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

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1. General

The Specialists group met in Paris, France, from September 19 to 22, 1988 at the kind invitation of Alcatel CIT with the support of SAT and CNET.

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

At the opening session, Chairman reported that Finland had indicted its willingness to send a specialist to the Group and that Mr. Helkio would attend the meetings as an observer until it would be approved in the coming Study Group XV meeting.

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, 49 normal documents and 11 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 Final Working Party XV/1 and Study Group XV Meetings (#347, #348)

Chairman reported the results obtained at the final meetings of WPXV/1 and SGXV which were held in April 1988 focusing on the topics of our direct concern; new terms of reference for the Specialists Group, new Recommendations, revised existing Recommendations and new Questions.

5. Discussion on 384 kbit/s Codec

5.1 Field trial

Mr. Speidel reported with a tape demonstration on international compatibility check between FRG/Netherlands and UK Flexible Hardware as well as coder to decoder loopback test. During the technical visit, a live videoconferencing between Paris and Ipswich was demonstrated via a

satellite link using France and UK Flexible Hardware operating at 384 kbit/s.

5.2 Parameter optimization (#363)

Statistics of the coding elements in the Flexible Hardware were presented which had been collected using the initial compatibility check parameters as defined in Doc. #249. Some comments were given on the VLC sets; those for TCOEFF/EOB and Differential Motion Vectors are near optimum whereas those for TYPE3 and CLASS should be modified.

5.3 Transmission errors (#379, #394)

Doc. #379 reported how Flexible Hardware behaves under transmission errors; random and burst errors. Mr. Guichard commented it is more resilient to transmission errors than originally expected. In response to a question, he clarified that no particular error resilience measures are implemented in the Hardware.

Doc. #394 gave information on European activities on the error correction. According to the hardware experimental results, Mr. Carr expressed his view that he would prefer simpler error correction codes because the current coding scheme has error resilience to some extent and that the (511,493)BCH seems reasonable for our purpose while the (255,239)BCH may be too powerful.

5.4 IDCT mismatch errors (Annex 3/#346R, #349; #351, #364, #366, #380; #365, #367, #377; TD5, TD6)

As the background of the discussion, Mr. Carr reported the summary of the meeting of DCT chip manufacturers held in May at BTRL (Doc. #349). The idea of a common design was not accepted because of the possible future improvements in chip design and the technology already developed. The meeting confirmed we would seek the approach of defining a reference IDCT and specifying some tolerance together with refresh interval. Mr. Carr advised the meeting that it would not be a problem for chip manufactures to specify tightly as required since the progressing chip technology would easily follow the specification if once given.

Analytical study results were presented in several documents; computer simulation using random numbers (Doc. #351, #364), mismatch error analysis based on transformer models (Doc. #366, #380). Picture coding results were also presented as useful input toward finalizing the specification; an extensive hardware experiments on the perceptible limit of mismatch errors (Doc. #365), hardware experiments on allowable cyclic refresh interval from the coding efficiency reduction point of view (#367), RM5 simulation of an existing chip at 64 kbit/s.

After some discussion, the meeting requested Mr. Haskell to coordinate a small group meeting for updating the current IDCT provisional specification (TD5) through reviewing all the information made available. The updated specification of IDCT is contained in Annex 3 which will be sent to chip manufacturers for comments. For the refresh interval specification, "at least once every 128 coded frames" were agreed.

6. **Discussion on 64 kbit/s CODEC**

6.1 Picture format (§5.1/#346R; #354, #372, #382; TD8)

Based on the simulation results addressed to the comparison between Full CIF and 4/9CIF, the meeting had an extensive discussion on the necessity of the third medium resolution format.

To form a basis of the discussion, Mr. Schaphorst coordinated a small group meeting to produce a status report as in Annex 4.

The summary of discussion is as follows;

1) Experimental Results

- Full CIF presentations are generally superior to 4/9 CIF ones in European results (against intuition in coding noise)
- Some ambiguities in Japanese results
- Lack of common comparison method

2) Necessity of 4/9 CIF

a. Not necessary (Europe)

- Experimental evidence in 1) above
- International compatibility at the highest quality
- Service point of view including multipoint simplicity

b. Necessary (US, Japan, Canada)

- Flexibility in spatio-temporal resolution trade-off
- Cheaper implementation

3) Possible solutions

a. Proceed with the agreed two formats (Full CIF, Quarter CIF).

b. Include 4/9 CIF as proposed by Japan, three formats are defined and when two different format codecs intercommunicate, the common largest format is used.

c. 4/9 CIF is recommended as a defined option. When 4/9 CIF intercommunicates with Full CIF codec, QCIF is used.

d. 4/9 CIF is not defined as one of the picture formats, but it may be implemented as covering part of the Full CIF Video multiplex. All codecs other than QCIF codecs have the capabilities;

- to decode Full CIF pictures, and
- to send reduced size pictures in the Full CIF video multiplex.

Whole of the picture information should be displayed, but how to display it is not the matter of codec specification. In order to facilitate the full size display, indication of 4/9 CIF is inserted as a part of codec-to-codec signalling.

4) Considerations

- Simplification of the future work in the limited time frame.
- Worry about proliferation of the local standard equipment not compatible with CCITT standard codecs.

As a conclusion, the meeting agreed upon to proceed with the agreed two formats (Full CIF and Quarter CIF) unless firm, convincing evidence of 4/9CIF and consistent architecture among different formats are provided by the next meeting and agreed.

6.2 Source coding

6.2.1 Reference Model 5 based schemes

First, reports of the RM5 implementation were provided in Doc. #369 and #393, and complete description of RM5 was given in Doc. #375. Some statistics on motion compensated prediction errors and two-dimensional motion vectors were also reported in Doc. #370. As to the concentration of motion vectors on the 9 points in the first search step in Table V/Doc. #370, it was guessed as probably due to the priority given to the lower numbered position when the evaluation function values are equal.

Next, several improvements found in the simulation were presented with questions and answers accompanied;

1) Two-dimensional motion vector prediction and coding (#355, #389)

   Mr. May informed that +/-15 pel displacements are required from the hardware study.

