CCITT SGXV
Working Party XV/1
Specialists Group on Coding for Visual Telephony

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TITLE : REPORT OF THE FOURTEENTH MEETING IN FLORIDA (December 6 - 9, 1988)

CONTENTS

1. General

The Specialists Group met in Orlando, Florida, USA, from December 6 to 9, 1988 at the kind invitation of GEC PLESSEY TELECOMMUNICATIONS LIMITED. Welcoming address was delivered by Mr. Duffy on behalf of the hosting organization.

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

At the closing session, Chairman thanked the hosting organization for the meeting facilities provided and the excellent operation of the meeting.

2. Documents for the Meeting (TD2)

For this meeting, 50 normal documents and 13 temporary documents have been available. Annex 1 shows the outline of each document.

3. Tape Demonstrations (TD3)

A number of tape demonstrations as listed in Annex 2 were presented during the meeting.

4. Report of the CCITT Plenary Assembly (TD4)

Chairman reported the results obtained at the CCITT Plenary Assembly held in Melbourne, focusing on the following items of our direct concern.

- New Recommendations and revised existing Recommendations,
- Revision of Resolution No. 2,
- Revision of terms of reference for CMTT, and
- CCITT calendar of 1989.

5. Source Coding

5.1 Picture Format

5.1.1 4/9 CIF (#399, #403, § 6.1/#395R)

Japan, Canada and several companies in the US proposed the use of 4/9CIF as an optional format for the following reasons;

- Less expensive hardware relative to full CIF.
- Resolution is adequate for many teleconferencing scenes.
- Easy conversion to/from PAL and NTSC.

This position was opposed by all European countries and one US company because of the potential reduction of the quality of international service which would result. This group was also not convinced that potential cost reduction would be significant or that 4/9CIF would offer any significant performance benefit because supporting evidence has not been produced.

Based upon these opposed opinions we could not reach an agreement, and decided to proceed with the agreed two formats (Full CIF and Quarter CIF). Since we agree that we are now in the convergence period, the Specialists Group will consider 4/9CIF after this point only if it can be shown to be of significant benefit to the standard.

5.1.2 Temporal aspect (#402, § 1.1/#415)

The meeting discussed on how to specify the temporal aspect of the source coder input format, and reached the following conclusions.

1) Item to be specified is "minimum coded frame interval" which the decoder can accept.
2) Minimum coded frame interval is determined through a negotiation. Since there is no return channel in broadcasting environment, default values are also defined.
3) In Flexible Hardware, lowest possible interval is implemented in each hardware and "negotiation" will be carried out through telephone and manual switch. Specific value for Flexible Hardware is decided in the drafting group chaired by Mr. Morrison.
4) Detailed specification will be decided based upon the hardware experimental results.

5.1.3 Relation between the two formats and values of p

Though Quarter CIF has been considered to be for lower values of p, it was recognized necessary to clarify the relation between the two formats and values of p. A typical question to illustrate the problem is whether QCIF operation is meaningful at p=6 or higher.

Different views were expressed as follows;

- QCIF should be used only for p=1,2 from service quality point of view.
- Standards should not preclude the QCIF operation at higher values of p with various applications and spatio-temporal resolution trade-off considered.
- Encoder and decoder operations should be defined separately. e.g., Encoder should follow the decoder capability, while decoder should

receive FCIF at $p > 2$.

After some discussion, the meeting decided to examine this matter through hardware experiments and specify detailed values in the final Recommendation.

5.2 Reference Model 6

5.2.1 Implementation and performance (#426, #413; #403, #425)

Simulation results of RM6 for defined test sequences and artificial zone-plate type signals were reported in Doc. #426, #413 with tape demonstrations. Operations at 60 kbit/s and 15 Hz were also presented in Doc. #403, #425.

5.2.2 Higher bit rate operations (#404, #427)

Operations at 300 kbit/s, 1.1 Mbit/s, 1.5 Mbit/s and 2 Mbit/s were presented with tape demonstrations. General feeling obtained was that optimization of the algorithm at higher bit rates may not be necessary once it is optimized for lower bit rates.

5.2.3 Clarifications and modifications to RM6 (#396, #420)

The following items were agreed to clarify or modify RM6;

- VLC for differential motion vector,
- Buffer control, and
- First picture and scene change.

Revised version RM7 will be submitted as Doc. #446 after this meeting taking into account the action points in § 10.1.

5.3 Motion compensation (#405, #416)

Study results on a number of features of motion compensation were presented. The following points were agreed for Flexible Hardware specification and envisaged to be transferred to the final Recommendation.

- Integer motion vectors are used.
- Motion vector data is transmitted with VLC of differential MV (RM6 method).
- Motion vector range is $\pm 15 \times \pm 15$.

Use of motion vectors for each 8x8 sub-block are targeted to Quarter CIF operation and higher bit rate operation. Whether or not to include this feature in the standard is left open at the moment. Relatedly, comparison between the method in Appendix/Doc. #416 and the RM4 method or a method to switch on/off of motion compensation in each sub-block using the motion vector detected for the macro block was suggested during the discussion.

5.4 Loop filter (#406, #422, #423, #428)

After presentation of extensive simulation works carried out in Japan, Korea and Europe, the meeting had questions and answers for clarification. For more detailed discussion and sorting out the problems, Mr. Brusewitz undertook to coordinate a small group. The outcome of this small group, which the meeting approved, is as follows:

From existing simulation results, it was concluded that:

1) An adaptive filter before the frame memory performs better than RM6-filter.
2) Almost the same performance is achieved with RM6-filter and post-filter.
3) The adaptive filter should use 10x10 blocks.
4) RM6-filter is sufficient for higher bit rates.

The adaptive noise-filter has the following drawbacks:

A) It uses decoded pel values for adaptation, which is dangerous due to IDCT mismatch.
B) Several characteristics (directions) causes complex hardware.
C) Uses 10x10 blocks.
D) Adaptation needs further study.

In order to enable flexible hardware construction as soon as possible, the small group agreed on the following:

The flexible hardware should use a filter after the frame memory (as in RM6). An 8x8 block is filtered on an on/off basis within block boundaries. Exact characteristics and adaptation rule (see Note) is for further study. If it is shown to give a significant improvement over post-filtering, a noise-filter before the frame memory (using pels inside 8x8 block boundaries) may be introduced by the next meeting but not after.

> Note: Possible adaptation parameters may be: bit rate, motion vector, side information, step size in previous frame, coded/uncoded in previous frame.

5.5 IDCT specification (#397, #442)

Mr. Haskell presented his correspondence with concerned organizations on the specification revised at the Paris meeting. Since all of the responses are positive, the meeting decided to finalize this specification with the random number generator program modified as appears on the last page of Doc. #422.

Mr. Min-Ting Sun, Chairman of the IEEE Standards Committee for DCT/IDCT, presented the plan and procedure of standardization in IEEE. The approach to be taken is the same as that of this Group, to define a reference DCT/IDCT and mismatch error allowed, considering the IEEE's policy to standardize based on performance but not design.

5.6 Quantizer (#429)

Clarification of the variable thresholding technique was provided in the document as well as in the tape demonstration showing which coefficients are transmitted or discarded. A possible interpretation of the effectiveness is that this technique removes noises (input, quantization, DCT).

Other aspects of the quantizer, number of quantizers and possibility of adaptive quantization were left to the discussion of Mr. Morrison's drafting group on the Flexible Hardware specification.

5.7 Data rate control (#411, #424; #384)

Simulation results were presented for data rate control on a basis of 18 GOB (RM6), 12 GOB as in Doc. #385 or macro-block. It was recognized that abnormal operation can happen due to buffer underflowing followed by overflowing if only GOB based data rate control is used. Mr. Guichard suggested for simulation work that before some threshold of the buffer occupancy the quantizer should be changed even if it is in the middle of a GOB.

For hardware specification, the meeting recognized that the quantizer allocation by TYPE3 proposed in Doc. #384 would provide a sufficient mechanism and agreed on the adoption of this proposal.

5.8 Intra mode

5.8.1 Transmission elements and INTRA NOT CODED (#407)

The idea of transmitting absolute mean values of chrominance blocks and definition of "INTRA NOT CODED" macro block type was generally accepted. It was pointed out that transmission of differential DC values may be redundant.

Though the proposal was recognized as a useful input for the hardware specification, further considerations were requested by the next meeting, particularly from hardware implementation, taking into account possibilities of other solutions.

5.8.2 Prediction of DC component (#417)

The proposal to forget about it was accepted.

5.8.3 Number of bits to transmit a whole picture in INTRA mode (#430)

Hardware experimental results show that at least 50-120 kbits are required. It was pointed out that a previous simulation work in Doc. #225 gave the corresponding results.

During the presentation, Mr. Carr stated that the most stressing case is in the switched multipoint situation where the continuously receiving partner should not be affected by the forced update at the sending partner. It was noted that in this case we may be able to utilize the fact that the start of update is known a priori.

6. Video Multiplex Coding

6.1 Structure of the video multiplex (#400, #410, #437)

There were two proposals on the structure of the video multiplex; one has three layers (picture, GOB, macro block) and the other has two layers (picture, macro block). After clarification of the two proposals, the meeting asked Mr. Speidel to coordinate a small group meeting to sort out the problems. The outcome was obtained as follows;

The group, consisting of members from Japan, USA and Europe, met to formulate a proposal on the above mentioned items.

