CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding
(Rapporteur's Group on Part of Q.3/XV)

Document AVC-443R
January 29, 1993

SOURCE: CHAIRMAN OF THE EXPERTS GROUP FOR ATM VIDEO CODING
TITLE : REPORT OF THE TENTH MEETING IN TORINO AND ROMA (21-29 January 1993) - PART I and PART II
Purpose : Report

Part I General
Part II Sole sessions in Torino
Part III Joint sessions in Roma (see AVC-444R)

Part I General

The tenth meeting of the Experts Group was held in Italy as follows;

- CCITT sole sessions in Torino during 21-22 January at the kind invitation of CSELT,
- Joint sessions with ISO/IEC JTC1/SC29/WG11 (MPEG) in Roma during 25-29 January at the kind invitation of the Ministry of Posts and Telecommunications.

The list of participants appears at the end of this document.

Dr. Franz May announced to resign Coordinating Member of FRG due to his new mandate. The meeting thanked his active contributions to the progress of the Experts Group and wished his success in the new environments.

Part II Sole Sessions

Contents

1. Introduction

The CCITT sole sessions were held in the CSELT main building during 21-22 January 1993 at the kind invitation of CSELT . At the opening session, Dr. Leonardo Chiariglione (Head, Multimedia and Video Services) made a welcoming address on behalf of the hosting organization.

At the end of the sessions, Chairman thanked the hosting organization for the meeting facilities provided and the excellent secretarial support.

We had also a short closing session on January 29 at Ministero P.T. to review both sole and joint sessions as well as to prepare for the Sydney/Melbourne meeting

2. Documentation (TD-2)

For the sole sessions, 44 AVC-numbered documents and 8 Temporary Documents have been made available as listed in Annex 1.

3. Tape demonstration (TD-3)

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

4. Review of the previous meetings

4.1 Ipswich/London meeting (AVC-398R,399R, 435)

Chairman introduced some amendments in AVC-398R which were made to reflect the review of the draft at the London closing session. Mr. Biggar presented the outcome of the correspondence work for the multimedia multiplex summary table which were contained in a liaison statement to SGXVIII.

4.2 WPXV/1 meeting (AVC-401,402)

Chairman presented the outcome of the outcome of the WPXV/1 meeting in November 1992, highlighting items relevant to this group;

- general SGXV and MPEG relationship,
- multimedia multiplexing,
- common text approach for H.26X\MPEG-2,
- timetable for broadband audiovisual system Recommendations,
- PSTN videophone.

4.3 CMTT/2 and its SRG

Mr. Zedler briefly introduced current activities of CMTT/2 and its SRG and CCIR, focusing on their relationship with MPEG activities.

5. Test Model

5.1 TM3 (AVC-400, 400b)

Mr. Koster presented his editorial work for documenting agreed coding algorithm and (core) experiments. He raised a question whether TM4 is required in the light of freezing specifications in March, and whether agreed specifications should rather be transferred to Working Draft. The meeting felt that as far as new action points are identified, they should be documented somehow, e.g. as TM3bis.

5.2 Basic performance (AVC-420)

A part of TM2 coded HDTV pictures (reported previously in AVC-365) were demonstrated in CCIR601 format.

6. Low delay mode

6.1 Clarification on TM3 specifications (AVC-417)

The meeting reviewed proposed clarification concerning;

- decoder operation,
- value of the vbv_delay field to be set at the encoder and its use at the decoder,
- data removing timing in VBV,

and concluded as almost agreeable, but decided to leave it for further study due to limited time available for this discussion.

6.2 Special prediction

Mr. Nakajima and Mr. Bjoentegaard summarized current status of the experiments and converged simple architecture, reporting that SNR improvement obtained with this method exceeds that of bi-directional prediction (frame/field adaptive, M=3) at 4 Mbit/s if averaged over whole sequences Position of the CCITT Experts Group was concluded as follows;

"In the interest of improving the low delay operation, many members of CCITT EG are supportive of inclusion of this technique in the core (mandatory element for the decoder, the encoder may implement it as an option), but some are not due to its increased complexity."

6.3 Non 8x8 DCT (AVC-415)

Reduction of mosquito noise by use of adaptive 8x1/8x8 DCT were demonstrated for low delay operation. As response to a question, it was clarified that selection of 8x1 DCT is about 50%. There was an unanswered question whether vertical 1x8 DCT also helps to reduce coding artifacts. The meeting further discussed whether this technique is reducing the same or different redundancy with other techniques such as special prediction, frame/field DCT. Feeling was that this technique attacks different physical property of the coding algorithm compared to special prediction and field/frame DCT (transform vs decorrelation), thus their improvements will be additive. Related to this discussion, there was a suggestion of testing this technique for progressive sources.

7. Error resilience

7.1 Framework

7.1.1 Cell loss generation for experiments (AVC-421)

The meeting agreed to the modification of the cell loss generation method contained in TM3 and the warning note proposed in AVC-421.

7.1.2 Error resilient operation of the decoder (AVC-432)

The meeting appreciated the decoder strategies for errors provided in AVC-432, confirming that this area is outside the scope of standardization.

7.1.3 Informative text for H.26X|MPEG-2 (AVC-425; TD-7)

Error resilience techniques and how to use them in error prone environments are to be included in the standard as informative text. Mr. Bigger provided a draft framework in AVC-425 containing list of contents and information required and Mr. Sakai provided a summary of cell loss resilience schemes to make this text further informative. Mr. Biggar coordinated a small group discussion to draft a text to be included in WD and generated an expanded framework as in Annex 3.

During this discussion, it was reminded that protection against bit errors in ATM cells is awaiting study.

7.1.4 Relevance to "Core Profile" (AVC-426)

Document AVC-426 proposed to consider that an error resilience method with scalable extension be considered for the MPEG-2 core because not only it can achieve cell loss resilience but also scalability functionality with minimum complexity, the core should be as big as possible. There was some strong support for this proposal, but different views were also expressed that its resilience performance is not yet fully demonstrated, that spatial

scalability similarly provides cell loss resilience and that including too much in the "core profile" may not bring expected wide availability of standards conforming products. It was also argued that "core profile" is yet to be well defined.

The meeting concluded that no consensus of the group was obtained, thus this proposal be forwarded to the joint sessions as an individual input.

7.1.5 Cell loss characteristics for VBR video (AVC-430)

Document AVC-430 provided simulation results for average burst length and average inter burst length by using modeled VBR MPEG-1 video traffic. There was a comment that the average burst length is for multiplexed sources, thus each source would suffer only 1/N of the value listed in Table 1/AVC-430. Another comment was a request to relate this model for calculating CLR and the network model being used in this group (see Annex 4 to AVC-357).