2) Loop filter (#356, #376)

   Mr. Guichard raised a question to Doc. #356 how the results can be compared with the case where 121 filter is kept after the frame memory and post processing is applied to the decoded picture.

3) Coding of the first picture (#358, #389) and inter/intra switch (#389)

   Necessity of intra mode was generally supported not only for the rapid build-up but also for cyclic refreshing required to cope with IDCT mismatch.

4) Entropy coding of the quantizer index (#374, #392)

   It drew attention that a 1-bit code is assigned to EOB code in Tables 3-5 of Doc. #374. Block type definition was felt better to handle the abundance of EOBs. It was also pointed out that VLC might better be adapted to transmission bit rate as well. In Doc. #392, remaining EOBs after block addressing are removed by coding the number of events.

6) Variable thresholding for quantizers (#392)

   This technique provides a significant gain. Mr. Kato pointed out that his previous simulation work showed some gain had been obtained by lowering the first representation level. Mr. Ericsson gave his interpretation using cost function that an isolated coefficient transmission is more costly.

7) Block addressing by transmitting coded/non-coded patterns (#357, #392)

It was pointed out that if this method is used, the code length of EOB may need be changed.

6.2.2 New elements or new schemes

The following study results were presented as the state of the art where new coding elements or new schemes different from those of RM5 are used.

1) VQ schemes (#359, #362)

2) New transforms (#360, #381, #382)

Mr. Bjoentegaard stated that the Directional Transform was designed to reproduce clearer edges with mosquito noise reduced.

3) Background prediction (#390)

Mr. Haskell pointed out that a possible problem may be in AGC of cameras.

4) Segmentation (#361)

Mr. Plompen and Mr. Brusewitz suggested that the problem of where to allocate more bits is not straightforward.

6.2.3 Summary

Based on the study results presented, the meeting obtained the following agreement on the future algorithm study;

It is agreed that the Reference Model (RM) based algorithm is the base line leading candidate for the 64 kbit/s algorithm, and that the group should continue to refine the algorithm. Since we agree that we are now in the convergence period, using RM as a base, the group will consider other algorithms after this point only if they can be shown to be significantly superior to the RM version existing at that time.

As to the improvement of the Reference Model, the meeting requested Mr. Guichard to further review those results in § 5.1 and § 5.2 above and Doc. #352, #362 in a small group meeting and decide which elements be incorporated in the RM6 and which elements require further study. The outcome is in Annex 5.

Mr. Plompen undertook to submit a document on the RM6 specification (Doc. #396) by revising Doc. #375.

6.3 Video multiplex structure (#384, #385, #386, #387)

Revision of some parts of the videomultiplex specification were proposed. Generally the concept of these proposals were understood and supported, waiting for the detailed considerations by the next meeting.

The syntax diagram used for describing video multiplex structures in Doc. #386 is recommended as an easy-to-understand and clear way of presentation.

6.4 px64 kbit/s Flexible Hardware Specification (#373)

A first draft of the specification was proposed. The meeting recognized this as a useful input. Thorough considerations are requested of the members

toward the next meeting.

7. Scope of Recommendation and Future Work Plan
(#347, #348, #353, #373; TD4, TD9)

At the start of the meeting, Chairman raised questions to clarify the scope of Recommendations we should draft and the work schedule for coming years in TD4 (Annex 6).

Japan and US expressed their opinions to support "Plan 1" in TD4 with the following reasons;

- Recommendation on nx384 have been awaited.
- We should not drop what we gained and head for other objectives.
- Criticism that we are producing nothing.
- Current draft Recommendation H.261 does not allow manufacturers to make codecs because so many items are under study.
- Saying nx384 in Blue Book and px64 now makes confusion in the market.

Europe expressed its support to "Plan 2" in TD4 with the following reasons;

- Looking at the RM5 improvements, a single standard with px64 becomes possible at an early date.
- Two Recommendations in one year difference make confusion by allowing two CCITT codecs which are not compatible at the common bit rates.
- Not so much concern in nx384 in Europe, strong concern in 64.

After some discussion, the meeting reached the conclusion that we would produce a complete draft Recommendation on the px64 kbit/s (p=1-30) codec at the end of 1989, while in March 1989 we would obtain provisional Recommendation with as much detail as possible in time available. Mr. Carr undertook to draft the following time table with explanatory notes (see p.7).

This time table was agreed by the meeting (Note).

Note: Japan stated the need to confirm this plan at the next national committee.

8. Others

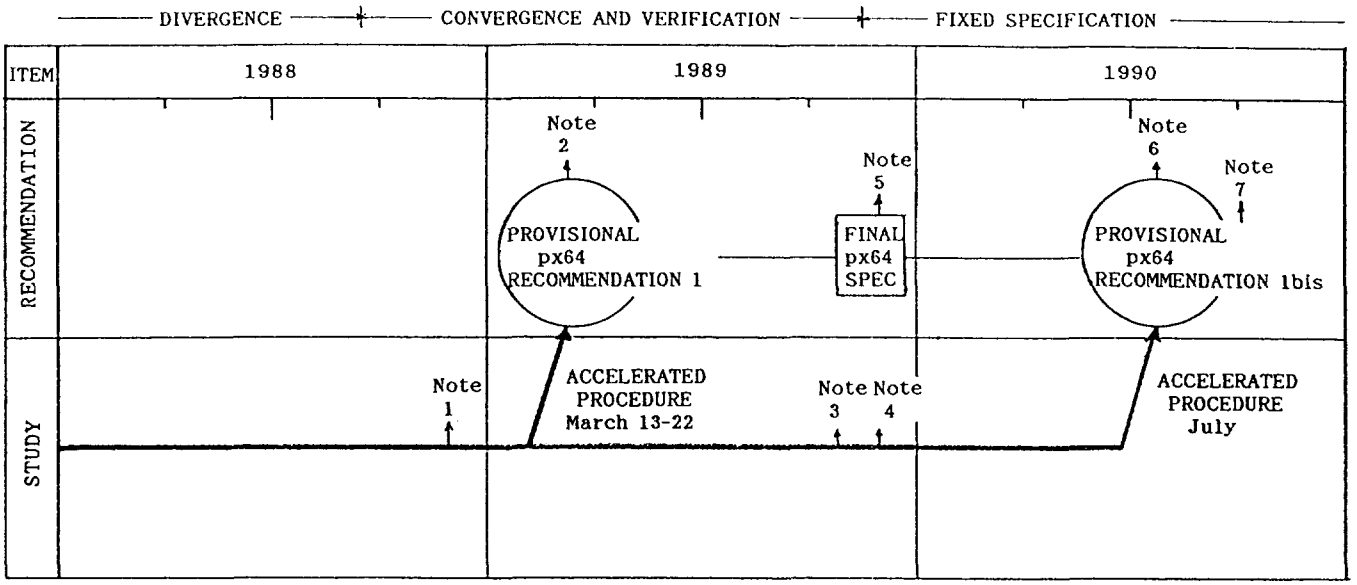
8.1 Tester (#391)

