

译 ITU-T G.1080 IPTV的体验质量(QoE)要求 (Quality of experience requirements for IPTV services)

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IPTV的服务质量(QoE)要求 Quality of experience requirements for IPTV services

Summary

This Recommendation defines user requirements for Quality of Experience for IPTV services. The QoE requirements are defined from an end user perspective and are agnostic to network deployment architectures and transport protocols. The QoE requirements are specified as end-to-end and information is provided on how they influence network transport and application layer behaviour. QoE requirements for video, audio, text, graphics, control functions and meta-data are provided. Compression coding schemes addressed in this Recommendation are examples, and detailed numeric values as performance targets, e.g. bit rate, packet loss rate, are also examples. The readers may appropriately choose or replace these parameters values in order to be consistent with the requirements of each IPTV service context to which they are intended to be applied.

Keywords

IPTV, QoE, QoS

1 范围 (Scope)

This Recommendation defines user requirements for Quality of Experience (QoE) for IPTV services. The QoE requirements are defined from an end-user perspective and are agnostic to network deployment architectures and transport protocols. The QoE requirements are specified for the end-to-end service and information is provided on how they influence network transport and application layer behaviour. Compression coding schemes addressed in this Recommendation are examples, and detailed numeric values given as performance targets, e.g. bit rate, packet loss rate, are also examples. The readers may appropriately choose or replace these parameters values in order to be consistent with the requirements of each IPTV service context to which they are intended to be applied.

2 参考(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 published regularly. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-TE.800]	ITU-T Recommendation E.800 (1994), <i>Terms and Definitions Related to Quality of Service and Network Performance Including Dependability</i>
[ITU-T F.700]	ITU-T F.700 (2000), <i>Framework recommendation for multimedia services</i> ,
[ITU-T H.262]	ITU-T Recommendation H.262 (2000), <i>Information technology - Generic coding of moving pictures and associated audio information: Video</i>
[ITU-T H.264]	ITU-T Recommendation H.264 (2005), <i>Advanced video coding for generic audiovisual services</i>
[ITU-T P.10/G.100]	ITU-T Recommendation P.10/G.100, Amd 1 (2007), <i>New Appendix I, Definition of Quality of Experience (QoE)</i>
[ITU-T P.800]	ITU-T Recommendation P.800 (1996), <i>Methods for Subjective Determination of Transmission Quality</i>
[ITU-TT.140]	ITU-T Recommendation T.140 (1998), <i>Protocol for Multimedia Application Text Conversation</i>
[ITU-TY.1541]	ITU-T Recommendation Y.1541 (2006), <i>Network Performance Objectives for IP-based Services</i>
[ITU-R BT.500-11]	Recommendation ITU-R BT.500-11 (2002), <i>Methodology for the subjective assessment of the quality of television pictures</i>
[ITU-R BT.601-6]	Recommendation ITU-R BT.601-6 (2007), <i>Studio encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios</i>
[ITU-R BT.1359-1]	Recommendation ITU-R BT.1359-1 (1998), <i>Relative timing of sound and vision for broadcasting</i>

3 定义(Definitions)

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 Quality of experience (QoE) [ITU-TP.10/G.100]: The overall acceptability of an application or service, as perceived subjectively by the end-user.

NOTE 1 – Quality of Experience includes the complete end-to-end system effects (client, terminal, network, services infrastructure, etc.).

NOTE 2 – Overall acceptability may be influenced by user expectations and context.

3.2 Terms defined in this recommendation

This recommendation defines the following terms:

3.2.1 Channel zapping: The act of quickly changing from one channel to another

3.2.2 Group of Pictures: The Group of Pictures (GOP) is a group of successive pictures within a MPEG-coded film and/or video stream. Each MPEG-coded film and/or video stream consists of successive GOPs. From the MPEG pictures contained in it, the visible frames are generated.

3.2.3 VoD Trick Modes: Download and streaming video on demand (VoD) systems provide the user with a large subset of VCR functionality including **pause**, **fast forward**, **fast rewind**, **slow forward**, **slow rewind**, **jump to previous/future frame** etc. These functions are usually referred to as "trick modes".

