

**Committee T1 Performance
Standards Contribution**

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STANDARDS PROJECT:

Analog Interface Performance Specifications for Digital Video
Teleconferencing/Video Telephony Service (T1Q1-12)

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SUBJECT:

Results from the Experts meeting on subjective and objective video quality held
in Turin, Italy, October 14-16, 1997.

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SOURCE:

NTIA/ITS

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CONTACT:

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video quality, picture quality, subjective, objective,
performance assessment, multimedia, JRG.

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DISTRIBUTION:

Working Group T1A1.5

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**Results from the
Experts Meeting on Subjective and Objective Video Quality Assessment
Turin, Italy
October 14-16, 1997**

The status of this meeting was changed from a meeting of the Joint Rapporteurs' Group to a meeting of experts on subjective and objective video quality assessment. This was done to ensure that the representatives from the ITU-R WP11E were given equal status to the members from the ITU-T.

The first two days were devoted to objective measures of video quality. Topics of discussion included:

Purpose of the test.

One or more objective video quality assessment methods are sought to meet a number of measurement needs.

See Table 1 below for a depiction of some of these needs.

It was decided that the first effort to test objective measures for video quality would concentrate on the TV3 class and include smaller examples of MM4, TV2, and perhaps TV1.

Criteria of Acceptance

There was no agreement on a criteria of acceptance. A number of data analysis techniques were proposed including:

Correlation coefficient, Rank-order correlation, RMS Error, weighted RMS Error, and Variance-Covariance Analysis.

Other considerations were discussed including monotonicity, clustering, robustness, graceful degradation, non-linear regression methods, outlier considerations, generalizability, color error sensitivity, and complexity of measurement method.

This topic was referred to an ad hoc group for further work.

Fairness of Test

To avoid proponents utilizing apriori knowledge, it was decided to require proponents to submit an executable program (complete with any input parameters) to an Independent Lab by June 1, 1998. Furthermore, all test scenes and the final HRC list will be decided by the Independent Lab and Selection Committee.

Test Plan for Subjective Test

The test will include approximately 200 clips chosen (intelligently) from a set of 20 HRCs and 20 test scenes. The test will be of the DSCQE type from Rec. 500. The test scenes will probably be 8 seconds, but 5 second test scenes are being considered.

This topic was referred to an ad hoc group for further work.. A Subjective test plan will be completed by January 1, 1998 and submitted to Study Groups 9, 12, and WP11E for comments.

Test Plan for Objective Test

Items to be decided include data analysis techniques, criteria for acceptance, computer platform on which the submitted executable code will run.

This topic was referred to an ad hoc group for further work. An Objective test plan will be completed by January 1, 1998 and submitted to Study Groups 9, 12, and WP11E for comments.

Video Classes Table and Definitions

Some changes were made to the Video Classes and Attributes tables (See Tables 2 and 3). This is still considered a working document.

Delay measurements

The current draft of P.DEL was presented and comments were solicited.

Established Ad-hoc Groups:

Subjective Test Plan

Co-chairs: Phil Corriveau and Alexander Schertz

Objective Test Plan (including acceptance criteria)

Co-chairs: Mihir Ravel and John Beerends

Video Classes Table and Definitions

Co-chairs: Dave Fibush and Arthur Webster

Independent Lab and Selection Committee

Co-chairs: Laura Contin and Phil Corriveau

Subjective Testing Labs:

CRC, RAI, IRT (Subj. or Obj), CCETT,

Possibly Swiss Telecom, CSELT, and one Lab from Japan

Objective Testing Labs

IRT (Subj. or Obj), CRC, CSELT, Possibly one from Japan

List of Attendees

John Beerends, KPN, the Netherlands

Paul Bowman, BT, Great Britain

Noel Chateau, France Telecom/CNET, France

Stephanie Colonnese, FUB, Italy

Laura Contin, CSELT, Italy

Philip Corriveau, CRC, Canada

David Fibush, Tektronix, USA

Brian Flowers, EBU/BBC

Takahiro Hamada, KDD, Japan

Jeff Lubin, Sarnoff, USA

Dominique Pascal, France Telecom/CNET, France

Stephane Pefferkorn, CCETT, France

Mihir Ravel, Tektronix, USA

Alexander Schertz, IRT, Germany

Massimo Visca, RAI, Italy

Arthur Webster, NTIA, USA

Stefan Winkler, EPFL, Switzerland

Revised list of HRCs.

