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

Document #74R
January 24, 1986

SOURCE: CHAIRMAN OF THE SPECIALISTS GROUP ON CODING FOR VISUAL TELEPHONY

TITLE : REPORT OF THE FOURTH MEETING IN IPSWICH (JANUARY 21-24, 1986)

CONTENTS

1. General

The Specialists Group met in Ipswich from January 21 to 24, 1986, at the kind invitation of BTRL, United Kingdom. Welcoming address was delivered on behalf of the hosting organization by Mr. Kenyon.

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

At the final session, Chairman thanked the inviting organization for the meeting facilities provided and the excellent organization.

2. Documents for the Meeting

The following documents have been considered during the Ipswich meeting.

2.1 Normal document

#54R: ~~REPORT OF THE THIRD MEETING IN TORINO (CHAIRMAN)~~
Points agreed and/or under study are recorded for all the aspects in order to provide backgrounds for the discussion in this meeting.

#55: STANDARD CONVERSION TO AND FROM SINGLE MODE 288, 29.97 FORMAT (BT, NTT)
Describes details of the conversion algorithm for both 625/50 and 525/60 systems. Parameter optimization is for further study.

#56: GRAPHICS FOR n x 384 kbit/s CODEC (BT)
It is proposed that the moving picture algorithm should inherently permit the full spatial resolution of the common intermediate format to be realized when the incoming video

comprises pictures having little movement. It is also proposed that an optional full definition mode should be transmitted at 64 kbit/s in parallel with moving picture information.

#57: CHROMINANCE SAMPLING PARAMETERS FOR n x 384 kbit/s VIDEO CODEC (F.R.G., NETHERLANDS, U.K.)
Chrominance resolution of 180 samples per line and 144 lines per frame is proposed for each of R-Y and B-Y signals to keep sufficient chrominance resolution even for documents transmission. It is also proposed that the phasing of the colour difference samples be such as to give alignment of chrominance block edges with luminance ones.

#58: SYNCHRONIZATION ASPECTS IN THE FRAMING STRUCTURE (FRANCE)
A detailed procedure for frame synchronization and configuration description is given based on the proposal presented at the last meeting (Document #34). Also a first trial in describing side information necessary for a teleconference service is made as a working basis.

#59: OPINION CONCERNING GRAPHICS FACILITY (NTT, KDD, NEC, FUJITSU)
An opinion is expressed that the graphics facility should be optional. The idea of defining graphics parameters as a simple super-set of the common intermediate format is supported.

#60: GENERIC STRUCTURE OF 384 x n kbit/s CODEC (NTT, KDD, NEC, FUJITSU)
A generic codec structure consisting of a coarse component coder and a fine component coder is presented to further process the motion-compensated interframe prediction errors. The coarse component coder operates on a block basis with DCT or VQ. The fine component coder processes the residual portion of the C-coder output. Common parameters for coding algorithm simulation work are also presented.

#61: DCT-BASED CODING ALGORITHM (NTT, KDD, NEC, FUJITSU)
The C-coder transforms and quantizes significant 8 lines x 8 pels block interframe prediction errors with adaptive quantization, while the F-coder scalar-quantizes those components for which DCT does not work well. A specific example is demonstrated with simulation results.

#62: VQ-BASED CODING ALGORITHM (NTT, KDD, NEC, FUJITSU)
The C-coder vector-quantizes significant blocks of 4 lines x 4 pels blocksize with adaptive spatial subsampling technique, while the F-coder scalar-quantizes the residual components of the C-coder output. A specific example is demonstrated with simulation results.

#63: CODING FULL MOTION COLOR VIDEO AT 300-400 kilobits/second, SOME COMPUTER SIMULATION RESULTS (AT&T BELL LAB.)
The 'Miss America' test image is processed with block quantization of frame differences between the alternate fields in an 8 x 8 pels blocksize. The omitted fields are coded with

conditional field subsampling in which omitted fields are predicted using the adjacent fields and large errors are transmitted.

#64: A PROCEDURE FOR EVALUATING ALTERNATIVE VIDEO CODING TECHNIQUES (U.S.A.)
A methodology to rank the codecs tested in order of performance capability for teleconferencing applications is described. The evaluation of each codec is on a subjective, comparative basis.

