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Technical Report

Speech and multimedia Transmission Quality (STQ); Guidelines for the use of Video Quality Algorithms for Mobile Applications

Reference

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Foreword

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

1 Scope

The present document gives guidelines for the use of video quality algorithms for the different services and scenarios applied in the mobile environment.

2 References

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Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] ETSI TS 126 233: "Universal Mobile Telecommunications System (UMTS); LTE; End-to-end transparent streaming service; General description (3GPP TS 26.233 version 8.0.0 Release 8)".

[i.2] VQEG: "Multimedia Group: Test Plan", Draft Version 1.5, March 2005.

[i.3] ETSI TS 122 960: "Universal Mobile Telecommunications System (UMTS); Mobile Multimedia services including mobile Intranet and Internet services".

[i.4] Final Report from the Video Quality Experts Group on the validation of the objective models of multimedia quality assessment, Phase.

[i.5] ITU-T Recommendation J.247: Objective perceptual multimedia video quality measurement in presence of a full reference.

[i.6] ITU-T Recommendation J.246: Perceptual visual quality measurement techniques for multimedia services over digital cable television networks in the presence of a reduced bandwidth reference.

[i.7] ETSI TS 126 114: "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Multimedia telephony; Media handling and interaction (3GPP TS 26.114 Release 7)".

3 Definitions and abbreviations

3.1 Definitions

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

bitstream model: computational model that predicts the subjectively perceived quality of video, audio or multimedia, based on analysis of the payload and transport headers

hybrid model: computational model that predicts the subjectively perceived quality of video, audio, or multimedia, based on the media signal and the payload and transport headers

live Streaming: streaming of live content e.g. web cam, TV programs, etc.

parametric model: computational algorithm that predicts the subjectively perceived quality of video, based on transport layer and client parameters

perceptual model: computational algorithm that aims to predict the subjectively perceived quality of video, based on the media signal

streaming on demand: streaming of stored content e.g. movies

3.2 Abbreviations

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

BLER	BLock Error Rates
CIF	Common Intermediate Format (352 x 288 pixels)
DMOS	Difference Mean Opinion Score
FR	Full Reference Algorithm
HRC	Hypothetical Reference Circuit
ITU	International Telecom standardization Union
MOS	Mean Opinion Score
NR	No Reference Algorithm
PLR	Packet Loss Rates
PSNR	Peak Signal Noise Ratio
QCIF	Quarter Common Intermediate Format (176 x 144 pixesls)
RR	Reduced Reference
SRC	Source Reference Channel (or Circuit)
VGA	Video Graphics Adapter
VQEG	Video Quality Expert Group

4 General

Video quality assessment has become a central issue with the increasing use of digital video compression systems and their delivery over mobile networks. Due to the nature of the coding standards and delivery networks the provided quality will differ in time and space. Thus, methods for video quality assessment represent important tools to compare the performance of end-to-end applications.

The present document sets the guidelines of video quality algorithms applicable for mobile applications and the scenarios of their application. Any eligible algorithm needs to predict the perceived quality by the user using mobile terminal equipment. The goal is to have one or more objective video quality measurement algorithm(s), which predicts the video quality as perceived by a human viewer, which is in conformance with the minimum requirements list given in the present document.

On the input of the Video Quality Experts Group (VQEG) the ITU has recommended in ITU-T Recommendation J.247 [i.5] an objective perceptual video quality measurement in the presence of a full reference and in ITU-T Recommendation J.246 [i.6] a perceptual video quality measurement in the presence of a reduced reference. An objective perceptual multimedia video quality for no-reference algorithms has not been recommended. However continuing research within the VQEG is directed towards providing further input to the ITU on digital multimedia objective video quality measurement models. Work is going on in ITU-T and VQEG to develop and standardize hybrid, bitstream and parametric models.

It is common to all services treated in the present document that quality as seen from the user's perspective depends on the server and client applications used. For example, is has to be expected that under the same network conditions, two different video streaming clients will exhibit different video quality due to differences in the way these clients use available bandwidth. Therefore, for full validation of tools type and version of clients used has to be fully documented and are seen as part of the information needed to reproduce and calibrate measurements.

NOTE: The present document focuses on those visual continuous media reproductions where the source and the player are connected via a (mobile) telecommunication network rather than the replay of a clip that has been completely stored on the same device as the player and is replayed from there.

5 Services

The aspect of video quality is of interest wherever there are services where the transfer of 'moving pictures' or still images is involved. Three major fields of transferring video content can be identified that make use of packet switched and circuit switched services.

Table 1: Requirement profiles of the services

Application	Symmetry	Data rates	One Way Delay	Lip-sync	Information loss
Video telephony	Two-way	32 kbps to 2 Mbps	< 150 ms preferred < 400 ms limit	< 80 ms	< 1 % pl
Streaming	One-way	32 kbps to 2 Mbps	< 10 s		< 1 % pl
Conversational Multimedia	Two-way		< 150 ms	Mutual service dependency, echo	