Note: This list is general. Specific hardware or software implementations as well as final resolution, profile, level, and/or GOP structure will be left to the Independent Selection Committee.

	Bit rate	Res	Method	Comments
1	768 kb/s	CIF	H.263	
2	1.5 Mb/s	CIF	H.263	
3	2 Mb/s	3/4	mp@ml	This is a horizontal resolution reduction only
4	2 Mb/s	3/4	sp@ml	
5	3 Mb/s		mp@ml	
6	4.5 Mb/s		mp@ml	
7	4.5 Mb/s.		mp@ml	Composite NTSC and/or PAL
8	4.5 Mb/s	3/4	sp@ml	At least one commercial encoder does this
9	6 Mb/s		mp@ml	
10	8 Mb/s		mp@ml	
11	8 Mb/s		mp@ml	Composite NTSC and/or PAL
12	8 & 4.5 Mb/s		mp@ml	Two codecs concatenated
13	12 Mb/s		mp@ml	
14	18 Mb/s		422p@ml	IB only, true SX encoder preferred
15	21 Mb/s		422p@ml	Large GOP, new EBU standard
16	36 Mb/s		422p@ml	I only
17	36 Mb/s		422p@ml	IB only Eight generations, spatial and GOP shifts
18	n/a		n/a	VHS (must be fully time base corrected)
19	n/a		n/a	Multi-generation Betacam (4 or 5, composite or component)
20	4.5 Mb/s		mp@ml	w/errors TBD (to be determined)
21	36 Mb/s		422p@ml	I only, w/errors TBD (perhaps a lower bit rate)

For 20 and 21, artifacts are to be kept within the same quality range as the other impairments in the test.

List of Documents

- jrg002.rtf - 2nd version of Table defining video quality classes
- jrg003.rtf - Sarnoff JND Vision Model-Algorithm Description and Testing (Presentation by Jeffrey Lubin of Sarnoff to T1A1.5 Aug.97)
- jrg004.pdf - Survey of Image and Video Quality Metrics based on Vision Models (Presentation by Christian van den Branden Lambrecht of Hewlett Packard to T1A1.5 Aug. 97)
- jrg005.rtf - Draft P.DEL, ATT
- jrg006.doc - Proposals on Methods for Determining Algorithms for Recommendation Agendum #3), ATT
- jrg007.doc - Proposals on Test Material Production and Other Issues (Agendum #4 and #5), ATT
- jrg008.pdf - Preliminary Results, Subjective Desktop Video Teleconferencing Audiovisual Test, NTIA/ITS
- jrg009.pdf - Single-Ended Multimedia Subjective Test NTIA/ITS
- jrg010.pdf - Subjective and Objective Measures of Scene Criticality, NTIA/ITS
- jrg011.rtf - Objective Picture Quality Evaluation for the Digital Broadcasting by Introduction of Criticality, NHK Science & Technical Research Laboratories
- jrg012.lis - Comments for the Turin ITU Experts Meeting on Subjective and Objective Audio/Visual Quality Assessment Methods, CableLabs
- jrg014.rtf - IRT/Tektronix Investigation of Subjective and Objective Picture Quality for 2-10 Mbit/sec MPEG-2 Video: Phase 1 Results, IRT and Tektronix
- jrg015.rtf - Video Codec Evaluation Scheme and Implementation Based on Characteristics of Human Visual Perception, KDD
- jrg016.doc - Some Results from a methodological preliminary experiment for assessing the audio-visual quality in group communication, France Telecom/CNET
- jrg017.rtf - Objective Picture Quality Scale for Digital Compressed Picture for Broadcast, NHK
- jrg018 - Objective Video Quality Assessment by Image Comparison, TDF-CR2 France, et.al.
- jrg019 - ITU-T SG9 Question 22, Measurement and Control of the Quality of Service of Digital Television Transmission Networks
- jrg020 - Com-9-15, Draft New ITU-T Recommendation J.SVQ1- Subjective Picture Quality Assessment for Digital Cable Television Systems, Ass. Rapporteur A. Karwowska-Lamparka
- jrg021 - Objective Performance Assessment: Video Quality as an Influence on Audio Perception, BT
- jrg022 - List of participants
- jrg023 - Excerpt from Quovadis document: Transmission errors
- jrg024 - Excerpt from Quovadis document: Conclusions
- jrg025 - Flow diagram for validation testing
- jrg026 - Revised HRC list
- jrg027 - Statistical Analysis of Image-Fidelity Ratings, Sarnoff (Mike Brill)
- jrg028 - ITU-R WP11E Revised a question on Objective Quality