As to the use of 10*N cells buffer, concern was expressed for increased delay. It was responded that this study was carried out for multiple program transmission for satellite and delay is not so critical in satellite distribution systems.

7.2 Concealment (AVC-405; AVC-403,407,412,432)

Error concealment by use of motion vectors in I-frames was presented in AVC-405. In response to a question whether inclusion of motion vectors to intra macroblocks increases error resilience, Mr. Uz clarified that for an intra macroblock a motion vector is available at the inter macroblock above it. thus the improvement is small. He also clarified that if the encoder does not wish to send motion vectors for I-pictures, it can do so without losing coding efficiency by not using the particular picture macroblock_type table entry. There was another question of what would happen if the motion vector above the lost macroblock is also lost and the answer was to use the motion vector of a further above macroblock.

The meeting concluded that further study is required in comparison with other alternative techniques.

7.3 Spatial localization (AVC-406,412,427,428; AVC-403)

Documents AVC-406,412,427,428 addressed;

- structured packing vs short slice size,
- structured packing and/or concealment,
- AAL and video syntax specifications to support the structured packing.

The meeting concluded that CCITT EG does not support the inclusion of "absolute macroblock" for error resilience purpose because the short slice method can achieve similar performance without changing the syntax. However, use of this structured packing technique at the system level is open.

During the discussion, error resilience study for transmission of pre-recorded materials and cascading two transport methods, e.g. satellite and ATM, was pointed out. Ms. Verreth suggested from her observation (see AVC-432) that applying different slice sizes for I, P, B pictures may be effective.

7.4 Temporal localization - leaky prediction (AVC-403,413,414,431,442; TD-4; AVC-412)

Several experimental results were reported on leaky prediction giving the following findings;

- Two solutions for the limit cycle fix offer the similar performance. A small difference is that Solution 2 gives perfect tracking between encoder and decoder while some residual (-50 dB) remains in Solution 1.

- As to the noisy background, AVC-414 showed that adaptive quantization of dc components solves the problem. This fact corresponds to the results demonstrated in AVC-413; leaky prediction using rate control of up to Step 2 showed significant noisy background but it disappears in non-leaky prediction of dc components.

There was a question how this technique affects random access and editing with an answer that it allows random access by starting to decode one or two seconds in advance, but does not group of picture editing. It was also pointed out that picture unit editing, which is required in program production, is only possible with wholly intra coding.

As to channel hopping performance, Mr. Haskell suggested compensating leak factor at the decoder to improve performance.

There was a general comment to the leaky prediction that there is inconsistency of design philosophy in seeking high prediction efficiency by special prediction on one hand and losing it by leaky prediction on the other hand.

The meeting concluded as follows;

CCITT EG supports the cyclic INTRA insertion (INTRA picture, slice, column) as a default solution for temporal localization of cell loss affects and for channel hopping. However, a final decision will be made after one more round of experiments to compare these two solutions.

7.5 Layered coding (AVC-404,407,424)

The following three error resilience techniques by layering were presented;

- coefficient scanning(AVC-404)
- spatial scalability (AVC-407)
- frequency scalability (AVC-424)

They all assume a guaranteed channel for high priority (base layer) and are most effective at cell loss rates of 10^{-3} or higher. During the discussion, the following clarification or comments were stated;

- In the coefficient scanning, reproduction of HP components only gives blurring and jerky pictures if 25% is assigned to these components. Coding efficiency is not lost if there is no rate control in the base layer; rate control for 25% assignment case is most difficult.
- Frequency scalable scheme achieves layered coding with minimum increase of complexity.
- A difference between spatial scalability and frequency scalability is that the former supports compatibility. The same base layer performance is obtained with less bit rates in the spatial scalability. If anything can be done in the coefficient domain, it must be achievable in the pel domain as well.

The meeting concluded that this topic requires further study together with the issue how to structure scalability functionality in the standard.

8. Compatibility

8.1 Framework (AVC-409,419,440,441; AVC-416)

Documents AVC-409 and 419 addressed;

- system consideration; where this "compatibility" is effective in terms of communication situations and bit rates,
- flexible layering.

To the embedded architecture raised in AVC-409, there was a question whether 25% more throughput increase leads the standard to the widest use. A rebuttal is that the cost problem will go away in the future, starting with a little more cost will facilitate the future. Another question was whether flexible layering eventually requires full layering to achieve interworking among different applications. An answer was that the necessary number of layers depend on applications.

Document AVC-419 provided discussion materials for a particular case of multipoint communication system, pointing out some items requiring further input. Mr. Biggar commented that H.32X-H.320 interworking is transitional, thus we should focus on long term solutions looking at the time when B-ISDN prevails, but some others expressed a differing view that the interworking requirement would last for a considerably long transitional time.

Similar system study for frequency scalable scheme and comparison with spatial scalable scheme is requested as pointed out in §6.4.3/AVC-398R (Ipswich/London meeting report). These two may be alternatives or may have their own areas.

Document AVC-440 analyzed approaches to the upsampling filter of the compatible scheme for discussion. Consideration of the members is requested.

Document AVC-441 proposed some items to exploit the correlation between similar video signals over a pair of video codecs (such as stereoscopic coding). As to the interlace/progressive indication, the meeting considered that it should be in picture layer rather than sequence layer, taking into account other requirements of rapidly switching between progressive film sources, interlaced camera sources, etc. as well (see also §5.3/AVC-398R). As Items 2 and 3 received reservation, the meeting concluded that this proposal be forwarded to the joint sessions as an individual input.

8.2 Interlace-progressive compatibility (AVC-422; AVC-411)

Document AVC-422 informed that adding compatible prediction to even fields from the odd field base layer does not affect performance in SNR and subjective quality in a field picture compatible scheme. A possible reason is temporal misalignment between predicting and target pictures. Mr. Ueno commented that in frame picture structure prediction from base layer picture improves coding efficiency of I frames of the target regardless of the temporal misalignment.

8.3 Interlace-interlace compatibility (AVC-408,411,423,433,434)

Documents AVC-408,411,433 reported coding results of the spatio-temporal weighting for the interlace-interlace compatibility scheme. AVC-412 showed coding loss of the compatible coding in a sequence, to which a suggestion was given to visually check prediction errors if there is any pel displacement; pel displacement appears as disturbing moire-like patters.