#65: OBJECTIVE MEASURES OF QUALITY IN HIGHLY COMPRESSED IMAGES (BT)
Related work is reviewed and a tentative suggestion for an improved method is presented.

#66: MOTION COMPENSATING FIELD INTERPOLATION (F.R.G.)
The current state of study is summarized. The interpolation algorithm is composed of displacement estimator, change detector and motion compensating interpolation filter.

#67: ON BLOCKSIZE AND OVERHEAD FOR DISPLACEMENT VECTORS IN BLOCK MATCHING AND OBJECT MATCHING VIDEOTELEPHONE CODECS (F.R.G.)
A comparison between block matching and object matching techniques is made in terms of movement compensation gain, overhead bit amount and introduced artefacts. A common blocksize of 16 x 16 is proposed for both block matching and block quantizing. It is also proposed that the possibility of decoding signals with movement compensation by object matching should be included in a future standard.

#68: PROPERTIES OF DCT BASED HYBRID CODER (SWEDEN)
Some desirable properties of coding algorithm to be standardized are mentioned. Use of 16 x 16 blocksize is proposed to allow for compatibility with 64 kbit/s codecs. Comments on other aspects such as different spatial resolutions, variable frame rate, adaptive coding algorithm and chrominance coding are also given.

#69: A CONTRIBUTION TO VIDEO MULTIPLEX CODING (FRANCE, ITALY)
Coding control commands are defined using the attribute method. Some examples are given according to their rate of transmission: ~~frame rate, line of block rate, block rate.~~

#70: VQ BASED CODER (FRANCE, NETHERLANDS, BT, ITALY, BELGIUM)
The structure of a VQ-based codec is described. An intra-frame coder with conditional replenishment strategy is used with an interframe mode having either VQ or another quantization procedure.

#71: VQ CODING SIMULATION (FRANCE)
Blocks of 6x6 blocksize are vector quantized into 11 bits. The training set is divided into 4 classes; uniform ones, vertical oriented blocks, horizontal oriented blocks, and others, for each of which codebook is computed excluding the uniform class. Conditional replenishment and scene change mode are provided.

#72: EXAMPLES OF SIMULATION WITH HYBRID CODING SCHEME -DCT- (FRANCE)
Prediction errors of the adaptive predictor consisting of intra-frame, interframe with no motion compensation or interframe with motion compensation are quantized with energy adapted and zonal non linear quantization and energy adapted scanning. Simulation results are presented.

#73: RESULTS OF REFERENCE SIMULATION (CHAIRMAN)
Results and participated organizations are reported on the reference simulation for a simple interframe encoding scheme.

2.2 Temporary document

No. 1 Agenda (Chairman)
No. 2 Agreements on Basic Parameters and Graphics Facility (Chairman)
No. 3 Report of the Fourth Meeting in Ipswich (Chairman)

3. Basic Parameters (#55, 57)

As for the remaining items in the basic parameters, the following points were agreed upon.

(1) Color difference signal parameters

1)	Active pels per line	180
2)	Active lines per picture	144
3)	Pictures per second	29.97
4)	Interlace	1:1
5)	Signal levels	as defined in CCIR Rec. 601

(2) Sampling structure

1) Orthogonal sampling structure is adopted for both luminance and color difference signals in the common intermediate format.

2) Positioning of chrominance samples is defined so as to share the same block boundaries with luminance samples (see Fig. 2/#57).

Also, the following points were confirmed.

(1) Meaning of the common intermediate format

1) The common intermediate format defines the maximum attainable spatial and temporal resolution in the codec. Effective resolution may eventually be reduced by some coding operating modes.

2) The common intermediate format is a logical specification to ensure compatibility among codecs. Hence, it might not appear at the physical interface points in the codec.

(2) TDM format

TDM format is left open for hardware implementation. Compatibility among different design codecs is ensured through the specifications to the video multiplex.

4. Graphics Facility (#56, 59)

After some discussion on the proposals presented with the documents, we reached the following agreements.

1) Graphic mode parameters are not defined independently of moving picture mode parameters in the 384 x n kbit/s codec.

2) The coding algorithm should, for all bit rates, inherently permit the full spatial resolution (luminance and chrominance) of the common intermediate format to be realized when the incoming video comprises pictures having little movement.

