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SERIES J: CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Measurement of the quality of service

Measurement and control of the quality of service for sound transmission over contribution and distribution networks

ITU-T Recommendation J.145

(Formerly CCITT Recommendation)

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ITU-T Recommendation J.145

Measurement and control of the quality of service for sound transmission over contribution and distribution networks

Summary

This Recommendation specifies the parameters and the methods for the measurement and control of the QoS for digital sound transmission on contribution and distribution networks.

Source

ITU-T Recommendation J.145 was prepared by ITU-T Study Group 9 (2001-2004) and approved under the WTSA Resolution 1 procedure on 9 March 2001.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. 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.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Introduction

Digital audio transmission with or without compression requires new methods for measurement and control of the overall Quality of Service (QoS). These methods are divided into four parts:

– subjective assessment of audio quality;

– objective measurement of audio quality;

– network related audio parameters;

– general network parameters.

ITU-T Recommendation J.145

Measurement and control of the quality of service for sound transmission over contribution and distribution networks

1 Scope

This Recommendation specifies the parameters and the methods for the measurement and control of the overall Quality of Service for digital sound transmission over contribution and distribution networks. It concerns the end-to-end performance of digital audio signals from the signal source to the end of the contribution or distribution line. This transmission chain includes all types of transmission links, terrestrial links and/or satellite links.

2 References

The following 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 Recommendation and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-R BS.1116-1 (1997), *Methods for the subjective assessment of small impairments in audio systems including multichannel sound systems*.
- ITU-R BS.1283 (1997), *Subjective assessment of sound quality – A guide to existing Recommendations*.
- ITU-R BS.1284 (1997), *Methods for subjective assessment of sound quality – General requirements*.
- ITU-R BS.1285 (1997), *Pre-selection methods for the subjective assessment of small impairments in audio systems*.
- ITU-R BS.1286 (1997), *Methods for the subjective assessment of audio systems with accompanying picture*.
- ITU-R BS.1387 (1998), *Method for objective measurements of perceived audio quality*.
- ITU-R BT.1359-1 (1998), *Relative timing of sound and vision for broadcasting*.
- ITU-T G.821 (1996), *Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network.*
- ITU-T G.822 (1988), *Controlled slip rate objectives on an international digital connection*.
- ITU-T G.823 (2000), *The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy*.
- ITU-T G.824 (2000), *The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy*.
- ITU-T G.825 (2000), *The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH*).
- ITU-T G.826 (1999), *Error performance parameters and objectives for international constant-bit rate digital paths at or above the primary rate*.

– ITU-T G.827 (2000), *Availability parameters and objectives for paths elements of international constant-bit rate digital paths at or above the primary rate*.

3 Terms and definitions

This Recommendation defines the following terms:

3.1 Quality of Service (QoS): The collective effect of service performances which determine the degree of satisfaction of a user of the service.

NOTE – The Quality of Service is characterized by the combined aspects of service support performance, service operability performance, service integrity and other factors specific to each service.

3.2 Intermediate audio quality: Audio quality lower than defined in ITU-R BS.1116, if acceptable or unavoidable. Rapid developments in the use of the Internet for distribution and broadcast of audio material, where the data rate is limited, have led to a compromise in audio quality. Other applications for such lower audio quality are digital AM, digital satellite broadcasting, commentary circuits in radio and TV, audio on demand services and audio on dial-up lines.

3.3 Latency time: The absolute delay of a signal between the signal source and the signal destination. The latency time can be divided into codec latency time, i.e. the latency ascribed to the codec equipment in the connection, and network latency time dependent on the type and length of the transmission channel.

3.4 Response time: Delay in applications of interactive services between the start of a user command and the reaction of the whole system reaching the user. It is combined from both the latency time of the interaction channel, the latency time of the server and the combined network and codec latency time of the forward channel.

3.5 Recovery time: Delay from the end of an interruption (or after an impairment or disturbance) until the start of the normal operation, i.e. up to the time when the audio quality comes back to the normative quality.