There was some discussion on requirements to upsampling and downsampling filters for the compatible coding. It seems that filters appropriate for obtaining best efficiency in the enhancement layer and those for obtaining best pictures in the base layer are not the same. For prediction, pel alignment is critical to usefulness of the base layer. As to complexity of the compatible scheme, Mr. Morrison pointed out a possibility to use reordering memories for up/down sampling filters. AVC-423 reported relevant experimental results regarding horizontal upsampling filters, informing that tried simple and complex filters did not differ in coding efficiency.

There was also a comment that relationship between complexity of downsampling filters and coding efficiency is also studied in frequency scalable coding, hence the results should be compared. Mr. Parke drew attention of the meeting that coding efficiency of the compatible coding is quite sequence dependent.

Differing views were expressed regarding spatio-temporal weighting; some thought it is not justified for adoption, others thought it is effective. The meeting concluded that study should be continued.

Document AVC-433 reported on HDTV/CTV compatibility experiments using pyramid coding. Mr. Nam stated his observation that 4:2:2 and 4:2:0 in HDTV show no significant difference. There were comments that this pyramid scheme had been tried previously for compatible coding but now it evolved into the current spatial scalable scheme.

8.4 H.261 compatibility (AVC-416,429,439)

Document AVC-416 reported on cascade coding of MPEG-2 at 4 Mbit/s and H.261 at 1.5 Mbit/s, 384 kbit/s and 128 kbit/s indicating that this is one of the possibilities to make a compatible system. Concern was expressed for increase of delay, leading to that this technique is applicable when two bit rates are largely different.

The other two documents AVC-429 and 439 addressed embedded coding, demonstrating spatio-temporal weighting is effective for H.261 in the base layer. An interpretation is that low bit rate H.261 pictures are not so good as 1.5 Mbit/s MPEG-1 base layer pictures. To the block noise observed in the non-compatible scheme of AVC-429, a possibility of actual motion exceeding the motion vector tracking range was pointed out. Characteristics of up/down sampling filters to obtain better coding efficiency and better H.261 layer pictures are subject to further study as in §8.3.

8.5 SNR scalability (AVC-410)

Two SNR scalable configurations were tested in AVC-410 according to the compatibility/spatial scalability syntax. In response to a question that coding efficiency could be further improved, Mr. Parke clarified that removing current overhead in the enhancement layer video multiplex coding will bring improvements.

As to possible applications of this SNR scalability, broadcasting and data base were listed as typical ones. Another possibility of software decoder in computers was also mentioned.

9. Frequency scalability (AVC-424,426)

The meeting shortly considered where this functionality is most effective. The following three areas were found typical;

- computer networks,
- in processing power sensitive areas rather than in bit rate sensitive areas,
- in broadcasting situations.

10. Core Profile (AVC-418,438)

The meeting discussed what definition is desirable from communication applications consideration. Though common understanding on "core" definition is not yet obtained, Chairman stressed in response to the questions in AVC-438 that current efforts in the generic coding framework are not to define application oriented profiles (such as telecom profile, broadcasting profile, ...), but functionality oriented profiles. It was also stated that "profile" is closely related to conformance.

Document AVC-418 proposed attributes and their values of the core profile in terms of TM3 syntax elements, taking five typical audiovisual communication services on B-ISDN into account.

Two differing views were expressed for the core profile;

- It should include maximum number of functionalities necessary for communications to achieve interworking.

- It should be practical in functionality to make commercial production take off. It should be really minimum but still useful.

Since no consensus on the proposal contained in AVC-418, the meeting confirmed that this should be provided as a discussion paper for consideration of the joint sessions.

During the discussion, Mr. Stevens suggested to evaluate implementability of each functionality listed to decide practicality of the core. Mr. Parke drew attention of the group that H.26X/MPEG-2 should support not only 4 Mbit/s or above, but also lower bit rates down to 64 kbit/s to support various scale pictures.

As a further step, this group should study relation between H.26X/MPEG-2 profiles (core and extension) and total system Recommendations.

At the closing session in Roma, the meeting confirmed that we need not a separate "low delay profile", rather we need a low delay operational mode contained in the "Main Profile" (Note) so that we can achieve service integration at the B-ISDN terminal. It should be checked that all the necessary syntactic elements for low delay operation are included in "Main Profile"; skipped picture, special prediction, VBV consideration, and others if any. It was also recognized that there may be defined another profile which addresses no B pictures thus allows low delay, but its objective is low cost, hence it should not be confused with the above mentioned "low delay profile".

Note - A profile previously called "Core Profile" was renamed as "Main Profile" at the joint sessions in Roma.

11 Work plan (AVC-402,436,437; TD-5)

Document AVC-436 provided work items, their current status, timetable, etc. for consideration of the group. TD-5 is an excerpt from the document "GUIDE FOR CCITT AND ISO/IEC JTC1 COOPERATION" to highlight the synchronization of H.26X/MPEG-2 approval process between two standardization bodies.

The target dates for total system Recommendations and priority should be more clearly stated at the next meeting. In the mean time, Chairman of Experts Group will seek advice of Chairman of Working Party/1 and Special Rapporteur of Q.4/XV from the overall SGXV planning perspective.

As to the H.320 terminal adaptation proposed in AVC-437, the meeting agreed to its inclusion in the Experts Group work program based on the understanding that this has already been studied to some extent in the B-N interworking framework and that the Group's terms of reference include "to study video coding algorithm appropriate to the ATM environment for conversational services, particularly to study whether modifications are necessary to make the present AV Recommendations applicable to the ATM network".

12. Joint sessions with MPEG

12.1 Documents

Information and discussion documents

AVC-403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,420,422,423,424, 427,428,429,430,431,432,433,434,438,439,442

Individual proposal documents

AVC-426,441

Group proposal documents

AVC-412,421,425; TD-7

12.2 Representatives

CCITT EG	S. Okubo
Requirements	A. Tabatabai
Video	G. Bjoentegaard
System	B. Haskell
Implementation	P. Stevens

13. Others

Future meetings

March/April 1993	joint sessions in Sydney (March 29 - April 2) sole sessions in Melbourne (April 5-7)
July 1993	sole sessions in ??? joint sessions in New York (July 12-16)
November 1993	sole sessions in ??? joint sessions in Seoul (November 1-5)

At the closing session in Roma, it was agreed that we will have a coordination meeting among regional coordinators (America, Asia, Europe, Oceania) during 16:00 - 18:00 on Sunday, March 28 to prepare for the joint sessions which are held before the sole sessions this time. Chairman will later advise Group members of the details.

