CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

Document AVC-177R
November 29, 1991

SOURCE : CHAIRMAN
TITLE : REPORT OF THE FOURTH MEETING OF THE EXPERTS GROUP FOR ATM VIDEO CODING IN YOKOSUKA (November 18-29, 1991)
Purpose: Report

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1. General

The fourth meeting of the Experts Group consisted of two parts; joint sessions with ISO/IEC JTC1/SC2/WG11 (MPEG) and CCITT sole sessions. The list of participants appears at the end of this report.

The first part was held at JVC R&D Center in Kurihama, Japan, during 18-26 November 1991 at the kind invitation of JVC. At the start of the meeting, Mr. H. Aoike, Senior Managing Director, made a welcoming address. At the final plenary of MPEG, Chairman thanked the hosting organization for the meeting facilities provided and the excellent secretarial support.

The second part was held at NTT Yokosuka R&D Center in Yokosuka, Japan, at the kind invitation of Ministry of Posts and Telecommunications. At the starting session, Dr. T. Kamae, Director of NTT Human Interface Laboratories, made a welcoming address on behalf of the the hosting organizations. At the closing session, Mr. D.G. Morrison, UK, thanked the hosts for the meeting facilities and excellent services provided on behalf of the participants.

The Experts Group accepted resignation of Mr. Milton Anderson, Bellcore, as liaison representative between WPXV/1 and MPEG, and thanked his outstanding efforts (see Section 3.1/TD-7).

2. Documentation (TD2)

For this meeting, 71 AVC-numbered documents and 11 temporary documents were available as listed in Annex 1.

3. Tape demonstration (TD3)

Several video tape demonstrations were given with D1 as detailed in Annex 2 to present experimental results.

4. Review of the joint sessions with MPEG

4.1 Technical sessions (TD-4,5,6; AVC-176)

Appointed representatives of the Experts Group made the following summary reports on the joint sessions with MPEG that were held during 18-26 November 1991 at JVC-Kurihama. At the end of this report, Chairman thanked the proposal submission by the Experts Group members and stressed that one of the most effective ways to make influence on other groups is through good technical work.

4.1.1 Test (S. Okubo)

Subjective tests for the thirty algorithm proposals were carried out according to the double-stimulus continuous quality-scale method defined in CCIR Rec. 500-3. Three test sequences were used for the 4 Mbit/s test and four sequences for the 9 Mbit/s test. According to the average scores, rank orders for 525 and 625 systems were obtained. Furthermore, the top ranking group whose members are mutually indistinguishable in a statistical sense was identified by using the Duncan's method. Draft report on the test results are contained in TD-5.

During the discussion, it was raised whether the test results meet the objective of "NTSC/PAL level quality at 3-5 Mbit/s" and "close to CCIR Rec.601 quality level at 8-10 Mbit/s." It was felt necessary to know the relationship between MOS (Mean Opinion Score) and the testing scales following CCIR Recommendation 500-3.

It was also felt necessary to know how NTSC/PAL picture quality maps onto the testing scale. Mr. Tabatabai presented AVC-176 that contains relevant information showing that pictures coded at 4 Mbit/s are better than NTSC pictures on average. It was pointed out that the average score values differ in the testing scale between TD-5 and AVC-176 even for the same coded picture.

The meeting recognized the desirability to test the coding algorithm for source signals that are converted from NTSC/PAL/SECAM signals to 4:2:2 digital component signals, because they may include particular artifacts. There may be some practical difficulties, however, to convert a CCIR-601 digital signal into an analog NTSC/PAL/SECAM signal and then record the NTSC/PAL/SECAM signal in a D-1 tape.

4.1.2 Requirements (S. Okubo)

The Requirements sub-group assisted the Video sub-group in setting the guidelines toward defining Test Model 0 (TM0) as summarized in TD-6. The goal of developing a generic video coding standard which meets the requirements of various applications was confirmed. Use of TM as a vehicle to reach this objective was also confirmed. General feeling was that we could start with MPEG-1 syntax using simple field merging.

4.1.3 System (B.G. Haskell)

Normative part of CD 11172-1 (MPEG-1 System) was completed at Kurihama. It contains specifications for multimedia syntax, which provides CBR and VBR operations, buffering for each medium as well as multiplexed signals and timing for audio/video cross media synchronization.

4.1.4 Video (G. Bjoentegaard)

After each proposer had given 10 minute introduction to his/her coding scheme, three groups reviewed the proposals in details, analyzing coding methods, characteristics and functionalities. As an outcome of this work, the summary table was produced as in TD-4.

Considering these analyses and test results, a joint Video/Requirement meeting discussed how to start the convergence work. Guidelines and specific action plans toward the next meeting in Singapore were obtained as in TD-6.

4.1.5 Implementation (D.G. Morrison)

A work to rank the proposals was initiated, but there were some significant differences between assessor's opinions. This difference will be sorted out by the first day of the Singapore meeting through correspondence. Implementation sub-group recommended that coding performance be evaluated whether backward prediction is necessary or not, since it gives a great impact on the coding scheme implementation.

4.2 DSM/ATM workshop (AVC-172; AVC-114,131,140)

This workshop was held in the afternoon of November 20. Two speakers invited by the DSM group presented storage characteristics of the optical disk and the label format. Then the following four speakers from the Experts Group presented ATM network characteristics and their impacts on video coding;

M. Biggar	Broadband ISDN evolution
O. Poncin	ATM network characteristics
T. Tanaka	VBR aspects
G. Morrison	Video coding techniques suitable for utilizing ATM network characteristics

This workshop was found effective in obtaining mutual understanding among experts participating in the MPEG/CCITT EG joint work. The meeting thanked these four speakers for informative presentation.

5. Discussion

5.1 Report of the meetings relevant to the Experts Group

5.1.1 CMTT/2 SRG meetings in Torino and Paris (AVC-173,174)

Mr. Carbiere presented the two documents, focusing on items of our concern. Mr. Sawada provided additional information in response to the questions.

Through the questions and answers, the following were clarified;

- Exact number of lines per field for the 525/60 TV system is discussed as in the note of p.2/AVC-174.
- The two different HDTV frame rates, 60 Hz and 59.94 Hz, may require two oscillators in the codec, because frame rate conversion is not straightforward.
- The pyramidal coding between HDTV and EDTV/CTV formats is still an example without consensus.

- A 20-30 year long lifetime of consumer equipment implies that the coming video coding standard should not become obsolete in e.g. five years time frame, and it should leave room for the encoder to make performance improvements by maintaining the syntax, thus the existing receivers can enjoy the improved coding performance.

5.1.2 IVS Co-ordination meeting in Tokyo (AVC-110)

Chairman reported that the objective of this meeting included two aspects; co-ordination between network and video coding standards and co-ordination among video coding standards, and that several action points were identified for the co-ordination purpose. The meeting paid attention to the time tables of network, video coding and service standards development.

Mr. Carbiere clarified that CMTT/2 assumes and considers as a mandatory constraint that the same bit-rate reduction algorithm may be used for secondary distribution in both STM and ATM networks, and in the latter case for both CBR and VBR modes. This information was sent to relevant groups.