4 Abbreviations

This Recommendation uses the following abbreviations:

BAQ Basic Audio Quality

BER Bit Error Rate

MOV Model Output Variable

ODG Objective Difference Grade

PEAQ Perceived Audio Quality

QoS Quality of Service

5 Quality of Service (QoS): Parameters, measurement and control

5.1 Subjective assessment of audio quality

ITU-R BS.1116-1, BS.1283, BS.1284, BS.1285 and BS.1286 describe the methods, parameters, acoustical conditions and further details for subjective listening tests, organized and carried out with relatively high demand and evaluated with complex and complicated mathematical methods[1].

Tests and experiences made in the normal daily operation of audio transmission have shown that methods for the subjective assessment of audio quality described in these Recommendations are too precise and complicated for the daily operation. But such methods may be appropriate for tests of new equipment or during the lining-up period of new circuits before they go into operation.

5.2 Objective measurement of audio quality

Traditional audio quality parameters as "weighted or unweighted noise", "harmonic distortions" and others cannot be used if the audio signal is compressed with any coding method (MPEG-1, MPEG-2 or others). ITU-R BS.1387 uses the parameter "Basic Audio Quality" (BAQ), expressed in Objective Difference Grades (ODG).

The *Method for objective Measurement of Perceived Audio Quality (PEAQ)* consists of a peripheral ear model, several intermediate steps, the calculation of a (mostly) psychoacoustically-based *Model Output Variables (MOVs)* and a mapping from a set of Model Output Variables to a single value representing the *Basic Audio Quality (BAQ)* of the signal under test. It includes two peripheral ear models, one based on an FFT and one based on a filterbank. The *Basic Version* includes only MOVs that are calculated from the FFT-based ear model. The filterbank-based part of the model is not used. The *Basic Version* uses a total of 11 MOVs for the prediction of the perceived BAQ. The *Advanced Version* includes MOVs that are calculated from the filterbank-based ear model as well as MOVs that are calculated from the FFT-based ear model. This version uses a total of 5 MOVs for the prediction of the perceived BAQ.

The ODG values range from 1 to 5, where 5 corresponds to an imperceptible impairment and 1 to an impairment judged as very annoying. For the transmission over contribution and distribution networks, the following relation is valid:

in x% of the time, the ODG should be better than ODG_x;

in y% of the time, the ODG should be better than ODG_y;

for example: 99.5% of the time: ODG > 4.5

99.99% of the time: ODG > 4.0.

The operational measurement technology of the PEAQ method has still to be developed on the basis of the new PEAQ equipment. This technology will be suitable objectively to assess the audio quality, even during a live transmission. At present, PEAQ supports one parameter (BAQ), other parameters (for example "Coding Margin") require further study.

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[1] The new draft Recommendation BS.1534 was prepared by ITU-R JWP 10/11Q and the EBU Project Group B/AIM in 1999. This draft describes a method for subjective assessment of intermediate audio quality. The method is called MUSHRA (MUlti Stimulus test with Hidden Reference and Anchor). Its status is Draft new Recommendation and was approved in June 2000.

5.3 Network related audio quality parameters

Network related audio quality parameters are audio quality parameters which have a relationship with the network characteristics and network performances. Such parameters are:

– latency time;

– time difference between different signals (audio/video, audio/audio, (see ITU-R BT.1359-1)];

– response time for interactive services;

– recovery time;

– availability figures connected with the audio equipment.

The acceptable limits and the measurement methods for the values of these parameters are for further study.

5.4 General network parameters

These parameters describe the performance of the digital transmission network, not directly connected with the audio performance. Such parameters are:

– error performance (BER, cell losses, etc);

– slip rate;

– jitter and wander;

– availability parameters related to the network.

ITU-T G.821, G.822, G.823, G.824, G.825, G.826 and G.827, have defined these parameters and methods for their measurement and control.

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