Papers under consideration have been Doc. #410 and Doc. #437. Doc. #400 has been withdrawn earlier. USA supported the Japanese position.

The main point was whether to change the GOB-structure (Doc. #437) or remove it (Doc. #410). The decision was based upon the following items:

1) Support of multiple source formats.
2) Side information for addressing.
3) Error recovery.
4) Combination of 4 QCIFs into one FCIF picture.
5) Simplicity of hardware, software and specification.
6) Coding mode control (e.g. GOB-based quantizers, motion vectors, etc.)
7) Flexibility for future inclusions.
8) Delay.

Several parties were of the opinion to have a final decision at this meeting. Item 4 was not weighted heavily, because further study is required on continuous presence multipoint techniques.

In the discussion, USA stressed point 7) and Japan points 2) and 5) as advantages of a scheme without GOBs. On the other hand, Europe saw an advantage in error recovery in their scheme and in the fact that the present flexible hardware includes a GOB-structure.

After discussion, the meeting came to the conclusion to adopt the proposal in Doc. #437, but further work should be done to reduce the side information due to GOB headers.

As to the TYPE4 block layer property, Chairman raised a question whether it should be mandatory or optional. TYPE4 is thought perhaps necessary for Quarter CIF and higher bit rates, but there is not sufficient supporting evidence at the moment.

This point was reflected in the discussion of the Hardware specification.

6.2 Picture header (#431)

The principle to place PEI/GEI bit immediately before each optional data field was agreed upon.

6.3 Signalling coded sub-blocks (#409, #418)

Methods to encode coded block pattern were discussed. Inclusion of signalling coded sub-blocks with some type of pattern was agreed, but detailed method was left for further study. Against a concrete specification proposal in Doc. #409, reservation was expressed on the ground that a method having less complexity but similar characteristics may be the solution. Hardware implications should also be studied so that we can reach agreement at the next meeting.

6.4 Scanning classes (#436, § 2.2.4/#415)

Use of adaptive scanning was discussed. The experimental results obtained at 60 kbit/s indicates that one scanning class is sufficient. A previous work at 300 kbit/s indicated adaptive scanning is not necessary if 2D-VLC is used. Expectation is that it may become effective at Quarter CIF or at higher bit rates.

The meeting agreed to adopt a single scanning class unless convincing evidence is obtained by the next meeting.

6.5 VLCs

6.5.1 VLC for DCT coefficients (#408, #435)

According to the proposal in Doc. #435, the meeting agreed to use 2D-VLC which includes 1D-VLC as a subset in the Flexible Hardware.

Information was provided in Doc. #408 on the adaptation rule for multiple 2D-VLCs.

6.5.2 Macro block addressing (#419)

Information was provided that VLC choice for relative addressing is not critical in RM6.

7. Transmission Coding

7.1 Buffer specification

7.1.1 Prevention of underflowing (§ 3/#412, #438)

This issue was also discussed in Mr. Speidel's small group. The outcome is as follows;

The related papers were Doc. #412 and #438. The meeting concluded to adopt the principles of the method outlined in Doc. #412.

It was found that a framing structure for forward error correction will be present in a px64 kbit/s codec, also in case that no error correction is applied in certain applications. This framing structure should be used for insertion of stuffing bits to prevent buffer underflow.

7.1.2 Buffer specification (§ 4/#412)

A specification is required to secure stable decoder operation in various combinations of different buffer architectures. The following items were proposed to be included in the specification;

- Minimum coded picture interval, and
- Maximum coded picture interval.

It was also pointed out that some specification is required to ensure delay below a certain amount.

These points could not be discussed in detail because of the lack of time. Members are requested to examine the problem further.

7.2 Forward error correction (#401, #412, #421, #432)

For transmission of error correcting codes, use of a single framing structure for video data only was agreed. We could not reach agreement, however, on the choice of a specific code, BCH or Reed-Solomon. Major differences between the two codes are in burst error correcting capability and complexity of hardware implementation. Further study is requested to decide at the next meeting.

7.3 Values of p to be experimented (#440, § 3.1/#415)

The meeting confirmed that the value of "p" is addressed to the channel rate to transmit whole of video, audio, optional data and system control signals. When video rate is concerned, "number of bits per second" will be used.

In order to test compatibility between different hardwares, the following limited set of values are assigned to "p";

p	video rate	TSSI
1	~ 48 kbit/s	
2	64 kbit/s	no
6	320 kbit/s	yes
24/30	1472/1856 kbit/s	yes

7.4 Frame structure (#441)

Comments on the ISDN compatibility of Rec. H.221 was provided for information. Chairman would get contact with the author of this document to clarify the problem.

7.5 Privacy in audiovisual conferencing (#444)

Activities in Europe on the subject matter was informed.

8. Flexible Hardware Specification (#373, #415)

Mr. Morrison undertook to chair a small group meeting to update the draft specification in Doc. #373, incorporating the discussion results during this meeting. The outcome is found in Annex 3. Further refinements will be worked out through correspondence.

9. Patent (#439; #398, #434)

Statements on patent information disclosure policies were presented in Doc. #439. Collection of statements will be continued.

Information on the known patents were provided in Doc. #398 and #434. Chairman would examine whether statements of the patent holders on their licensing policies have already been received.

10. Work Plan

10.1 Action points for simulation work

Mr. Guichard undertook to chair a small group meeting to list up the action points toward the next Specialists Group meeting. The outcome is found in Annex 4.

10.2 Development of Flexible Hardware (#414, #443)

Activities in Japan were presented in Doc. #414, stressing that the specification should be finalized as soon as possible. The test signal generator is considered necessary by June 1989.

The development plan of the test signal generator was presented in Doc. #443. It was announced that the previous type of generator design is being considered to cope with the limited time frame. Inclusion of QCIF and supply of bit streams with floppy were requested for consideration.

10.3 Actions in the March 1989 Study Group XV meeting (TD4)

Considering that Resolution No. 2 had been revised at the CCITT Plenary and that the intention of putting accelerated procedure in March 1989 had been to indicate our change of standardization plan as decided at the Paris meeting, Chairman proposed the following actions, which the meeting accepted;

1) We will submit a white paper on our plan to extend the scope of H.261 to px64 kbit/s and complete our work by the end of 1989. Chairman would distribute a draft contribution after this meeting for review of the group.
2) We get approval of Study Group XV for this plan, and it would be recorded as a part of the Study Group XV meeting report.
3) At the Oslo meeting, we would finalize the Flexible Hardware specification, indicating the firm items which are to be transferred to the draft Recommendation. This specification will be included in the SGXV meeting report.

10.4 Milestones

The meeting confirmed the following milestones toward the final draft H.261, which Chairman proposed.

1) Complete Flexible Hardware specification: March 1989
2) Get approval of our plan at Study Group XV meeting: March 1989
3) Decide the initial compatibility check parameters: March-June 1989
4) Supply of the test signal generator: June 1989
5) Initiate the international compatibility check: September 1989
6) Optimize the parameters: September-October 1989
7) Final draft H.261: October 1989

The meeting further discussed on the minimum requirement for hardware verification which leads to the final draft H.261. The conclusion was "compatibility between one combination of independently developed coder and decoder".

Mr. Helkio pointed out the necessity of verification from service requirement point of view; picture quality, encoding/decoding delay, transmission error performance, audio quality, etc. After some discussion, it was felt that these service aspects should be covered by other CCITT groups related to audiovisual services under Q.D/XV, and that the Specialists Group should concentrate on completing the Recommendation on video coding.

10.5 Press Release (#433)

The meeting reviewed the proposed text thoroughly and revised it as in Annex 5. The meeting decided to release this text in the following way;

- English text: Annex 5.
- Language : Translated in each country if necessary.
- Date : December 16 or after.
- Channel : Core member of each country undertakes to distribute the text through an appropriate channel in his country.

11. **Others**

11.1 GLOBECOM'88

Mr. Guichard reported the session dedicated to "Standardization on video coding" where four papers had been presented from the Specialists Group. He pointed out we should make further publicities and all the members should use the same style of slides on such occasions.

11.2 Liaison with the audio coding experts group (TD5, TD6)

Since 16 kbit/s audio coding is indispensable for videophone, the meeting recognized the need to push the audio coding experts group so that audio and video coding Recommendations are produced at the same time. As initial attempts, requests as in TD5 and TD6 were submitted to the audio coding experts group meeting which happened to be held in parallel with our meeting in Orlando.

11.3 Future meetings

- 15th meeting: March 7(Tue) - 10(Fri), 1989 in Oslo, hosted by NTA.
- 16th meeting: June 1989 in Europe.
- 17th meeting: September - October 1989 in Japan.