END

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Annexes

Annex 1 Documentation
Annex 2 List of tape demonstrations
Annex 3 Error resilience framework for informative text and further experimentation

Participants of the tenth meeting of Experts Group for ATM Video Coding (21-29 January 1993, Torino and Roma)

			T	R	
FRG	Mr. M. Kühn	DBP TELEKOM		X	
	Mr. F. May	Daimler-Benz	X		CM
	Mr. G. Zedler	DBP TELEKOM		X	CM
Australia	Mr. M. Biggar	Telecom Australia	X	X	CM
	Mr. R. Brandis	Australian Defence Force Academy	X	X	
	Mr. T. Sikora	Monash University	X	X	
	Mr. G. Smith	Optus Communications	X	X	
	Mr. P. Stevens	Siemens	X	X	
Belgium	Mr. O. Poncin	Belgacom	X	X	CM
Korea	Mr. J-Y. Nam	ETRI	X	X	CM
USA	Mr. B.G. Haskell	AT&T Bell Labs	X	X	
	Mr. D. Klenke	CLI	X	X	
	Mr. A. Tabatabai	Tektronix	X	X	CM
	Mr. M. Uz	DSRC	X	X	
	Ms. A. Wong	Bellcore	X	X	
France	Mr. G. Eude	CNET	X	X	
	Mr. J. Guichard	CNET	X		CM
Italy	Ms. L. Conte	CSELT	X	X	CM
Japan	Mr. Y. Machida	Matsushita	X	X	
	Mr. K. Matsuzaki	Mitsubishi	X	X	
	Mr. Y. Nakajima	KDD	X	X	(CM)
	Mr. S. Okubo	NTT	X	X	Chairman
	Mr. K. Sakai	Fujitsu	X	X	
	Mr. H. Ueno	Toshiba	X	X	
Netherlands	Mr. A. Koster	PTT Research	X	X	(CM)
	Mr. R. ter Horst	PTT Research		X	
Norway	Mr. G. Bjøntegaard	NTR	X	X	(CM)
UK	Mr. G. Morrison	BT	X	X	CM
	Mr. I. Parke	BT	X	X	
Sweden	Ms. C. Verreth	Telia Research	X	X	CM

CM: Coordinating Member
(CM): Substitute for CM

Documents for the Torino/Roma meeting
(21-29 January 1993)

Normal Documents

Note - [93/nnn] indicates MPEG93/nnn.

AVC-398R REPORT OF THE NINTH MEETING IN IPSWICH and LONDON - PART I (CHAIRMAN)
AVC-399R REPORT OF THE NINTH MEETING IN IPSWICH and LONDON - PART II (CHAIRMAN)

These two documents report the outcome of the sole and joint sessions held in October and November 1992.

AVC-400 TEST MODEL 3 (TEST MODEL EDITING COMMITTEE)
AVC-400b TEST MODEL 3 (TEST MODEL EDITING COMMITTEE)
[N0328]

Achievements and clarification obtained at the London meeting were incorporated into Test Model 3, and several core experiments were defined for action.

AVC-401 FOURTH PROGRESS REPORT (CHAIRMAN)

This document reports major achievements of the Experts Group toward defining Recommendation H.26X for video coding in the ATM environments, covering three meetings in July, September and October. Three particular items were raised for consideration of WPXV/1; work plan for broadband audiovisual Recommendations, common text approach for H.26X|MPEG-2, and very low bit rate videophone activities.

AVC-402 MEETING REPORT - EXCERPT (WPXV/1)

Items of the Experts Group concern are extracted from the outcome of the WPXV/1 meeting in November 1992; general SGXV and MPEG relationship, multimedia multiplexing, common text approach for H.26X|MPEG-2, timetable for broadband audiovisual system Recommendations, PSTN videophone, etc.

AVC-403 EXPERIMENTS COMPARING LEAKY-PREDICTION AND ERROR CONCEALMENT
[93/115] (DSRC)

Experimental results are reported for three cell loss concealment techniques (temporal substitution, motion compensated substitution, motion compensated substitution plus I-frame concealment) and leaky prediction (Core Experiment F.3). Slice size of 15 macroblocks is used. It is concluded that leaky prediction degrades picture quality with or without cell losses while decoder only concealment techniques can significantly improve picture quality under cell losses. Channel hopping performance of the leaky prediction is also tested to conclude that annoying artifacts are present even one second after hopping.

AVC-404 EXPERIMENTS ON COEFFICIENT SCANNING - F.5 (DSRC)
[93/108]

Experimental results are reported for two layer transmission of coded data by separating scanned coefficients at some point into High Priority and Low Priority channels. It is concluded that the coefficient scanning approach provides an additional measure of robustness without losing coding efficiency in the no-error case.

AVC-405 EXPERIMENTS ON INCREASED ERROR RESILIENCE BY TRANSMITTING I-FRAME
[93/116] MOTION VECTORS (DSRC)

A syntax change and experimental results are reported for transmitting motion vectors for I-frames and subsequent use of these motion vectors for concealment at the decoder. Experimental results for changing slice sizes at no loss and CLR=10^{-2} are also included. It is concluded that this technique enables simple yet effective error concealment without impacting system features such as random access and bitstream editing via I frames and with only losing 0.7% of total bitrate.

AVC-406 EXPERIMENTS ON STRUCTURED PACKING WITH ERROR CONCEALMENT (DSRC)
[93/107]

Experimental results are reported for comparison of short slice and structured packing approaches (Core Experiment F.8). It is concluded that using absolute macroblock intervals of 4 results in 0.3 dB loss in the no-error performance but 2.4 dB gain at CLR=10^{-2} relative to the 22 MB interval.

AVC-407 EXPERIMENTS ON SPATIAL SCALABILITY WITH ERROR CONCEALMENT (DSRC)
[93/114]

Experimental results are reported for cell loss resilience of two-layer spatial scalable coding compared that of non-compatible one. Three different error concealment methods are tested; upsampled substitution, motion vector substitution, mixed (the first for I, the second for P, B) It is concluded that the hierarchical transmission provides more possibilities for error concealment at cell loss rated higher than 10^{-3} and that the upsampled substitution performs best for error concealment at such high cell loss rates.

AVC-408 DEMONSTRATION OF TV AND INTERLACED SIF COMPATIBILITY (UK)
[93/002]

Compatible coding has been experimented for TV (at 2.5 Mbit/s) and Interlaced SIF (at 1.5 Mbit/s). The results show that TM3 compatible coding is also effective to interlaced pictures in the base layer, that the simplified syntax in MPEG92/651 is valid, and that the two-layered coding is more efficient than the simulcast.