5.1.3 SGXV WPXV/1 meeting in Geneva (AVC-138; TD-7)

Mr. Makoto Yamashita, Vice-Chairman of Study Group XV and Chairman of Working Party XV/1, presented the outcome of the WPXV/1 meeting held in Geneva during November 11-15, appreciating the activities of the Experts Group. He also provided information on the coming meetings of WPXV/1 (May 1992, November 1992, July-September 1993), stressing that Recommendations can now be produced virtually at any time using Resolution No. 2. He also touched upon the expected restructuring of ITU leading to integration of CCITT and part of CCIR into the Standardization Sector.

5.2 Picture format (Annex 3/AVC-106R)

Issues concerning the picture format selection for Recommendation H.26X are summarized in Annex 3 to AVC-106R. The meeting reviewed several documents addressing this topic.

5.2.1 Number of formats (AVC-125,134,169,174)

AVC-125

Experimental results were provided to conclude that geometric distortion of 6% is clearly perceptible for the Miss America picture. It was pointed out that circles are more demanding in geometric distortion. Related to whether the pel aspect ratio is exactly 16:15 for CIF, it was questioned whether 720 pels per line in CCIR-601 correspond to exactly "4" of 4:3 aspect ratio. Clarification is needed.

AVC-134

This document discussed several issues regarding the use of a flexible set of formats, which had been identified in the previous Santa Clara meeting. During the discussion, the following comments were obtained;

- Since aspect ratio is flexible inside the maximum sized container, square pixel can be covered in this flexible set of formats using an indication flag.

- Many filter banks may be required to convert the decoded pictures into the display format, but display methods are not subject to standardization.
- CCITT should be concerned with end-to-end services. Leaving the format conversion process outside the coding standard is not sufficient.

AVC-174

As part of CMTT Special Rapporteur's Group activities, picture format related matters were taken up for further review. The following clarification was made;

- In the secondary distribution, signals of different television standards will be converted into local television signals in front of the encoder, thus the decoder needs to handle only regional formats.
- In Figure 1/AVC-174 the common coding format for CTV and EDTV may be either 2:1 interlaced or progressive, because it has not yet been standardized whether EDTV format be either 2:1 interlaced or progressive.

5.2.2 Loss of coding efficiency due to conversion between CCIR-601 and SCIF (AVC-113,174)

AVC-113

This document reported that no visible degradations due to 480 to 576 to 480 line conversion had been observed. The presentation was supported by a tape demonstration. Coding loss due to the use of 576 line progressive format with 30 Hz frame rate was found as less than 3% against 20% increase in number of pels to be coded.

AVC-126

This document reported that coding efficiency improvement can not be expected by using optimized 2-d VLC for INTER mode. Mr. Bjoentegaard pointed out that his experiments indicated that INTRA had not improved but INTER had improved, and that NTA's coding algorithm proposal uses coefficient by coefficient adaptation for DCT coefficient coding, leading to 5-10% gain.

AVC-169

This document compared coding efficiency between a SCIF with 576x720 spatial resolution and a SCIF with square pixel geometry (e.g. 528x704) for the 525/60 signals. The following comment and clarification were obtained during the discussion;

- As a rule of thumb, 10% coding efficiency difference corresponds to 0.5 dB of SNR. SNR difference of 0.28 dB may not be negligible compared to loss of coding efficiency by 5.8 %.
- Conversion filter is integer based.

5.2.3 Conclusion

a. We will try to make a decision at the March 1992 meeting as agreed at the Santa Clara meeting.

b. We need to clarify the color resolution, namely 4:2:2 vs 4:2:0 considering the following;

- picture quality
- use of a 4:2:0 family in existing standards (H.261, MPEG-1)
- interlaced or progressive format as the source coder input
- computer applications requiring 4:4:4

c. Testing environments are not yet ready for progressive format experiments. A practical problem is that simulation systems including progressive scan displays are not yet widely available.

d. An idea was raised that side information indicating the origin of the SCIF signals may be utilized to facilitate selection of coding parameters (or alternatively coding modes). It may not be used by the decoder if unnecessary. Concept of the common intermediate format lies, however, in that encoder or decoder need not worry about the origin of the signals.

e. The following issues are still open;

- single coding format or multiple ones for higher quality video coding
- possible parameter values? how related to CIF? square pixel?
- extension to larger formats such as EDTV and HDTV?
- service integration aspects
- take the initiative to adopt the single format approach (if viable) to other groups?
- sufficient picture quality is achievable?
- 50/60 Hz frame rate conversion is practical?
- not so much coding loss due to conversion?

5.3 Framework for H.26X video coding

5.3.1 Requirements

1) Current status (AVC-108,173)

Various requirements coming from communication, distribution and storage & retrieval applications have been identified in AVC-108, Proposal Package Description.

CMTT/2 provided an updated version of the paper on preliminary functional requirements for the secondary distribution (see AVC-173) where a "channel hopping" requirement is included as "a limited response time between selecting a channel and having the service fully operating, a range of 0.3 to 1 second is being considered."

2) ATM coding specific requirements (AVC-115)

Compatibility, low end-to-end delay and cell loss resilience are the items of our greatest concern from CCITT point of view. Lower bit rate operation of the H.26X codec is also of our concern, though the overlapping with H.261 bit rates needs careful consideration. These should be reflected in the definition of Test Model 0 (see Annex 4).

5.3.2 Architecture

1) Cell loss resilient coding (AVC-120,139)

AVC-120

This document provided a collection of techniques for cell loss resilience, identifying matters of standardization. The small group for video coding algorithm study encouraged the contributor to make it more illustrative and extensive for submission to the Singapore joint sessions.

AVC-139

This scheme consists of one-layer source coding and one-layer or two-layer transmission coding, which was submitted to FCC for testing of advanced digital television systems. Cell loss resilience performance was demonstrated with D1 tape. During the discussion, the following were clarified;

- The digital television broadcasting medium requires two separate channels having different transmission error performance for better radio spectrum usage.
- Payload capacity of 128 bytes was selected in consideration of overhead penalty and hardware complexity. It can not be 48 bytes due to overhead penalty.
- Cell loss was made by using a free running random generator.

2) Compatibility with existing and companion standards (AVC-122,123,135)

AVC-122

This document reported experimental results on the comparison of compatible mode and non-compatible mode for the algorithm proposal #13 (AVC-150). During the discussion, the following were clarified and commented;

- Difference of 1.2 dB in SNR is visible. Optimization has not yet been carried out.
- In this configuration, Encoder 2 deals with only differential signals between input and upconverted ones. However, Encoders 1,2,3 should better be identical from implementation simplicity point of view, awaiting further study.
- Horizontal upconversion filter is the one used in SM3.
- There was a comment that the simulcast method had given better pictures than the pyramidal method. At the same time, there was another view that the simulcast could be as good as the pyramidal scheme, but never be better.

AV-123

This document discussed the H.26X compatibilities with existing and future companion standards in terms of "bit stream level compatibility" and "source coding level compatibility." It was clarified that H.32X should have interworking capability in H.221, H.242 as well, but there was expressed an expectation that network interworking facilities may ease the problem.

AVC-135

This document reported the progress of the ongoing work regarding the flexible layering approach for backward compatible coding where layering is based on the DCT coefficient domain decomposition. There was some discussion whether this decomposition causes inherent artifacts, including a

comment that the "incremental low frequency information" will reduce those artifacts in a full size picture.