A design of the tester which outputs the test signals to confirm proper decoder operation was presented. If there are any suggestions, comments, etc., members are requested to get contact with Mr. Schaphorst.

8.2 Multiconferencing unit (#378)

Requirements were identified for the second generation codec MCU. The meeting recognized that the codec-to-codec signalling part is under its responsibility, but general system aspects should be dealt with in the Working Party. Chairman suggested the material be put forward to WPXV/1 as well.

Agreed Time Table for px64 kbit/s Codec Standardization



Note 1 Next Specialists Group meeting (14th meeting). Firm proposals for items to be included in Provisional Recommendation.

Note 2 Obtain Provisional Recommendation 1 by Accelerated Procedure with as much as possible in time available. Formal procedures need to be checked with CCITT Secretariat.

Note 3 Make proposals and agree all items for inclusion in a complete final px64 specification.

Note 4 Prepare final document for submission to CCITT Working Party meeting.

Note 5 px64 specification complete.

Note 6 Final specification becomes a Provisional Recommendation by Accelerated Procedure.

Note 7 Recommendation 1bis is a completed version of Recommendation 1 (ie all study items complete).

8.3 Patents

8.3.1 Patent information disclosing policy (#350)

AEG Olympia (FRG) informed the Group of its disclosure policy. It was recalled that new members joining the group are requested to follow the same policy and provide statements (see § 4.9/Doc. #346R).

8.3.2 Patent applications (#368, #371, #383, #388)

According to the agreements in the Hague (§4.9/#346R), the group was informed of the patent applications by the following organizations;

- NTT, KDD, NEC, FUJITSU (5 patents)
- British Telecom (4 patents)
- PKI (6 patents)
- Swedish Telecom (1 patent)

8.4 Future Meetings

- 14th meeting: Dec. 6(Tue)-9(Fri), 1988 in Florida, hosted by GPT.
- 15th meeting: Mar. 7(Tue)-10(Fri), 1989 in Oslo, hosted by Norwegian Telecom.
- 16th meeting: June 1989, Europe/Japan.
- 17th meeting: Sep-Oct 1989, Japan/Europe.

END

Annexes

Annex 1 Available documents (Reproduction of TD2)
Annex 2 List of tape demonstrations (Reproduction of TD3)
Annex 3 Report of the IDCT small group (Reproduction of TD6)
Annex 4 Report of the picture format small group (Reproduction of TD7)
Annex 5 Report of the algorithm study small group (Reproduction of TD10)
Annex 6 Scope of Recommendations and work plan (Reproduction of TD4)

LIST OF PARTICIPANTS
(Paris; September 19-22, 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
	R.A. Schaphorst	- DIS
France	G. Eude	- CNET
	J. Guichard	- CNET
Italy	M. Guglielmo	- CSELT (acting for L. Chariglione)
Japan	Y. Kato	- NTT
	M. Wada	- KDD
Korea	J-S. Lee	- ETRI
Norway	G. Bjoentegaard	- Norwegian Telecom
The Netherlands	R. Plompen	- DNL
United Kingdom	D. G. Morrison	- BTRL (acting for R. Nicol)
	N.L. Shilston	- GPT Video Systems
Sweden	H. Brusewitz	- Swedish Telecom Admin.

Assisting Experts

F. R. of Germany	W. Geuen	- SEL
	F. May	
USA	S. Ericsson	- PictureTel
	N.J. Fedele	- David Sarnoff Research Center
	D.N. Hein	- Video Telecom
	L.V. Rennick	- CLI
	T. Townsend	- CLI
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	J. David	- Alcatel CIT
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	J. Thiberville	- Alcatel CIT
Japan	T. Koga	- NEC
	K. Matsuda	- FUJITSU
	T. Murakami	- Mitsubishi Electric
	F. Sugiyama	- Toshiba
	M. Takizawa	- Hitachi
Korea	O-W. Kwon	- ETRI
United Kingdom	M.D. Carr	- BTRL
	T.S. Duffy	- GPT Video Systems
	G. Sexton	- BTRL

Observer

Finland	R. Helkio	- VISTACOM

DOCUMENTS FOR THE PARIS MEETING

Normal Documents

#346R REPORT OF THE TWELFTH MEETING IN THE HAGUE (CHAIRMAN)

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

#347 SUMMARY OF FINAL MEETINGS OF WP XV/1 AND SGXV (CHAIRMAN)

Major results on the topics of our direct concern are reported which were discussed under Questions 4/XV and 5/XV;

- Progress and future of the Specialists Group activities
- New Recommendations
- Revised existing Recommendations
- New Questions C/XV and D/XV

#348 PROPOSAL FOR ITEMS TO BE STUDIED UNDER THE NEW QUESTION ON 64 kbit/s VIDEOPHONE DURING THE NEXT STUDY PERIOD (FINLAND)

- A list of system parameters should be worked out.
- Only field proven coding methods should be taken into account for
- the final evaluation work.
- Only those proprietary coding methods declared to be available on "reasonable terms" should be taken into consideration.

