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SERIES P: TELEPHONE TRANSMISSION QUALITY,
TELEPHONE INSTALLATIONS, LOCAL LINE
NETWORKS

Models and tools for quality assessment of streamed
media

**Parametric bitstream-based quality assessment
of progressive download and adaptive
audiovisual streaming services over reliable
transport**

Recommendation ITU-T P.1203

ITU-T

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For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T P.1203

Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport

Summary

Recommendation ITU-T P.1203 provides the introductory document for a set of documents that describe model algorithms for monitoring the integral media session quality for TCP-type video streaming. The models comprise modules for short-term audio- and video-quality estimation. The per-one-second outputs of these short-term modules are integrated into estimates of audiovisual quality and, together with information about initial loading delay and media playout stalling events, further integrated into the final model output, the estimate of integral quality. The respective ITU-T work item has formerly been referred to as P.NATS (Parametric non-intrusive assessment of TCP-based multimedia streaming quality).

The structure of the set of recommendations reflects the different functionality of modules described in each document:

- ITU-T P.1203: Introductory document (this Recommendation)
- ITU-T P.1203.1: Video quality estimation module (short-term, providing per-one-second output information)
- ITU-T P.1203.2: Audio quality estimation module (short-term, providing per-one-second output information)
- ITU-T P.1203.3: Audiovisual integration and integration of final score, reflecting remembered quality for viewing sessions between 30 s and 5 min duration

The input used by the models consists of information obtained by prior stream inspection. Four different levels of inspection are included, resulting in models of different complexity both of the input information and the model algorithms, which are called "modes of operation" in the following:

- Mode 0: Information obtained from meta-information available during progressive download or adaptive streaming, for example from manifest files used in DASH, about codec and bitrate, and initial loading delay and stalling.
- Mode 1: All information from Mode 0, with additional video and audio frame information based on packet header inspection
- Mode 2: All information from Mode 1, and up to 2% (in Bytes) of the overall media stream information based on deep packet inspection and partial bitstream parsing
- Mode 3: All information from Mode 1, and complete media stream information based on bitstream parsing

The ITU-T P.1203-series of Recommendations addresses two application areas, which are respectively indicated in the module-related Recommendations ITU-T P.1203.1, ITU-T P.1203.2, ITU-T P.1203.3:

- Large-screen presentation as with fixed-network video streaming
- Mobile streaming on handheld devices such as smartphones

The ITU-T P.1203 module algorithms are no-reference, bitstream-based models.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T P.1203	2016-11-29	5	11.1002/1000/13158
1.1	ITU-T P.1203 (2016) Amd. 1	2017-01-19	12	11.1002/1000/13166
2.0	ITU-T P.1203	2017-10-29	12	11.1002/1000/13399

Keywords

Adaptive streaming, audio, audiovisual, IPTV, mean opinion score (MOS), mobile video, mobile TV, monitoring, multimedia, progressive download, QoE, TV, video.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

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Recommendation ITU-T P.1203

Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport

1 Scope

This Recommendation describes a set of objective parametric quality assessment modules that together can be used to form a complete model to predict the impact of audio and video media encodings and observed IP network impairments on quality experienced by the end-user in multimedia streaming applications. The addressed streaming techniques comprise progressive download as well as adaptive streaming, for both mobile and fixed network streaming applications.

Four modes are defined to cover a range of use-cases, from monitoring streams where the video payload is fully encrypted through to unencrypted streams, and where there are no limitations on processing power so that deep packet inspection is possible.

The model described is restricted to information provided to it by an appropriate bit stream analysis module or set of modules. The model described here is applicable to progressive download and adaptive streaming, where the quality experienced by the end user is affected by audio-coding and/or video degradations due to coding, spatial re-scaling or variations in video frame rates, as well as delivery degradations due to initial loading delay, stalling (which are both caused by rebuffering at the client), and media adaptations. Here, a "media adaptation" refers to events where the player switches video playback between a known set of media quality levels while adapting to network conditions. Each of the quality levels typically differs in a significant video and/or audio (and thus audiovisual) quality change. These quality changes are most readily observed by changes in bitrate, resolution, frame rate, and similar attributes.

The model predicts a mean opinion score (MOS) on a 5-point absolute category rating (ACR) scale (see [ITU-T P.910]) as a global multi-media MOS score (as defined in [ITU-T P.911], for instance). In addition, the well-defined modules provide several diagnostic outputs.

The primary applications for this model are monitoring of transmission quality for operations and maintenance purposes. The ITU-T P.1203 model for adaptive- and progressive-download-type media streaming may be deployed both in end-point locations and at mid-network monitoring points. Note, however, that the present Recommendation only describes the model that maps input parameters obtained from a probe located at a specific point in the network or in the client to the global multimedia MOS-scores and related quality diagnostic indicators, as described above.

The model associated with this Recommendation cannot provide a comprehensive evaluation of transmission quality as perceived by an *individual end-user* because its scores reflect the perceived impairments due to coded audiovisual media data being transmitted over an IP connection with certain performance, and does not include specific terminal devices or user-specific. The scores predicted by a general quality model necessarily reflect *average perceptual impairments*.

Effects such as those due to audio levels, signal noise and effects due to source generation such as video shake or certain colour properties (and other similar video or audio factors) and other impairments related to the payload are not reflected in the scores computed by this model. Therefore, it is possible to have high scores with this model, yet have a poor overall stream quality.

As a consequence, this Recommendation can be used for applications such as:

- In-service quality monitoring for specific IP-based audiovisual services, as specified in more detail below.
- Benchmarking of different service implementations. However, it cannot be used for direct benchmarking of different encoder implementations.