3) In the future, higher resolution graphics facility may be defined to utilize a part (e.g. 64 kbit/s) or the whole of the video signal time slot.

5. Coding Algorithm

Reference was made to the Documents #54R, 60, 61, 62, 63, 66, 67, 68, 70, 71 and 72. After presentation of the documents, extensive questions and answers were carried out for clarification. Various demonstrations of source coding simulation results were also given. An overview of these demonstrations is listed here.

- DCT based coding (Japan)
- VQ based coding (Japan)
- Interframe prediction with interpolation and block quantization (U.S.A.)
- Motion compensated field interpolation, blocksize of the DCT and the motion analysis, comparison between block matching and object matching (F.R.G.)
- DCT based coding (France)
- VQ based coding (France)

A number of topics, related to the source coding, have been discussed. The outcome of this discussion is summarized here.

5.1 Compatibility with the 64 x m kbit/s codec (#67, 68)

Since the possible need for compatibility between services such as videophone, audiographic conferencing using 64 x m kbit/s codecs and video conferencing using 384 x n kbit/s codecs is foreseen in the future, this matter has been discussed first. Various opinions were expressed.

The meeting agreed that compatibility between these services mentioned is desirable. For the moment it has been agreed to concentrate on 384 x n kbit/s codecs bearing in mind the desirable compatibility with

64 x m kbit/s codecs. It is requested that each coding algorithm proposal will contain some comments on this point.

5.2 Candidate algorithms (#60, 61, 62, 63, 68, 70, 71, 72)

At the Torino meeting (24-27 Sep. 1985) the Specialists Group agreed to focus further study on Category 1 with the generic structure shown in Fig. 1/Document #43. It was furthermore decided that coding schemes of Category 2 should not be presented after the Ipswich meeting. As there were no proposals on Category 2 coding algorithms, the Specialists Group concentrates future study on Category 1 coding algorithms: 'interframe prediction + further processing'.

Since there were no proposals for coding algorithms based on 'prediction/interpolation', the Specialists Group will evaluate and compose Transform, VQ or a combination of these approaches in the future. The meeting agreed to make the decision on the coding algorithm and the generic structure at the next meeting.

It is expected that the performance of the remaining candidate algorithms still can be improved toward the next meeting.

5.3 Blocksize (#61, 62, 67, 68, 71, 72)

(1) Transform-based

Simulation studies have been carried out using 8x8 and 16x16 for the blocksize. Since there is not sufficient evidence to decide which blocksize is more appropriate for the 384 x n kbit/s codec, the meeting was asked to study this topic further taking account of performance as well as hardware considerations and the amount of overhead. Contributions are requested for the next meeting.

(2) VQ-based

Several blocksizes are used in simulation work. The choice of the blocksize needs more considerations and is still open.

5.4 Motion compensation (#67)

It has been agreed that the motion compensation part of the coder has to be treated as an option for manufacturing, though that part of the decoder is mandatory. There is, however, a general feeling that motion compensation will be a necessity at 384 kbit/s. This is not clear for the values n > 1.

As for the blocksize for motion compensation, the meeting expressed a general view that it should be the same as the blocksize for coding in the Transform-based scheme.

Furthermore, the way of transmitting the motion vectors should be studied further. F.R.G. undertook to produce a contribution on this topic.

It was agreed that no more than one motion vector would be transmitted for each block.

5.5 DCT transform

It has been agreed to use the classical DCT for further simulation studies whereas further considerations of more easily implementable transform are required as soon as hardware has to be defined.

5.6 Test material (#60)

It has been agreed to add graphical test sequences in order to evaluate the performance of a coding scheme for a variety of input pictures.

BTRL undertook to produce a digital tape containing two different graphic images in the common intermediate format. The evaluation should be carried out by the subsequent coding of 30 frames of each graphical data, which are produced by simply repeating the given single frame graphics. When processed pictures are displayed, the last graphic frame should be repeated as appropriate.

BTRL will send a copy to Japan and F.R.G. Japan will send a copy to U.S.A., while F.R.G. will distribute copies within Europe.