#349 REPORT OF THE MEETING OF DCT CHIP MANUFACTURERS - MARTLESHAM UK 24-25 MAY 1988 (CHAIRMAN OF DCT CHIP MANUFACTURERS MEETING - Mike Carr)

The meeting strongly supported to define a test specification rather than a single structure. Some suggestions were made to improve the test procedure; inclusion of critical test patters, 64-bit floating point accuracy for the reference data, and use of reference data comprising several thousands blocks with known results.

#350 STATEMENT ON DISCLOSE OF PATENTS (AEG)

It is stated that AEG follows the policy "B" in Doc. #342.

#351 PERFORMANCE OF A NEW FAST ALGORITHM FOR 8*8 IDCT (TELECOM PARIS UNIVERSITY)

Simulation results for the IDCT mismatch are presented for a new fast DCT algorithm. Only mean square error (0.029) is outside the provisional specification (0.02). Lower and higher ranges of input to DCT are also experimented.

#352 BLUE JACKET (JAPAN)

Information on the test sequence "BLUE JACKET" is provided with some statistics.

#353 CONTRIBUTIONS ON mx64 kbit/s CODING ALGORITHM IN JAPAN (JAPAN)

An overview is given to the standardization activities in Japan by describing the organization, its current status and outlines for submitted documents.

#354 4/9 CIF (JAPAN)

Based on the RM5 simulation results for Full CIF, 4/9CIF and Quarter CIF, 4/9CIF is concluded to be included in Recommendation because it gives better SNR for critical scenes and better temporal resolution for simple sequences.

#355 IMPROVEMENT OF MOTION COMPENSATION IN RM5 (JAPAN)

Use of differential vector coding (coding of prediction error between an average of surrounding 4 vectors and the current vector) and use of one of 9 surrounding vectors as the initial step for 3-step vector detection are proposed. Information is also provided on a pel-based motion compensation without DCT as a potential means to improve coding efficiency at higher bit rates.

#356 LOOP FILTER IMPROVEMENT (JAPAN)

Improvements of RM5 with an adaptive loop filter placed before the frame memory are shown as 0.3 to 0.6 dB in SNR. Adaptivity is controlled by block attributes and the step size. Due to its potentiality, it is concluded that the characteristics should be further investigated and optimized.

#357 BLOCK ADDRESSING METHOD FOR MACRO BLOCK ATTRIBUTE (JAPAN)

It is proposed to encode the six coded/non-coded flags in a macro-block by categorizing them into 7 patterns to reduce the number of bits for macro block attribute and EOBs.

#358 IMPROVEMENT OF THE 1ST FRAME PICTURE QUALITY (JAPAN)

The following three techniques are applied to the first coded frame;
- DPCM for DC components of macro-blocks,
- Separate VLCs for AC components and addressing,
- Equalization of the step sizes throughout the 1st frame.

It is reported that these techniques improve performance of the first 10 coded frames but does not affect the subsequent frames.

#359 A COMPARISON BETWEEN VQ AND DCT IN RM5 BASED CODING SYSTEM (JAPAN)

VQ is implemented by replacing the DCT-IDCT part of RM5 and loop filters are optimized for each DCT and VQ schemes. Simulation results show that the performance is comparable for the present, relative merits being dependent upon test sequences. It is concluded that more study is required to clarify whether the quantization scheme itself or the block size is more influential.

#360 ENHANCEMENT TO THE ENCODING CHARACTERISTICS (JAPAN)

Information on a movement-adaptive DCT scheme is provided to show the possibility of RM5, concluding that further study is required on the current RM5.

#361 IMPROVEMENT OF PICTURE IN THE FACIAL REGION (JAPAN)

Experimental results are shown for a scheme to assign more bits for the detected rectangular facial region. Considering its possibility, it is proposed to take into account some means to send extra information to designate the position and size of the rectangle.

#362 SIMULATION OF A VECTOR QUANTIZATION AND SOME COMMENTS ON EVALUATION OF CODING SCHEMES (JAPAN)

Results of coding simulation on a VQ scheme are reported and some comments on the evaluation of coding schemes are given.

#363 STATISTICS OF CODED ELEMENTS IN FLEXIBLE HARDWARE (NTT, KDD, NEC, FUJITSU)

Measured statistics on Block Address, Block Type, Classification Index, Motion Vector Information, Transform Coefficients and EOB are provided. After evaluating the coding efficiency of the initial compatibility check parameters (Doc. #249), comments on how they are optimum are given.

#364 MISMATCH ERRORS OF MATRIX MULTIPLICATION IDCT (NTT)

Simulation results for the mismatch against reference IDCT as well as mismatch between non-ideal IDCTs are provided where IDCT input is generated according to the method described in Doc. #346R. Effects of rounding and quantization at the IDCT input are discussed using the measured error distributions.

#365 IDCT MISMATCH EXPERIMENT BY FLEXIBLE HARDWARE (NTT, KDD, NEC, FUJITSU)

Hardware experiments are carried out to perform when the mismatch error becomes perceptible after the intra start picture for a number of combinations of coder and decoder IDCT precision with fixed step size of 4. It is concluded that;

- The coefficient precision is less influential than the transfer precision.
- Rounding should be used for the transfer.
- The transfer precision should be more than 14 for 6 second refresh cycle.

#366 PRECISION OF INVERSE DCT CALCULATION (NTT, KDD, NEC, FUJITSU)

IDCT mismatch errors are analyzed based on a model and compared with the experimental results, concluding that random number simulation is appropriate for evaluating IDCT mismatch errors, loop filter is effective in reducing mismatch errors but should not be counted for safety, expanding the number of bits at the IDCT output and thereafter is effective for mismatch error reduction. Experimental procedures to reach the specification are also suggested.

#367 EXPERIMENT OF REFRESH INTERVAL MODIFICATION IN nx384 kbit/s CODEC (NTT, KDD, NEC, FUJITSU)

Cyclic refresh intervals are changed in the Flexible Hardware operating at 384 kbit/s to observe its effects on coding performance. It is concluded that the refresh interval should be greater than 90 coded frames.

#368 RELEVANT PATENTS (NTT, KDD, NEC, FUJITSU)

Five patent applications are informed.