3) Delay analysis (AVC-124; TD-9)

Major delay causing elements were identified in the hybrid coding scheme.

Considering the variety of exactness in presenting the delay values for proposed algorithms, we concluded it necessary to clearly define coding/decoding delay including illustration of field-based, frame-based and backward prediction codings, and put it forward to the Singapore meeting so that everybody follows a presentation format. Ms. Verreth undertook to coordinate a small group to draft this contribution. The outcome was given as in Annex 3 (reproduction of TD-9).

As to the list of delay causing elements, the meeting concluded it better to make a precise illustration for the common understanding among members participating in the joint work with MPEG, and to list major inherent elements for a common data presentation format. Having seen that some coding algorithm proposals are of multi-pass for better coding rate control, the meeting also agreed to include a "pre-analysis" box to stress that it is delay demanding. Representation of delay time is recommended to be both in millisecond and frame time, such as 20 ms (0.5 frame time).

These will be reflected in a contribution of the Experts Group to the Singapore meeting.

4) Difference between H.261 and MPEG-1

The meeting recognized that this reality should be considered when we discuss the compatibility issue. Some preliminary thoughts were expressed in the course of discussion;

- Some chips include both H.261 and MPEG-1 decoders, hence they can be used as core in as switchable manner. It will be convenient if picture formats of H.26X/MPEG-2 have simple relationship with those of H.261/MPEG-1. Mr. Parke clarified that the pyramidal scheme allows the use of any format in the core as far as spatial and temporal upconversion methods are standardized.
- Bitstream should contain standards indicator? MPEG-1 system includes private bitstream indication. These may suggest consideration of "open system" in the audiovisual coding area?
- Negotiation can not be used in distribution oriented applications, requiring a mechanism to indicate the coding algorithm.
- Compatibility and commonality should be distinguished for clarity.

5.4 VBR vs CBR

5.4.1 Characteristics

AVC-116

This document provided buffer size and delay estimation for sliding window restriction in the network, indicating use of transmission buffer is cheaper than the use of display buffer. Mr. Haskell stated that AT&T is in favor of leaky bucket as UPC mechanism because of its simplicity.

AVC-127

This document presented some experimental results on the leaky bucket occupancy. It was clarified that "when coding rate is rather high" should read "when coding rate is rather low."

5.4.2 Statistics (AVC-171)

Analysis results were presented for the data that Mr. Verbiest distributed at the previous meeting in Santa Clara. It was found that the number of cells per frame follows Gamma distribution even if the coding schemes are quite different (DCT vs DPCM).

Data on MC based systems are solicited.

5.4.3 Network model (AVC-131)

It should be noted that the CLR equation in Annex 5 to AVC-109 (Status Report Issue 2, p.50) includes a mistyping and that the corresponding equation in AVC-138, p.13, has been corrected.

5.4.4 UPC (AVC-128,132; AVC-116,127)

AVC-128 investigated the transmission efficiency between sliding window and leaky bucket as UPC mechanism, while AVC-132 raised that this Experts Group should recommend a UPC mechanism appropriate for our video coding purpose. In the course of discussion, the following comments were obtained;

- Actual video signals are stochastic process, thus we should be careful of interpreting the results of AVC-128.
- When we request a particular method to the network, additional network cost should also be taken into account.
- Many of the participants feel in favor of the leaky bucket as UPC, but some others can not be sure which of leaky bucket or sliding window is better. Reasons for the support of leaky bucket are transmission efficiency and ease of coding control in both CBR and VBR.
- Leaky bucket is efficient for video, but may be questionable for other type of signals.
- It is beneficial for customers if simple designation of "class of picture quality" is sufficient without specifying many parameters. Leaky bucket size is better to be defined with one parameter; time length. If a bit rate is given then the buffer size is determined by the network. However, it may cause more congestion at higher bit rates.
- UPC should be the same all through the international connection, otherwise the terminal can not control its information generation rate.
- These should be reflected in our liaison statement to SGXVIII.

5.4.5 Open issues

The following issues are still open, awaiting contributions;

- VBR advantage in obtainable picture quality
- Appropriate UPC for video (audiovisual) coding
- Required window or bucket size for average rate monitoring in the network

5.5 Video coding algorithms

5.5.1 Layered coding (AVC-117,119; AVC-115,135)

Two implementation examples and their characteristics were presented in AVC-117 and AVC-119, both of which use layering for cell loss resilience.

It was clarified that the scheme in AVC-117 assumes a constant rate, cell-loss free base layer and a peak rate restricted enhanced layer. It was also stated that the low priority service is required to guarantee the high priority service. The meeting was reminded that the tariff structure would eventually decide the video coding structure, particularly use of the two channels with different QoS.

The meeting took note of the AVC-119 technique to use two frame memories in the coding loop for further investigation of cell loss resilience.

5.5.2 New schemes (AVC-118,133,141 through 167; AVC-119; TD-4,5,6)

There were 30 proposals submitted to the Kurihama tests, all of which use motion compensated interframe or interfield prediction for temporal redundancy reduction. For spatial redundancy reduction, some of them adopt DCT, while others adopt sub-band filters or Wavelet Transform.

5.5.3 Conclusion (TD-9)

Having reviewed the work in Kurihama (see Section 4.1 above) and submitted documents for the sole sessions, the meeting concluded that we can concentrate on the joint work with MPEG for the H.26X algorithm development which will be carried out through defining and improving the Test Model. Though this work may be focused on 5-10 Mbit/s for the time being, we should bear in mind that our terms of reference cover also extension to the lower bit rates and to the higher formats.

Regarding the low bit rate operation of H.26X, the meeting confirmed that H.26X should cover a range of applications including support of lower quality services and interworking between H.26X and H.261. It was also pointed out that in layered schemes the choice of base layer bit rate may affect the total performance, and that 384 kbit/s is a typical bit rate for videoconferencing services. It was further pointed out that at lower rates streamlining overhead information should be taken into account.

Based on this conclusion, Mr. Guichard led a small group for establishing guiding principles for the Singapore meeting, covering low delay, compatibility with existing standards, scalability or low bit rate operation, and cell loss resilience. The outcome was presented with TD-9. The meeting supported this proposal with an editorial clarification, recognizing that the "core experiments" should be specific enough so that independent laboratories will obtain the same results to prove or disprove an issue item. The finalized document is contained in Annex 4.

As to the cell loss experiment specification, the meeting requested Mr. Parke to organize a correspondence group for making a written proposal to the Singapore meeting. The group consists of Messrs Brusewitz, Eude, Parke (Chair), Sakai, Schinkel, Tabatabai, Yukitake, Wada, Zdepski.

There was some discussion on the availability of proper test sequences to check lower bit rate operation of Test Model. "Susie" was suggested for the moment, but other sequences may be needed in the future.

5.6 Multimedia multiplexing (AVC-129,136)

5.6.1 Comparison of possible methods

Documents AVC-129 and AVC-136 presented comparison of the following three methods of multimedia multiplexing for the Experts Group discussion;

- cell based approach
- packet based approach
- H.221 based approach

It was confirmed that the first approach had been chosen as reference to help the progress of our work, taking into account of the B-ISDN long term objectives. A view was expressed, however, that the multiplex method should be chosen independent of the network characteristics because audiovisual services may be supported by not only B-ISDN but also by other networks. Additionally, it was pointed out whether the H.221 based approach is appropriate for VBR services as well.