END

Annexes

Annex 1 Available documents
Annex 2 List of tape demonstrations
Annex 3 Specification for p*64 kbit/s Flexible Hardware
Annex 4 RM7 and action points
Annex 5 Press release

LIST OF PARTICIPANTS
(Florida; December 6 - 9, 1988)

Chairman	S. Okubo	- NTT, Japan

Core Members

F. R. of Germany	J. Speidel	- PKI
	G. Zedler	- FTZ
Canada	D. Lemay	- BNR
USA	A. Tabatabai	- BELLCORE
	B.G. Haskell	- AT&T Bell Laboratories
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France	G. Eude	- CNET
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Assisting Experts

F. R. of Germany	W. Geuen	- SEL
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Observer

Finland	R. Helkio	- VISTACOM

DOCUMENTS FOR THE FLORIDA MEETING

Normal Documents

#395R REPORT OF THE THIRTEENTH MEETING IN PARIS (CHAIRMAN)

Points agreed upon and/or left for further study in the previous meeting are recorded to provide backgrounds for discussions in this meeting.

#396 DESCRIPTION OF REF. MODEL 6 - RM6 (SPECIALISTS GROUP)

Revision of Doc. #375 on RM5, incorporating the items agreed at the Paris meeting (Annex 5 to Doc. #395R).

#397 IDCT SPECIFICATION (CHAIRMAN)

Specification updated at the Paris meeting (Annex 4 to Doc. #395R) with the random number generating program in C language.

#398 PATENTS HOLD BY AEG VIA LINCENTIA-PATENT-VERWALTUNGS-GMBH, FRANKFURT IN THE FIELD OF LOW BIT RATE PICTURE CODING WITH FRAME TO FRAME PREDICTION (AEG)

Outline of four relevant patents are described.

#399 PICTURE FORMAT FOR px64 kbps VIDEO TELEPHONY (AT&T, BELLCORE, DIS, PICTURETEL)

It is proposed that 4/9CIF should be included as an optional picture format along with full CIF with the following reasons;

- A less expensive hardware implementation for a codec with only 4/9CIF and QCIF.
- Resolution of 4/9CIF is sufficient for small groups of people.
- Conversion from/to local TV standards are simple.

#400 GROUP-OF-BLOCK (GOB) DEFINITION FOR px64 kbps VIDEO TELEPHONY (AT&T, BELLCORE, DIS, PICTURETEL)

Two alternative methods are proposed for defining the transmission format in each of the three resolution modes (FCIF, 4/9CIF, QCIF);

1) FCIF : 18 GOBs (GOB=22 MBs scanned horizontally)
   4/9CIF: 12 GOBs (GOB=15 MBs scanned horizontally)
   QCIF : 9 GOBs (GOB=11 MBs scanned horizontally)
2) For 4/9CIF, a sub-widow of the FCIF is used. Outer borders are transmitted as "FIXED" macroblocks.

#401 ERROR CORRECTION FOR px64 kb/s VIDEO TELEPHONY (AT&T, CLI, DIS, PICTURETEL)

Reed-Solomon error correction technique is proposed which has error correcting capability for 2 bit random errors per block or a single 9-bit burst error. Two variations of block length are proposed; 255 octets and truncated 128 octets.

#402 FRAME RATE NEGOTIATION FOR px64 kbps VIDEO TELEPHONY (AT&T, CLI, DIS, PICTURETEL)

In order to minimize cost in codecs which support only low bit rates, it is proposed that the communication procedure include a negotiation of the maximum frame rate from 7.5 to 30 in increments of 2.5 frames per sec.

#403 4/9CIF (JAPAN)

Two points requiring further study which were found out at the Paris meeting was experimented; spatio-temporal trade-off and format conversion filtering directly from NTSC sources. Experimental results are summarized as follows;

- For complex sequences, 4/9CIF gives comparable pictures to Full CIF, but it does not outperform.
- For simple sequences, Full CIF gives better impressions.

#404 SIMULATION RESULTS OF REFERENCE MODEL 6 AT p=5 and p=24 (JAPAN)

RM6 was compared with RM4 in coding performance at higher bit rates, concluding that RM6 can provide similar performance. Two peculiarities observed for RM6 are also reported; granular noise build-up in MISS AMERICA's background and underflow in CLAIRE at p=24.

#405 IMPROVEMENT ON MOTION COMPENSATION (JAPAN)

A motion vector range of +/-15 x +/-15 is proposed for the px64 Flexible Hardware specification. The following simulation results concerning motion compensation is provided for information;

1) No significant difference among three tracking ranges (H x V) for the full search method; +/-7 x +/-7, +/-15 x +/-7 and +/-7 x +/-15.
2) Criteria for MC/No-MC switch at small value of block difference affects subjective quality.
3) For the second coded frame, absolute vector coding works better than differential coding.
4) Motion compensation with predicted vector gives a slight improvement, where No-MC codeword means use of the predicting vector.

#406 LOOP FILTER INVESTIGATIONS IN JAPAN (JAPAN)

Experimental results are presented in various aspects of the loop filter.

1) Adaptive loop filter placed before frame memory (F1 position) reduces blocking and mosquito noise significantly. Current 121 loop filter placed after frame memory (F2 position) plus adaptive post filter (F3 position) improves the reproduced picture but does not reach the level of the above adaptive loop filter.
2) Over the block boundary filtering is essential at F2 position, but not at F1 position.
3) For higher bit rates, loop filter is essential at p=5 but not at p=23. The current 121 filter performs well for p=5 and 23.
4) In the IDCT mismatch environment, adaptive loop filter using the decoded pel values as adaptation source is not recommendable. The current 121 filter placed at F1 position is sufficiently robust for the IDCT mismatch.

#407 IMPROVEMENTS OF INTRA MODE (JAPAN)

Modifications of INTRA mode coding is proposed to improve scene change performance;

- Coding of DC values for Cr and Cb.
- Introduction of INTRA NOT CODED mode which transmits only DC values.

Information is also provided on an intra/inter decision method using motion calculation function and an interpolation of the first coded picture.

#408 ADAPTIVENESS OF A 2-D VLC TABLE (JAPAN)

Adaptive encoding of transform coefficients was experimented using 4 different 2-D tables. It is concluded that selection by the quantizer step size and selection by optimum for each GOB interval give similar results.

#409 BLOCK ADDRESSING METHOD FOR MACRO ATTRIBUTE (JAPAN)

Two code sets optimized for "inter coded" and "MC coded" are compared with one code set for both cases. Since the difference in coding efficiency is slight, use of one code set is recommended. As conclusion, transmission element "Coded Block Pattern" and a transmission order in the macro block are proposed for Flexible Hardware specification.

#410 VIDEO MULTIPLEX SCHEME (JAPAN)

A video multiplex structure is proposed which consists of two layers, picture layer and macro block layer, removing GOB layer in Doc. #386. Considerations are for simplicity of hardware and specification as well as coding efficiency. A simple horizontal scanning of macro blocks is also proposed.

#411 SIMULATION RESULTS OF DOC. #384 & #385 (JAPAN)

Three step size allocations are compared; GOB based allocations (18 GOB and 12GOB) and macro block based allocation. The three methods are reported to give almost the same performance. As conclusion, it is stressed that the specification should allow to set the quantization step size at any timing we want.

#412 PROPOSAL ON FORWARD ERROR CORRECTION AND BUFFER CONTROL (JAPAN)

The (511,493)BCH is proposed with detailed framing for transmission of error correcting codes. Use of this framing for fill bits insertion is also proposed to prevent buffer underflowing. As to transmission buffer related specification, it is proposed to stipulate at least minimum coded picture interval and maximum coded picture interval.

#413 EVALUATION RESULTS OF RM6 (JAPAN)

Information is given on how RM6 behaves against four different zone plate type test signals. Some observations are commented.

#414 FLEXIBLE HARDWARE EXPERIMENT IN JAPAN (JAPAN)

Setting up of a volunteer group for px64 flexible Hardware experiments is informed. In order to meet the tight schedule, it is stressed in conclusion that;

- The specification should be completed as soon as possible.
- The hardware architecture related items should be decided at this meeting.
- Test signal generator should be provided by June.

#415 COMMENTS ON DOC. #373 - px64 FLEXIBLE HARDWARE SPECIFICATION (JAPAN)

Proposals, comments and questions are provided for discussion as a summary of various works in Japan.

#416 MOTION COMPENSATION CONCLUSION (SWEDEN, NORWAY, ITALY, UK, FRG, FRANCE, THE NETHERLANDS)

The following proposals/conclusion are derived for the px64 standard from the study results;

1) Fractional displacement should not be included.
2) For transmission of MV data, the RM6 method (VLC of differential MV) should be used.
3) MV range: +/-15 x +/-15
4) Motion vectors for each 8x8 sub-block gives a slight gain at p=1. Further study is required for higher bit rates and QCIF.

#417 PREDICTION OF DC COMPONENTS IN INTRA MODE (SWEDEN, NORWAY, ITALY, UK, FRG, FRANCE, THE NETHERLANDS)

It is proposed to forget about DC prediction.

#418 SIGNALLING CODED SUB-BLOCKS WITHIN A CODED MACRO-BLOCK (SWEDEN)

Coding efficiency of four methods are presented for information; RM5, RM6, 6 bits/MB and VLC (63 patterns), together with comments on complexity.

#419 VLC FOR RELATIVE ADDRESSING (SWEDEN)

After comparing the three methods; 1 bit/MB, VLC (RM5/RM6) and optimum VLC, it is concluded that VLC choice for relative addressing is not critical.

