ATIS-0100801.02.1996(R2006)

Digital Transport of Video Teleconferencing/Video Telephony Signals – Performance Terms, Definitions, and Examples

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Contents

Foreword (This foreword is not part of American National Standard T1.801.02-1996.)

This standard specifies a set of terms and definitions that are useful in descriptions of digital video telephony system quality. Until now, practitioners in this industry have used certain terms when communicating about their work, and have been particularly creative in choosing designators for the imperfections (impairments or distortions) associated with digital transmission of video and images. Many terms lacked formal definitions and two difficulties emerged, the introduction of terms having essentially identical definitions with existing terms, and the use of different definitions for the same term. The desire to communicate about this art as clearly as possible has prompted the development of these standard terms and definitions. Also, the desire for clarity has prompted the production of a video tape of illustrative examples for many of the definitions. A description of the contents of the tape is provided in informative annex A, and a copy of the tape is available for purchase from the Alliance for Telecommunications Industry Solutions (ATIS). For those who seek more information, a bibliography of related standards and publications may be found in informative annex B.

This standard was developed by Technical Subcommittee T1A1 under the Video Teleconference/Video Telephony Performance project. This project was begun in 1988 under the auspices of Technical Subcommittee T1Q1. With the goal of developing useful information for describing the performance of video telephony systems, members of the subcommittee recognized that communication in their industry would benefit from the standardization of their terminology. Further, the terms and definitions combined with illustrative examples are of sufficient value to communicate to the industry on their own.

This standard contains two annexes that are for information only and are not part of this standard.

Suggestions for the improvement of this standard are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005.

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American National Standard
for Telecommunications –

Digital Transport of Video Teleconferencing/Video Telephony Signals – Performance Terms, Definitions, and Examples

1 Scope, purpose, and application

1.1 Scope

This standard covers terms and definitions that are applicable to the digital transport of Video Teleconferencing/Video Telephony Signals (VTC/VT).

1.2 Purpose

The purpose of this standard is to define a common terminology for use in the VTC/VT community, thereby improving communication among current and future members.

1.3 Application

These standard terms, definitions, and examples are intended for use in verbal, written, and visual descriptions of VTC/VT quality and performance. There may be other forms of digital video communication, such as entertainment video, to which this standard is applicable.

2 Normative references

There are no normative references in this standard.

3 Definitions

This clause organizes the terms and definitions into two categories: General terms and Impairment terms. Terms marked with an asterisk are illustrated on the video tape described in clause 4.

3.1 General terms

3.1.1 digital transport: Communication using digital methods for the transmission of signals from one point to another.

3.1.2 lip synchronization: Operation to provide the feeling that the speaking motion of the displayed person is synchronized with that person's voice. The minimization of the relative delay between the visual display of a person speaking and the audio of the voice of the person speaking. The objective is to achieve a natural relationship between the visual image and the aural message for the viewer/listener.

3.1.3 motion video*: Temporally varying visual imagery intended to communicate or convey movement or change.

3.1.4 resolution: A parameter that specifies the ability to distinguish video detail in the spatial dimension or the temporal dimension.

3.1.5 scene cut *: Video imagery where consecutive frames are highly uncorrelated.

3.1.6 spatial application *: An application needing high spatial resolution, possibly at the expense of reduced temporal resolution (or increased jerkiness). Example spatial applications include the ability to read small characters and see fine detail in still video or motion video which contains a very limited amount of movement.

3.1.7 spatial performance: A measure of the ability of a video transmission system to accurately reproduce still scenes.

3.1.8 still video *: Video imagery that conveys no motion or change.

3.1.9 temporal application *: An application needing high temporal resolution (or reduced jerkiness), possibly at the expense of reduced spatial resolution. Example temporal applications include the ability to accurately discern moving image features, such as facial expressions and lip movements.

3.1.10 temporal performance: A measure of the ability of a video transmission system to accurately reproduce motion or changing scenes.

3.1.11 transmission service channel: A transmission service channel is the one-way transmission path between two designated points (for example, analog input, analog output).

3.1.12 video: (1) The visually displayed images of video teleconferencing/video telephony. (2) A signal that contains timing/synchronization information as well as luminance (intensity) and chrominance (color) information that when displayed on an appropriate device gives a visual representation of the original image sequence. (3) Of or pertaining to the visually displayed images of video teleconferencing/video telephony.

3.1.13 video frame: One complete scanned image or picture from a set comprising video imagery. A video frame is usually composed of two interlaced fields.

3.1.14 video imagery: A sequence of video frames.

3.1.15 video teleconferencing/video telephony service (VTC/VT): The transmission of video signals capable of portraying motion and the accompanying audio signal(s) between two or more locations using bidirectional transmission facilities. Both analog and digital transmission may be used. A typical example of this service is interactive video teleconferencing between groups of personnel located at two or more locations.