Mr. Zdepski clarified that his multimedia multiplex scheme in AVC-139 corresponds to Figure 2/AVC-129 (packet based approach).

As a conclusion of the discussion, Chairman requested of the members to propose a methodology to quantify the comparison and to further study this multimedia multiplexing matter.

5.6.2 Interworking between N-ISDN and B-ISDN terminals (AVC-136)

This document provided several possible scenarios of B-ISDN and N-ISDN interworking, focusing on multimedia multiplexing methods. Though support of the in-channel protocol conversion by Network Adaptor (NA) is assumed in some scenarios, there was expressed a strong view that it is unlikely in some countries. It was also pointed out that it may not be so difficult for H.32X terminals to have two multimedia multiplex methods if they are implemented with software.

5.6.3 "Media Control Layer" functions (AVC-129)

Mr. Hibi clarified that his idea of virtual media control layer is to maintain the same logical interfaces between respective media sources and this media control layer, thus to allow different multimedia multiplex methods without need to change the media source configuration.

5.7 AAL (AVC-112)

This document provided recent work on AAL Type 1 by Rapporteurs group of SGXVIII, which will be elaborated at the SGXVIII Melbourne meeting.

Since the H.32X terminal is assumed to use AAL Type 2 and the H.320 terminal is assumed to use AAL Type 1, it was pointed out that we need clear understanding on the use of AAL Type 1 and Type 2 for VBR and CBR support. It was said that Type 1 should always fill the cell, thus can support continuous bits, while Type 2 supports message start/stop, thus half filled cells are allowed. This aspect should also be clarified.

5.8 Network aspects

5.8.1 Timing synchronization (AVC-121,130)

This document raised a question whether H.26X should provide some means to synchronize encoder and decoder video sampling clocks. It was clarified that CCIR Rec. 723 includes this functionality.

After some discussion, the meeting reached a common view to include necessary information in the coded video bitstream so that the decoder can display the encoded pictures without frame dropping or frame repeating being required. This information can be in picture layer, GOB (slice) layer or even macroblock layer.

To decide a specific method to achieve the video clock synchronization, more information is required about what support of the network can be obtained. In particular, if we seek commonality between AAL Type 1 and Type 2, we must accelerate our study.

This timing recovery issue was included in the liaison statement to SGXVIII (see Annex 5).

5.8.2 CLP (AVC-170)

This document raised some questions concerning ATM cell header fields to the Experts Group's attention; CLP availability to the receiving end user, tagging of compliant cells, inter-dependence between CLP and user information, QoS values.

These were included in the liaison statement to SGXVIII (see Annex 5).

5.8.3 Liaison to SGXVIII (AVC-130; AVC-136,139; TD-10)

The meeting decided to send a liaison statement on the network related requests and questions proposed in AVC-130 and other documents to SGXVIII which meets during 2-13 December 1991 in Melbourne. Mr. Biggar undertook to coordinate a small group, which made a draft as in TD-10. The meeting approved this draft and sent the content in Annex 5 as addendum to the previous liaison statement produced at the Santa Clara meeting.

6. Harmonization

6.1 CCIR SG11 (AVC-111)

Chairman requested the members to pay attention to this new player in video coding area.

6.2 CMTT/2 (AVC-174)

After having briefly reviewed our previous actions and expected interaction at the Singapore meeting, the meeting concluded to see the progress in Singapore without sending new liaison statements at this time.

6.3 SGXVIII (AVC-110)

Chairman requested cooperation of the members at the IVS workshop that would take place next autumn, perhaps in Europe.

The meeting endorsed that Mr. Biggar kindly act as Representative of this Experts Group at the SGXVIII Melbourne meeting.

6.4 MPEG (TD-6)

We will seek the success of the joint work as concluded in Section 5.5.4 above.

6.5 ISO/IEC JTC1/SC29 (AVC-175)

Dr. Hiroshi Yasuda, Chairman of newly founded SC29, presented the outcome of its first meeting held in Tokyo during 21-23 November. The meeting took note of the fact that SC29 is seeking formal relationship with CCITT Study Group XV for collaborative interchange.

7. Work plan (AVC-137)

This document suggested a staged approach of the video coding standard development in correspondence with the B-ISDN standard development.

The Experts Group will consider this suggestion to elaborate its future work plan. One area needing consideration may be splitting and integration of video coding aspects and network related aspects.

8. Others

8.1 Status report (AVC-109)

Updating by appointed editors will be carried out on a continuous basis. The current version is a good summary of necessary work. Inclusion of more answers are desirable in the future.

8.2 Future meetings

- 5th meeting: Sole session in the afternoon of 6 January 1992, joint sessions with MPEG during 7-9 January in Singapore.

- 6th meeting: Sole sessions during 18-20 March 1992 in Stockholm and joint sessions with MPEG during March 23-27 in Haifa.

END

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Annexes to AVC-177R

Annex 1 Documents for the fourth meeting of the Experts Group
Annex 2 List of tape demonstrations
Annex 3 Definition of end-to-end delay
Annex 4 Guiding principles for the Singapore meeting
Annex 5 Addendum to liaison statement from SGXV Experts Group to SGXVIII

Participants of the fourth meeting of
Experts Group for ATM Video Coding

(18-29 November 1991, Yokosuka)

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	Mr. B.G. Haskell		AT&T Bell Labs	
	Mr. K. O'Connell		Motorola	
	Mr. R.P. Rao	+	Compression Labs	
	Mr. A.J. Tabatabai	*	Bellcore	CM
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	Mr. K. Matsuda		Fujitsu	
	Mr. K. Matsuzaki		Mitsubishi Electric	
	Mr. S. Okubo		NTT	Chairman
	Mr. K. Sawada	*	NTT	
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	Mr. T. Tanaka		NTT	CM
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Korea	Mr. Y-H. Kim		ETRI	Observer

CM: Coordinating Member
(CM): Substitute for CM
LR: Liaison Representative

* Sole sessions (27-29 November) only
+ Joint sessions (18-26 November) only

Documents for the third meeting of the Experts Group
18-29 December 1991, Yokosuka

Normal Documents

Note: Contributions with "*" have also been submitted to MPEG.

AVC-106R REPORT OF THE THIRD MEETING OF THE EXPERTS GROUP FOR ATM VIDEO CODING IN SANTA CLARA - PART I (CHAIRMAN)

Achievements and action points obtained at the third meeting (CCITT sole sessions) are recorded to facilitate our discussion at this meeting.

AVC-107R REPORT OF THE THIRD MEETING OF THE EXPERTS GROUP FOR ATM VIDEO CODING IN SANTA CLARA - PART II (CHAIRMAN)

Achievements and action points obtained at the third meeting (MPEG/CCITT EG joint sessions) are recorded to facilitate our discussion at this meeting.

AVC-108 PROPOSAL PACKAGE DESCRIPTION FOR MPEG PHASE 2 (CHAIR OF MPEG/REQUIREMENTS SUB-GROUP)

This is the version updated according to the outcome of the Santa Clara meeting in August 1991.

AVC-109 STATUS REPORT ON ATM VIDEO CODING STANDARDIZATION, ISSUE 2 (EXPERTS GROUP)

Study results as well as further study items are summarized for common understanding among members of the the group and publicity of the group's activities. This is a version updated according to the Santa Clara meeting outcome.