3.2.4 Triple Play Services: Services that include IPTV, VoIP, and Internet Access

3.2.5 Clean Audio: Audiobook of an IPTV Service with background sounds removed.

4 缩写和首字母缩略词(Abbreviations and acronyms)

This Recommendation uses the following abbreviations and acronyms:

AAC	Advanced Audio Coding 高级音频编码
AC-3	Dolby Digital Audio (Advanced Codec 3)AC-3杜比数字音频
ARQ	Automatic Repeat reQuest 自动重发请求
ATIS	Alliance for Telecommunications Industry Solutions
ATSC	Advanced Television Systems Committee 先进电视系统委员会
A/V	Audio Video 音频视频
AVC	Advanced Video Codec 高级视频编解码器
AVS	Audio and Video coding Standard (Chinese) AVS音视频编码标准 (中国)
BER	Bit Error Rate 误比特率
BML	Broadcast Markup Language
CBR	Constant Bit Rate
CPU	Central Processing Unit
DCT	Discrete Cosine Transform
DSCQS	Double Stimulus Continuous Quality Scale
DSL	Digital Subscriber Line
DVB	Digital Video Broadcast
DVD	Digital Video Disk
ECG	Electronic Content Guide
EPG	Electronic Program Guide
FEC	Forward Error Correction
FFW	Fast Forward
fps	frames per second
GOP	Group of Pictures
GWR	GateWay Router

HDTV	HighDefinition TeleVision
HG	HomeGateway
HTML	HyperTextMarkup Language
IETF	TheInternet Engineering Task Force
IGMP	InternetGroup Management Protocol
IGP	InteractiveGateway Protocol
IPG	InteractiveProgram Guide
ITU-R	InternationalTelecommunication Union RadiocommunicationSector
ITU-T	InternationalTelecommunication Union TelecommunicationStandardization Sector
IP	InternetProtocol
IPTV	InternetProtocol TeleVision
MOS	MeanOpinion Score
MP	MeasuredPoint
MP-3	MPEG-1Audio Layer 3
MPEG	MovingPictures Expert Group
MPLS	MultiProtocolLabel Switching
NICAM	NearInstantaneous Companded Audio Multiplex
NTSC	NationalTelevision Standards Committee
PAL	PhaseAlternating Line
PC	PersonalComputer
PDV	PacketDelay Variation
PHB	Per-Hop Behaviour
PLR	Packet Loss Ratio
PTD	PacketTransfer Delay
QoE	Qualityof Experience
QoS	Qualityof Service
RFC	RequestFor Comments
SDH	SynchronousDigital Hierarchy
SDTV	StandardDefinition TeleVision
SECAM	SEquentielCouleur A Mémoire, French for "Sequential Color with Memory"
SMPTE	Societyof Motion Picture and Television Engineers
SONET	SynchronousOptical NETwork
STB	Set-TopBox
TS	TransportStream
VBR	VariableBit Rate
VoD	Video on Demand
VoIP	Voice over IP
VCR	Video Cassette Recorder

5 介绍QoE (Introduction to QoE)

QoE is defined in [ITU-T P.10/G.100] in Appendix I as the overall acceptability of an application or service, as perceived subjectively by the end-user. It includes the complete end-to-end system effects (client, terminal, network, services infrastructure, etc) and may be influenced by user expectations and context. Hence in principle, QoE is measured subjectively by the end-user and may differ from one user to the other. However, it is often estimated using objective measurements.

Differences in perceptual acuity and preference mean that QoE judgments obtained from different people may vary. Therefore, measurements of QoE are generally made using group data. Where the necessary studies have been done to calibrate the relationship with QoE, it may also be estimated using objective measurements.

A number of system performance characteristics contribute to QoE of the media stream. For example, the codec and the encoding bit rate used, media resolution in the source and at the display, corruption or loss of information, and delay. Interactions among video content, the codec and bit rate used, and the specific bits corrupted and/or packets lost contribute to a high variability in the perceived quality of the video output.

There are additional factors that can influence the viewer's response. Some of these affect the perception of quality, such as the context of the judgment (a particular image will be rated one way in the context of standard definition TV (SDTV), another in the context of high definition TV (HDTV), and still differently in the context of a video clip on Internet), cultural background, motivation, attention related factors, emotional state, and so on. (Direct evaluations of QoE are designed to exclude these factors, since they are not generally under the control of a network operator and so do not contribute to equipment requirements.)

Other factors influence the viewer's judgment of acceptability. These include things like previous experience with the specific communication mode or related modes (for instance, experience with DVD quality will influence how acceptable one finds IPTV or VoD), how much one is paying for the service, and what special benefits the service provides (mobility, time independence, exceptionally large program library), and soon.

Acceptability is not equivalent to QoE. A low resolution video image will have a lower QoE than a high resolution image, but it may be completely acceptable for certain applications and services, depending on the end device, the physical size of the display, and the purpose for which it is being used.

Figure 5-1 shows factors contributing to QoE. These factors are organized as those related to quality of service and those that can be classified as human components.

QoE for video is often measured via carefully controlled subjective tests [ITU-R BT.500-11], [ITU-T P.800], where video samples are played to viewers, who are asked to rate them on a scale, typically consisting of five points. The rating assigned to each case is averaged together to yield a mean rating or mean opinion score (MOS).