5.7 Chrominance signal (#60)

Two methods of processing chrominance signals are used in simulation studies. One is to treat them identically with the luminance signal in the coder. The other is to treat them with separate coders other than luminance coders. Though pre-emphasis and de-emphasis is suggested by Document #60 for the first approach, the requirement to encode highly saturated color bar test signal has been pointed out.

Further study is needed.

5.8 Motion compensated field interpolation (#60, 63, 66, 67)

As simple field repetition might introduce impairments such as jerkiness and blurring, the use of motion compensated field interpolation deserves consideration.

A first approach has been demonstrated during the meeting. Further study is required bearing in mind the hardware implications, the type of motion vectors to be used and required amount of information in case of transmitting interpolation errors.

5.9 Transmission errors

It was pointed out that the codec should be designed in such a way to keep error resilience, because error correction and/or demand refresh proposed by Document #45 are not enough if broadcasting mode or multipoint communication is considered.

CCITT Rec. G.821 should be taken into account when coding schemes are being proposed. France undertook to contribute information on the CCITT Rec. G.821 in order to explain the impact of it on the videoconference service, at the next meeting.

5.10 Working plan for coding algorithm study

The meeting discussed the available resources and the interest to work on the remaining candidate coding schemes. Japan will contribute at the next meeting on DCT-based and VQ-based configurations. BTRL is able to contribute on VQ, this will be first discussed however in the COST 211-bis group. It is furthermore likely that Europe will present work on DCT based configuration.

(1) DCT-based algorithm

Since all presented DCT-based configurations have different adaptive quantization strategies, a small group (France, F.R.G., Japan, Sweden) discussed on a framework to deal with this topic toward the next meeting (Annex).

In the Japanese configuration of DCT-based codec, there is a C-coder as well as an F-coder. The advantage of the F-coder depends on the used test sequence and of course on the implemented algorithm. It has been agreed that the F-coder needs further considerations. Japan undertook to provide more information bearing in mind the hardware implications and the trade-off between hardware and performance. Other countries are also requested to examine the effects of the F-coder.

(2) VQ-based algorithm

The framework for future investigations has to be established. Europe will contact Chairman whether they will contribute on this work.

6. Evaluation Methods (#64, 65)

Two documents were presented to introduce the methods of coded moving picture evaluation. Studies on objective measurements of coding ~~distortions, including various spatial and temporal resolution~~ reduction impairments and noises are encouraged by the Specialists Group.

7. Frame Structure (#58, 69)

Mr. Temime reported the results of the System Aspects meeting of the SGXVIII Rapporteur's Group on Wideband Speech Coding, which dealt with frame structure applied for mode switching of wideband speech coding.

After some discussion, the Specialists Group supported the basic frame structure for 384 x n kbit/s videoconferencing codec proposed by Document #58, which consists of one timeslot of audio and Service Channel and five or more timeslots of moving video, one of them capable of being dynamically allocated to data.

It was confirmed that the Specialists Group is responsible to define 'Transfer Rate' attribute in Fig. 4/Document #58 and also some bits in the Application Channel related to videoconferencing codec-to-codec control.

The meeting took note of the following comments to the proposed frame structure.

- For 64 x m kbit/s videophone, bitrate for video coding is crucial. Hence, 32 kbit/s audio coding may be used. In that case, remaining bitrate should better be used for video signals.

- If we define values of 'Transfer Rate' attribute and do not provide all of the operational modes corresponding to the values, then we need some codec facility indication to guarantee the compatibility among different design codecs. This is undesirable as it will cause problems in multipoint and broadcasting working.

In addition to that, the meeting confirmed that in videoconferencing codecs, 'Type 2' audio facility should be used.

Document #69 proposed to apply the attribute method to the video multiplex coding. The meeting accepted the concept leaving the precise definition of attributes, assignment of specific values and variable length coding of those values for further study.

8. Transmission Aspects

Time Slot Integrity and one's density restriction problems were discussed. The Specialists Group confirmed that the new generation sub-primary rate codecs be designed assuming the usage of transparent transmission channel. Measures to the restriction will be dealt with as optional exceptions.

In order to promote the videoconferencing service, it is recognized that switched HO services should be recommended. This request will be forwarded from this Group to SGXVIII through SGXV.