#420 MODIFICATIONS TO DOC. #396 - DESCRIPTION OF REFERENCE MODEL 6 (NL, BTRL, F, I, FRG, S, N)

In order to remove some ambiguities, the following modifications are proposed;

- VLC for differential motion vector
- Buffer control
- First picture and scene change

#421 STATUS FIELD TRIALS ERROR CORRECTION HARDWARE H.261 CODECS (THE NETHERLANDS, BTRL)

Field trials and problems found are reported. Experiments were carried out applying BCH (255,239) code and BCH (511,493) code to H.120 codec operated at 1.5 Mbit/s and placing the error correcting bits in the remaining part of 2 Mbit/s frame. Future work plans are also described.

#422 LOOP FILTER (NL, BTRL, F, I, FRG, S, N)

After describing the problems (position and number of the filters), draft workplan, experimental results, it is proposed that the filter maintains after the frame memory but;

- it operates inside the block boundaries,
- the adaptation has to be verified,
- the inclusion of the filter before frame memory depends on the performance and complexity,
- a work plan should be developed to fix the outstanding parameters as soon as possible.

#423 IMPROVEMENT OF RM6 BY LOOP FILTER OPERATIONS ON 16x16 LUMINANCE BLOCK (REPUBLIC OF KOREA - ETRI)

Application of the loop filter on 16x16 luminance blocks for luminance data instead of 8x8 is proposed, since it reduces 8x8 blocking effect and increases SNR.

#424 BUFFER REGULATION (CNET - FRANCE)

A new GOB structure allowing intercommunications between Full CIF and Quarter CIF is simulated at p=1. It is reported that this new picture partition has highlighted problems in the buffer regulation causing overflow in SWING.

#425 COMPARISON BETWEEN SIMULATION RESULTS AT 10 Hz AND 15 Hz ON SALESMAN AND CLAIRE (FRANCE, FRG)

Simulation results with 10 Hz and 15 Hz operations of RM6 are provided for the two test sequences.

#426 SIMULATION RESULTS AT 10 Hz (F, FRG, NL, S, N, UK, I)

It is reported that eight labs have simulated RM6 at 10 Hz with comparable results.

#427 SIMULATION RESULTS AT HIGHER BIT RATES USING RM6 (FRANCE, FRG)

Experimental results of RM6 are provided for higher bit rates; 300 kbit/s, 1.1 Mbit/s and 2 bit/s.

#428 VIDEOTAPE - TRIALS ON LOOP FILTER (ALCATEL CIT - FRANCE)

A comparison between RM6 and loop filter modification described in Doc. #356 is given. It is reported that no SNR improvements were gained with the modification, and that subjectively blocking effect is a little reduced involving a slight blurring and a granular noise on motion.

#429 COMMENTS ON VARIABLE THRESHOLDING (FRANCE - CNET)

Effects of the variable thresholding are analyzed as follows;

1) It discards medium and high frequency coefficients.
2) Those discarded coefficients are very often coded at the following frame.
3) A certain number of discarded coefficients with values of +/-1 are never coded.

Three attempts to improve further are commented; application of the process twice, adapting the quantizer to the threshold, maintaining the threshold at 1.5*g after an encoded coefficient.

#430 BITS PER INTRA CODED PICTURE (UK)

Through the hardware experiments, the number of bits produced by INTRA coding whole picture was measured to be at least 50 - 120 kbits with minimum of 35 kbit/s. Comments are given on the time required for complete update at lower bit rates, possible buffer overflow for detailed pictures, and visibility of update.

#431 PEI AND GEI BITS (UK, FRG, FRANCE, NETHERLANDS, NORWAY, SWEDEN)

It is proposed that the individual indication bit (PEI/GEI) for presence of optional data is placed immediately before each optional data field.

#432 ERROR CORRECTION SCHEME FOR px64 kbit/s
(UK, FRG, FRANCE, ITALY, NETHERLANDS, NORWAY, SWEDEN)

Provision of a single framing structure for the video data only are proposed to transmit error correcting codes.

#433 PRESS RELEASE FROM SPECIALISTS GROUP
(FRANCE, GERMANY, UK, ITALY, SWEDEN, NETHERLANDS, NORWAY)

A draft statement is provided for a press release from the Specialists Group to clarify the situation on standards for low bit rate moving video codecs.

#434 LIST OF INFORMED PATENTS - ISSUE 3 (CHAIRMAN)

Patents are listed up which have been informed the Specialists Group as being relevant to the nx384 Flexible Hardware specification or the draft H.261.

#435 1D VERSUS 2D VLC FOR COEFFICIENT CODING
(NORWAY, FRANCE, UK, NETHERLANDS, SWEDEN, ITALY, FRG)

From the performance analysis, it is found that one can obtain practically the same results using 2D VLC or two 1D VLCs which are switched according to the previous coefficient value. Since the implementation gain of two 1D VLCs is small, 2D VLC implementation is proposed for Hardware Specification.

#436 NUMBER OF SCANNING PATHS FOR EFFICIENT CODING (CSELT, NTA)

Experiments on adaptive scanning were carried out using different scanning paths (large/small number) and different classification rules (a posteori/ a priori). It is concluded that single zig-zag scanning is sufficient for p=1. Further work is required for p > 1.

#437 DEFINITION OF GOB FOR px64 kbit/s (FRG, UK, F, I, NL, S, N)

GOB definition consisting of 3 MB (width) x 11 MB (length) is proposed, considering delay-time, side-information and error recovery as well as identical size for Full CIF and Quarter CIF.

#438 ABOUT THE IMPLEMENTATION OF A STUFFING CODEWORD (FRG, F, UK, I, NL, N, S)

As the stuffing codeword, a unique codeword (no start code) is proposed which can be inserted at each position when a macro block address is expected. Considered items are; multipoint conferencing, prevention of buffer underflowing, total time delay, hardware implementation and compatibility of invalid Picture/GOB headers.

#439 PATENT INFORMATION DISCLOSURE POLICIES (CHAIRMAN)

Statements from 4 organizations.

#440 ALIGNMENT OF THE px64 VIDEO CODEC PARAMETERS WITH EXISTING ISDN BEARER SERVICE CATEGORIES (AT&T)

Initial parameters which are to be assigned to "p" in the px64 kbit/s codec Recommendation is proposed as follows;

p=1		(I.231.5)
p=2,	RDTD	(I.231.5)
p=6,	TSSI	(I.231.6)
p=24,	TSSI	(I.231.8)
p=30,	TSSI	(I.231.9)

#441 MIGRATION PLAN TO MOVE H.221 TO FULL ISDN COMPATIBILITY (AT&T)

Necessity of transition from H.221 inband signaling to the more robust ISDN signaling scheme is pointed out. Particular issues requiring study are;

- Call set-up of px64 connections in ISDN according to I.451.
- Multipoint call in ISDN using "D" channel signaling.
- Encryption aspects relating to multipoint calls.

Necessity of study on specific requirements of the residual overhead channel is also pointed out.

#442 PROGRESS ON INVERSE DCT ACCURACY SPECIFICATIONS (AT&T BELL LABORATORIES)

Copies of correspondence between parties interested in chip manufacturers are contained. All the responses from chip manufactures are positive.

#443 TEST SIGNAL GENERATOR (DELTA INFORMATIONS SYSTEMS)

According to the "px64" plan decided in Paris, a "Test Signal Generator" similar to the previous one for nx384 is proposed.

#444 THE WORK OF THE CEPT AD-HOC GROUP ON PRIVACY IN AUDIO-VISUAL CONFERENCING (UK, FRANCE, GERMANY, NETHERLANDS, ITALY)

CEPT activities on the subject are introduced, whose objective is to develop a privacy system with the following services; confidentiality of information, mutual authentication of communicating parties, and limited access control of MCUs.

Temporary Documents

No. 1	Agenda for the Florida meeting (Chairman)
No. 2	Available documents (Chairman)
No. 3	List of tape demonstrations (Chairman)
No. 4	Report of CCITT Plenary held in Melbourne (Chairman)
No. 5	Audio coding for visual telephony (Special Rapporteur for Q.4/XV)
No. 6	16 kbit/s speech coding for videophone service (Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom)
No. 7	Draft conclusion on the 4/9CIF discussion (Chairman)
No. 8	Loop filter (Small group)
No. 9	GOB-structure and techniques to prevent transmission buffer underflow (Small group)
No. 10	RM7 and action points (Small group)
No. 11	Specification for p*64 kbit/s Flexible Hardware (Drafting group)
No. 12	Press release from CCITT SG XV/1 Specialists Group
No. 13	Draft report of the fourteenth meeting in Florida (Chairman)

END

LIST OF TAPE DEMONSTRATIONS (December 6, 1988)

Topics	Source	Doc.
a. 4/9CIF	Japan	#403
b. Simulation results of RM6 at p=5, p=24	Japan	#404
c. RM6	France	#426
d. RM6 at 15Hz, FCIF	France	#425
e. RM6 at 300 kbit/s, 1.1 Mbit/s	France	#427
f. GOB structure	France	#424
g. Variable thresholding	France	#429
h. Hardware performance (presented at GLOBECOM'88)	UK/France	-
i. MC on/off decision rule	Japan	#405
j. Setting step size on MB layer and 12GOB	Japan	#411
k. Improvements of INTRA mode	Japan	#407
l. Evaluation results of RM6	Japan	#413
m. Comparison RM5/RM6	FRG	#426
n. RM6 at 60 kbit/s; 10 Hz, 15 Hz, 30 Hz	FRG	#425
o. RM6 at 320 kbit/s, 1920 kbit/s, 3840 kbit/s	FRG	#427
p. Loop filters	Japan	#406
q. Loop filters	NL	#422
r. Directional loop filter	Norway	#422
s. MCV for 8x8 blocks	Norway	#416
t. Loop filtering on 16x16 blocks	Korea	#423
u. Trial on loop filter	France	#428

Specification for p*64 kbit/s Flexible Hardware

CONTENTS

An outline block diagram of the codec is given in Figure 1.