Quality of service (QoS, see ITU-T E.800) involves the totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service. In general, network performance is a major component of QoS, and so network mechanisms for QoS are an important consideration. QoS mechanisms include any mechanism that contributes to improvement of the overall performance of the system and hence to improving end-user experience. QoS mechanisms can be implemented at different levels. For example at the network level it includes traffic management mechanisms such as buffering and scheduling employed to differentiate between traffic belonging to different applications. QoS mechanisms at levels other than the transport include loss concealment, application forward error correction (FEC), etc.

Related to QoS are the QoS performance parameters. Similar to the QoS mechanisms QoS parameters can be defined for different layers. At the network layer those parameters usually include packet loss rate, delay and delay variation.

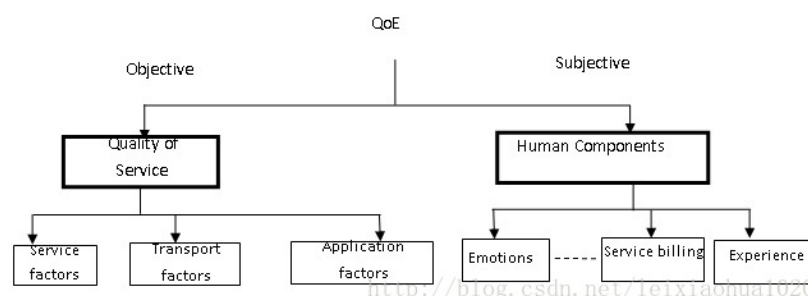


Figure 5-1/G.1080 - QoE Dimension

Note that in this Figure, service billing relates to the "value for money" perceived by the user for the particular service.

Typically there will be multiple service level performance (QoS) metrics that impact overall QoE. There are a number of service level performance characteristics (that is, objective parameters of service performance such as encoding bit rate, packet loss, delay, availability, etc.) that affect QoE. In general, these are correlated with QoE as measured by the MOS. The relation between QoE and service performance (QoS) metrics is typically estimated empirically. Having identified the QoE/QoS relationship, it can be used in two ways:

1. Given a QoS measurement, one could in principle predict the expected QoE for a user, with appropriate assumptions.
2. Given a target QoE for a user, one could in principle deduce the net required service layer performance, with appropriate assumptions.

To ensure that the appropriate service quality is delivered, QoE targets should be established for each service and be included early on in system design and engineering processes where they are translated into objective service level performance metrics. Quality of Experience will be an important factor in the marketplace success of triple-play services and is expected to be a key differentiator with respect to competing service offerings. Subscribers to network services do not care how service quality is achieved. What matters to them is how well a service meets their expectations for effectiveness, operability, availability, and ease of use.

6 视频和音频的QoE (QoE for video and audio)

QoE requirements for video and audio may be based on QoE scales such as the Mean Opinion Score (MOS) and Double Stimulus Continuous Quality Scale (DSCQS) [ITU-R BT.500-11]. However, conducting subjective tests is difficult because they are time consuming and expensive. Moreover, reliable objective quality assessment methods have not been established for transmitted video and audio. Therefore, this clause provides provisional QoE requirements on the basis of the objective parameters that are correlated to the subjective QoE.

This Recommendation addresses QoE targets and shows how to express QoE requirements in the context of numerical parameters such as bit rate or packet loss rate. The process of determining QoE performance targets must consider a number of issues for example: the purpose of the IPTV service, QoE level of the current broadcasting systems (which sets user expectation), compression coding scheme to be used for the service, content characteristics, content provider requirements, customer satisfactions. While the requirement values shown in the tables in this clause are NOT generically applicable to any specific or all IPTV services, they are to be understood as provisional values which are subject to change. Readers of this Recommendation are invited to replace the numerical values shown in the tables in this clause with appropriate ones that conform to the requirements required by a specific IPTV service context.

6.1 媒体压缩和同步要求 Requirements for media compression and synchronization

One of the main components of QoE for video and audio is digitization and compression of video and audio source materials and the various settings and parameters selected. Since video compression schemes such as those defined by the Moving Picture Expert Group (MPEG) are not lossless and an identical copy of the original source material cannot be recovered, there are potentially negative impacts on video picture quality and therefore on viewer QoE. The main factors influencing video QoE at the application layer due to compression are:

- Quality of source material

- the quality of the delivered media depends on the quality of the source material.

- The baseline quality (no network impairments) of the codec.

Note: A partial list of video codecs is provided in Appendix II.

- Resolution

- Some systems reduce the horizontal resolution to achieve the target bit rates, for example in standard definition television (SDTV) the resolution may be reduced to 'Half' or 'Three Quarters' which produces a less sharp picture than 'Full' resolution

- Bit rate

- During periods of high complexity (entropy) compression may leave visible artefacts if the bit rate is not sufficient

- Application layer video encoding - constant bit rate (CBR) vs. variable bitrate (VBR) at the encoder output

- Video encoding is naturally variable bit rate but to simplify network engineering for Telco delivery systems, the video encoders are set to provide a constant bit rate (as averaged over some specified time period in the order of seconds).