AVC-110 MEETING REPORT (ITU IVS CO-ORDINATION MEETING)

IVS co-ordination meeting was held to align the development of network standards and that of video coding standards. Harmonization among video coding related standardization was also intended. As outcome of the meeting, standardization timetables were produced, and a number of action points together with responsible persons for each point were identified.

AVC-111 ACTIVITIES OF CCIR SG11 FOR DIGITAL TELEVISION (CHAIRMAN OF WP-11B)

This document presents CCIR SG11 activities that have been found closely related to ours in the IVS coordination meeting. They are going to work on digital emission of HDTV (and other television?) signals, and to study generic video coding covering terrestrial and satellite emission as well as secondary distribution through cables. We should be conscious of CCIR SG11 in addition to MPEG and CMTT/2 for our successful work.

AVC-112 REPORT OF MEETING (WPXVIII/8-5, 8-3)

Outcome of the Rapporteur's meeting on AAL Type 1 and Type 3,4 is reported, listing some open items as well.

AVC-113 PICTURE FORMAT FOR CONVERSATIONAL VIDEO APPLICATIONS (CANADA)

Experimental results are provided on the impact of 480 to 576 to 480 lines conversion (with 30 Hz frame rate) for 525-line TV systems, concluding that using a high-order vertical filtering results in no visible quality degradation and that coding efficiency loss due to the use of 576-line format is less than 3%.

AVC-114* ATM COMPENDIUM (THE NETHERLANDS, BELGIUM, FRG, FRANCE, SWEDEN, ITALY, GREEK, UK)

Information is provided on a European living document for the area of ATM video coding, which is a collection of work carried out in ETSI NA5 VCM and Cost 211ter.

AVC-115* FEATURES OF MUPCOS (PTT RESEARCH, THE NETHERLANDS)

Implementation methods and obtained performance are provided for features such as MPEG1/H.261 forward/backward compatibility, upward/downward compatibility, low end-to-end delay, cell loss resilience, scalability.

AVC-116 BUFFERING AND DELAYS FOR A SLIDING WINDOW CONSTRAINT (AT&T)

This document gives the delay and the encoder and decoder buffer sizes that allow any encoded bit-stream conforming to a peak-plus-sliding window channel rate constraint to be transmitted and decoded. The post-coding buffer solution is shown as much cheaper in implementation compared to the display buffer solution described in AVC-90.

AVC-117* CELL LOSS RESILIENCE IN A TWO-LAYER CODING SCHEME (UK)

Experimental results are reported on the effect of cell loss in a two-layered scheme that has a guaranteed CBR path for base layer and a cell loss susceptible VBR enhancement layer carrying difference between the DCT coefficients of the base layer and their quantized values. It is concluded that for cell loss ratios of 1 in 10 the picture quality degradation is negligible when 50% of the bits are spent in coding the base layer information.

AVC-118* Algorithm proposal (BT)

AVC-119 LAYERED INTERFRAME CODING SYSTEM BASED ON MOTION QUANTITY (JAPAN)

Information is provided on a H.261 based layered coding scheme where large movement blocks are assigned to the high priority cells and the small movement blocks to the low priority cells. Two frame memories are used in the prediction loop, one of which stores full video signals including low priority blocks while the other stores only the high priority block signals. This scheme is characterized by the fact that full-band prediction is used at normal state, and that interframe prediction is applied even after cell loss happens in the low priority blocks. Some experimental results are presented.

AVC-120* CELL LOSS RECOVERY BY CODING ALGORITHM (JAPAN)

Various cell loss recovery methods are listed with focus on the necessary elements in the standard; leaky prediction, layered coding, cyclic refresh, demand refresh, error concealment and packetization.

AVC-121 VIDEO CLOCK JUSTIFICATION (JAPAN)

Necessity of video clock transmission for H.26X codecs is pointed out. Three possible methods for this purpose are outlined; use of the network clock as a reference, use of temporal reference in the coded video signal and use of the AAL function. It is concluded that this matter should be discussed and decided at an early stage.

AVC-122 COMPARISON BETWEEN COMPATIBLE AND NON-COMPATIBLE CODING (JAPAN)

Simulation results are reported on a hierarchical coding scheme proposed for the Kurihama tests (see AVC-150). This scheme can operate in downward compatible mode, upward compatible mode and non-compatible mode. Coding efficiency loss due to compatible coding has been found as 1.6 dB at both 4 and 9 Mbit/s for Flower Garden.

AVC-123* INTERWORKING OF H.32X TERMINALS (JAPAN)

Interworking methods of H.32X terminals with various terminals are discussed from the bit stream level compatibility and algorithm level compatibility. The followings are pointed out;

- H.32X terminal must have bit stream level compatibility with H.261.
- Conversion between different service classes becomes easier by a unified source coding algorithm.
- This conversion in video multiplex and/or transmission coding should be kept as necessary minimum by proper design.

AVC-124* CONSIDERATIONS ON PROCESSING DELAY WITH HYBRID CODING (JAPAN)

Analysis of processing delay for hybrid codecs is presented to identify the most demanding elements that require more than one frame time. Format conversion, frame reordering for bidirectional prediction are those factors. Transmission buffer causes another significant delay in CBR, but it can be eliminated in VBR.

AVC-125 SCIF ON A SQUARE PIXEL DISPLAY (JAPAN)

Experimental results are given for displaying a 16:15 pel aspect ratio signal (720 pels/line x 576 lines) on a square pixel display, concluding that this 6% error causes distinguishable geometric distortion unless proper compensation is carried out.

AVC-126 OPTIMIZATION OF 2-D VLC FOR SCIF CODING (JAPAN)

Some experimental results are provided to clarify possibilities of coding efficiency improvements through optimizing 2-d VLCs for coding through a progressive SCIF (720 pels/line, 576 lines per picture, 59.94 pictures per sec). It is concluded that we can not expect to save coding efficiency loss due to the use of progressive SCIF by optimizing the 2-d VLC for INTER pictures, but that use of an optimized 2-d VLC for INTRA improves coding efficiency by up to 10%.

AVC-127 TRANSITION OF THE BUFFER OCCUPANCY UNDER VBR ENVIRONMENTS (JAPAN)

Experimental results are reported on the leaky bucket occupancy when 89 frames of "Edited Sequence" are coded with H.261 and rate controlled by a certain method (see AVC-89). Findings are that coding rate control with short response time and a low coding rate provide small value of BOCmax and that a transmission rate slightly higher than the coding rate makes BOCmax quite small.

AVC-128 COMPARISON BETWEEN SLIDING WINDOW AND LEAKY BUCKET AS A UPC MECHANISM (JAPAN)

This document compares two average rate monitoring methods, "sliding window" and "leaky bucket," assuming a simple square wave source model for information generation. It is concluded that "leaky bucket" is a more suitable UPC mechanism for video coding at least from transmission efficiency.

AVC-129 COMPARISON OF MULTIMEDIA MULTIPLEX (JAPAN)

Three multimedia multiplex methods, cell multiplex (VCI approach), SAR multiplex (packet approach) and user multiplex approach (H.221 approach) are compared in terms of channel utilization, compatibility with H.320 and MPEG, multimedia aspect, cell loss influence, etc. The logical interface between virtual media control layer and upper layer (e.g. video codec) is illustrated and necessary functions of the media control layer are listed for each of the three approaches. It is concluded that we need further study to definitely adopt the VCI approach.