#369 REFERENCE MODEL 5 SIMULATION (REPUBLIC OF KOREA - ETRI)

RM5 numerical data and macroblock/block patterns are presented for MISS AMERICA and CLAIRE.

#370 A NOTE ON THE DISTRIBUTION OF MOTION-COMPENSATED INTERFRAME ERRORS AND MOTION VECTORS (REPUBLIC OF KOREA - ETRI)

Motion compensated interframe prediction errors are reported to follow Laplacian distribution, dc component as well as ac components, based on simulation results for the MISS AMERICA sequence. Two-dimensional motion vector distribution is also provided.

#371 BT PATENT APPLICATIONS (BRITISH TELECOM)

Four relevant patent applications are informed.

#372 COMPARISON OF FULL CIF AND 4/9 CIF FORMAT CODED AT 64 KBIT/S USING REFERENCE MODEL 5 (UK, FRG, NORWAY, FRANCE, NETHERLANDS)

Numerical data and processed pictures of performance comparison between Full CIF and 4/9 CIF in RM5 are reported. A broadcast quality two dimensional filter as well as simplified 2D filter is used for down/up sampling. It is concluded that both the quantitative measurement of SNR and the subjective assessment of the sequences support Full CIF as being the better format.

#373 SPECIFICATION FOR p*64 kbit/s FLEXIBLE HARDWARE AND SOME PROPOSED ADDITIONS TO RECOMMENDATION H.261
(FRANCE, FRG, ITALY, NETHERLANDS, UK, NORWAY, SWEDEN)

A first draft of the flexible hardware specification for px64 kbit/s codec is proposed based upon Rec. H.261, nx384 kbit/s Flexible Hardware Specification (Doc. #249), RM5 (Doc. #339) and ongoing studies in Europe.

#374 IMPROVEMENTS ON THE RM5 ADAPTIVENESS OF THE 2D RUNLENGTH TABLE (FRANCE)

According to the quantizer index statistics measured in RM5 (p=1,5), five 2D VLCs are generated for adaptive encoding; four for different step sizes of luminance, one for chrominance. It is concluded that by adaptively applying these tables the best improvements are gained for SWING (0.5 dB, Y) and SALESMAN (0.4 dB, Y) at p=1.

#375 DESCRIPTION OF REF. MODEL 5 - RM5
(NETHERLANDS, FRANCE, FRG, ITALY, SWEDEN, BTRL)

An update of Doc. #339.

#376 IMPROVEMENT REFERENCE MODEL 5 BY A NOISE REDUCTION FILTER
(NETHERLANDS)

An adaptive noise reduction filter consisting of two concatenated 1D subfilters is placed before the frame memory as a loop filter as well as outside the loop as a post processing filter. This filter is controlled adaptively by the quantizer step size and the motion vector. Simulation results show that both arrangements give a significant improvement of the subjective quality and that the loop filter performs better than the post processing filter.

#377 THOMSON DCT CHIP MISMATCH (CNET-FRANCE)

Mismatch errors of an existing chip are reported according to the test procedure in Doc. #346R. Accumulation of mismatch errors in RM5 are also presented.

#378 PROPOSAL OF A DRAFT MULTI-CONFERENCE UNIT - MCU - SPECIFICATION
(FRG, ITALY, NETHERLANDS, UK, FRANCE)

General requirements for a switched operating mode Multiconference Unit are given taking into account wider range of bit rates in the new generation codec and two different service possibilities; videophone using desk top terminals and videoconferencing using larger terminals in dedicated rooms.

#379 RESULTS OF TRIALS ON ERROR TRANSMISSION AT 384 kbit/s (FRANCE)

Transmission errors were added to the video part of the Flexible Hardware codec operated at 384 kbit/s. Decoded pictures are presented for a number of cases; a single error every 0.025-1 sec, 8/64 consecutive errors every 1 sec, 8-4096 consecutive errors every 10 sec. It is concluded that the codec scheme has some error resilience.

#380 RESULTS RELATED TO THE TRANSFORMER SPECIFICATION (CSELT)

Observations are made according to the analysis of IDCT mismatch errors;
- Using a specified arithmetic and matrix multiplication, it is possible to make DCT-IDCT transformation errorless.
- If DCT output is quantized, mismatch can not be avoided.

Considerations on fast algorithm are also given.

#381 CODING WITH DIRECTIONAL TRANSFORMS AS ALTERNATIVE TO DCT IN RM5
(NORWAY)

Directional transform is described where one of several transforms is selected according to the orientation of the block. By using this DT instead of DCT in RM5, 20% saving of bits is obtained. In conclusion it is proposed to include this type of transform as a supplement of RM5.

#382 TAPE DEMONSTRATIONS FOR mx64 kbit/s CODING (NORWAY)

A list of tape demonstrations.

#383 PATENT APPLICATIONS BY PKI ON LOW BIT RATE VIDEO ENCODING (PKI-FRG)

Six relevant patent applications are informed.

#384 QUANTIZER ALLOCATION BY TYPE3 (FRG)

A quantizer designation method is proposed to allow modification on a macroblock basis with fast error recovery and bit savings considered;

- A starting value is designated in the GOB header, QUANT1 but without the current first bit.
- TYPE3 codes are specified to designate a new quantizer which overrides the QUANT1 designation.
- The quantizer designated by TYPE3 is valid until the next renewal by TYPE3 or QUANT1.

#385 AN IDENTICAL SIZED GOB FOR FULL CIF AND QUARTER CIF (FRG)

A GOB structure is proposed taking into account intercommunication between Full CIF and Quarter CIF, required number of bits, fast error recovery and mixing of four coded Quarter CIF pictures into one Full CIF picture. A GOB consists of 3 lines of 11 macroblocks, resulting in 12 GOBs for Full CIF and 3 GOBs for Quarter CIF.

#386 A STRUCTURED VIDEO MULTIPLEX SCHEME (FRG)

Elaboration of the block type definition is proposed;

- TYPE1 (picture level) is not used for the block type definition.
- TYPE2 (GOB level) is the highest layer to define attributes applied to all macroblocks in the GOB.
- TYPE3 (macroblock level) denotes all parts transmitted for the macroblock.
- TYPE4 (block level) denotes particularities of a single block with a macroblock enabling optimization at higher bitrates.