- VBR streams such as those used in DVD encoding have constant quality since the bit rate is allowed to vary to accommodate varying complexity of the source material

- CBR streams have variable quality since there may be times when the bitrate is insufficient to accommodate the video complexity but CBR streams allow straightforward traffic engineering and system design

- Group of Pictures (GOP) structure

- Shorter GOPs improve quality in terms of performance of random accessibility and error recovery, but reduce the maximum compression ratio.

- Longer GOPs improve maximum compression ratio, but increase channel change time and the amount of damage a lost packet will cause.

- Dynamic GOPs can be used to better handle scene changes and other effects but are not always implemented on STBs. In addition, dynamic GOPs can cause variability in zapping latency and may complicate mechanisms intended to increase zapping speed.

- Motion Vector Search Range

- Wider searches provide improved quality but at increased complexity and encoder delay

- Large search ranges are required for high motion content such as sports

- Rate Control

- Mode decisions greatly affect the bit rate
- Proprietary schemes are commonly used to gain competitive advantage
- Pre-processing (such as noise reduction)
- Usually proprietary and non-standard but can improve bit rate / quality trade-off
- Tandem encoding and rate shaping (e.g. digital turnaround)

Video Compression Artefact Examples

Figure 6-1 illustrates several kinds of compression artefacts that are largely due to insufficient bits allocated resulting in too coarse quantization of DCT coefficients or motion vectors and/or otherwise poor motion estimation. Additional details of compression artefacts may be found in [b NTI A264].



Figure 6-1/G.1080 - Compression Artefacts [1]

Similarly, there are similar parameter implications on the audio side.

Note: A partial list of audio codecs is provided in Appendix II

In addition to the separate audio and video application layer impairments, the synchronization between audio and video components must be maintained to ensure satisfactory QoE. There has been a great deal of research on A/V synchronization requirements in video conferencing and analogue broadcast systems and specifications in such bodies as ITU-R [b ITU-R BT.1359-1].

Because audio that appears before video is very unnatural (sound takes longer to propagate than light so sound lagging visual is normal) some broadcast systems specifying television specific A/V synchronization have recommended tighter tolerances than typically used for video conferencing applications.

Recommended provisional minimum engineering objectives for application layer, data plane parameters are presented in the following sub-clauses for various video services.

Note: Appendix III provides supplementary information related to the following sub-clauses.

6.1.1 标清电视：一般最低要求 Standard definition TV (SDTV): General minimum objectives

Table 6-1 provides provisional video application layer performance objectives at the MPEG elementary stream level, prior to IP encapsulation for broadcast SDTV (480i / 576i). The objectives for audio elementary stream bitrates are additionally specified below.

Table 6-1/G.1080 - Provisional Application Layer Performance requirements for Standard Definition Broadcast Program Sources

Video Codec standard (non-inclusive list)	Minimum Bit Rate (video elementary stream level)	Pre-processing Enabled
H.262 - Main profile at Main level (MP@ML)	2.5 Mbit/s CBR	Yes (if available)
H.264 (Main profile at Level 3.0)	1.75 Mbit/s CBR	Yes (if available)
SMPTE 421M	1.75 Mbit/s CBR	Yes (if available)
AVS	1.75 Mbit/s CBR	Yes (if available)

Table 6-2 provides provisional audio application layer performance requirements for standard definition audio sources.

Table 6-2/G.1080 - Provisional Audio Application Layer Performance requirements for Standard Definition Sources

Audio Codec Standard (Non-inclusive list)	Number of Channels	Minimum Bit Rate (audio elementary stream level, in kbit/s)
MPEG-1 Audio Layer II	Mono or stereo	128 for stereo
Dolby Digital (AC-3)	5.1 if available, else left/right stereo pair	384 for 5.1ch / 128 for stereo
AAC	Stereo	96 for stereo
MPEG-1 Audio Layer III (MP3)	Stereo	128
MPEG-2 Audio Layer III (MP3)	Stereo	For further study

In general, audio codecs chosen should align with industry standards in the geography of deployment to ensure maximum compatibility with consumer receivers. Bit rates should be aligned with original source material quality and transcoding between formats should be avoided if possible.

Table 6-3 provides provisional audio-video synchronization requirements.

Table 6-3/G.1080 - Provisional SDTV Audio – Video Synchronization Requirement

Audio – Video Synchronization	Audio Lead Video	Audio Lag Video
	15 ms maximum	45 ms maximum

Inconsistent loudness levels between channels can negatively impact QoE. It is recommended that equipment be used in the service provider head-end to ensure similar loudness levels across the range of channels provided to the user.

Another audio quality issue beyond the scope of this document is the dynamic range compression for links between the STB and TV.