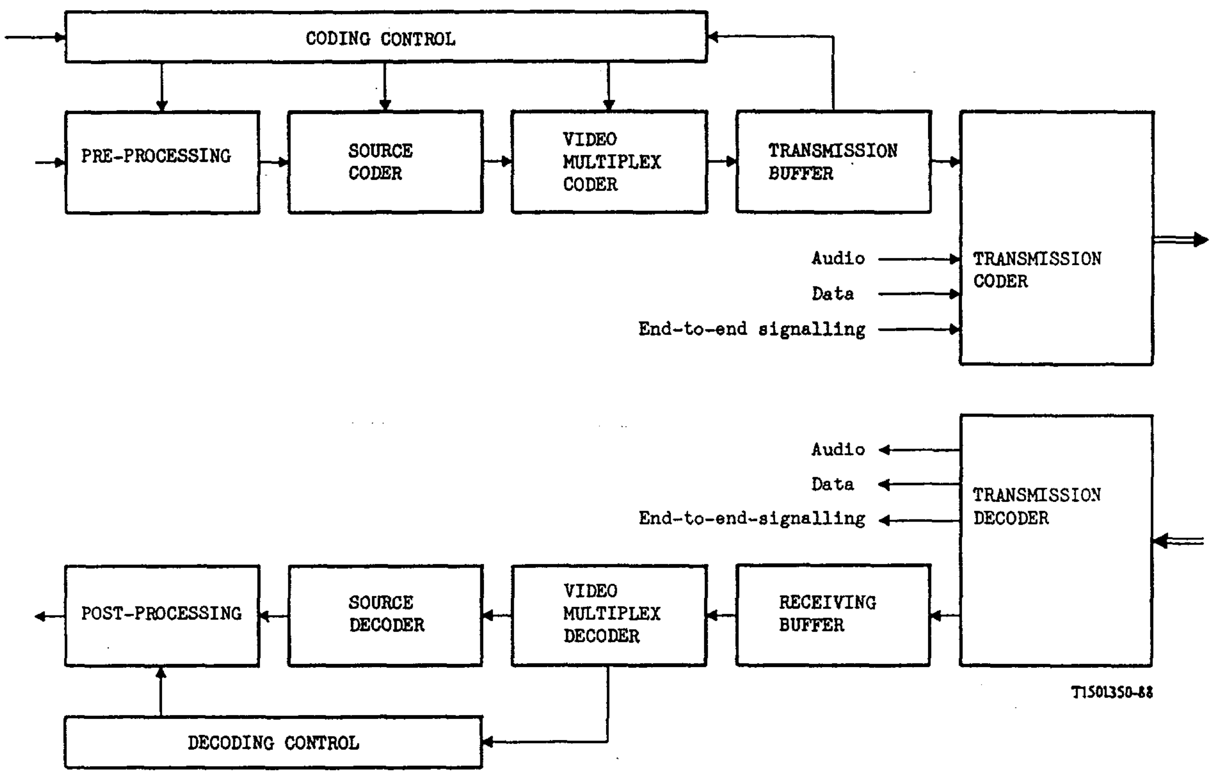


Figure 1 Outline blockdiagram of the codec

1. Source Coder

1.1 Source format

The source coder operates on non-interlaced pictures occurring 30000/1001 (approximately 29.97) times per second. The tolerance on picture frequency is +/-50ppm.

Pictures are coded as luminance and two colour difference components (Y, CR and CB). These components and the codes representing their sampled values are as defined in CCIR Recommendation 601.

Black = 16
White = 235
Zero colour difference = 128
Peak colour difference = 16 and 240

These values are nominal ones and the coding algorithm functions with input values of 0 through to 255.

Two picture scanning formats are specified.

In the first format (CIF), the luminance sampling structure is 288 lines per picture, 352 pels per line in an orthogonal arrangement. Sampling of each of the two colour difference components is at 144 lines, 176 pels per line, orthogonal. Colour difference samples are sited such that their block boundaries coincide with luminance block boundaries as shown in Figure 2. The picture area covered by these numbers of pels and lines has an aspect ratio of 4:3 and corresponds to the active portion of the local standard video input.

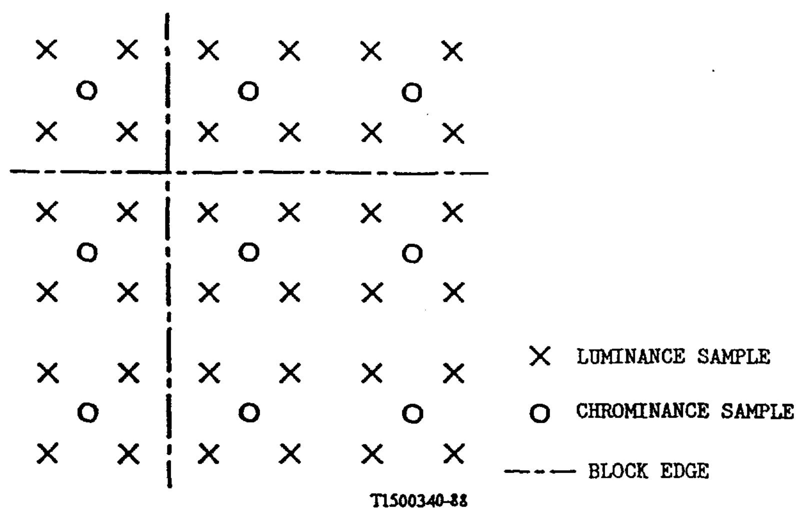


Figure 2 Positioning of luminance and chrominance samples

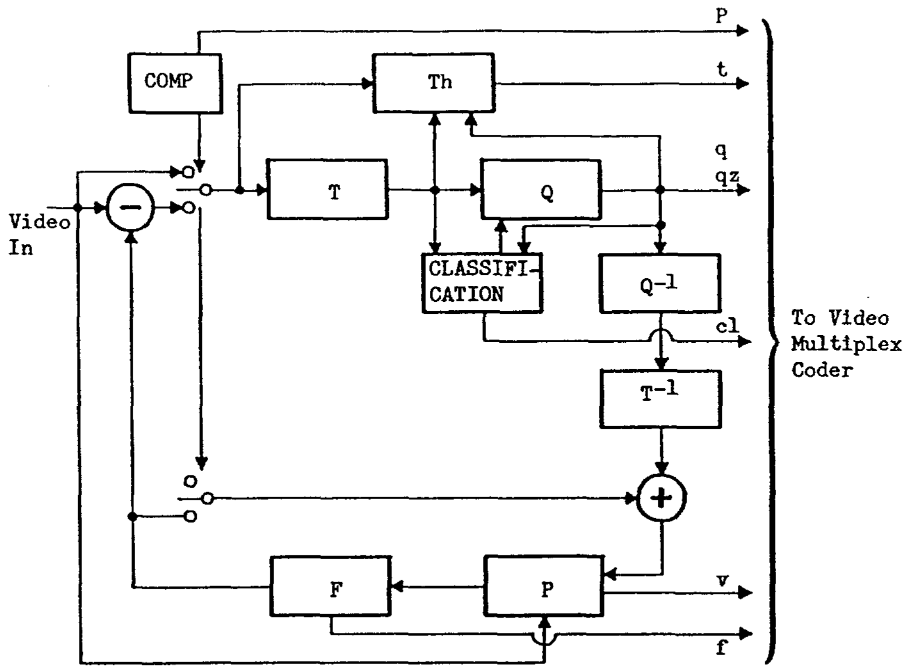
The second video format (QCIF) has half the number of pels and half the number of lines stated above.

The maximum picture rate (CIF and QCIF) is under study. Means shall be provided to restrict the maximum picture rate of encoders by having at least 0, 1, 2 or 3 non-transmitted pictures between transmitted ones. Selection of this minimum number will be performed manually.

Codecs operating at small values of p might have QCIF only.

1.2 Video source coding algorithm

The video coding algorithm is shown in generalised form in Figure 3. The main elements are prediction, block transformation, quantisation and classification.