Syntax diagrams are given for clarification.

#387 A STUFFING CODEWORD FOR SEVERAL PURPOSES (FRG)

To prevent the buffer underflow, use of either a picture start code with a non-valid group number or a GOB start code with a non-valid group number is proposed.

#388 INFORMATION ON PATENTS FROM STA (SWEDEN)

Application of a relevant patent is informed.

#389 IMPROVEMENTS OF RM5 (FRG)

Four techniques are proposed to improve RM5, particularly for such difficult sequences as TREVOR, SALESMAN, SWING;

- Two-dimensional prediction of VLC for the displacement vectors.
- Inter/intra switch per macroblock.
- Prevention of buffer overflow.
- Simplified and effective coding of the first picture.

#390 CODING OF REPETITIVE MOTION WITH REFERENCE MEMORIES (FINLAND)

Use of reference memory(s) is demonstrated to improve the performance of conditional replenishment codecs for uncovered backgrounds. Three strategies of updating the reference memory are also described.

#391 CONFORMANCE CHECKER (DELTA INFORMATION SYSTEMS)

A plan of making conformance checker for the forthcoming Recommendation is presented. An interface card and software package will be designed so that PC is used. It has the potential to accept encoded pictures as input by means of floppy disk.

#392 RM5 IMPROVEMENTS: VARIABLE THRESHOLDING TECHNIQUE (FRANCE)

A great improvement has been obtained in the SWING and SALESMAN sequences by making the threshold variable according to the length of zero strings. This technique speeds up the convergence of the coding scheme in stationary parts, thus allowing more bits in the moving parts.

#393 COMPUTER EVALUATION OF REFERENCE MODEL 5 (BELLCORE)

Statistical data and processed pictures are provided.

#394 ERROR CORRECTION FOR THE H261 CODEC (UK, NETHERLANDS, FRANCE)

Progress report of the European study on the error correction. Hardware experimental results are reported with tape demonstration on the (255,239)BCH and (511,493)BCH codes in random error environments.

Temporary Documents

No. 1 Agenda (Chairman)
No. 2 Available documents (Chairman)
No. 3 List of tape demonstrations (Chairman)
No. 4 Scope of Recommendations and work plan (Chairman)
No. 5 Transform part specification (Chairman)
No. 6 IDCT specification (Small group on IDCT specification)
No. 7 Evaluation of CIF and 4/9CIF tape demonstrations (Small group on picture format)
No. 8 Summary of the 4/9CIF discussion (Chairman)
No. 9 Proposed time table (Small group on future work plan)
No.10 RM6 (Small group on algorithm study)

END

LIST OF TAPE DEMONSTRATIONS (September 19-20, 1988)

Topics	Source	Doc.
Sep. 19		
a. Field trial with flexible Hardware	FRG/NL	-
b. Refresh interval by Flexible Hardware	Japan	#367
c. IDCT mismatch discussion	Japan	#365
d. Mismatch	France	#377
e. Transmission error at 384 kbit/s	France	#379
f. Error correction	UK	#394
Sep. 20		
g. RM5 improvements	France	#392
h. 4/9 CIF vs Full CIF	France	#372
i. 4/9 CIF vs Full CIF	UK	#372
j. 4/9 CIF	Japan	#354
k. Loop filter improvements	Japan	#356
l. VQ vs DCT	Japan	#359
m. Pel based motion compensation	Japan	#355
n. Improvement of picture in facial region	Japan	#361
o. Scene change (64 kbit/s)	Japan	#358
p. VQ	Japan	#362
q. Adaptiveness of the 2D-VLC	France	#374
r. Comparison of CIF and 4/9 CIF	FRG	#372
s. RM5	NL	#375
t. Loop filter	NL	#376
u. RM5 + Directional Transform	Norway	#381 #382
v. 4/9 CIF	Norway	#372 #382
w. Improvements of RM5	FRG	#389
x. Reference method	Finland	#390
y. RM5 simulation results	USA	#393

To : Respondents to CCITT Request for IDCT

Dear Sirs and Mesdames,

Thank you for your responses so far to the CCITT request for IDCT chip information. Based on further computer simulations and hardware studies, we think we are very close to a performance specification for ISDN video codecs (see attached, changes from the March version are indicated by a vertical line in the left margin). Could you examine the proposed method and let us know your thoughts?

Please send responses to:

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AT&T Bell Labs - Room 4C538
Holmdel, NJ 07733 USA
Phone: +1 201 949 5459
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with a copy to

Mr. Sakae Okubo
Visual Media Laboratory
NTT Human Interface Labs
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Proposed Specification for Inverse DCT Chips

1. Generate random integer pixel data values in the range -L to +H according to the attached random number generator (C or FORTRAN). Arrange into 8x8 blocks. Data sets of 10,000 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 Transform (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.

END

Annex 4 to Doc. #395R - Report of the picture format small group

EVALUATION OF CIF AND 4/9 CIF TAPE PRESENTATIONS

1. It was agreed that the full CIF presentations were generally superior to the 4/9 CIF presentations for the European contributions.

2. Representatives of the Japanese and American delegations pointed out the following difficulties with the comparison of 4/9 CIF vs Full CIF presentations;

   - The potential advantage of the exchange between temporal and spatial resolution could not be evaluated since all European demonstrations were provided at 10 frames/sec.

   - It is difficult to correlate the results of the Japanese demonstration with the European presentations due to the variable picture size.

   - There is a potential for coding the 4/9 CIF pictures more effectively to reduce the effects of artifacts.

   - The simulations using NTSC sources (Miss America, Salesman) actually used materials that had already been converted to CIF, and were then converted to 4/9 CIF. In a real-life situation, the CIF format would require two NTSC fields per frame, while the 4/9 CIF would require only one NTSC field. The relative motion between two NTSC fields would cause an additional coding loss that was not taken into account in the CIF simulations using NTSC sources.

