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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 – Video quality estimation module**

Recommendation ITU-T P.1203.1



TELEPHONE TRANSMISSION QUALITY, TELEPHONE INSTALLATIONS, LOCAL LINE NETWORKS

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

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

Summary

Recommendation ITU-T P.1203.1 specifies the short-term video representation quality estimation modules for ITU-T P.1203 (Pv module). The ITU-T P.1203-series of Recommendations specifies modules for a set of model algorithms for monitoring the integral media session quality for transport control protocol (TCP) type video streaming. The models comprise modules for short-term video-quality (described in this part of the Recommendation family) and audio-quality estimation. The per-one-second outputs of these short-term modules are integrated into estimates of audio-visual quality and together with information about initial loading delay and media playout stalling events, they are further integrated into the final model output, to provide an estimate of integral quality. The respective ITU-T work item has formerly been referred to as "Parametric non-intrusive assessment of TCP-based multimedia streaming quality", or "P.NATS". The ITU-T P.1203.1 part of ITU-T P.1203 provides details for the modules for bitstream-based, short-term video quality estimation.

Four different modes can be used for the Pv module specified in this Recommendation. These modes – referred to as mode 0 to 3 – use input information of differing complexity and amount and represent four model algorithms each with a different level of complexity. The Pv modules comprise components reflecting the effects due to video compression, up-scaling of content and the effect due to low frame rates. The four different modes use the same overall model architecture and individual coefficients and all have the same components for up-scaling and framerate. The only Pv module component that differs between modes is the Pv module component related to video compression.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Adaptive streaming, audio, audiovisual, IPTV, mean opinion score (MOS), mobile TV, mobile video, 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.1203.1

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

1 Scope

This Recommendation describes the video module as an integral part of the ITU-T P.1203-series Recommendations. The ITU-T P.1203 Recommendations describe a set of objective parametric quality assessment modules. Combined, these modules can be used to predict the impact of audio and video media encodings as well as Internet protocol (IP) network impairments on the quality experienced by an end-user of multi-media streaming applications.

The addressed streaming techniques comprise progressive download as well as adaptive streaming, for both mobile and fixed network streaming applications over transport control protocol (TCP) or other TCP like protocols which are not affected by transmission errors.

The model described is restricted to information provided to it by an appropriate packet- or bitstream-analysis module. The overall ITU-T P.1203 model is applicable for the effects due to audio- and video-coding as well as initial loading delay or stalling (which are both caused by rebuffering at the client) as the typical degradations associated with progressive download. As final output, the ITU-T P.1203-series models target integral audiovisual media quality scores.

This Recommendation describes four different quality modules, one for each mode of ITU-T P.1203, that is, modes 0, 1, 2 and 3. The video quality module predicts mean opinion scores (MOS) on a 5-point ACR scale (see [ITU-T P.910]) as a per-one-second MOS score. The underlying measurement window is described in [ITU-T P.1203]. If used stand-alone, the video module can provide estimates of short-term video quality at per-one-second intervals.

This model cannot provide a comprehensive evaluation of video transmission quality as perceived by an individual end user because its scores reflect the impairments due to video scaling, framerate and coding only. Furthermore, the scores predicted by a parametric model necessarily reflect an average perceptual impairment.

Note also that the model was developed and validated for one specific encoder and decoder implementation. If a different encoder and decoder pair is used in a monitoring situation the scores may not reflect that.

Effects such as flicker due to low source bitrate or other, not coding or transmission caused impairments related to the payload are not reflected in the scores computed by this model. Moreover, the scores predicted by a parametric model (especially in case of no access to payload or pixel information) necessarily reflect a somewhat simplified representation of the perceptual impairment of the considered stream.

However, the model still enables estimation of some coding quality related information and thus valid and in most cases accurate predictions, presuming that it is applied in an appropriate manner, following this Recommendation.

Table 1-1 shows application areas, test factors and coding technologies where ITU-T P.1203.1 for adaptive streaming and progressive download has been verified and is known to produce reliable results.

Table 1-1 – Application areas, test factors and coding technologies where ITU-T P.1203.1 for adaptive streaming and progressive download has been verified and is known to produce reliable results

Applications for which the model is intended	
In-service monitoring of TCP- video. Both so called over-the-top (OTT) services (for example YouTube) and operator managed video services (over TCP), using the protocols HTTP/TCP/IP and RTMP/TCP/IP. Note that this model is agnostic to the type of container format (Flash (FLV), MP4, WebM and 3GP).	
Performance and quality assessment of live networks (including codecs) considering the effect due to encoding bitrate, encoding resolution, and encoding framerate.	
Video test factors for which the model has been validated	
Video content	Movie trailers, sports videos, documentaries, freely available HD content, time lapse videos, etc.
Input video length	Maximum 20 seconds. The video model produces a per-second score considering input data from a measurement window of max. 20 s length.
Bitstream container	Elementary stream contained in MPEG-2 transport stream (TS) segments
Encoder/decoder implementation	The model has been trained using the following video encoder/decoder: – ITU-T H.264/MPEG-4 AVC High profile: x264 (ffmpeg) – A common framework was developed based on the above codec, all the test data was generated using the common framework. It is assumed that the model can be used for estimating quality when other encoder implementations for the given codec have been used. However, model performance cannot be guaranteed in this case.
Slice size	1 slice per video frame
Scene-cut detection	Off
x264 Preset	Medium
Video resolution/bitrate	240p: 75-150 kbit/s 360p: 220-450 kbit/s 480p: 375-750 kbit/s 720p: 1 050-2 100 kbit/s 1080p: 1 875-12 500 kbit/s Note that aspect ratio of 16:9 is maintained for all quality levels.
Group of pictures (GOP)	1 second length, IBBBP only
Segment length	1-9 seconds NOTE – The segment length determines how often the quality can be adapted.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T G.107] Recommendation ITU-T G.107 (2015), *The E-model: a computational model for use in transmission planning*.
- [ITU-T H.264] Recommendation ITU-T H.264 (2016), *Advanced video coding for generic audiovisual services*.
- [ITU-T P.800.1] Recommendation ITU-T P.800.1 (2006), *Mean opinion score (MOS) terminology*.
- [ITU-T P.910] Recommendation ITU-T P.910 (2008), *Subjective video quality assessment methods for multimedia applications*.
- [ITU-T P.911] Recommendation ITU-T P.911 (1998), *Subjective audiovisual quality assessment methods for multimedia applications*.
- [ITU-T P.1201.1] Recommendation ITU-T P.1201.1 (2012), *Parametric non-intrusive assessment of audiovisual media streaming quality – Lower resolution application area*.
- [ITU-T P.1201.2] Recommendation ITU-T P.1201.2 (2012), *Parametric non-intrusive assessment of audiovisual media streaming quality – Higher resolution application area*.
- [ITU-T P.1202] Recommendation ITU-T P.1202 (2012), *Parametric non-intrusive bitstream assessment of video media streaming quality*.
- [ITU-T P.1202.1] Recommendation ITU-T P.1202.1 (2012), *Parametric non-intrusive bitstream assessment of video media streaming quality – Lower resolution application area*.
- [ITU-T P.1203] Recommendation ITU-T P.1203 (2016), *Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport*.
- [ITU-T P.1203.2] Recommendation ITU-T P.1203.2 (2016), *Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport – Audio quality estimation module*.
- [ITU-T P.1203.3] Recommendation ITU-T P.1203.3 (2016), *Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport – Quality integration module*.
- [ITU-T P.1401] Recommendation ITU-T P.1401 (2012), *Methods, metrics and procedures for statistical evaluation, qualification and comparison of objective quality prediction models*.