3.2 Impairment terms

3.2.1 block distortion *: Distortion of the image characterized by the appearance of an underlying block encoding structure. Also called tiling.

3.2.2 blurring *: A global distortion over the entire image, characterized by reduced sharpness of edges and spatial detail.

3.2.3 color errors *: Distortion of all or a portion of the final image characterized by the appearance of unnatural or unexpected hues or saturation levels. These hues or saturation levels were not present in the original image.

Annex A
(informative)

Video tape contents

Table A.1 – Description of the contents of video tape

Clip	Time code hh:mm:ss:ff	Description
Color Bars	00:00:00:00	
Gray	00:01:00:00	
Blue + Main Title	00:02:00:00	
3 seconds Blue	00:02:47:00	
BLOCK DISTORTION EXAMPLE 1	00:02:50:00	A block pattern is present throughout this artificially generated sequence (prepared by Bellcore using VIRIS).
BLOCK DISTORTION EXAMPLE 2	00:03:03:06	The block encoding structure of this compressed video is revealed, primarily in the subject's face and neck. Some blurring is also present, and some jerkiness when the subject sits up or moves her head.
BLURRING Reference scene without impairment	00:03:19:02	
BLURRING Scene with blurring	00:03:27:02	An overall loss of spatial acuity, exemplified by the reduced legibility of street names and other details of the map.
COLOR ERRORS EXAMPLE 1 Split screen	00:03:38:20	The scene on the right illustrates obvious color errors, with its green sky and pink houses. The orange flowers are also in error, but only a comparison with the original image (left) reveals this. (This example is looped.)
COLOR ERRORS EXAMPLE 2 Reference scene without impairment	00:03:53:26	
COLOR ERRORS EXAMPLE 2 Scene with color errors	00:04:02:09	The hue and saturation of the teacher's headband and blouse have changed in the impaired sequence, while the "white board" takes on a pink tint. There is also some error in the facial tones, they are darker in the example. The impairment is very subtle. It is very difficult to see the color errors in this example when viewing a VHS-format tape.
EDGE BUSYNESS SPATIAL EDGE NOISE	00:04:13:29	Noise around the letters on the white board and profile of the teacher exhibits some spatial variation.
EDGE BUSYNESS TEMPORAL EDGE NOISE	00:04:29:22	Noise around the lines in the circuit diagram varies with time. (This example is looped.)
EDGE BUSYNESS MOSQUITO NOISE	00:04:44:15	As the speaker moves from side to side, "mosquitoes" appear over and around her head and torso.
ERROR BLOCKS	00:05:00:07	During the sequence, highly colorful and/or textured blocks suddenly appear and remain visible for more than 2 seconds.
JERKINESS EXAMPLE 1	00:05:15:14	In this artificially generated sequence, the man's movements are displayed at 2 frames per second. (Prepared by Bellcore using VIRIS)
JERKINESS EXAMPLE 2	00:05:28:01	This second artificially generated sequence shows the man's movements at 4.2 frames per second. (Prepared by Bellcore using VIRIS)
JERKINESS EXAMPLE 3	00:05:40:26	In this compressed video sequence, the man's movements are portrayed as a series of snap shots. In nearly 9 seconds of video, only 19 different frames are displayed, yielding 2.1 average frames per second. There is also some block distortion present.
MOTION VIDEO	00:05:56:19	As the sequence begins, the windmill is turning. Motion increases as the camera's platform begins to move.

(continued)

3.2.4 edge busyness: Distortion concentrated at or near the edge of objects, and further categorized by its temporal and spatial characteristics.

3.2.5 temporal edge noise *: A form of edge busyness characterized by time-varying sharpness (shimmering) to edges of objects.

3.2.6 spatial edge noise *: A form of edge busyness characterized by spatially varying distortion in close proximity to the edges of objects.

3.2.7 mosquito noise *: A form of edge busyness distortion sometimes associated with movement, characterized by moving artifacts around edges and/or blotchy noise patterns superimposed over the objects (resembling a mosquito flying around a person's head and shoulders).

3.2.8 error blocks *: A form of block distortion where one or more blocks in the image bear no resemblance to the current or previous scene and often contrast greatly with adjacent blocks.

3.2.9 jerkiness *: Motion that was originally smooth and continuous is perceived as a series of distinct "snapshots".

3.2.10 motion-related artifacts: Distortion of motion video potentially observable by the viewer. In some instances, the distortion becomes more observable with increased motion. The distortion may appear as smearing, block distortion, jerkiness, or other impairments.

3.2.11 motion response degradation: The deterioration of motion video such that the video imagery has suffered a loss of spatio-temporal resolution.