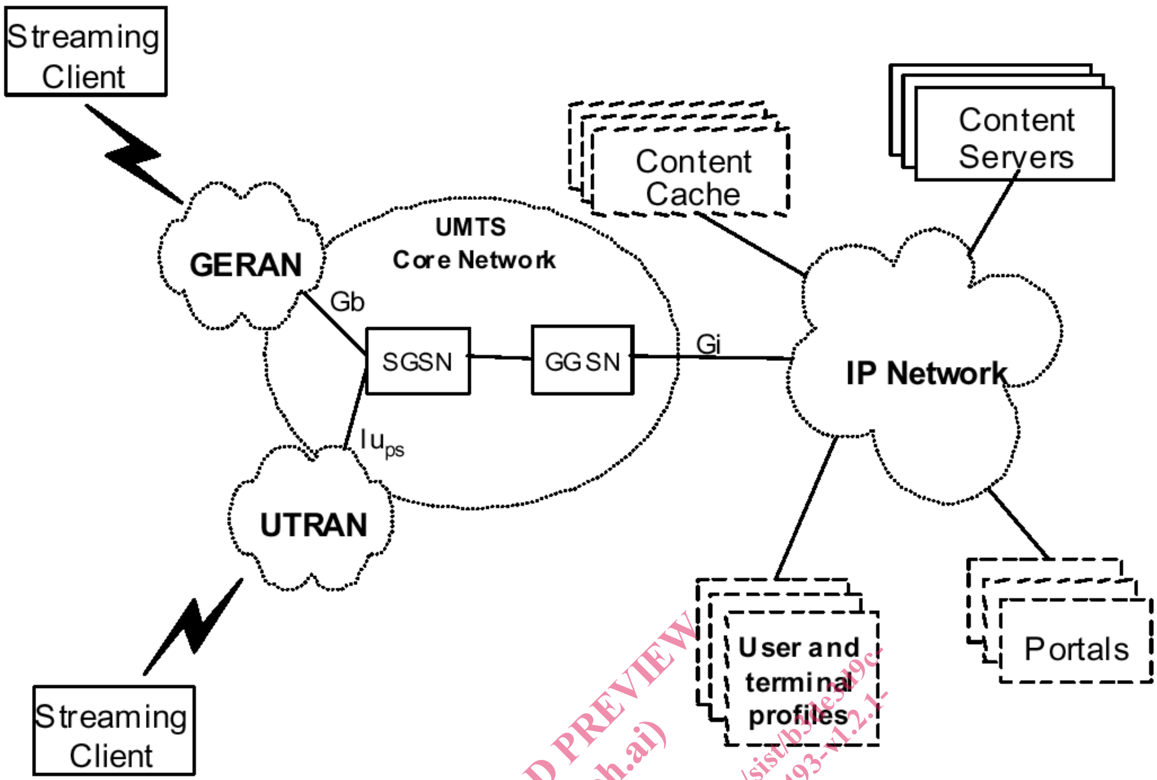

Figure 1: Streaming (TS 126 233 [i.1])

5.1 Streaming

Streaming refers to the ability of an application to play synchronized media streams like audio and video streams in a continuous way while those streams are being transmitted to the client over a data network. The client plays the incoming multimedia stream in real time as the data is received.

Typical applications can be classified into on-demand and live information delivery applications. Examples of the first group are music and news-on-demand applications. Live delivery of radio and television programs is an example of the second category.

For 3G systems, the 3G packet-switched streaming service (PSS) fills the gap between 3G MMS, e.g. downloading, and conversational services.

5.2 Conversational Multimedia

Multimedia services combine two or more media components within a call. The service where two or more parties exchange video, audio and text and maybe even share documents is a multimedia service. Microsoft Netmeeting is an example for a conversational multimedia application [i.3]. This is a peer-to-peer set up in which one party acts as the source (server) and the other as client(s) and vice versa in real time. Another example of a new multimedia conversational service is the 3GPP standardized MTSI service [i.7].

5.3 Video Telephony

Video telephony is a full-duplex system, carrying both video and audio and intended for use in a conversational environment. In principle the same delay requirements as for conversational voice will apply, i.e. no echo and minimal effect on conversational dynamics, with the added requirement that the audio and video have to be synchronized within certain limits to provide "lip-synch".

6 QoS Scenarios

The different services that are making use of video can be delivered in a variety of ways and situations. To obtain the full picture of the quality of these services they need to be tested accordingly. However for practical purposes and general feasibility key scenarios need to be identified to facilitate video quality measurements.

6.1 Key Scenarios

The key scenarios are live streaming, streaming on demand, video telephony and conversational multimedia. These services can be tested by drive test or in a static fashion.

The algorithms for estimating video and audiovisual quality can be classified depending on:

- Type of input:
  - Perceptual (access to the video signal).
  - Bitstream (access to the transport layer payload, but not the video signal).
  - Hybrid (access to both the video signal and the transport layer payload).
  - Parametric (access to transport header, client information, and knowledge about used codecs).
- Access to reference video: The algorithm models that are used are:
  - Full reference model (FR).
  - No reference model (NR).
- Media types: An algorithm can estimate:
  - Video quality only.
  - Audiovisual quality (taking into account the combined effect of audio and video quality).

Table 2: Key scenarios and model applicability for video quality algorithm assessment

	Live streaming	Streaming on Demand	Video Telephony	Conversational MM
FR perceptual	Require pre-stored source - normally not applicable for live streaming.	Applicable. Require pre-stored source.	Applicable. Require pre-stored source.	Applicable. Require pre-stored source.
NR perceptual	Applicable. Might have bad performance when video contains artefact-like content.	Applicable. Might have bad performance when video contains artefact-like content.	Applicable. Might have bad performance when video contains artefact-like content.	Applicable. Might have bad performance when video contains artefact-like content.
FR hybrid	Require pre-stored source - normally not applicable for live streaming.	Applicable. Require pre-stored source.	Applicable. Require pre-stored source.	Applicable. Require pre-stored source.
NR Hybrid	Applicable.	Applicable.	Applicable.	Applicable.
Bitstream	Applicable.	Applicable.	Applicable.	Applicable.
Parametric	Applicable.	Applicable.	Applicable.	Applicable.

6.2 Other scenarios

There is a further approach of video testing that does not focus on the perceptual quality of a delivered video but on the pure availability (delivery) of the desired content in real time. This is referred to as live verification or live monitoring. Like in the previous clause all four scenarios can be tested with all models. However due to the nature of the NR, parametric and bitstream models they are more suitable for that purpose.