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Speech and multimedia Transmission Quality (STQ);
QoS aspects of TCP-based video services like YouTube™

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Contents

List of figures

List of tables

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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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Introduction

There are a variety of popular IP-based video services available on the internet, on which users can view, upload and share videos. These services have become very popular and have a major share of the internet traffic worldwide. Due to their high popularity in general and use over mobile internet their availability and quality is of key interest for the provider of mobile internet access, which makes the services a matter for benchmarking. The down-stream scenario, the probability to access and see a desired video and the quality of the video is the subject of measurement method laid out in the present document.

Any video content is accessed via a link that is provided by the service on request. This request can be triggered by selecting a video on a web-page, by selecting a video in a smartphone application or – if the URL is known – by direct access of a video player with streaming capabilities. A popular example for a video streaming service is YouTube™.

NOTE: YouTube™ is the trade name of a product supplied by Google. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Today's video streaming services are mainly based on reliable transmission. It is often TCP, but e.g. YouTube™ applies a proprietary protocol named QUIC. This protocol is based on UDP but secures transmission at a higher layer.

The source video, either uploaded by a user or provided e.g. by a broadcasting station or live stream is usually in high quality in high resolution. Typically, the receiving video server re-processes the video, add streaming information and is usually transcoding it to meet its coding schemes and data rate classes. In practice these videos are transcoded in different resolutions and stored for down-streaming by the video server.

State of the art video streaming services do not downstream the entire video in one pre-defined resolution (or bitrate), they adjust the amount of data to transport at the available channel capacity or restrictions given by the operators (called: adaptive bitrate). To adjust the amount of data the most efficient strategy is to change the image resolution. Other strategies are decreasing encoding depth or reducing the picture rate (frame-rate) of the video. It is obvious that the applied compression affects the perceived video quality, the degree of degradation is depending on compression and the strategy of compression.

Typically, the resolution is not changed continuously. It is usually switching between fixed resolutions as e.g. 240, 360, 480, 720 and 1 080 lines. The most common schemes for adaptive bitrate are DASH and HLS, where the video is requested in sub-sequent portions of a few seconds in a defined resolution.

On the other hand the clips not need to come physically from the same server since mobile operators employ proxies in order to move the content closer to their subscriber and the downlink bandwidth could be controlled by both the mobile operator network and the video service. Therefore the clips need to be streamed from the actual live network and may not be streamed from a dedicated server.

It should be considered that the rendering of the video and finally the quality of its reproduction depends on the buffering and decoding strategy of the player, as well as on the operating system and available system resources.

1 Scope

The present document focuses on Quality of Service (QoS) measurements for IP-based video services with reliable transport where downloading and viewing takes place in parallel. In principle the presented measurement approach can be used for all video services, where the video is embedded in a HTML context as of video on demand services like e.g. YouTube™. Similar applications are also available on social networks.

In the following, QoS parameters to be used for such video service measurements are presented. The underlying procedure consists of two phases: first requesting a control script containing among other information a link to the content, and second, requesting this content. In the present document, YouTube™ serves as the default example but the described QoS parameters can easily be applied to other IP-based video services based on reliable transport.

Furthermore, the present document also offers practical guidance for measurement execution and evaluation of HTTP/HTTPS streaming QoS measurement.

The present document covers the video request and playout of the video. Other services offered by content providers such as e.g. uploading video or managing the private account are not covered.

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

3 Abbreviations

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

CPU	Central Processing Unit
DASH	Dynamic Adaptive Streaming over HTTP
DNS	Domain Name System
FLV	Flash® Video
FTP	File Transfer Protocol
GPU	Graphics Processing Unit
HDD	Hard Disk Drive
HLS	HTTP Live Streaming
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol

HTTPS	HTTP Secure
IP	Internet Protocol
LAN	Local Area Network
NDIS	Network Driver Interface Specification
OS	Operating System
PC	Personal Computer
PEC	Performance Enhancement Client
QoS	Quality of Service
QUIC	Quick UDP Internet Connection
RTP	Real-time Transport Protocol
RTSP	Real Time Streaming Protocol
SYN	TCP synchronize flag
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
URL	Uniform Resource Locator
WLAN	Wireless Local Area Network

4 Quality of Service measurements for IP-based video services like YouTube™

4.0 General

Many video services offer the videos in several resolutions and allows the viewer to select the resolution quality manually. However, most services apply an adaptive mode (called 'automatic' for YouTube™), where based on the transport channel performances or other information the chosen resolution (bitrate) and the Pre-Playout buffering time is adjusted adaptively to an optimum regarding video quality, avoiding freezing and long waiting time before the video reproduction starts. The maximum available resolution is defined by the video provider and often by the display of the user device.

4.1 Phases of IP-based video services

Most IP-based video services, like the YouTube™ video service, are comprised of several phases which are mainly the set-up of a HTML context including the request for the actual video server location and the download of the video itself. It has to be considered that there is no sub-sequent download of HTML content and video rather a parallel set-up of many connections.

Figure 1 shows typical phases of IP-based video services, like YouTube™.