END

Reference Model 6

Reference document: #375 description of RM5

Two kinds of changes have been discussed: modifications which are accepted and action points related to topics which have to be clarified before been accepted as core elements.

There are four modifications and nine action points.

I. Modifications

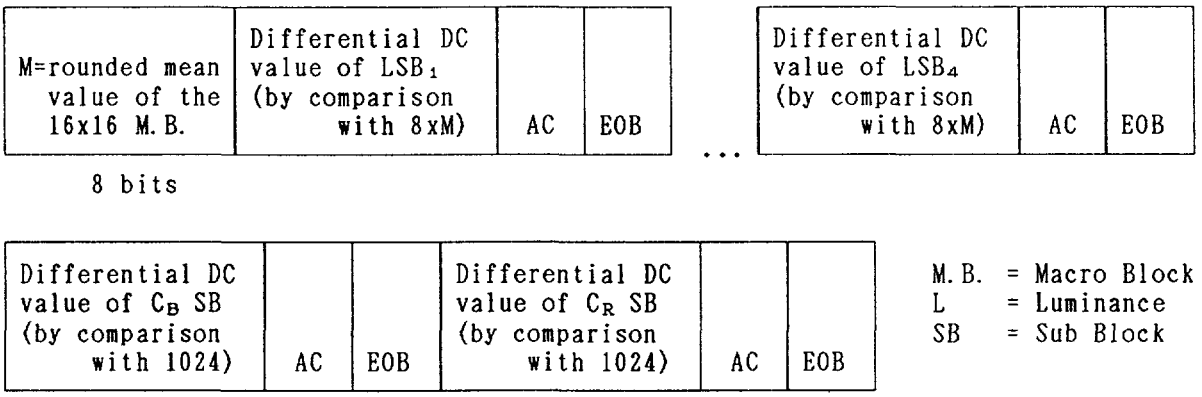
1) Variable thresholding technique as depicted in Doc. #392. (Only modification 1 of #392 is concerned. The quantization levels as well as the reconstructed levels are independent of the threshold.)

Example for g=32

Coefficients	50	0	0	0	33	34	0	40	33	34	10	32	...
Threshold	32	32	33	34	35	36	37	38	32	32	32	33	...
New Coef.	50	0	0	0	0	0	0	40	33	34	0	0	...
Quantized value	48	0	0	0	0	0	0	48	48	48	0	0	...

where "New Coef." is new coefficients after thresholding and before quantization.

2) Intra mode (derived from Doc. #389) as defined in Appendix 1 of this Annex 5. After the block has been decided intra, the coefficients are transmitted as follows;



The same quantizer and the same 2D-VLC as for inter mode are used. The modified VLC for the block attributes is;

Macro block type	Code with relative addressing
1. No MC, not coded	-
2. MC coded	1
3. MC not coded	0 1
4. MO MC coded	0 0 1
5. intra	0 0 0

3) Motion vector coding as depicted in Doc. #355 and #389. Differential technique is employed based on a 1-d prediction: the prediction is the motion vector of the previous macro block. In cage of the first macro block in GOB, previous vector is zero. The differential motion vectors are encoded by using the VLC table of Appendix 2 of this Annex.

4) The so-called method 4 described in Doc. #357 is adopted. The pattern and the VLC are depicted in Appendix 3 of this Annex.

II. **Action points**

1) Filtering in the loop (Doc. #356 and #376). The following topics have to be checked:

   - the number of filters in the loop
   - the position of the filter(s); before, after or both sides of the frame memory
   - the adaptivity of the filter(s) and how to control it
   - the effectiveness of the filter(s) in the loop v.s. outside the loop

2) DC intra prediction: coding of the prediction error (related to modification No. 2)

3) Motion estimation technique: use of surrounding motion vectors for the search technique; size and shape of the search area

4) Variable threshold: adaptation rules (related to mod. 1)

5) Directional Transform (DT): information will be provided as soon as possible by Norway.

6) Impact of the modifications at 384kbit/s

7) Number of scanning classes

8) Impact of the GOB configuration as described in Doc. #385 and #373

9) VLC optimization

END

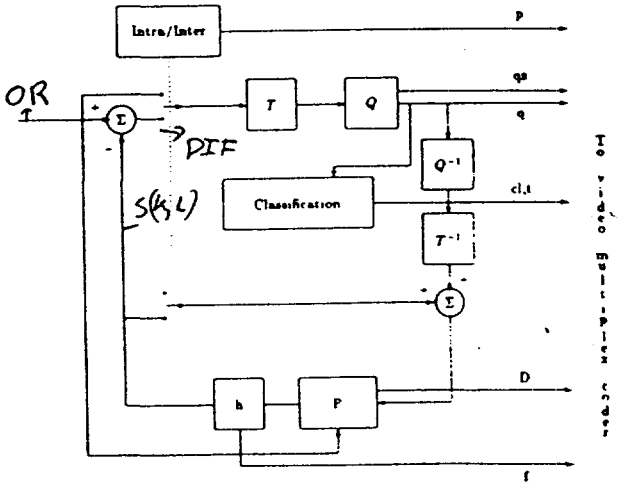
Appendix 1 to ANNEX 5/Doc. #395R

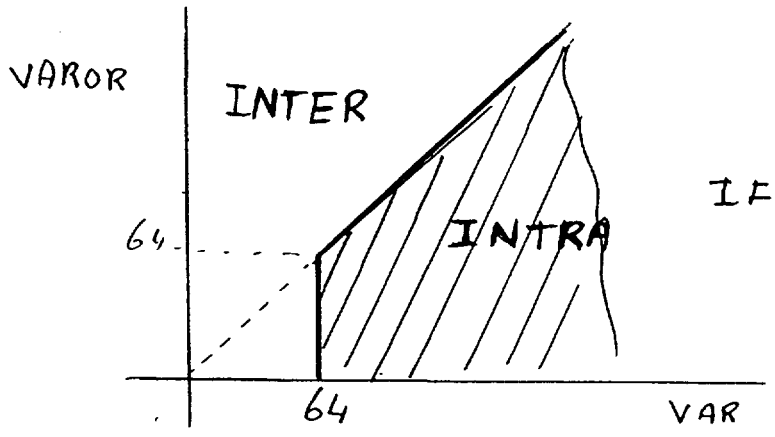
Intra switch per macro block

```
DO K=1,16
  DO L=1,16
    OR=O(K,L)
    DIF=OR - S(K,L)
    VAR=VAR + DIF*DIF
    VAROR=VAROR + OR*OR
    MWOR=MWOR + OR
  ENDDO
ENDDO

VAR=VAR/256
VAROR=VAR/256 - (MWOR/256)*(MWOR/256)
```

where OR=O(K,L)=original macro block pixels
S(K,L)=motion compensated macro block