Flow diagram for Objective Measurements Test

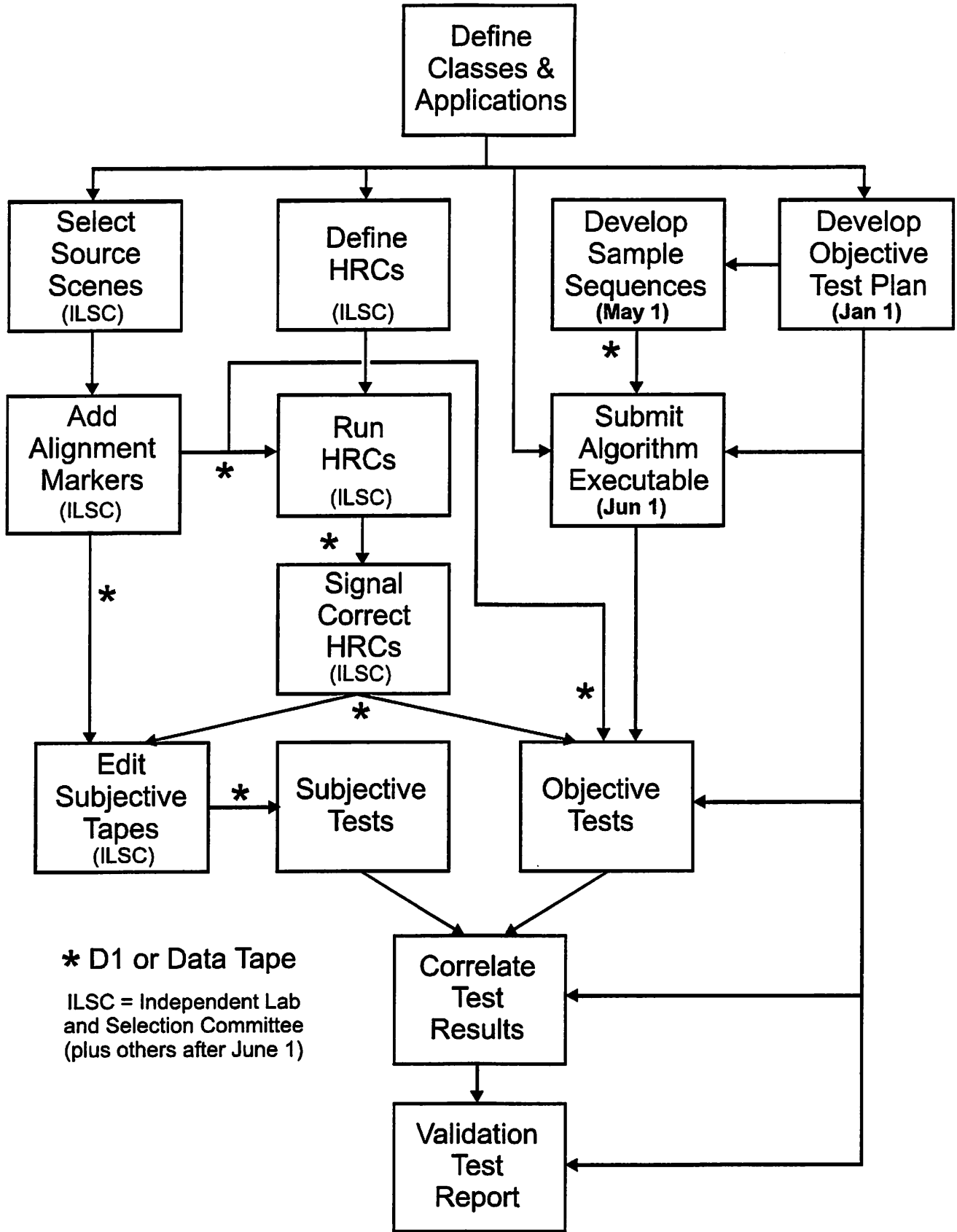


TABLE 1 Video Quality Classes (vertical) and Test Scope Levels

CLASS	OUT OF SERVICE TESTS					IN SERVICE TESTS				
	1	2	3	4	5	1	2	3	4	5
TV1										
TV2										
TV3										
MM4										
MM5										
MM6										

from Document #6 for Levels 1, 2, 3, & 4, Al Morton, ATT

1. to assess the continued operational readiness of a video transmission system.
2. to compare the relative levels of impairment between two different systems at the same or different bit rates (both may exhibit supra-threshold impairment).
3. to assess the level of sub-detection threshold impairment of a system, in such a way that the assessments of individual systems can be combined in calculations to design a perceptually loss-less system.
4. to assess the level of supra-threshold impairment of a system, in such a way that the assessments of individual systems can be combined in calculations to design a system to a specific perceived impairment level.
5. to replace subjective tests.

Table 2 Definitions of Classes

TV 0	Loss-less:
TV 1	Contribution: Used for complete post production, many edits and processing layers, intra-plant transmission. Also used for remote site to plant transmission.