9. Future Work Plan (T.D. No. 1)

Chairman presented an example of future work plan for the 384 x n kbit/s codec study covering 1986-1987 and consisting of the following steps.

1) Specifications for prototype hardware
2) Construction of prototype hardware and parameter optimization
3) Compatibility checks at laboratories
4) International field trial
5) Drafting of Recommendations

The general scope toward the recommendation at the end of this CCITT study period was accepted. More details will be discussed and decided in a step-by-step way. The relatively short period for hardware

construction was pointed out and the full usage of available time by the end of this study period was suggested.

As for hardware construction, France, F.R.G., Japan, The Netherlands, Sweden, U.K., U.S.A. expressed their interest to participate in compatibility check.

Mr. Nicol reported the result of contact with INTELSAT through BTI concerning the field trial. It was recognized that we should first clarify the purpose of the trial, participants, time and duration. This will be investigated continuously. Information on the possibility of setting up digital circuits on ad-hoc basis among Europe, U.S.A. and Japan was also exchanged.

In order to facilitate compatibility check, a necessity of having the same test pattern generator among concerned organizations was stressed. The Specialists Group solicited a volunteer to provide such test equipment, and GEC (U.K.) offered to do so.

It was understood that this test unit would be required by early 1987.

10. Others

(1) Reference simulation

In Document #73, Chairman reported the results of and the participated organizations in the reference simulation task, which was charged at the Torino meeting. As other organizations need more time, the second report will be made based upon the correspondence up to February 21.

(2) Intellectual property

Chairman requested of each member to express his opinion at the next meeting on how this problem should be dealt with for the sub-primary rate codec standardization. It was also requested to refer relevant patents, as was done in Document #63, when any proposals are made.

(3) Progress report to the Working Party XV/1 next February

Chairman will draft a concise contribution based on the reports of the two meetings, Torino and Ipswich, and mail to each core member for approval.

(4) Next meeting

Time : March 25-28, 1986
Place : Tokyo, KDD Building
Topics:
- Source coding scheme and structure
- Transmission coding
- Frame structure
- Drafting specifications for experimental hardware
- Details of future work plan

Annex to Document #74R

REPORT ON THE QUANTIZATION STRATEGY SUB-MEETING

The different quantization strategies were examined and it appeared that there are presently several strategies. It was also pointed out that the different quantization strategies were not referring to the same parameters: signal power, error power, motion vector, buffer fulness and frame difference.

For the future, it was decided that:

1) Japan simplifies the DCT/VQ scheme.
2) France and F.R.G. study the relationship between the quantizer and the motion vector.
3) France introduces VQ in its DCT scheme.
4) France, F.R.G., Italy, Japan, Netherlands and Sweden consider the compatibility with the 64 kbit/s codec.
5) F.R.G., Japan, Netherlands and Sweden study the French clarification.
6) F.R.G. studies the French adaptive characteristics of the quantizer.

It was also suggested that, for the next meeting, the different countries make comments on:

a. picture quality
b. hardware complexity
c. compatibility to 64 kbit/s

LIST OF PARTICIPANTS
(Ipswich, January 21 - 24, 1986)

Chairman	S. Okubo	- NTT
Core Members		
F. R. of Germany	J. Speidel	- PKI/TEKADE
	G. Zedler	- FTZ
U.S.A.	B. G. Haskell	- AT&T Bell Lab.
	R. A. Schaphorst	- DIS
France	J. Guichard	- CNET
	J. P. Temime	- CNET
Italy	M. Guglielmo	- CSELT (acting for L. Chariglione)
Japan	Y. Hatori	- KDD
	N. Mukawa	- NTT
Netherlands	F. Booman	- DNL
United Kingdom	D. Bonnie	- GEC Video Systems
	R. Nicol	- BT
Sweden	H. Brusewitz	- Sw. Telecom (acting for P. Weiss)
Assisting Experts		
F. R. of Germany	W. Geuen	- FTZ-FI15
France	J. Thiberville	- Alcatel
Japan	T. Koga	- NEC
	K. Matsuda	- Fujitsu
United Kingdom	D. Beaumont	- BT (Secretary)
	M. Carr	- BT
	G. Morrison	- BT
	N. Shilston	- GEC Video Systems
	M. Whybray	- BT