6.1.2 标清电视：点播和优质内容的要求 Standard definition (SD) TV: VoD and Premium Content Objectives

Video on demand (VoD) and other premium content such as pay per view in standard definition format will have similar application layer performance factors as regular broadcast materials. However, subscriber expectation may be higher because of additional fees paid to access the content and comparison to alternative delivery options. In the case of VoD, users may compare to VoD materials delivered over digital cable systems or even contained in DVDs.

Table 6-4 provides recommended video encoding bit rates for standard definition, VoD and other premium content.

Table 6-4/G.1080 - Provisional Application Layer Performance requirements for H.262 Standard Definition VoD and Premium Program Sources

Video Codec standard (Non-inclusive list)	Minimum Bit Rate (video elementary stream level)	Pre-processing Enabled
H.262 - Main profile at Main level (MP@ML)	3.18 Mbit/s CBR	Yes (if available)
H.264 (Main profile at Level 3)	2.1 Mbit/s CBR	Yes (if available)
SMPTE 421M	2.1 Mbit/s CBR	Yes (if available)
AVS	2.1 Mbit/s CBR	Yes (if available)

Table 6-5 provides provisional recommended audio codec bit rates for VoD and premium content.

Table 6-5/G.1080 - Provisional Audio Application Layer Performance for VoD and Premium Standard Definition sources

Audio Codec Standard (non-inclusive list)	Number of Channels	Minimum Bit Rate (audio elementary stream level, in kbit/s)
Dolby Digital (AC-3)	5.1 if available, else left/right stereo pair	384 for 5.1ch / 192 for stereo
AAC	5.1 if available, else left/right stereo pair	384 for 5.1ch / 192 for stereo

6.1.3 高清电视 High definition TV (HDTV):

Table 6-6 provides provisional video application layer performance objectives for broadcast HDTV (720p / 1080i).

Table 6-6/G.1080 - Provisional Application Layer Performance requirements for High Definition (HD) Broadcast Program Sources

Video Codec standard (non-inclusive list)	Minimum Bit Rate (video elementary stream level)	Pre-processing Enabled
H.262 - Main profile at Main level (MP@ML)	15 Mbit/s CBR	Yes (if available)
H.264 (Main profile at Level 4)	10 Mbit/s CBR	Yes (if available)
SMPTE 421M	10 Mbit/s CBR	Yes (if available)
AVS	10 Mbits/s CBR	Yes (if available)

Table 6-7 provides provisional audio application layer performance requirements for high definition audio sources.

Table 6-7/G.1080 - Provisional Minimum Audio Application Layer Performance requirements for High Definition Sources

Audio Codec standard (non-inclusive list)	Number of Channels	Minimum Bit Rate (Audio elementary stream level, in kbit/s)
MPEG-1 Audio Layer II	Mono or stereo	128 for stereo
Dolby Digital (AC-3)	5.1 if available, else left/right stereo pair	384 for 5.1ch / 128 for stereo
AAC	5.1 if available, else left/right stereo pair	384 for 5.1ch / 128 for stereo
MPEG-1/2 Audio Layer III (MP3)	Stereo	128

6.2 网络传输性能的影响 Impact of network transmission on performance

Key criteria for network transmission include loss, latency and jitter (see Appendix I). In general, reasonable end-to-end delay and jitter values are not problematic due to STB de-jitter buffers, provided the de-jitter buffer size is provisioned to match network and video element performance. Video streams however are highly sensitive to information loss and the QoE impact is in turn correlated to a number of variables including:

- Highly dependent on type of data lost
- System information and header losses produce different impairments
- Lost data from I and P frames produced different impairments than B frame packet losses due to temporal error propagation
 - Dependent on codec used
 - Dependent on MPEG transport stream packetization used
 - Loss distance and loss profile
 - With high encoding bit rates, the stream is more vulnerable to packet loss impairments
- For the same packet loss ratio, impairments due to loss on a higher rate video stream occur more frequently (i.e. there are more visible errors per unit time) simply because there are more packets per second transmitted and each one has the same probability to be affected.
 - Decoder concealment algorithms can mitigate perceptual impact of some losses.

An error or sequence of errors in a video bit stream can cause effects ranging from no noticeable audio or video impact to the user to complete loss of the video or audio signal depending on what was lost and the robustness of the implementation.

Appendix IV provides additional information as to how transmission impairments can affect quality.

The video application should be able to operate normally in the presence of normal operational defects. One such normal operational consideration is the operation of protection switching mechanisms in the network. SONET/SDH protection switching mechanisms may result in a potential packet loss duration in the order of, for example, 50ms. For some other protection mechanisms (e.g. MPLS fast reroute, fast IGP convergence) the potential packet loss duration can be longer, for example, on the order of 250ms. Service providers are encouraged to add mechanisms to minimize or eliminate the visible effect of such protection mechanisms as these events cascade to a large number of subscribers.