AVC-130 REQUIREMENTS FOR SGXVIII (JAPAN)

The following items are listed for request (a,b) and question (c,d);

a. video clock transmission, network clock to be provided for the terminal, timing information in AAL
b. definition of standard DOS for international connections
c. UPC mechanism and its standardization
d. Negotiation for use of VCI's in multimedia communication

AVC-131 NETWORK MODELS (SWEDEN, BELGIUM, FRANCE, FRG, GREEK, ITALY, THE NETHERLANDS, UK)

The following three ATM network models are presented which provide the congestion probability Psat and cell loss ratio CLR;

- Method of large deviation (as in the reference model)
- Gaussian (Normal Distribution) model
- Method of equivalent bursts

The first model gives more pessimistic statistical multiplex gain than the other two models that are both based on mean and variance. It is stated that though Psat and CLR are different in 2 orders of magnitude, the number of allowable calls is only 5% different. Some calculation examples for the number of allowable calls are also provided.

AVC-132 POLICING FUNCTION FOR VBR CODING (SWEDEN, BELGIUM, FRANCE, FRG, GREEK, ITALY, THE NETHERLANDS, UK)

It is proposed that the SGXV undertakes some action to actively try to specify some policing functions for VBR video coding.

AVC-133 Algorithm proposal (PTT Research)

AVC-134 PICTURE FORMAT CONSIDERATIONS (AUSTRALIA)

The concept of flexible spatial resolutions and frame rates as proposed in AVC-36 is supported. A number of questions raised at the previous meeting are discussed in detail, leading to the above conclusion. It is stressed that the ability to code sources which have frame rates not related to 59.94 Hz coder rate, proposed for SCIF, by integer factors, is essential.

AVC-135 FLEXIBLE LAYERED CODING EFFICIENCY (AUSTRALIA)

A layered coding structure for interworking between different service classes, which implements the flexible layering concept, is outlined. Several potential sources of inefficiency in layered coders have been identified; appropriate motion compensation in different layers, critical sampling, incremental signal coding in the higher layer. Work is currently being carried out to remove these sources of inefficiency.

AVC-136 B-ISDN MULTIMEDIA SERVICE INTERWORKING (AUSTRALIA)

The following three multimedia multiplex methods are compared in terms of interworking between H.32X and H.320 terminals for different communication scenarios;

- User multiplex that multiplexes the multimedia into H.221 frame structure
- Cell-base multiplex that supports the multimedia with different VCs
- Hybrid multiplex that combine features of the user multiplex and the cell-base multiplex

It is concluded that the importance of cell-base multiplexing for longer term terminal interworking scenarios is strongly identified, together with the possible interim, short term role of user and hybrid multiplexing.

AVC-137 B-ISDN NETWORK STANDARDIZATION - ITS IMPACT ON THE DEVELOPMENT OF ATM VIDEO CODING (AUSTRALIA)

After a review on recent activity in defining the scope and intent of B-ISDN network standards, particularly staged service support capabilities, resource allocation strategies, charging principles and B-ISDN performance, it is proposed for the Experts Group to take a similarly staged approach to develop appropriate video coding standards. It is also proposed that SGXV should provide an indication of the likely range of required cell loss performance values to ensure flexible and efficient coding.

AVC-138 SECOND PROGRESS REPORT TO WPXV/1 (CHAIRMAN)

There are reported major achievements since February, toward defining Recommendation H.26X for high quality video coding in the ATM environments. Particular items needing consideration of WPXV/1 are also raised; formal

aspects of collaboration with other standardization bodies and study on system aspects such as multimedia multiplexing.

AVC-139 TRANSPORT AND ERROR CONCEALMENT FOR MPEG-2 (DAVID SARNOFF RESEARCH, THOMSON CONSUMER ELECTRONICS)

A packet-oriented transport format for a specific MPEG-2 algorithm proposal (see AVC-159) is described. The transport format contains "data link level" containing generic transport information (such as priority indicator, service ID) and "adaptation level" containing video related information fields (such as slice/MB pointer, slice/MB number, picture #, picture type) that aids error recovery at the video decoder. The use of HP/LP data types allow partitioning subjectively important and less important bit-streams when appropriate transmission facilities are available. Possible error concealment methods as well as cell loss simulation results are described.

AVC-140 STATISTICAL MULTIPLEX GAINS FOR VARIABLE BIT RATE (BELGIUM, FRANCE, FRG, GREEK, ITALY, THE NETHERLANDS, SWEDEN, UK)

It is argued that if both provides the same quality, VBR has always larger statistical multiplex gain than CBR since VBR is an "eroded" version of CBR.

Several factors impacting the statistical multiplex gain are listed up; codec adaptability, noise in source, source bit rate, link bit rate, change in image contents, integration periods. It is concluded that there is no need to make a generic choice between CBR and VBR; CBR is a particular case of VBR.

AVC-141 to 168 Algorithm proposals

AVC-169 PICTURE FORMAT FOR HIGH QUALITY INTERACTIVE VIDEO SERVICES (BELLCORE)

Simulation results are presented on a coding efficiency comparison between a SCIF with 576x720 spatial resolution and a SCIF with 528x720 spatial resolution (square pixel), concluding that the latter format is on average 5.5% more efficient than the former.

AVC-170 ATM CELL HEADER FIELD (BELLCORE)

Several questions on the ATM cell header field are brought to the Experts Group's attention; availability of CLP field to the receiver end user, tagging compliant cells at the edge of network, support of user information by the existing ATM cell header field, and number of cell loss performance objectives.

AVC-171 STATISTICAL ANALYSIS OF VIDEO TELECONFERENCE TRAFFIC (BELLCORE)

Histograms and Q-Q plots are provided for the number of cells per frame in "viconf" and "viphone" sequences which were provided by Alcatel Bell (see AVC-99), concluding that it follows a gamma distribution.

AVC-172 DSM/ATM WORKSHOP (EXPERTS GROUP)

Collection of the following four talks given during the MPEG/CCITT EG joint sessions at JVC-Kurihama on 20 November 1991;

M. Biggar Broadband ISDN evolution
O. Poncin ATM network characteristics
T. Tanaka VBR aspects
G. Morrison Video coding techniques suitable for utilizing ATM network characteristics

AVC-173 PRELIMINARY FUNCTIONAL REQUIREMENTS FOR SECONDARY DISTRIBUTION OF TV AND HDTV SIGNALS (TG CMTT/2 SRG)

This is an update of the previous document AVC-67.

AVC-174 REPORT OF THE ACTIVITIES OF THE GROUPS OF EXPERTS ASSISTING THE SPECIAL RAPPORTEUR (TG CMTT/2 SRG)

Work progress is reported covering 4 meetings since May 1991. It is noted that CMTT/2 SRG are confident;

- that a family of formats can be defined for 50 or 59.94/60 Hz systems,
- that the same algorithm scheme can be adopted for both the families,
- that compatibility between 50 Hz and 59.94 Hz is not a requirement at the decoder.

Two examples of compatible coding structures are given; both of which use a progressive or interlaced format for CTV and EDTV, while compatibility between this format and HDTV format is achieved by pyramidal coding.