AVC-409 COMPATIBLE CODING (UK)
[93/004]

It is explained how compatible coding is advantageous for manufactures, service providers and consumers and a proposal is made that this approach be applied to the whole range of video coding developments. Out of the three possible compatible arrangements (simulcast, tightly coupled layering, loosely coupled layering), loosely coupled layering is proposed for its more efficient bandwidth usage and more flexibility in coding format and algorithm selection. As an evidence, four layered (QQSIF, QSIF, SIF, CCIR601) coding results are given with those of the simulcast approach, indicating significant difference in picture quality.

AVC-410 SNR SCALABLE EXPERIMENT WITH COMPATIBLE SYNTAX (UK)
[93/003]

Compatible syntax is used for the SNR scalability. Experimental results are given to two schemes; one uses I pictures only for extension, the other uses I/P/B pictures. For a particular case of coding Mob&Cal with 2.5 Mbit/s base layer and 1.5 Mbit/s enhancement, 1 dB and 0.66 dB gains were obtained for the I/P/B and I only enhancements, respectively, compared to simulcast.

AVC-411 SIMULATION RESULTS ON COMPATIBILITY (JAPAN)
[93/015]

Simulation results show that gain of embedded coding for the interlace-interlace case is smaller than that for the interlace-progressive case. The sophisticated upsampling filter in MPEG92/758 does not improve coding efficiency, but intra quantization for compatible macroblocks provides more improvement. Based on the coding efficiency comparison between spatio-temporal weighting and simple prediction from the base layer, it is proposed not to include the spatio-temporal weighting in the syntax taking its hardware complexity into account.

AVC-412 COMPARISON BETWEEN SHORT-SLICE METHOD AND STRUCTURED PACKING
[93/079] (JAPAN)

Experimental results and numerical evaluations are given for the comparison between the short slice method and the structured packing method, which are defined in Core Experiment F.8. Considering the small difference in SNR and subjective quality, short slice is recommended since it does not need syntactic changes. Experimental results for concealment and leaky prediction combined with short slice or structured packing are also given. Evaluation of re-synchronization period by observation of processed pictures is described as 4 macroblocks being sometimes insufficient, requiring further study on applications, picture size, etc.

AVC-413 REPORT OF AC-LEAKY PREDICTION (JAPAN)
[93/158]

Experimental results are reported for Core Experiment F.7 "AC-leaky prediction", stating that DC refresh once every 6 frames gives the same coding efficiency as N=15 non-leaky prediction without limit cycle problem or noisy background.

AVC-414 FIX FOR THE NOISY BACKGROUND PROBLEM IN LEAKY PREDICTION (JAPAN)
[93/080]

Experimental results for adaptive DC quantization in leaky prediction (Core Experiment F.3) are reported, concluding that the noisy background is significantly improved thus the leaky prediction is a desirable method of temporal localization of errors. Fixed step size of 8 is applied to DC components if a macroblock is identified as belonging to background according to the value of N_act defined in the TM3 rate control Step 3. Use of adaptive quantizer weighting matrix is suggested for this purpose.

AVC-415 RESULTS ON NON-8X8 DCT CORE EXPERIMENTS (Q.5) IN LOW DELAY
[93/083] MODE(JAPAN)

Experimental results for the adaptive 8x1/8x8 DCT defined as Core Experiment Q.5 are reported, concluding that application of this technique is effective for the low delay operation in reducing mosquito noise, that adaptation based on absolute value summation of DCT coefficients is effective, and that the syntax can be simplified without significant loss of coding efficiency.

AVC-416 CASCADE CODING OF H.26X AND H.261 (JAPAN)
[93/081]

Cascade coding of TM2 (CCIR 601-525 format) at 4 Mbit/s and RM8 (CIF) at 1.5 Mbit/s, 384 kbit/s and 64 kbit/s has been experimented for Flower Garden to find that coding performance in terms of SNR and subjective quality does not differ from that of direct RM8 coding. It is concluded that transcoding is a possible means of compatibility between H.26X and H.261.

AVC-417 CLARIFICATION OF LOW DELAY DESCRIPTIONS (JAPAN)
[93/084]

The following clarification is proposed for the syntax and semantics of the skipped picture (S-picture);
- decoder operation,
- value of the vbv_delay field to be set at the encoder and its use at the decoder,
- data removing timing in VBV.

AVC-418 CORE PROFILE BASED ON COMMUNICATION APPLICATIONS CONSIDERATION
[93/082] (JAPAN)

Attributes and their values of the core profile is proposed in terms of TM3 syntax elements. The approach taken here is first to select necessary elements for each of five typical audiovisual communication services on B-ISDN, and then to decide core profile elements considering those selection results and the fact that the core profile should cover other non-communicational services as well. Some items are left for further study; compatibility/spatial scalability, chroma format, special prediction, non 8x8 DCT/NTC. Influence of Cable TV on chroma format and special prediction is mentioned because of its demand size.

AVC-419 USE OF COMPATIBILITY/SPATIAL SCALABILITY IN MULTIPOINT AUDIOVISUAL COMMUNICATION SYSTEMS (JAPAN)

Analysis is given to a multipoint communication system where H.32X terminals (containing H.26X) and H.320 terminals (containing H.261) are involved. Three configurations (embedded, simulcast, switchable) are compared in terms of qualitative order for picture quality, delay, complexity of terminal and MCU. It is concluded that video coding for H.32X should be switchable between H.26X and H.261, and if the transcoding approach for multipoint communications is not appropriate it should further support embedded or simulcast as a mandatory or optional specification. Some items are listed for further study; bit rates, implementation complexity, multimedia multiplexing.

AVC-420 DEMONSTRATION OF HDTV CODING BY D1 VCR (JAPAN)
[93/014]

A part of TM2 coded HDTV pictures (presented in AVC-365) is demonstrated by using D1, where two sequences coded at 30/45/60 Mbit/s are contained.

AVC-421 MODIFICATION OF THE CCITT/MPEG ATM CELL LOSS MODEL
[93/159] (NL, UK, I, F, N, B, FRG)

In this document, it is pointed out that the characteristics of the random generator also influence the simulation of cell loss when cells of only one priority are used. A modification to the cell loss model is proposed to improve the simulation of cell loss.

AVC-422 ADDING COMPATIBLE PREDICTION TO EVEN FIELDS (PTT RESEARCH)
[93/048]

Experimental results are reported for adding compatible prediction to even fields from the odd field base layer in a field picture compatible scheme, concluding that this addition does not affect the performance in SNR and subjective quality.