Considering some other protection mechanisms the potential packet loss duration can be longer. For example, a complete reconvergence of the IGP routing table would imply potential packet loss bursts in the order of 30 sec. An IPTV system would not be expected to maintain normal service through such an event. Such events can be considered a service outage rather than an in-service quality defect.

The goal is to minimize visible artefacts to as few as possible using a combination of network performance requirements, loss recovery mechanisms (e.g. FEC, interleaver) and loss mitigation mechanisms (e.g. decoder loss concealment).

7 文字和显示的QoE (QoE for text and graphics)

Information in this clause is taken from [ITU-T F.700].

7.1 Media component text

7.1.1 定义 Definition

The media component text allows for the capture and representation of information, its transfer from originating user(s) to destination user(s), its presentation to human user(s), processing, filing and retrieval.

7.1.2 描述 Description

7.1.2.1 General description

Text is a representation medium consisting of formatted characters. It is stored and transmitted as a sequence of codes. Although it may be displayed on the same screen as video and still pictures, it requires decoding into specific fonts for presentation to the user, whether on the screen or on paper. The input is through a keyboard. The output may be presented by a printer or on a screen.

The following levels of quality are defined:

T0: minimum quality, basic alphabet and punctuation, no formatting or choice of font;

T0 *bis*: videotex quality, basic alphabet and punctuation, basic graphic character set, no formatting or choice of font;

T1: Usable text conversation quality characterized by:

- Font support for [b_ISO-10646] Language area Latin-1 plus the target language area for the implementation.
- No more than 1 corrupted, dropped or marked missing character per 100.
- Delay from character input in the transmitter to display in the receiver shorter than 2 s.

T2: Good text conversation quality characterized by:

- Font support for all characters in [b_ISO-10646].
- No more than 1 corrupted, dropped or marked missing character per 500.
- Delay from character input in the transmitter to display in the receiver shorter than 1 s.

7.1.2.2 Additional facilities

The user may be given control over text through editing and presentation functions. He may also be able to insert graphics, still pictures or animated pictures within the text.

7.1.2.3 Requirements for various audiovisual services

When text is for the support of conversational services, the timing aspects of text entry and display are critical. Text may be transmitted and displayed in near real time, as text is entered. It may also be transmitted only after specific end-of-sentence action or on a specific send request. In a conversation between two users, the near real-time conversation is important for optimized benefit of the conversation. For multi-user conferences, a sentence-based transmission may be more relevant in an open discussion, while for a subtitled speech, the real-time text transmission is preferred.

For retrieval services, it may be accepted to transmit and display a whole page of text in one operation.

For conversation, editing may be reduced to "new line", "erase last character", while the editing for information retrieval should contain a possibility to replace text anywhere on the page and add various formatting effects to any part of text. Annotations that stand out distinctly are also desirable.

The levels of text quality required for various services are the following (marked by X):

Table 7-1/G.1080 - Levels of Text Requirements

Service	Quality level			
	T0	T0 <i>bis</i>	T1	T2
Telex	X			
Videotex		X		
Text telephony			X	X
Total Conversation				X
Messaging services			X	X
Retrieval services			X	X

7.1.3 质量方面 Quality Aspects

The quality of text depends mainly upon the capabilities for formatting and using different types of fonts and special characters. When no error correction is made, for instance in conversation, text quality is also measured in terms of corrupted characters, dropped characters and characters replaced by the missing text marker [ITU-T T.140].

7.1.4 Intercommunication

The characters with their formatting may be decoded and assembled into bit maps which can then be handled as still pictures, e.g. as facsimile pages.

7.2 Media component graphics

7.2.1 定义 Definition

The media component graphics allows for the capture and representation of information, its transfer from originating user(s) to destination user(s), its presentation to human user(s), processing, filing and retrieval. This media component allows graphic pictures to be captured and transmitted as geometrical objects whose positions, shapes and colours are coded so that they can be reproduced in a distant terminal.

7.2.2 描述 Description

7.2.2.1 General description

Graphics is a representation medium consisting of geometrical objects featured by their positions, shapes and colours. It is stored and transmitted as a set of codes and parameters. Although it may be displayed on the same screen as video and still pictures, it requires decoding into specific geometrical figures for presentation to the user, whether on a screen or on paper.

The input may be through a graphics tablet, an electronic pencil, some other two-dimensional transducer or dedicated graphic software on a micro computer or workstation. The output device may be a printer or a screen.

7.2.3 Quality aspects

The intrinsic quality of the graphic depends on the number and the complexity of the objects that can be generated, the precision of their dimensions and positions, the number of possible colours. The overall quality perceived by the user depends also on the resolution of the input and output systems.

7.2.4 Intercommunication

The graphic objects may be decoded and assembled into bit maps which can then be handled as still pictures.

