. X is an integer number that ranges from 1 to Number of CDN Media Servers.	QoS
	CDN Downlink Application throughput (Kbps)	It is the overall Downlink Application Throughput related to media content downloaded from CDN Media Servers (Kbps).	QoS
Video/Audio	Avg. video buffer (s)	Average Player video buffer size during play time in second.	Aux
	Avg. audio buffer (s)	Average Player Audio buffer size during play time in second.	Aux
	Avg. video bit rate (Kbps)	Average video bit rate during play time (Kbps).	QoS
	Avg. video bit rate Range	Average video bit rate range during play time (low, fair, excellent). See clause 6 for Range definition.	QoS
	Avg. audio bit rate Range	Avg. audio bit rate during play time (low, fair, excellent). See clause 6 for range definition.	QoS
	Low Video bit rate %	Play time % at Low Video Bit Rate range. See clause 6 for range definition.	QoS
	Low Audio bit rate %	Play time % at Low Audio Bit Rate range. See clause 6 for range definition.	QoS
	Good Video bit rate %	Play time % at Good Video Bit Rate range. See clause 6 for range definition.	QoS
	Good Audio bit rate %	Play time % at Good Audio Bit Rate range. See clause 6 for range definition.	QoS
	Excellent Video bit rate %	Play time % at Excellent Video bit rate range. See clause 6 for range definition.	QoS
	Excellent Audio bit rate %	Play time % at Excellent Audio bit rate range. See clause 6 for range definition.	QoS
	Video bit rate range switches	Number of Video bit rate range switches. See clause 6 for range definition.	QoS
	Audio bit rate range switches	Number of Audio bit rate range switches. See clause 6 for range definition.	QoS
	Positive Video bit rate range switches	Number of switches to higher video bit rate range. See Clause 6 for range definition.	QoS
	Positive Audio bit rate range switches	Number of switches to higher audio bit rate range. See clause 6 for range definition.	QoS
	Negative Video bit rate range switches	Number of switches to lower video bit rate range. See clause 6 for range definition.	QoS
	Negative Audio bit rate range switches	Number of switches to lower audio bit rate range. See clause 6 for range definition.	QoS
	Video DL Mbytes	Video downloaded Mbytes.	Aux
	Audio DL Mbytes	Audio downloaded Mbytes.	Aux
	Video Quality	It refers to ETSI TR 101 578 [i.2] Video Quality parameter.	QoS