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

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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Introduction

There are a variety of popular TCP-based video services available on the internet, on which users can upload, view and share videos. These services use mainly Adobe® Flash® Video but also RealPlayer® and QuickTime® and lately HTML5 technology to display a wide variety of video content, including movie clips, TV clips, and music videos, as well as amateur content such as video blogging and short original videos.

NOTE 1: Adobe® Flash® is the trade name of a product supplied by Adobe. 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.

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These services have become very popular and have a major share of the internet traffic worldwide. Due to its high popularity in general and its use over mobile internet its availability and quality is of key interest of 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 a web page. The actual linked videos need to be qualified however e.g. YouTube™ provides different quality profiles of the same video content e.g. a music video clip.

NOTE 4: 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.

The individual quality profiles can differ in resolution (e.g. 240p, 360p, 480p, HD720p, HD1080p), in the data-rate and other aspects. Since these differences of clips have an impact on their size and thus on the reproduction speed and quality, a fair comparison can only be provided if actually the same clips are streamed over different networks. 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 is often controlled primarily by the video service. Therefore the clips need to be streamed from the actual live network and may not be streamed from a dedicated server.

For cases in which the video content is compressed during the transfer by a proxy hence the content arriving at the subscriber is not identical, the compression ratio may be indicated to show that possible advantages in performance are achieved by reducing the amount of data to be transferred. Whether this enhancement was achieved at the cost of the general quality of the content could be determined by an objective video quality assessment.

The TCP-based videos can be received either on Smartphone or a PC connected via mobile network to the internet. For the Smartphone the way the content is provided can differ significantly with the type and the OS the phone is using. In the present document content delivery for special Apps, RealPlayer® and QuickTime® is not taken into consideration but only the streaming over TCP as e.g. used by YouTube™ with a Browser on a PC or Smartphone with the respective player.

1 Scope

The present document focuses on Quality of Service (QoS) measurements for TCP-based video services 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 TCP-based video services.

Furthermore, the present document also offers practical guidance for measurement execution and evaluation of HTTP 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

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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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
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
HTTPS	Secure HTTP
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
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 TCP-based video services like YouTube™

4.0 General

Many TCP-based video services, like e.g. the YouTube™ video service, provide videos in several resolutions and qualities. For some video services the client can choose the resolution and quality of the video playback manually. On the other hand, several mobile clients often allow only lower resolutions (delivered in lower bandwidth). Usually, videos are streamed in proprietary Flash® format (FLV) over TCP. In addition, for very large videos or client devices not supporting Flash® other formats are supported as well, e.g. 3GP video down-stream via RTP/UDP for RealPlayer® on Symbian OS™.

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NOTE: Symbian OS™ is the trade name of a product supplied by Symbian Ltd. 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.

4.1 Phases of TCP-based video services

Most TCP-based video services, like the YouTube™ video service, are comprised of several phases which are mainly the set-up of a HTML context including downloading the control script for the multimedia playout entity (in the following: "player") and the down-stream of the video itself.

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

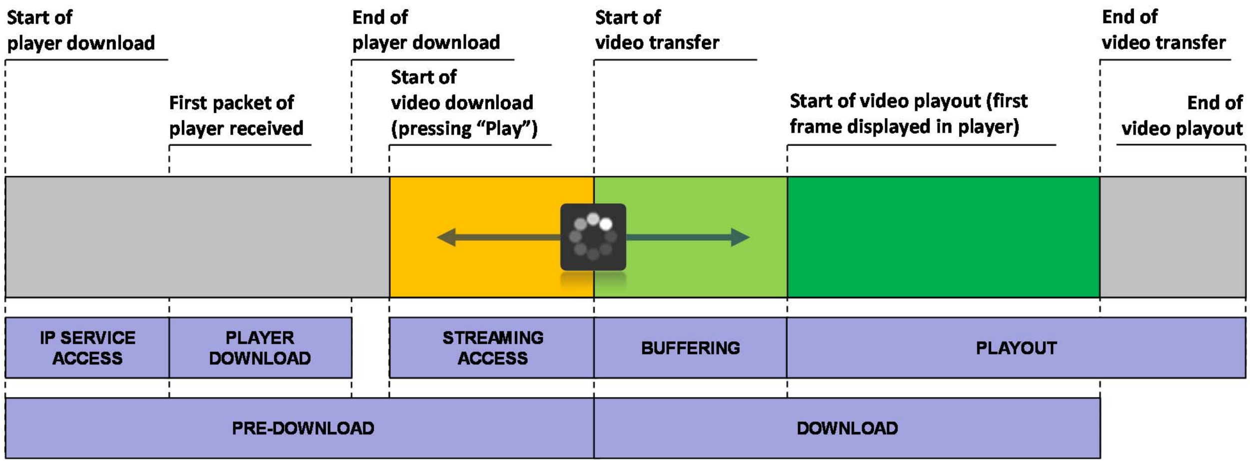

Figure 1: Typical phases of TCP-based video services

In principle the video service can be divided into the setup of the context until the player is ready to play and the download and playout of the video.

The setup of the context until the player is ready to play can be divided into two phases, the "IP service access" phase and the "player download" phase.

The "IP service access" phase starts when the HTML context and the player configuration download are requested. It ends upon receipt of the first data byte containing HTML content, starting the player download phase.

NOTE: The initial DNS request sent when e. g. the YouTube™ URL is opened is not considered to be part of the "IP service access" phase. Thus, the quality of service for the initial DNS resolution for the HTML context and the player configuration download is not covered by the QoS parameters defined in the present document for the "IP service access" phase.

The "IP service access" phase is followed by downloading the HTML context information and the player configuration script (in case of Flash® Player). It contains potential surrounding HTML based information (YouTube™ site), which can be the original YouTube™ site with an embedded player (YouTube™ in a browser window), or the player application without any visible HTML context (YouTube™ App or Flash® Player in an empty HTML context). The last step of the context setup is the download of the player configuration script. The entire download phase is called simplified "player download". At the point the context and the configuration is downloaded completely, the player is "ready to play".

The "streaming access" phase is started by pressing the "Play" button (or in case of "AutoPlay" with the event "Ready To Play" that is then equivalent to requesting the video) and ends with receiving the first video packet over TCP or RTP. This phase could be very interesting if there are proxies between the user and the content server, thus making DNS resolution and other events an influential factor.

In a simple case, during "streaming access" phase there will be only one GET (in case of a requested TCP stream) or a RTSP DESCRIBE (in case of a requested RTP stream) request for the video, followed immediately by the 200 OK message and the payload packets for FLV (TCP) or 3GP (RTP) video. In a more complex case, there may either be several ranged GET requests or it may happen that after the first GET request there will be several redirects (because of proxies) and several more resolving of DNS, etc. so this phase can be much longer. Basically, QoS parameters related to this phase allow concluding how close the network is to the content server for the measured video. Even if a preferred server (URL) is given and firstly requested, the actual approached location of the clip may differ and lead to a redirection to a closer or more appropriate server and DNS has to be contacted again.

In case of RTSP, an RTSP link is embedded in the HTML context. After receiving the final URL or the video, the video can be streamed/downloaded (Ready to Play).

Upon receiving the first video packet, the "buffering" phase commences. While the "download" phase will end with the last received video packet, the "buffering" phase ends in the moment the video playout actually starts. QoS parameters related to this phase allow estimating the initial buffer size for the measured video and current Internet connection type (e.g. DialUp, NDIS, WLAN, LAN).

The "IP service access", the "player download" and the "streaming access" phases jointly constitute the "pre-download" phase. The "buffering" and the remaining video content transfer constitute the "download" phase.