AVC-423 INTERLACE TO INTERLACE CONVERSION (PTT RESEARCH)
[93/0049]

Experimental results are given for the maximum gain obtainable with interlace-interlace compatible coding and for impacts of horizontal upconversion filters. It is concluded that the maximum gain by use of the non-coded base layer picture is 0.5 - 0.8 dB and that short and long horizontal filters presents no significant difference in SNR performance.

AVC-424 RESULTS OF FREQUENCY SCALABLE CODEC ERROR RESILIENCE EXPERIMENTS
[93/122] (AUSTRALIAN UVC CONSORTIUM)

Cell loss experimental results are reported for the following four schemes;
- single layered coding,
- simple frequency scalable coding using scale_8 and scale_4 layered with no errors in scale_4,
- the same with CLR=0.001 in scale_4,
- the same with equal errors in scale_4 and scale_8.

It is concluded that the simple frequency scalable coding performed well with respect to cell loss resilience.

AVC-425 PROPOSED FRAMEWORK FOR ERROR RESILIENCE INFORMATIVE TEXT IN
[93/016] MPEG2/H.26X (AUSTRALIAN UVC CONSORTIUM)

A framework of informative text for the error/cell loss resilience is proposed for consideration and refinement. It consists of general description of error/cell loss environments and possible techniques to cope with them; concealment, spatial localization, temporal localization, layered coding.

AVC-426 ERROR RESILIENCE AND FREQUENCY SCALABLE CODING
[93/017] (AUSTRALIAN UVC CONSORTIUM)

Advantages of the frequency scalable coding are discussed with respect to increased cell loss resilience, obtained by allocating most important DCT coefficients to a guaranteed channel, and by-product of some scalability features. It is proposed that an error resilience method with scalable extensions be considered for the MPEG-2 core and that converging this technique with "Coefficients Scanning" in Core Experiment F.5 be merged to add additional functionality.

AVC-427 SPATIAL LOCALISATION FOR CELL LOSS RESILIENCE
[93/018] (AUSTRALIAN UVC CONSORTIUM)

Experimental results are reported regarding the number of lost macroblocks per lost cell for four different AAL packetization schemes; combination of whether AAL is streaming mode or message mode and whether macroblock resynchronization is used or not. It is summarized that the number of macroblocks per lost cell is roughly half of the slice size for the case without macroblock resynchronization, and that it reduces to 1/3 to 1/10 for the case with macroblock resynchronization regardless of the AAL packetization scheme if the slice size is not smaller than 22, and that if the slice

size is shortened message mode with macroblock resynchronization becomes overly inefficient due to overhead of unused cell capacity.

AVC-428 A HYBRID AAL PACKING SCHEME (AUSTRALIAN UVC CONSORTIUM)
[93/019]

A new AAL packing scheme is presented which combines features from the structured packing and the short slice size method; the first macroblock in every cell is made the first macroblock of a slice. AAL has 1 bit of "Slice Start Present" and 9 bits of "Slice Start POSition" to indicate the start of the slice, the encoder taking into account where the cell boundary is. It is shown that coding efficiency and performance under cell loss condition is very comparable to that of the structured packing approach.

AVC-429 DEMONSTRATION OF COMPATIBILITY WITH H.261 (UK)
[93/005]

Experimental results are reported for a loosely coupled 'spatial split' scheme using H.261 coded 30 Hz CIF at the base layer and TM3 coded 25 Hz CCIR601 at the upper layer. Bit rates are 0.5 Mbit/s for the base layer and 2 Mbit/s in total. It is concluded that the 'spatial split' from TM3 provides the possibility of compatible layered coding with such combination, but that requirements of the general upsampling process needs further study. It is pointed out that temporal imperfections of up- and down-sampling process have an effect on the performance of the compatible prediction, suggesting motion compensated interpolation.

AVC-430 ON THE CHARACTERIZATION OF THE CELL LOSS PROCESS OF VBR MPEG ON
[93/???] ATM (DSRC)

Simulation results for average burst length and average inter burst length are presented for a wide range of network utilization by modeled VBR MPEG-1 video traffic (average bit rate = 5.4 Mbit/s, average peak/average ration = 4, average SNR = 31dB).

AVC-431 LEAKY PREDICTION (TELIA RESEARCH)
[93/076]

Experimental results are reported for leaky prediction with limit cycle solutions 1 and 2 in TM3 with adaptive macroblock quantization, concluding that the two solutions present no difference in SNR performance. It is also reported that leaky prediction for Mob&Cal produces quite noisy background.

AVC-432 CELL LOSS ON ONE LAYER CODING (TELIA RESEARCH)
[93/0077]

Decoding strategies for transmission errors (cell losses in particular) are first discussed for cases with and without error detection, two possible ways when an unused VLC codeword is encountered, and two possible ways to process undecoded area lying between a discovered error and a next start code. Simulations results are also presented to compare these to conclude that cell loss detection is preferable, that undecoded areas should be carefully reconstructed, and that for panning scenes use of the last correctly received motion vector is effective but further study is necessary for intelligent prediction frame store for other type of scenes.

AVC-433 SPATIAL SCALABILITY, INTERLACED TO INTERLACED (TELIA RESEARCH)
[93/078]

Experimental results are reported for compatible coding of Mob&Cal using interlace-interlace scalability, concluding that the best spatio-temporal weight is (w1,w2)=(0.25,0.25) and that simple spatial filters are not useful.

AVC-434 SIMULATION RESULTS ON DTV AND HDTV COMPATIBILITY (ETRI)
[93/160]

Experimental results are reported for embedded coding of HDTV (1920x1024 Y-pels per picture) and DTV (960x512 Y-pels per picture). The coding scheme is a spatial pyramidal one which uses TM2 for both layers, assigning 15 Mbit/s to DTV and additional 20 Mbit/s to HDTV.

AVC-435 LIAISON STATEMENTS SENT TO SGXVIII (CHAIRMAN)

This document contains the following three liaison statements sent to SGXVIII from the Experts Group;
- support of H.320 terminals in B-ISDN,
- VBR video coding advantage vs UPC time constant,
- update of the multimedia multiplex summary table in IVS Baseline Document.

AVC-436 LIST OF OPEN ISSUES (CHAIRMAN)

Open issues are listed with description of options, status, input required. aimed Recommendation, applications and target date according to the following categories;
- framework for video coding standardization,
- picture format,
- video coding,
- VBR vs CBR,
- interface with networks,
- end-to-end signalling,
- multipoint communication system,
- B-N interworking,
- audio coding.

Background information such as system configuration, applications, milestones and target date (priority) is also contained.

AVC-437 NEW WORK ITEM ON H.320 ADAPTATION TO ATM (F,UK,B,I,N,G,NL)

It is stated that ETSI/NA5/VCM members agree to include a new work item on adaptation (or extension) of existing H.320 terminals to ATM environments in the studies of the Experts Group. The target date to complete this Recommendation should be 1994.