8 控制功能的QoE (QoE for control functions)

8.1 频道切换时间的QoE要求 QoE requirements for channel zapping time

Channel zapping time (channel switching time) has strong relationship with end user experience of service quality. Generally, it is primarily determined by the time required to have a proper frame at the STB to start decode processing for the new channel. Channel zapping requests can occur when

- Meta data request in EPG or IPG
- Random selecting channel by entering channel number using remote control
- Channel Up/Down button using remote control
- Channel Up/Down button using STB front panel
- Selecting a channel on IPG application menu
- Powering on STB/TV and tuning to initial channel assigned by IPG

As a QoE parameter, channel zapping time can be described by three components: IGMP delay, buffering delay, and decoding delay, as shown in the Figure below (note that the timings are not necessarily to scale).

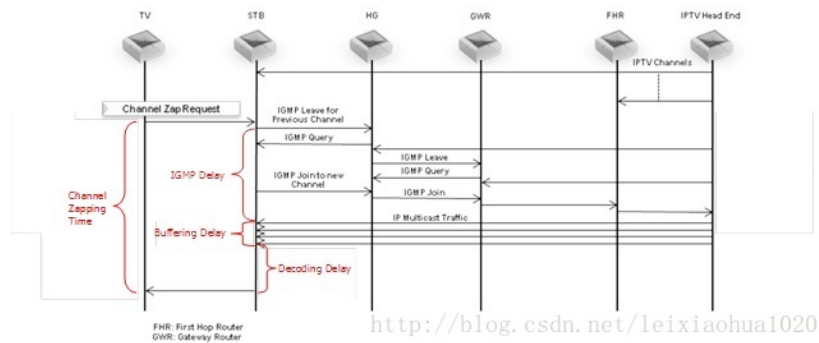


Figure 8-1/G.1080 - Components that contribute to Channel Zapping Time

8.1.1 频道切换时间的分类 Classification of channel zapping time

8.1.1.1 IGMP延时 IGMP delay

A channel zap request is triggered by a channel change which is mapped by the STB to a multicast group address carried in the IGMP message. The IGMP message, which includes join message, is sent to the home gate (HG). The HG, playing an IGMP proxy role, will process the IGMP message and send an IGMP request to the Gateway Router (GWR). After the IGMP message is sent towards the rendezvous point by the GWR, the corresponding channel data should be delivered to the endpoint at some point. The time to get the content data after sending the first IGMP message is called the IGMP delay.

8.1.1.2 缓冲延时 Buffering delay

While the STB receives IPTV multicast traffic, it stacks the packets in a buffer. Buffering delay is the time between the arrival of the first multicast traffic in the buffer and when the STB has sufficient data for playing to the screen.

8.1.1.3 解码延时 Decoding delay

After STB starts to receive and buffers multicast stream, decoding delay processes buffered data and renders them to TV screen. This type of delay includes both codec decoding delay, which intends to program-specific information frames in order to decide the target channel and I-frame acquisition delay, which is for reduction of bandwidth required for digital video transmission.

8.1.2 频道切换时间的要求 Requirements for Channel Zapping Time

One of the key elements involved in validating Quality of Experience (QoE) in IPTV service is how quickly users can change TV channels, which is often referred to as Channel Zapping Time. However, the explicit relation between Channel Zapping Time and the user perceived quality as expressed as a Mean Opinion Score (MOS) is still under study [b_CZT_TNO].

8.2 视频点播控制功能的QoE要求 QoE requirements VoD trick mode

Video on Demand (VoD) trick mode provides VCR-like features in VoD services. When a subscriber desires a video content through STB, the subscriber accesses the video content from the EPG which supports the contents-search engine to help access of content information. To guarantee VCR-like flexibility, this mode provides the trick ability to handle pause, play, rewind, fast forward, and stop entries for these control features.

8.2.1 控制的延迟 Trick Latency

Correspondently, each control function (video selection, play, pause, rewind, FFW, stop) has its own delay. QoE metrics for VoD transaction quality are expressed by the following indicators:

- Video selection process delay: Timing period from the time when the subject is selected to the time when content is displayed.
- Play Delay: Timing period from the time when the Play entry was selected to the time the content is displayed.
- Stop Delay: Timing period from the time when the Stop play video entry was selected to the time the content is stopped playing as indicated by video content display.
- Rewind Delay: Timing period from the time when the Rewind video entry was selected to the time the rewind action is executed as indicated on display device.
- Pause Delay: Timing period from the time when the Pause video entry was selected to the time the pause action is executed as indicated on display device.
- FFW Delay: Timing period from the time when the Fast Forward video entry was selected to the time the FFW action is executed as indicated on display device.