AVC-175 RESOLUTIONS ADOPTED DURING THE FIRST PLENARY MEETING OF ISO/IEC JTC1/SC29, 21-23 NOVEMBER 1991, IN TOKYO, JAPAN (SECDREATRIAT ISO/IEC JTC1/SC29)

Decisions made at the first meeting of ISO/IEC JTC1/SC29 are brought to the Experts Group's attention; acivities of the groups under its umbrella and the relation to other groups.

AVC-176 PICTURE PERFORMANCE OF 1.3, 4 AND 9 MBIT/S BELLCORE ALGORITHMS AND OTHER TEST PROCESSES (BELLCORE, NTT)

Subjective study results are reported on the picture quality evaluation of compressed bit rate algorithms operating at 1.3, 4 and 9 Mbit/s, and the picture quality of other benchmark test processes (NTSC, VHS VCR). The subjective test plan is also detailed.

ALGORITHM PROPOSAL DOCUMENTS SUBMITTED FOR THE KURIHAMA TESTS

Note: "#nn" indicates the MPEG pre-registration number.

AVC-118	MPEG91/207	#08	BT Labs
AVC-133	MPEG91/215,216	#18,19	PTT Research, LEP-Philips, PRL-Philips
AVC-141	MPEG91/201	#02	AT&T
AVC-142	MPEG91/202	#03	Aware (I)
AVC-143	MPEG91/203	#04	Aware (II)
AVC-144	MPEG91/204	#05	Bellcore, NTT
AVC-145	MPEG91/206	#06	BBC et al.
AVC-146	MPEG91/206	#07	NTA
AVC-147	MPEG91/208	#09	CCETT et al.
AVC-148	MPEG91/209	#11	GCT et al.
AVC-149	MPEG91/210	#12	HHI
AVC-150	MPEG91/211	#13	Hitachi, Fujitsu
AVC-151	MPEG91/212	#14	IBM
AVC-152	MPEG91/213	#16	JVC
AVC-153	MPEG91/214	#17	KDD
AVC-154	MPEG91/217	#22	Matsushita
AVC-155	MPEG91/218	#23	MIT
AVC-156	MPEG91/219	#24	Mitsubishi
AVC-157	MPEG91/220	#25	NEC et al.
AVC-158	MPEG91/221	#26	NHK
AVC-159	MPEG91/223,255	#27,28,35	TCE, PCE, David Sarnoff, PTT Research
AVC-160	MPEG91/224	#30	RTT, UCL
AVC-161	MPEG91/225	#31	Sharp
AVC-162	MPEG91/226	#33	SONY
AVC-163	MPEG91/227	#34	Thomson-CSF/LER
AVC-164	MPEG91/228	#36	Toshiba
AVC-165	MPEG91/229	#37	UCL
AVC-166	MPEG91/230	#38	Waseda University
AVC-168	MPEG91/231	#39	Columbia University
AVC-151	MPEG91/232	#40	EPFL

Temporary Documents

TD-1 Agenda for the fourth meeting in Yokosuka (Chairman)
TD-2 Available documents (Chairman)
TD-3 List of tape demonstrations (Chairman)
tD-4 Summary of proposals (MPEG/VIDEO and REQUIREMENTS)
TD-5 Subjective test results of MPEG-2 (MPEG/TEST)
TD-6 Summary of discussion (MPEG/VIDEO and REQUIREMENTS)
TD-7 Meeting report (Chairman, WPXV/1)
TD-8 Guiding principles for the Singapore meeting (Small group)
TD-9 Definition of end to end delay (Small group)
TD-10 Addendum to liaison statement from CCITT SGXV Experts Group on Video Coding for ATM Networks (Small group)
TD-11 Draft report of the fourth meeting in Yokosuka (Chairman)

END

List of Tape Demonstrations
(28 and 29 November 1991, Yokosuka)

No Organization	Topics	Tape	Doc.
a. MPEG/TEST	- Pictures for subjective tests	D	TD-5
b. BNR	- Picture format for conversational video applications	D	AVC-113
c. Fujitsu	- Comparison between compatible and non-compatible coding	D	AVC-122
d. PTT Research	- Submitted tape for MPEG tests all compatible coded with 1 Mbit/s in MPEG1 layer - Backward compatibility - Low delay and cell loss resilience all at 4 Mbit/s and with 1 Mbit/s compatible in MPEG-1	D	AVC-133 115
e. David Sarnoff	- MPEG coding performance for #27, 28, 35 and cell loss	D	AVC-139
f. NEC	- Algorithm proposal (Wavelet Transform) #25	D	AVC-157
g. Matsushita	- Cell loss resilience	D	AVC-154
h. BT Labs	- Features of algorithm proposal #08 - Cell loss resilience using 2-layer coding	D U*	AVC-118 AVC-117

* Not demonstrated due to the equipment difficulty.

GUIDING PRINCIPLES FOR THE SINGAPORE MEETING

The sub-group expressed some requests regarding the Test Model TM0 that should be issued at the Singapore meeting.

1) The Test Model should be very simple at the beginning and be improved by including elements which have been verified.

2) Some room should be provided within TM0 to allow the optimization of the low delay mode.

   Note: End to end delay must be clearly defined for

   - forward field prediction
   - forward frame prediction
   - forward and backward prediction, use of B-frames.

3) A proposed core experiment should allow backward/forward compatibility with MPEG1 or H.261 (as embedded bitstream at 1.15 Mbit/s) and comparison with simulcast modes.

4) TM0 should provide sufficient room to implement schemes with forward prediction only in the interest of low delay and simple implementation.

5) Scalability and effectiveness of the coding schemes at low bit rates are important items.

The sub-group also agreed that the Experts group should make a proposal to specify a cell loss experiment, and particularly describe the simulation environment for cell loss resilience comparison.

END

DEFINITION OF END TO END DELAY

1. Introduction

The following description of the end to end coding delay is proposed to allow comparison between coding schemes regarding what end to end delay is concerned.

A this stage the transmission delay is neglected and the end to end delay is defined as a back to back delay (see Figure 1).

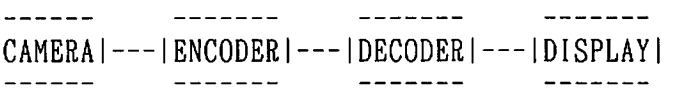


Figure 1

2. Description of end to end delay

The different delay in encoder and decoder are described in Figure 2.

The expression for the total end to end delay is

$$D_{tot} = \sum_{i=1}^{6} D_i^e + D_7 + \sum_{i=1}^{6} D_j^d$$

A more precise explanation of frame reordering is given in Figure 3.

3. Conclusion

The above definition has to be adopted to the specific coding. Mainly examples are given.