COMP Comparator for intra/inter
Th Threshold
T Transform
Q Quantizer
P Picture memory with motion compensated variable delay
F Loop filter

p Flag for intra/inter
t Flag for transmitted or not
q Quantizing index for transform coefficients
qz Quantizer indication
v Motion vector
cl Classification index
f Switching on/off of the loop filter

Figure 3 Video coding algorithm

The prediction error (INTER mode) or the input picture (INTRA mode) is subdivided into 8 pel by 8 line blocks which are segmented as transmitted or non-transmitted. The criteria for choice of mode and transmitting a block are not subject to recommendation and may be varied dynamically as part of the data rate control strategy. Transmitted blocks are transformed and resulting coefficients are quantised and variable length coded.

1.2.1 Prediction

The prediction is inter-picture and may be augmented by motion compensation (§ 1.2.2) and a spatial filter (§ 1.2.3).

1.2.2 Motion compensation

Motion compensation is optional in the encoder. The decoder will accept one vector for each luminance and chrominance block of 8 pels by 8 lines. Both horizontal and vertical components of the motion vectors for luminance blocks have integer values not exceeding +/- 15. Motion vectors for colour difference blocks are derived from the vectors for the four corresponding luminance blocks. In the case where the vectors for these four luminance blocks are identical the chrominance block vector is obtained by halving the component values and truncating towards zero. The derivation method for other cases is under study.

A positive value of the horizontal or vertical component of the motion vector signifies that the prediction is formed from pels in the previous picture which are spatially to the right or below the pels being predicted.

Motion vectors are restricted such that all pels referenced by them are within the coded picture area.

1.2.3 Loop filter (PROVISIONAL)

The prediction process may be modified by a two-dimensional spatial filter which operates on pels within a predicted block.

The filter is separable into one dimensional horizontal and vertical functions. Both are non-recursive with coefficients of 1/4, 1/2, 1/4. At block edges, where one of the taps world fall outside the block, the peripheral pel is used for two taps. Full arithmetic precision is retained with rounding to 8 bit integer values at the 2-D filter output. Values whose fractional part is one half are rounded up.

The filter may be switched on or off on a block by block basis. The method of signalling this is under study.

The inclusion of alternative filter designs and characteristics is under study.

Note that the possibility of a filter before the picture memory is not yet ruled out.

1.2.4 Transformer

Transmitted blocks are coded with a separable 2-dimensional Discrete Cosine Transform of size 8 by 8. The input to the forward transform and output from the inverse transform have 9 bits. The transfer function of the inverse transform is given by

$$f(x,y) = \frac{1}{4} \sum_{u=0}^{7} \sum_{v=0}^{7} C(u)\, C(v)\, F(u,v) \cos\left[\frac{\pi u(2x+1)}{16}\right] \cos\left[\frac{\pi v(2y+1)}{16}\right]$$

with $u,v,x,y = 0, 1, 2, \ldots, 7$

where x,y = spatial coordinates in the pixel domain
u,v = coordinates in the transform domain

$C(u),C(v) = 1/\sqrt{2}$ for $u,v = 0$
1 otherwise

The arithmetic procedures for computing the transforms are not defined, but the inverse one should meet the error tolerance specified in Appendix.

1.2.5 Quantisation

The number of quantisers is 32. Their characteristics are under study. Assignment of quantisers is as in Figure 4.

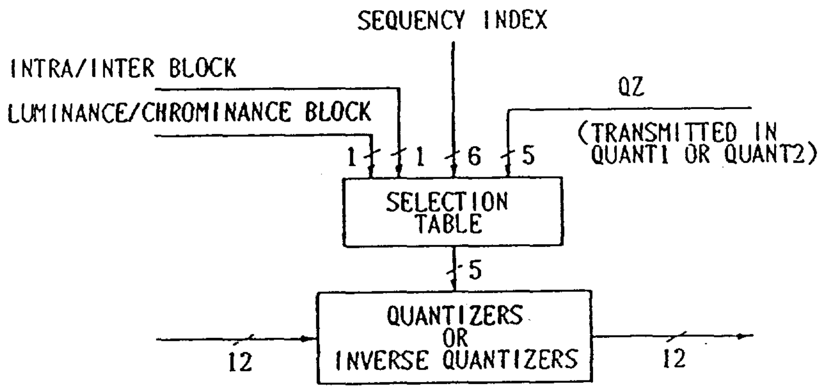


Figure 4 Quantiser assignment

1.2.6 Clipping

To prevent quantisation distortion of transform coefficient amplitudes causing arithmetic overflow in the encoder and decoder loops, clipping functions are inserted. In addition to those in the inverse transform, a clipping function is applied at both encoder and decoder to the reconstructed picture which is formed by summing the prediction and the prediction error as modified by the coding process. This clipper operates on resulting pel values less than 0 or greater than 255, changing them to 0 and 255 respectively.

1.3 Data rate control

Sections where parameters which may be varied to control the rate of generation of coded video data include processing prior to the source coder, the quantiser, block significance criterion and temporal subsampling. The proportions of such measures in the overall control strategy are not subject to recommendation.

When invoked, temporal subsampling is performed by discarding complete pictures. Interpolated pictures are not placed in the picture memory.

1.4 Forced updating

This function is achieved by forcing the use of the INTRA mode of the coding algorithm. The update pattern is not defined. For control of accumulation of inverse transform mismatch error a block should be forcibly updated at least once per every 128 times it is transmitted.

2. Video Multiplex Coder

2.1 Data Structure

Note 1: Unless specified otherwise the most significant bit is transmitted first.
Note 2: Unless specified otherwise Bit 1 is transmitted first.
Note 3: Unless specified otherwise all unused or spare bits are set to '1'.

2.2 Video Multiplex arrangement

The video multiplex is arranged in a hierarchical structure with four layers. From top to bottom the layers are:

Picture
Group of Blocks (GOB)
Macroblock (MB)
Block

2.2.1 Picture Layer

Data for each Picture consists of a Picture Header followed by data for GOBs. The structure is shown in Figure 5. Picture Headers for dropped pictures are not transmitted.

PSC	TR	TYPE1	PEI1	PARITY	PEI2	PSPARE	GOB Data

Figure 5 Structure of the Picture Layer

Picture Start Code (PSC) 20 bits

A word of 20 bits. Its value is 0000 0000 0000 0001 0000

Temporal Reference (TR) 5 bits

A five bit number derived using modulo-32 counting of pictures at 29.97 Hz.

Type Information (TYPE1) 13 bits

Information about the complete picture;

Bit 1 Split screen indicator. '0' off, '1' on.
Bit 2 Document camera. '0' off, '1' on.
Bit 3 Freeze Picture Release. Under study.
Bit 4 Format indicator. '0' QCIF, '1' CIF.
Bits 5 to 13 Under study.

Extra Insertion Information (PEI1) 1 bit

A bit which signals the presence of the following optional data field.

Parity Information (PARITY) 0 or 8 bits

For optional use and present only if the PEI1 bit is set to '1'. Eight parity bits each representing odd parity of the aggregate of the corresponding bit planes of the locally decoded PCM values of Y, CR and CB in the previous picture period.

Extra Insertion Information (PEI2) 1 bit

A bit which signals the presence of the following optional data field.

Spare Information (PSPARE)   0 or 16 bits

Sixteen bits are present when the PEI2 bit is set to '1'. The use of these bits is under study.

2.2.2 Group of Blocks Layer

Each picture is divided into Groups of Blocks (GOBs). A group of blocks (GOB) comprises one twelfth of the CIF or one third of the QCIF picture areas. A GOB relates to 176 pels by 48 lines of Y and the spatially corresponding 88 pels by 24 lines of each of CR and CB.

1	2
3	4
5	6
7	8
9	10
11	12

CIF

1
3
5

QCIF

Figure 6 Arrangement of GOBs in a Picture

Data for each Group of Blocks consists of a GOB Header followed by data for macroblocks. The structure is shown in Figure 7. Each GOB Header is transmitted once between Picture Start Codes in the CIF or QCIF sequence numbered above, even if no macroblock data is present in that GOB.

GBSC	GN	TYPE2	QUANT1	GEI	GSPARE	MB Data

Figure 7 Structure of Group of Blocks Layer

Group of Blocks Start Code (GBSC)   16 bits

A word of 16 bits, 0000 0000 0000 0001.

Group Number (GN)   4 bits

Four bits indicating the position of the group of blocks. The bits are the binary representation of the numbers in Figure 6. Group numbers 13, 14 and 15 are reserved for future use. Group number 0 is used in the PSC.

Type Information (TYPE2)   6 bits

TYPE2 is 6 bits which give information about all the transmitted blocks in a group of blocks.

Bit 1 When set to '1' indicates that all the transmitted blocks in the GOB are coded in INTRA mode and without block addressing data.
Bit 2 Under study. Possible uses include signalling of the use of motion compensation and the method of switching the loop filter.
Bit 3 Number of classes. '0' one, '1' four.
Bits 4 to 6 Spare, under study.

Quantiser Information (QUANT1) 5 bits

A codeword of 5 bits which indicates the quantiser table(s) to be used in the group of blocks until overridden by any subsequent QUANT2. The codewords are under study.

Extra Insertion Information (GEI) 1 bit

A bit which signals the presence of the following optional data field.

Spare Information (GSPARE) 0 or 16 bits

Sixteen bits are present if the GEI bit is set to '1'. The use of these bits is under study.