8.2.2 控制的QoE要求 Requirements for VoD Trick Features

From a QoE perspective, trick feature latency is one of the most important issues to guarantee satisfaction of subscribers. As each trick feature lat

ency directly affects QoE, the latency is required to be sufficiently low to meet user's requirement for QoE relating to VoD trick features.

9 其他IPTV服务的QoE (QoE for other IPTV services)

9.1 元数据的QoE要求 QoE requirements for Metadata

Figure 9-1 shows the components of Metadata.

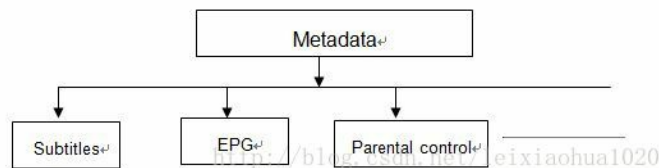


Figure 9-1/G.1080 - Components of Metadata

(1) Availability

High availability is recommended to be ensured in transmitting the metadata on network.

(2) Data size

Metadata is recommended to be transported in such a way that the size of the transported data would be sufficiently small, relative to such factors as the number of the total services, the number of the contents, and network bandwidth.

(3) Correctness

The service provider should ensure the metadata tagged to a particular content is correct.

An example to illustrate the importance of metadata is the correctness of "rating" of content. The correct rating on content is directly related to what the customer expects. An incorrect parental rating e.g. a "family" rating for an adult movie can have serious implications for the customer experience and business of the service provider.

9.1.1 EPG的QoE要求 QoE requirements for EPG

The following items are recommended to be considered as part of the definition of QoE for IPTV services.

(1) User-friendliness

EPG user interface is recommended to be designed for ease of use.

(2) Response time to display EPG page

The response time - the interval from pushing the EPG button of remote control to the display of the EPG page - is recommended to be sufficiently short.

9.2 浏览器的QoE要求 QoE requirements for Browser

If a browser, such as those for BML or HTML, is used to provide the user an interactive content from the service provider, the following points are recommended to be taken into account.

(1) Characteristics of a television set

The IPTV QoE requirements on browsers are recommended to take into account that the behavioural patterns and expectations of television users typically differ from those of PC users.

Moreover the differences in the capacities of typical TVs (and STBs), on one hand, and PCs, on the other, should be taken into account. For example, as the CPU performance of a television set is usually inferior to that of PC, the contents designed for PC-use does not necessarily work in the TV environment, making it necessary to set up QoE measures taking into account the difference in CPU performance between PC and television. It should be stressed that the browser on an IPTV service may not have the same capacity as the browser on a PC has.

(2) TV-like display

Some features of TV-like display is recommended to be considered necessary for browser QoE, for such are commonly imposed by content providers. Examples are:

- Overlay function,
- Consistency of displayed pictures across terminals.

(3) Character size

The character size is recommended to be sufficiently large.

(4) Navigation

The navigation function is recommended to be considered for increasing the level of convenience and operability.

(5) Cookie

The use of Cookies is recommended to be done with care because of the possible limitation on the nonvolatile memory capacity of the terminal. The number, the size and the expiration date of cookies may need to be clearly specified.

9.3 内容导航的QoE要求 QoE requirements for Content Navigation

Content navigation is defined as functions for contents discovery and selection. So, content navigation is provided by various methods such as direct channel selection, EPG, recommendation. QoE requirements according to navigation methods are described in the following sections.

9.3.1 内容导航通过直接的选择，通过向上/向下按钮 Contents navigation by direct channel selection, by up/down button

Ease of contents selection, especially under numerous contents condition, is recommended to be considered. For that sake, the elapsed time for selecting contents and subjective evaluations of ease of use (e.g. MOS) are recommended to be considered.

9.3.2 内容导航通过EPG/ECG Contents navigation by EPG/ECG

EPG/ECG is one of the most useful ways of contents navigation. The elapsed time for discovering and selecting contents, and subjective evaluations of ease of use (e.g. MOS) are recommended to be considered.

9.3.3 内容导航通过内容推荐 Contents navigation by contents recommendation

Effective contents recommendation is useful for users. For example, IPTV service provider recommends contents to the user according to his/her preferences. And, contents recommendation from his/her friends is also effective.

For contents recommendation, recommendation accuracy and security of personal information are recommended to be considered. If the recommended contents include many preferring contents, the QoE of recommendation would be high. Obviously, the security of personal information affects QoE. And communication functions such as obtaining the 3rd parties' metadata is recommended to be considered.

10 可达性的要求 (Accessibility requirements)

The intent of this clause is to capture specific performance requirements for IPTV services related to accessibility. This is for further study, but will encompass the following areas:

- Audio quality (including the provision of clean audio)
- Video quality (including sufficient frame rate and resolution for sign language, lip reading etc [b_ITU-T HSUP1])
- Audio/video synchronisation

11 安全性考虑 (Security considerations)

Security aspects have not been addressed in this Recommendation.

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