It can be pointed out that the main elements for delay are

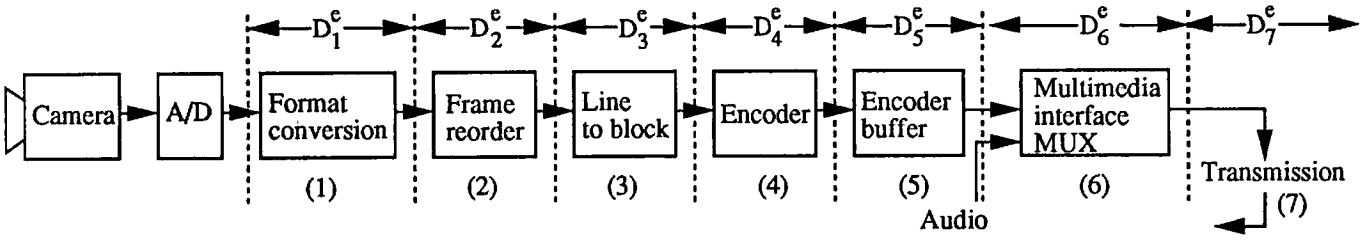
- format conversion
- frame reordering
- buffer delay

For simplicity reasons, $D_6^e+D_7+D_6^d$ can be neglected when comparing coding schemes.

It should however be noticed that this factor must be added to when the end to end delay is calculated to meet the requirements (low end to end delay).

References

AVC-124 (Japan) Considerations on processing delay with hybrid coding
AVC-115 (PTT Research - NL) Features of MUPCOS



(1) Format conversion
- field → frame
  (e.g. 0.5 frame time in case of simple field merging.)
- spatial conversion
- temporal conversion

(2) Frame reorder
I_4 B_5 B_6 P_7 → I_4 B_2 B_3 P_7
see also Fig. 3

(3) 16 lines → 16×16 Macroblocks

(4) Motion estimation,
pre-analysis for rate control etc.

(5) Delay not constant !

(6) Delay possibly not constant
Neglected for simplicity
(e.g. time stamping, FEC)

(7) Neglect at the moment

Note : $D_5^e + D_5^d$ = constant

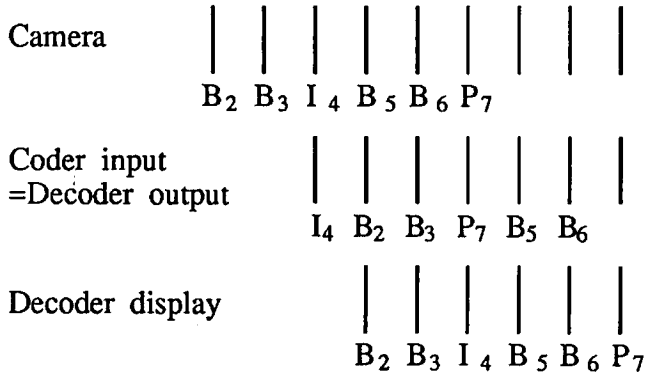
$$= \frac{\text{Buffer size}}{\text{nr. bits/s}}$$

if there is no frame dropping or frame repetition.

END TO END DELAY $= D_1^e+D_2^e+D_3^e+D_4^e+D_5^e+(D_6^e+D_7^e) + (D_6^d) +D_5^d+D_4^d+D_3^d+D_2^d+D_1^d$

Fig. 2

Frame reordering



Example

* M = 3
  Encoder D_2^e = maximum 3 frames (B frames)
  Decoder D_2^d = maximum 3 frames (I frames)
  $D_2^e + D_2^d$ = constant = 3 frames

* M = 1
  Only forward prediction

  $D_2^e = 0$, $D_2^d = 0$

Fig. 3

ADDENDUM TO LIAISON STATEMENT FROM SGXV EXPERTS GROUP TO SGXVIII

Source : Experts Group
Purpose: Action

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1. Introduction

At its fourth meeting in Yokosuka, Japan, November 1991, the following issues were discussed by the CCITT SGXV Experts Group for ATM Video Coding, and recognized as items about which SGXVIII could provide information. This addendum to the liaison statement prepared at the third meeting in Santa Clara, August 1991, seeks response from SGXVIII on the following issues.

2. UPC and NPC

The choice of algorithm used to perform UPC and NPC functions has an impact on the video coding scheme, since compliance will affect the rate control strategy, particularly for VBR video. Standardization of the UPC/NPC algorithm(s) is essential to ensure that terminal equipment can be used on any network and that inter-network (e.g. international) connections can be established.

The Experts Group wishes to advise SGXVIII of the impact that the UPC/NPC algorithm may have on the video coder, and seeks information on the program of standardization efforts in this area.

3. Clock recovery

While simple synchronization strategies such as frame repeat or frame dropping are possible for lower quality video services, such methods are not acceptable if high quality is to be maintained. Therefore, many video services will require a means of synchronizing encoder and decoder video clocks.

While the availability of a universal, synchronous, network based reference clock could provide a solution, the Experts Group has a concern that this may not always be available, particularly if network access is via a LAN and PBX.

In this latter case, an explicit means of providing clock synchronization is required. The Experts Group notes, form the report of the SGXVIII Rapporteurs Meeting on AAL (Ottawa, 1-3 October 1991), that this is an area being studied by CCITT SGXVIII. Both SFET and Time Stamping techniques are discussed in that report. We believe that Time Stamping is more appropriate for VBR services than is SFET, and have previously expressed our strong desire for commonality of AAL for the support of VBR and CBR video. We request that SGXVIII take this into account during its work in this area, and request early advice of progress.

4. Quality of Service guarantees

The Experts Group understands that, as yet, no agreement has been reached within SGXVIII on whether a guaranteed QoS will be offered on Low Priority channels. As the QoS (CLR, delay) has a major impact on the video coding

algorithms appropriate for video service support, the Experts Group urges SGXVIII to give urgent attention to this issue and request early advice of progress.

The Experts Group also perceives a risk if no values of QoS are standardized. If the same QoS cannot be provided on different networks or in different regions, this would compromise the viability of large terminal markets and communications spanning different regions.

5. ATM Header availability at receiving terminal

In discussion within the Experts Group and elsewhere, it has been suggested that certain bits within the ATM header (in particular, CLP and PT), if available to a receiving terminal, could provide useful information regarding the cell content and avoid the need for duplicate labeling at a higher layer. The viability of using this technique is dependent on the ATM header being passed up from the network to the receiving terminal device. Can SGXVIII advise whether this will always be possible?

6. Burstiness characteristics of cell loss

The length of a cell loss burst has a significant impact on the means of error protection/correction in a video coding system, and could even influence the basic coding architecture. While we appreciate the SGXVIII's information on this matter provided by WPXVIII/6 in November 1990, a quantitative description of the expected cell loss burst behavior is desired at the earliest opportunity.

The Experts Group notes, from the SGXVIII Rapporteurs Meeting on AAL (Ottawa, 1-3 October 1991), that a modulo 8 sequence number is considered adequate to detect error in a CBR, AAL Type 1 application, would this also be appropriate for a VBR video transmission using AAL Type 2? Any information that would give a quantitative description of cell loss burst behavior would be welcome. Are any measures of cell loss burst length likely to be included in the QoS parameters agreed between user and network?

7. Multimedia multiplexing

Some advantages of multiplexing the components of a multimedia call on different VCs (i.e. cell-based multiplexing) have been recognized by the Experts Group. To use this approach, however, requires determination of the media type by the receiving terminal at the time the connection/call is established. What is the mechanism by which this media identification is envisioned to occur?

8. Conclusion

In this addendum to the liaison statement to SGXVIII prepared at the August meeting in Santa Clara, the SGXV Experts Group for ATM Video Coding has provided information on the items it sees as important in progressing its video coding standardization activity. Consideration of, and response to the issues raised above are requested.

END