2.2.3 Macroblock Layer

Each GOB is divided into 33 macroblocks as shown in Figure 8. A macroblock relates to 16 lines by 16 pels of Y and the spatially corresponding 8 lines by 8 pels of each of CR and CB.

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33

Figure 8 Arrangement of macroblocks in a GOB

Data for a macroblock consists of a MB Header followed by data for blocks. The structure and order of the data in a macroblock are under study. A likely structure is shown in Figure 9. Elements are omitted when not required.

MBA	TYPE3	QUANT2	MVD	CBP & Block Data

Figure 9 Structure of macroblock layer

Macroblock Address (MBA) Variable Length

A Variable Length Code-word indicating the position of a macroblock within a group of blocks. The transmission order is as shown in Figure 8. VLC codewords using a combination of relative and absolute addressing are under study.

Macroblocks are not transmitted when they contain no information for that part of the picture.

When bit 1 of TYPE2 is '1' MBA is not included and up to 33 macroblocks beginning with and continuing in the above transmission order are transmitted before the next GOB Header.

Note: More explicit detail is required about what is and what is not present when this is invoked.

Type Information (TYPE3)   Variable Length

Variable length codewords giving information about the macroblock and which data elements are present. Macroblock types and VLC codewords are under study.

Quantiser (QUANT2)   5 bits

QUANT2 is present only if so indicated by TYPE3.

A codeword of 5 bits signifying the quantiser table(s) to be used for this and any following blocks in the group of blocks until overridden by any subsequent QUANT2.

Codewords for QUANT2 are the same as for QUANT1.

Motion Vector Data (MVD)

Motion vector data is obtained by differential calculation from the preceding vector. (More detail needed here and also may need to cover case of one vector per luminance block.) The prediction vector for macroblocks 1, 12 and 23 is zero.

When the vector data is zero, this is signalled by TYPE3 and MVD is not present.

When the vector data is non-zero, MVD is present consisting of a variable length codeword for the horizontal component followed by a variable length codeword for the vertical component.

Variable length coding of the vector components is under study.

(See note in § 2.2.4)

Coded Block Pattern (CBP)

Bits which indicate those blocks for which data is present. Under study.

2.2.4 Block Layer

Note: This part is not yet well defined. Information given below is incomplete and subject to amendment.

A macroblock comprises four luminance blocks and one of each of the two colour difference blocks.

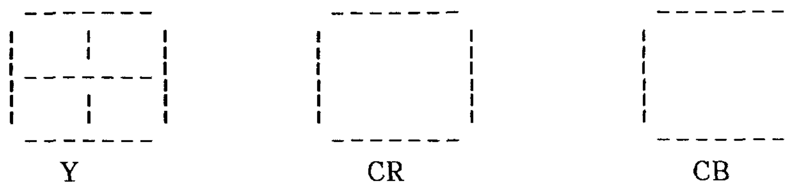


Figure 10 Arrangement of blocks in a macroblock

Data for a block consists of .... codewords for transform coefficients followed by an end of block marker. The structure is under study. The order of block transmission is under study.

```
 --------          ----------------------
| TYPE4 |........ CLASS | TCOEFF | EOB |
 --------          ----------------------
```

Figure 11 Structure of Block Layer

Note: For QCIF, motion vectors per block may be necessary. Hence, the definition of TYPE4 is open and other items may be added into the block structure.

Type Information (TYPE4)

....

Classification Index (CLASS)

Note that CLASS might be removed from specification if only the zig-zag scanning order is incorporated.

CLASS is present if bit 3 of TYPE2 is set to '1' and indicates which of the four available transmission sequence orders is used for luminance block coefficients. If bit 3 of TYPE2 is set to '0' then luminance block coefficients are transmitted in the default sequence order.

Chrominance block coefficients are transmitted in one sequence order.

The CLASS codewords and sequence orders are under study.

Transform Coefficients (TCOEFF)

The quantised transform coefficients are sequentially transmitted according to the sequence defined by CLASS. The DC component is always first. Coefficients after the last non-zero one are not transmitted. Hardware for 2-D VLC should be incorporated with possibility to operate in 1-D mode.

The VLC tables are under study.

End of Block Marker (EOB)

Use of and codeword for EOB are under study. An EOB without any transform coefficients for a block is allowed.

2.3 Multipoint considerations

Both switched and continuous presence multipoint are under study. The feasibility of the latter is increased by the two formats of CIF and QCIF together with the configuration of GOBs, which permit four QCIF sources to be combined into one CIF stream.

2.3.1 Freeze Picture Request

Causes the decoder to freeze its received picture until a picture freeze release signal is received or a timeout period has expired. The transmission method for this control signal and the timeout period are under study.

2.3.2 Fast Update Request

Causes the encoder to encode its next picture in INTRA mode with coding parameters such as to avoid buffer overflow. The transmission method for this control signal is under study.

2.3.3 Picture Freeze Release

A signal from an encoder which has responded to a Fast Update Request and causes a decoder to exit from its picture freeze mode and display decoded pictures in the normal manner. The transmission method for this signal is under study. (See § 2.2.1, TYPE1, bit 3)

2.3.4 Data continuity

The protocol adopted for ensuring continuity of data channels in a switched multipoint connection is handled by the message channel. Under study.

3. Transmission coder

3.1 Bit rate

The bit rate including audio and optional data channels is p*64 kbit/s where p is an integer between 1 and 30 both inclusive. Some codecs may have restrictions on the available values of p. Desirable values of p are 1, 2, 6, 24 and 30. The corresponding video rates are:

about 40 kbit/s (to be defined)
64 kbit/s
320 kbit/s
1472 kbit/s
1856 kbit/s

The source and stability of the encoder output clock are under study.

3.2 Video Data Buffering

Under study. The specification will cover both post-coding and pre-coding buffers. The effect on overall system delay will be considered. Likely to be specified as maximum allowable number of bits for one picture.

Encoder buffer overflow and underflow are not permitted. Underflow can be prevented by use of dummy block in the error corrector block framing. (See Document #412 for principle.)

3.3 Video clock justification

Video clock justification is not provided.

3.4 Frame structure

3.4.1 Frame structure

The frame structure is defined in Recommendations H.221 and H.222.

3.4.2 Bit assignment in application channel

Under study.

3.4.3 Timeslot positioning

According to Recommendation I.431.

3.5 Audio coding

For $p \geq x$, Recommendation G.722 56/48 kbit/s audio, 0/8 kbit/s data and 8 kbit/s service channel in the first timeslot.

For $p < x$, another audio coding scheme.

($x = 2$?)

The delay of the encoded audio relative to the encoded video at the channel output is under study.

3.6 Data transmission

For $p>2$ one or more timeslots may be allocated as data channels of 64 kbit/s each. The first channel uses the fourth timeslot of a primary rate interface.

Positioning of the other channels, and possible restrictions on availability at lower overall bit rates are under study. The BAS codes used to signal that these data channels are in use are specified in Recommendation H.221.

3.7 Error handling

Video coding strategy to be error resilient preferably without internal or external error correction. Note that demand refresh can be implemented using the Fast Update Request of § 2.3.2.

Framing for error correction.

Block length.

BCH or Reed Solomon

Framing alignment pattern

3.8 Encryption

3.9 Bit Sequence Independence Restrictions

3.10 Network interface

Access at the primary rate is with vacated timeslots as per Recommendation I.431.

For 1544 kbit/s interfaces the default H0 channel is timeslots 1 to 6.

For 2048 kbit/s interfaces the default H0 channel is timeslots 1-2-3-17-18-19.

Interfaces using ISDN basic access - Recommendation I.420.

END

Specification for Inverse DCT

1. Generate random integer pixel data values in the range -L to +H according to the attached random number generator (C version). Arrange into 8x8 blocks by allocating each set of consecutive 8 numbers in a row. Data sets of 10000 blocks each should be generated for (L=256, H=255), (L=H=5) and(L=H=300).

2. For each 8x8 block, perform a separable, orthonormal, matrix multiply, Forward Discrete Cosine Transform (FDCT) using at least 64-bit floating point accuracy.

3. For each block, round the 64 resulting transformed coefficients to the nearest integer values. Then clip them to the range -2048 to +2047. This is the 12-bit input data to the inverse transform.

4. For each 8x8 block of 12-bit data produced by step 3, perform a separable, orthonormal, matrix multiply, Inverse Discrete Cosine (IDCT) using at least 64-bit floating point accuracy. Round the resulting pixels to the nearest integer, and clip to the range -256 to +255. These blocks of 8x8 pixels are the "reference" IDCT output data.

5. For each 8x8 block of 12-bit data produced by step 3, use the proposed IDCT chip or an exact-bit simulation thereof to perform an Inverse Discrete Cosine Transform. Clip the output to the range -256 to +255. These blocks of 8x8 pixels are the "test" IDCT output data.

6. For each of the 64 IDCT output pixels, and for each of the 10,000 block data sets generated above, measure the peak, mean and mean square error between the "reference" and "test" data.

7. For any pixel, the peak error should not exceed 1 in magnitude.
   For any pixel, the mean square error should not exceed 0.06.
   Overall, the mean square error should not exceed 0.02.
   For any pixel, the mean error should not exceed 0.015 in magnitude.
   Overall, the mean error should not exceed 0.0015 in magnitude.