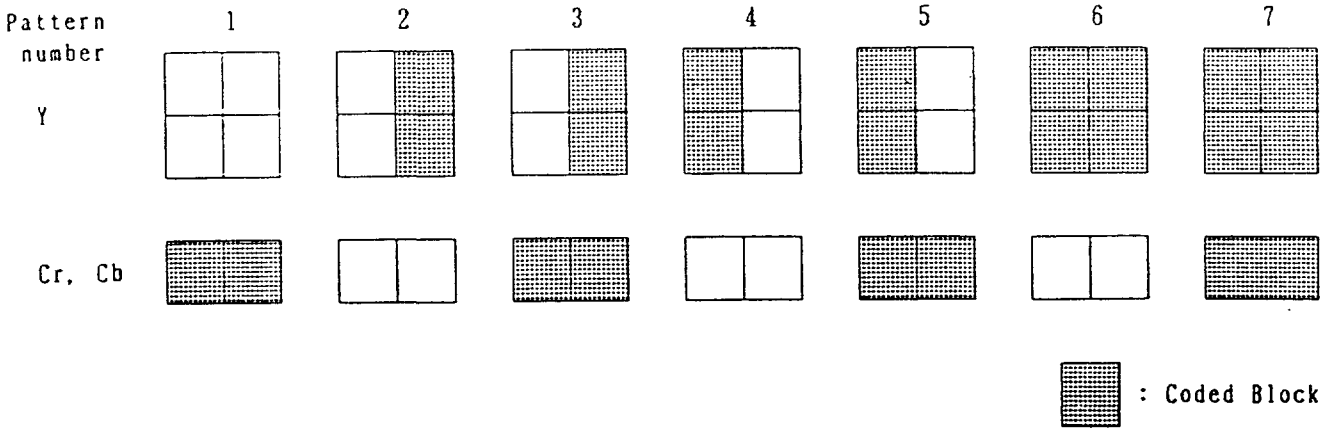


IF(VAROR.LT.VAR.AND.VAR.GT.64)

Appendix 2 to Annex 5/Doc. #395R - VLC Table

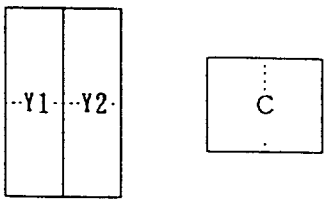
C	AMPLITUDE		CODE WORD	CW-LENGTH	
C			111111111111111	not allowed	
C	-64		111111111111110	14	
C	-63		111111111111101		
	.		.		
	.		.		
C	-44		11111111101010		
C	-43		11111111101001		
C	-42		11111111101000	23* 14	
C	-41		1111111110011	13	
C	-40		1111111110010		
C	-39		1111111110001		
C	-38		1111111110000		
C	-37		1111111101111		
C	-36		1111111101110		
C	-35		1111111101101		
C	-34		1111111101100		
C	-33		1111111101011		
C	-32		1111111101010		
C	-31		1111111101001		
C	-30		1111111101000	12* 13	
C	-29		111111110011	12	
C	-28		111111110010		
C	-27		111111110001		
C	-26		111111110000		
C	-25		111111101111		
C	-24		111111101110		
C	-23		111111101101		
C	-22		111111101100		
C	-21		111111101011		
C	-20		111111101010		
C	-19		111111101001		
C	-18		111111101000	12* 12	
C	-17		11111110011	11	
C	-16		11111110010		
C	-15		11111110001		
C	-14		11111110000		
C	-13		11111101111		
C	-12		11111101110	6* 11	
C	-11	1014	1111110110	10	
C	-10	1013	1111110101	10	
C	-9	1012	1111110100	10	
C	-8	505	111111001	9	
C	-7	504	111111000	9	
C	-6	251	11111011	8	
C	-5	250	11111010	8	
C	-4	124	1111100	7	
C	-3	30	11110	5	
C	-2	14	1110	4	
C	-1	6	110	3	
C	0	0	0	1	
C	1	4	100	3	
C	2	10	1010	4	
C	3	22	10110	5	
C	4	92	1011100	7	
C	5	186	10111010	8	
C	6	--	10111011	8	etc
C	7	--	will be	9	
C	8	--	proceed	9	
C	9	--	101111010	10	

Method 4 (7 patterns, vertical split in luminance)



Method 4 (Pattern 1~7)

Pattern number = Y1× 4 + Y2× 2 + C



Pattern number	Code Length	Code
6	2	00
2	2	10
4	2	11
7	3	011
1	4	0100
3	5	01010
5	5	01011

Note: If a macro block type is "intra", its pattern information is <u>not</u> transmitted.

Temporary Document No. 4 (Paris)
September 19, 1988

SOURCE: CHAIRMAN
TITLE : SCOPE OF RECOMMENDATIONS AND WORK PALN

Questions

1. Scope of Recommendations

H.261 for nx384 (n=1-5) or H.261 for px64 (p=1-30) ?
H.262 for mx64 (m=1,2)

2. Action plans

We have only two opportunities for applying the accelerated procedure during the next study period;

- March 13-22, 1989
- Summer-autumn 1990

We must submit white contributions at least two months in advance of these Study Group meetings. nx384 can be put into the next March SGXV meeting if parameter values are filled in. As for the 64 Recommendation, next March is impossible,thus the summer-autumn 1990 becomes the target.

Taking this environment into account, what should be our action plans?

- Reference Model
- Hardware verification

Time Table