3.2.12 object persistence *: Distortion where the object(s) that appeared in a previous video frame (and should no longer appear) remain(s) in current and subsequent video frames as an outline or faded image.

3.2.13 object retention *: Distortion where a fragment of an object that appeared in a previous video frame (and should no longer appear) remains in the current and subsequent video frames.

3.2.14 scene cut response *: The perceived impairments associated with a scene cut. For example, a slow build-up of a video image instead of an instantaneous change of images.

3.2.15 smearing *: A localized distortion over a sub-region of the received image, characterized by reduced sharpness of edges and spatial detail. For example, the portrayal of a fast moving object may exhibit smearing.

3.2.16 tiling *: See the definition of block distortion.

4 Examples on video tape

Experts agree that examples improve the understanding/comprehension of many of the terms and definitions given in the preceding sections.

Therefore, a set of illustrative video clips, focusing primarily on the impairment terms but illustrating some of the general terms as well, has been produced and is described in informative annex A. A copy of the tape may be obtained from the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005. The time scale of the examples is preserved when viewed at normal speed. The tape is over 9 minutes in length, and contains 26 examples of terms. When illustrating an impairment term, usually both the unimpaired and impaired versions of the video clip are present on the tape for comparison.

Table A.1 *(concluded)*

Clip	Time code hh:mm:ss:ff	Description
OBJECT PERSISTENCE	00:06:11:26	As the subject rocks and moves his head from side to side, his faded image trails behind him. (Produced with a nonlinear recursive temporal filter, a common pre-processing technique to increase compression efficiency.)
OBJECT RETENTION Full-motion	00:06:28:12	When the quarterback throws the screen pass and the camera begins to pan to the receiver, blocks containing the quarterback's neck, the hand of a defensive lineman, and other blocks containing pieces of uniforms remain in the frame. Jerkiness is also present throughout the sequence. Watching the slow-motion version, following, makes this impairment more noticeable upon replaying the Full-motion version.
OBJECT RETENTION Slow-motion	00:06:42:14	
SCENE CUT	00:06:58:16	The displayed video changes instantaneously from a wide shot of two people at a white board, to a close-up of the woman, and back to a wide shot. The changes are scene cuts.
SCENE CUT RESPONSE EXAMPLE 1	00:07:13:22	As the video cuts from gray to the flower garden scene, first the outline of the windmill arms appear, then many blocks change to the flower garden, while some remain gray.
SCENE CUT RESPONSE EXAMPLE 2	00:07:22:24	Just prior to the scene cuts between the wide shot and the close-up, the video image freezes for a moment (about 6 frames).
SMEARING EXAMPLE 1	00:07:33:28	As the camera zooms in, some areas of the circuit diagram are crisp, while other local areas are smeared and not distinguishable. (This example is looped.)
SMEARING EXAMPLE 2 Reference scene without impairment	00:07:48:21	
SMEARING EXAMPLE 2 Scene with smearing	00:07:58:04	In this scene, the smearing is localized in the moving areas.
SPATIAL APPLICATION	00:08:08:25	This map scene has a high level of spatial detail.
EXAMPLE TRANSMISSION OF SPATIAL APPLICATION	00:08:17:12	This example transmission is from a system that maintains the spatial detail in the non-moving map areas, and delivers less detail on the moving pen.
STILL VIDEO	00:08:28:06	The map remains motionless throughout the sequence.
TEMPORAL APPLICATION	00:08:43:14	This scene shows a moderate degree of temporal content and spatial detail.
EXAMPLE TRANSMISSION OF TEMPORAL APPLICATION	00:08:52:03	The example shows a system that manages to portray the motion as continuous, but sacrifices much spatial resolution in the balance, as seen in the blurring of the books in the background, and the complete loss of stripes on the man's shirt.
End of Clips	00:09:00:07	
End	00:09:30:00	

The master video tape of examples was prepared in Betacam SP format. This is also the recommended format for viewing. Copies of the master are available in other formats, but it will be difficult to observe some of the impairments in lower quality formats, such as VHS.

Annex B
(informative)

Bibliography

ANSI T1.502-1988, *Telecommunications – System M-NTSC television signals – Network interface specifications and performance parameters*

ANSI/IEEE 201-1979, *Television – Definitions of terms*

ANSI/SMPTE 170M-1994, *Television – Composite analog video signal – NTSC for studio applications*

Committee T1 Technical Report TR-16, *"Technical Report on DS3 Transport for Contribution Application of System M-NTSC Television Signals – Analog Interface Performance Objectives,"* 1992.[1)]

Fibush, David K., *"Guide to Digital Television Systems and Measurements,"* Tektronix, (25W-7203-1).

Whitaker, John, *"The Art of Digital Video,"* Focal Press, ISBN 0-240-51287-1, 1990.

[1)] Available from the Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington DC 20005.