8. All-zeros in must produce all-zeros out.

9. Rerun the measurements using exactly the same data values of step 1, but change the sign on each pixel.

```
                    /*L and H must be long, ie, 32 bits*/
long rand(L,H)
long      L,H;
{
   static long   randx = 1;    /*long is 32 bits*/
   static double   z = (double)0x7fffffff;

   long   i,j;
   double x;                  /*double is 64 bits*/

   randx = (randx * 1103515245) + 12345;
   i = randx & 0x7ffffffe;                    /*keep 30 bits*/
   x = ( (double)i ) / z;                     /* range 0 to 0.99999... */
   x *= (L+H+1);                              /* range 0 to  < L+H+1 */
   j = x ;                                    /*truncate to integer*/
   return( j - L );                       /*range  -L  to  H  */
}
```

RM7 and Action Points

I. RM7

RM7 is RM6 with the following modifications:

- Intra mode:

    * regarding the luminance it remains as described in Doc. #396' paragraph 4.13 on p.31 (RM6 description)
    * for the chrominance the mean value of CR and CB are transmitted using an 8 bit FLC (see Appendix 1)

- Simplification of the start (see Appendix 2). Intra mode is used. The bit rate for the video channel is qx64 kbit/s (q=1...29).

- GOB structure:

  The group of block structure depicted in Doc. #432, #385 is adopted. The stepsize is transmitted at the GOB level (an overflow occurs in the SWING sequence i.e. buffer control strategy will be proposed by the next meeting).

- Buffer control:

  The buffer size is only related to the bit rate. A table will be provided giving the number of bits per macro block for each combination of frame and bit rates for full and 1/4 CIF.

II. Action Points

1. Filtering in the loop (#356, #376, #406, #422)

   The following topics have to be checked:

    - the adaptivity of the filter(s) and how to control it
    - the effectiveness of the filter(s) in the loop vs outside the loop

2. Optimization of the intra mode (#407). Introduction of an intra not coded mode?

3. Use of motion vectors for sub-blocks (Annex to #416)

4. Pattern issue (#418, #409)

5. VLC optimization

6. Impact of the GOB configuration regarding the buffer control strategy.

7. Impact of the modification of qx64 kbit/s. q > 1.

8. Scanning classes

9. 1/4CIF simulation work: RM6 is applied with the number of GOB depicted in #437, #385.

* for 10Hz use 60 bits per MB with q=1
* for 15Hz use 39 bits per MB with q=1
* for 30Hz use 18 bits per MB with q=1
* in the first step use a pre-filter 11 for down conversion (see Appendix 3)
* use linear interpolation filter for the up conversion
* the result will be displayed by using a full screen
* the SNR will be calculated at both the CIF and QCIF levels
* the use of other filters must be studied

END

Appendix 1

Modification of Intra mode

See section 4.13 page 31 document 396'.

After the blocks have been declared intra the coeffiecients are transmitted as depicted in the figure below.

For LUMINANCE (Y)

M=rounded mean value of the 16x16 MB	Differential DC Value of LSB1 by comparison with 8 x M	AC	EOB	. . . .
8 bits FLC	VLC		2bits	

Differential DC Value of LSB4 by comparison with 8 x M	AC	EOB

For CHROMINANCE (U,V)

MU = rounded mean value of the 8×8 MB	AC	EOB	MV = rounded mean value of the 8×8 MB	AC	EOB
8 bit FLC		2 bit	8 bit FLC		2 bit

The condition for the first frame

This ANNEX replaces section 4.14 of document 396'.

The procedure for coding the first picture is according to following description:

- o Disregarding the number of bits for the first frame.
- o Using the stepsize depicted in table 1 for the various bitrates

VIDEO BITRATE CHANNELS	BITRATE	STEPSIZE
q=1	59.4	g = 32
q=5	297	g = 16
q=23	1472	g = 12
q=2q	1856	g = 8

- o Start second picture with half full buffer.

The temporal reference remains as depicted below

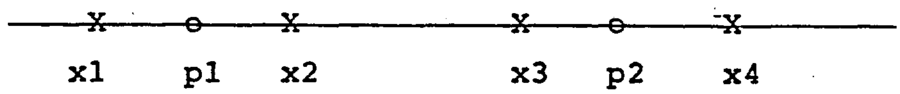
original sequence	1	2	3	4	5	6	7	8	(10 Hz)
coded sequence	1	2	3	4	5	6	7	8	(10 Hz)

Temporal reference

Note: For comparison purposes the number of bits for the first picture is counted.

Appendix 3

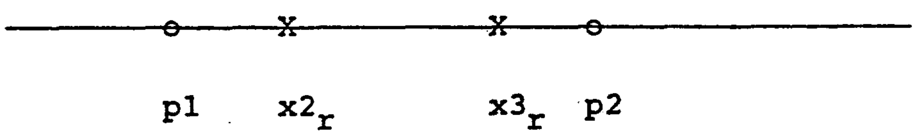
Down conversion CIF -- QCIF



$$p1 = \frac{x1 + x2}{2}$$

$$p2 = \frac{x3 + x4}{2}$$

Up conversion QCIF ---- CIF



$$x2_r = 3/4\ p1 + 1/4\ p2$$

$$x3_r = 1/4\ p1 + 3/4\ p2$$

Appendix 4

Number of fixed MAcro blocks	Codeword length
0	1
1	3
2	3
3	4
4	4
5	5
6	5
7	6
8	6
9	7
10	7
11	8
12	8
13	9
14	9
15	11
16	11
17	11
18	11
19	11
20	11
21	13
22	13
23	13
24	13
25	13
26	15
27	15
28	15
29	15
30	15
31	15
32	15
33	15

Table 1 provisional table

To start the simulations we will use the VLC depicted in table 1

NOte: The table does not give an optimal code, an optimal code will be provided updating the document 396', Description of refererence model 7

PRESS RELEASE FROM CCITT SG XV/1 SPECIALISTS GROUP

Standardisation activities in CCITT concerned with Low Bit Rate Moving Video Codecs take place in Study Group XV. Within SG XV there is a Working Party considering a number of questions, one being that concerned with methods of coding low bit rate video in the range of 64 kbit/s to 2 Mbit/s.

CCITT operates in 4 year cycles called study periods. The 1984-88 study period has just finished with a formal plenary meeting in Australia in November 1988, where Recommendations produced by the various Working Parties were formally agreed. Their Recommendations will be published in a series of 'Blue Books' which will be available in 1989.

In the area of low bit rate moving video codecs, two Recommendations will appear in the Blue Books:

Recommendation H.120 - which was originally produced at the end of the 1980-84 study period and has now been updated and covers the range of bit rates from 768 kbit/s - 2 Mbit/s.

Recommendation H.261 - which is a Recommendation for codecs operating at nx384 kbit/s where n can have all integer values from 1-5.

Recommendation H.261 has been the result of activities within a Picture Coding Specialists Group set up by the Working Party and chaired by S. Okubo from Japan with the participation of representatives from F.R. of Germany, Canada, U.S.A., France, Italy, Japan, Korea, The Netherlands, Norway, United Kingdom, Sweden and Finland. The Recommendation entering the Blue Book is incomplete as a number of items are still under study. A second topic of study within this Specialists Group has been coding for mx64 kbit/s where m can have integer values 1 or 2.

Recent results on the algorithm studies for the H.261 Recommendation have indicated that the algorithm chosen is sufficiently flexible so that it can be extended with good performance down to 64 kbit/s. Furthermore the evidence obtained in the Specialists Group suggests that the algorithm reflects the current state of the art in low bit rate video coding. The Specialists Group has therefore decided that it is no longer necessary to work on 2 independent Recommendations for the purposes of optimum coding performance. It is therefore the intention to complete H.261 as rapidly as possible and extend the scope of this Recommendation such that it will become a worldwide standard for coding at all bit rates from 64 kbit/s to 2 Mbit/s. Both H.120 and H.261 Recommendations will co-exist although transcoding will be required between the two standards.

A time-table of work has been agreed which will result in a complete px64 kbit/s Draft Recommendation, verified by hardware experiments, by the end of October 1989 containing sufficient detail to allow manufacturers to design codecs and VLSI devices. No changes to the px64 kbit/s Draft Recommendation will be allowed after this date except corrections and clarifications. The intention is to ensure that this complete px64 kbit/s specification gains "Recommendation" status by mid 1990. Furthermore it is the intention to formally announce the extension of H.261 to px64 kbit/s in March 1989. The main intention of this procedure is to indicate to interested parties that the Specialists Group is concentrating on a single Recommendation and making good progress.

Both standards are world-wide Recommendations, they cover operation in all networks irrespective of whether the hierarchy is based on the CEPT 2 Mbit/s or the Japanese and North American 1.5 Mbit/s building blocks and irrespective of whether the local video standard is PAL, NTSC or SECAM.

Recommendation H.261 has been developed to be suitable for video telephony on the basic ISDNs, videoconferencing and other applications where good but not broadcast quality video performance is acceptable. It is the result of several 100 man years of effort in Research Laboratories around the world and an outstanding example of international, pre-competitive collaborative research. It is the intention of the specifiers that this standard should endure through this century.

END