AVC-438 CLARIFICATION ON PROFILES (F,UK,B,I,N,G,NL)
[93/154]

This paper is a discussion paper that first lists some questions for clarification on profiles. It then describes two profiles as a basis for discussion: Telecom profiles for conversational applications and Telecom profile for retrieval services.

AVC-439 EXPERIMENT ON SPATIO-TEMPORAL WEIGHTED H.261/MPEG2 COMPATIBILITY
[93/106] WITH BASE LAYER AT 128/384 KBIT/S (FRANCE)

This paper present the results of a (core) experiment about H.261/H.26X compatibility by using a two layered prediction scheme with base layer at 128/384 kbit/s with subsampling. It also includes a combination of MC based temporal prediction from top layer with a spatial prediction from base layer.

AVC-440 SPECIFICATION OF UPSAMPLING FILTERS FOR HIERARCHICAL CODING IN H.26X/MPEG-2 (UK)

A question is raised whether the upsampling filters in the encoder and decoder must be identical in arithmetic processing. A possible alternative approach of defining an ideal target filter and tolerable deviation from it is discussed to encourage consideration and study of this approach.

AVC-441 PROPOSALS FOR AND DISCUSSION ON THE SYNTAX TO EXPLOIT THE
[93/179] CORRELATION BETWEEN SIMILAR VIDEO SIGNALS OVER A PAIR OF VIDEO CODECS (PTT RESEARCH)

Based on considerations of several embedded coding applications, this document proposes to include a 2 bit **interlaced** indication code in the sequence header and a **stream_id** codeword in the *if(embedded) {...}* section. Renaming of **sscalable** to **embedded**, replacing **sscalable_code** by a 3 bit **ssr** code and adding a note to clarifying **ssr** referring to frame pictures are also proposed.

AVC-442 RESULTS OF EXPERIMENTS ON LEAKY PREDICTION (AT&T)
[93/178]

This document present views on the leaky prediction, summarizing that it ought to be included in the MPEG-2 core bitstream. It is also mentioned that impairments are much less visible with 60Hz, progressively scanned pictures.

Temporary Documents

TD-1	Agenda for the sole sessions in Torino (Chairman)
TD-2	Available documents (Chairman)
TD-3	List of tape demonstrations (Chairman)
TD-4	Noise in leaky prediction (Chairman)
TD-5	Excerpt from "Guide for CCITT and ISO/IEC JTC1 Cooperation"
TD-6	Proposed CCITT EG positions for items requiring decision (Japan)
TD-7	Error resilience framework for informative text and experimentation (CCITT EG)
TD-8	Draft meeting report (Chairman)

END

List of Tape Demonstrations
(21 January 1993, CSELT)

No	Organization	Topics	Tape	Doc.
a	BT Labs	SNR scalability (Mob&Cal)	D-50	AVC-410
b	BT Labs	4 layer coding (QQSIF, QSIF, SIF, 601; Susie)	D-50	AVC-409
c	BT Labs	H.26X/H.261 compatibility (0.5 and 0.5+1.5 Mbit/s; Susie)	D-50	AVC-429
d	BT Labs	ISIF/TV compatibility (Mob&Cal)	D-50	AVC-408
e	PTT Research	Interlace to interlace compatibility	D-50	AVC-423
f	Telia Research	Spatial scalability - interlace to interlace	D-50	AVC-433
g	Telia Research	Leaky prediction	D-50	AVC-431
h	Telia Research	Cell loss experiment	D-50	AVC-432
i	Australian UVC	Frequency scalable coder error resilience	D-50	AVC-424
j	David Sarnoff	Leaky prediction	D-60	AVC-403
k	David Sarnoff	I-frame motion vectors	D-60	AVC-405
l	David Sarnoff	Coefficient scanning	D-60	AVC-404
m	Toshiba	Compatibility (Spatio-temporal weighting)	D-60	AVC-411
n	Fujitsu	Spatial localization of errors	D-60	AVC-412
o	Fujitsu	Leaky prediction	D-60	AVC-414
p	JVC	AC-leaky prediction	D-60	AVC-413
q	TEPCO	HDTV coding	D-60	AVC-420
r	Matsushita	Adaptive 8x1/8x8 DCT vs 8x8 DCT coding	D-60	AVC-415

CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding
(Rapporteur's Group on Part of Q.3/XV)

TD 7
January 1993

INTERNATIONAL ORGANISATION FOR STANDARDISATION
ORGANISATION INTERNATIONALE DE NORMALISATION
ISO/IEC JTC1/SC29/WG11
CODING OF MOVING PICTURES AND ASSOCIATED AUDIO

ISO/IEC JTC1/SC29/WG11
MPEG93/214
January 1993

Source: CCITT SGXV Experts Group on ATM Video Coding (Rapporteur's Group on Part of Q.3/XV)

Title: Error resilience framework for informative text and further experimentation.

Status: Proposal

The CCITT SGXV Experts Group on ATM Video Coding (Rapporteur's Group on Part of Q.3/XV) proposes the following means to progress activities leading to informative text in the MPEG2/H.26X standard. Section 1 below provides a framework for inclusion in the current WD at the Rome joint meeting. It includes several "holes" to be filled through contributions required by the next meeting. Section 2 provides some additional information on the status of ongoing studies of error resilience methods using tools that are not yet part of the agreed syntax, and therefore require further experimentation and decisions before they can be transferred to the WD. Summary tables, to assist with identification of appropriate error resilience techniques and any overlap between techniques, are also provided. Inputs are requested to update/complete these tables.

Note that text describing cell loss/error resilience techniques should include:

- Assumptions about network capabilities or requirements, such as notification of cell losses from an AAL, or the availability of prioritised transmission, must be indicated clearly.
- The encoder/decoder configurations, or profiles, that offer the tools that will be utilised to provide the error resilience must be identified.
- An indication of the CLR, burst lengths or other error statistics that can be protected against using the technique.

1. Text for WD

The following is offered for inclusion as informative text in the WD, providing preliminary information and a basis for further expansion on specific error resilience schemes.

Error Resilience

The coded video bitstream generated by this Recommendation I International Standard may be carried by different transport systems including packet systems. The Asynchronous Transfer Mode (ATM) of B-ISDN is an example of a packet system. ATM uses relatively short, fixed length packets, called cells, consisting of a 5 byte header containing routing information, and a user payload of 48 bytes. The nature of errors on ATM is such that some cells may be lost, and the user payload of some cells may contain bit errors. At the receive terminal, the network interface forwards received cells plus indications of lost cells. Indication of cells containing bit errors may also be available, depending on AAL (ATM Adaptation Layer) functionality.