TV 2	Primary distribution: Used for simple modifications, few edits, character/logo overlays, program insertion, and inter-facility transmission. A broadcast example would be network to affiliate transmission. An example in a cable system would be a regional downlink facility to a local headend.
TV 3	Secondary distribution: Used for delivery to home/consumer (no changes). An example in a cable system would be from a local headend to a home.
MM 4	All frames encoded. Low Artifacts. Usually ≥ 30 fps.
MM 5	Frames May be Dropped at Encoder. Perceptual artifacts possible, but useful for designed tasks.
MM 6	Series of Stills. Not Intended to provide full motion. (Examples: Surveillance, Graphics)

Table 3 Attributes of Classes

Class of Operation	Spatial Format	Typical Coding Algorithms ¹	Delivered Frame Rate	Nominal Bit Rate, Mbit/s
TV 0	Rec. 601	Loss-less	Max FR	270 or 360
TV 1	Rec. 601	MPEG-2	Max FR	18 to 50
TV 2	Rec. 601	MPEG-2, DV	Max FR	10 to 25
TV 3	Rec. 601	MPEG-2	Max FR Infrequent (occasional) frame repetition	1.5 to 10
MM 4	Rec. 601	H.262, MPEG-2	(15-) 30 fps	1.5
MM 4	CIF	H.263	~30 fps	0.768
MM 5	CIF		10-30 fps	
MM 5	QCIF		1-15 fps	
MM 5	Sub-QCIF	H.263	>0 fps <30 fps	
MM 6	16CIF	H.263		

Note 1: Proprietary coding algorithms are also possible. If used, they should provide performance at least as good as the specified standard algorithm.