As an indication of the impact of cell loss in an ATM environment, the following table summarises the average interval between cell losses for a range of CLR and service bit rates. Note, however, that this summary ignores cell loss bursts and other shorter term temporal statistics.

CLR	Average interval time of error			
	5 Mb/s	10 Mb/s	50 Mb/s	100 Mb/s
10^{-2}	$7.52*10^{-3}$ s	$3.76*10^{-3}$ s	$7.52*10^{-4}$ s	$3.76*10^{-4}$ s
10^{-3}	$7.52*10^{-2}$ s	$3.76*10^{-2}$ s	$7.52*10^{-3}$ s	$3.76*10^{-3}$ s
10^{-4}	$7.52*10^{-1}$ s	$3.76*10^{-1}$ s	$7.52*10^{-2}$ s	$3.76*10^{-2}$ s
10^{-5}	7.52 s	3.76 s	$7.52*10^{-1}$ s	$3.76*10^{-1}$ s
10^{-6}	1.25 s	37.6 s	7.52 s	3.76 s
10^{-7}	12.5 m	6.27 m	1.25 m	37.6 s
10^{-8}	2.09 h	1.04 h	12.5 m	6.27 m

[TEXT REQUIRED TO INTRODUCE OTHER ERROR/LOSS CONDITIONS]

The following techniques of minimising the impact of lost cells and other error/loss effects are provided for reference, and indicate example methods of using the various tools available in this Recommendation I International Standard to provide good performance in the presence of those errors. Note that, while the discussion is centred around cell loss resilience, the techniques described may be equally applicable in the cases of packets of other sizes (e.g. LANs or certain storage media) or video data with uncorrected errors of different characteristics.

The error resilience techniques are summarised in three categories, covering the restriction of the influence of a loss or error in both space (within a picture) and time (from picture to picture), and the methods of concealing the error once it has occurred.

1. Concealment

Concealment techniques attempt to hide the effect of losses/errors once they have occurred. Some concealment methods can be implemented using any encoded bitstream, while others are reliant on the encoder to structure the data or provide additional information to enable enhanced performance.

1.1 Concealment as a decoder-only function.

Independent of whether any attempt has been made at the encoder to make the generated video bitstream error resilient, a decoder always has the option of providing concealment of the errors by estimating the lost data from spatio-temporally adjacent data. Techniques may range from simply not updating a frame store in the event of lost macroblock data (i.e. concealment through estimation from the previous frame) to more sophisticated concealment methods that utilise motion compensation for the macroblock prediction.

[Reference system text required.]

1.2. Encoder-assisted concealment.

Layered Coding

The components produced by the coding process can be placed in a hierarchy of importance according to the effect of loss on the reconstructed image. By coding and multiplexing components of similar importance into independent bitstreams, and treating each bitstream with due importance, superior error concealment performance may be possible. The independent bitstreams may be treated differently at one or more of the following locations:

- coder - different channel coding might be used
- channel - the channel may be able to offer paths with different cell loss probabilities
- decoder - error concealment could be performed differently within each bitstream

[Reference system based on the scalability and compatibility enhancements for error concealment.]

2. Spatial localisation.

Spatial localisation encompasses those methods aimed at minimising the extent to which errors propagate within a picture, by providing early resynchronisation of the elements in the bitstream that are coded differentially.

[Reference text required on: Small slices

Adaptive slice sizes]

3. Temporal Localisation

Temporal localisation encompasses those methods aimed at minimising the extent to which errors propagate from picture to picture in the temporal sequence, by providing early resynchronisation of the elements in the bitstream that are coded differentially.

[Reference text required on: Intra pictures

Intra slices]

4. Summary table

The following table summarises the above error resilience techniques, indicating their applicability and range of CLR for which they provide effective resilience.

Category	Technique	Profile/Applicability	Range of CLR
Concealment (decoder only)	Simple (previous picture)	All	
	Motion compensated	All	
Concealment (Encoder assisted)	Layered coding	Freq. scalability, Spatial scalability	
Spatial Localisation	Small Slices	All	
	Adaptive slice sizes		
Temporal Localisation	Intra pictures		
	Intra slices		

2. Further techniques for study

Other techniques, outside those described in Section 1, are under study for cell loss/error resilience. They are summarised below, using the same categorisation as in the proposed text for the WD, with a summary of the open issues requiring further investigation.

1. Concealment

1.1 Concealment as a decoder-only function.

1.2. Encoder-assisted concealment.

Use of I-frame or I-MB motion vectors for assistance with motion compensated concealment.

Open issues: Under what circumstances does this method have advantages over others (that do not require syntax changes)

Should the Intra MVs be provided for all I-macroblocks, or only those in I pictures?

2. Spatial Localisation.

3. Temporal Localisation

Leaky Prediction:

The CCITT-EG recommends one more round of testing to compare INTRA insertion (INTRA picture, slice, column) with leaky prediction for purposes of error resilience.

Several benefits of leaky prediction were discussed, including...

1. Leaky prediction provides fault tolerance with no special error detection or correction at the decoder. Compared with simple replacement of errored MBs with previous frame values, leaky prediction provides significantly better picture quality.

2. After a random access or channel change, a pleasing picture can often be seen more quickly with leaky prediction than with INTRA insertion.

3. In low delay applications that require small buffers, better picture quality can often be obtained with leaky prediction than with INTRA pictures.

4. IDCT mismatch and frequency scalable drift are alleviated with leaky prediction.

5. Coding efficiency of leaky prediction and INTRA pictures with N=12 or 15 were comparable.

Several solutions to the problem of noisy background were presented, including...

1. Adaptive quantization with particular attention to reducing the step size in areas of low detail and motion.

2. Adaptive quantization of the DC component with low step size in areas of low detail and motion.

3. Leaky prediction of AC components only, with INTRA insertion of DC components. This solution also has the advantage of extremely quick channel hopping.

Core Experiment F.3 will be completed with the independent verification and comparison of these three solutions.

4. Expanded comparison table

Category	Technique	Profile/Applicability	Range of CLR
Concealment (decoder only)	Simple (previous picture)	All	
	Motion compensated	All	
Concealment (Encoder assisted)	Layered coding	Freq. scalability, Spatial scalability	
Spatial Localisation	Small Slices	All	
	Adaptive slice sizes		
Temporal Localisation	Intra pictures		
	Intra slices		
	Leaky prediction		