CCITT SGXV
Working Party on Visual Telephony
Specialists Group on Coding for Visual Telephony

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TITLE : REPORT OF THE SECOND MEETING IN HOLMDEL (APRIL 23-26, 1985)

CONTENTS

1. General

The Specialists Group met in Holmdel from April 23 to 26, 1985, at the kind invitation of AT&T Bell Laboratories and Bell Communications Research.

Opening remarks and welcoming address was delivered on behalf of the hosting organizations by Mr. Haskell (AT&T Bell Laboratories, U.S.A.).

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

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

2. Documentation for the Meeting

The following documents have been considered during the Holmdel meeting.

2.1 Normal Document

16 : AMENDMENTS TO REC H.120 AND H.130 (BT)

Revision of Part 2a necessary to show that it is also applicable for intra-regional use within 525 lines and 1.5 Mbit/s region.

17 : APPROACHES TO STANDARDS CONVERSION (BT)

Introduction of six general strategies in standards conversion between 525/60 and 625/50 codecs.

18 : COMMENTS ON SOURCE CODING (BT)

Overviews current source coding activities in Europe. Seven

different approaches are presented. Suggestion of one or more intermediate image formats involving less lines and/or fields/second than normal video that are common to both 625/50 and 525/60 codecs. Non-interlaced image structure is suggested.

19 : REVISION OF A DRAFT FOR PARTS 3 OF RECOMMENDATIONS H.120 AND H.130 (JAPAN)

Revision of H.130 to meet the requirement of the Tokyo meeting and some editorial revision.

20 : BASIC PARAMETERS OF 384 KBIT/S CODEC (NTT, KDD, NEC AND FUJITSU)

Proposal of a virtual digital video standard (consisting of 384 + 64 pels/line, 288 lines/field) which absorbs the difference of existing television standards. Analyzes the intra-regional and inter-regional connections, including the allocations of television standards conversion.

21 : PROPOSALS OF FUNDAMENTAL ARCHITECTURE OF THE 384 KBIT/S CODEC (NTT, KDD, NEC AND FUJITSU)

Investigation on operational clocks and functions to be included in each block based on the 'virtual digital video standard' concept.

22 : INVESTIGATION OF BASIC CODING ALGORITHM FOR THE STANDARD 384 KBIT/S CODEC (NTT, KDD, NEC AND FUJITSU)

Introduces basic concepts of the coding methods being investigated in Japan and overviews elemental coding technologies.

23 : COMMENTS ON SUB-RATE CODEC FRAME STRUCTURE PROPOSED BY FRANCE (NTT AND KDD)

Points out the necessity of study on definition of visual telephone signals which form a basis for the specification of codec frame structure. Some network aspects are commented.

24 : COMMENTS ON WORK PLAN FOR 64 x m KBIT/S CODEC (NTT AND KDD)

An example of work plan is presented.

25 : DEMONSTRATION OF PERFORMANCE OF FULL MOTION VIDEO CODECS FOR PART 3 OF RECOMMENDATIONS H.120 AND H.130 (U.S.A.)

Suggestion of verifying the performance of a video codec by demonstrations before it is adopted as a standard.

26 : PROPOSAL ON A VIDEO INTERFACE AND PRE-/POST-PROCESSING (F.R.G.)

Digital video interface conforming to 4:2:2 CCIR Rec. 601 format is proposed which is common to both face-to-face and graphics signals. Spatial filtering and subsequent sampling in a line quincunx structure without interlace are also proposed to reduce coded pels.

27 : DISCUSSION POINTS FOR THE 384 KBIT/S CODEC (SWEDEN)

Suggestion of bit rate allocation for audio, data and video.

Suggestion of basic coding blocks suitable for standardization. Points out the minimum solution in order to obtain implementation freedom, simplicity and flexibility.

28 : AN ANALOG VIDEO TAPE TO TEST FULL MOTION VIDEO CODECS (U.S.A.)

Introduction of an analog test tape which is useful in the test and evaluation of video codecs.

29 : PART 3 CCITT RECOMMENDATION H.120 H.130 (CLI)

Explanation of withdrawal from Part 3 / Rec. H.120 and H.130.

30 : DUAL MODE DIGITAL INTERFACE (NTT, KDD, NEC, FUJITSU)

Candidate E in TD No.6 can include virtual digital video standard concept.

31 : APPROACHES TO COMMON DIGITAL INTERFACE (NTT, KDD, NEC, FUJITSU)

Examples of digitization methods to obtain 360 pels per line. Comparison of component input system and composite input system.

2.2 Temporary Document

No.1 : Agenda (Chairman)
No.2 : Agreements related to H.120 and H.130 (Chairman)
No.3 : Comparison of basic parameters for 384 kbit/s codec (Chairman)
No.4 : Reference point to define basic parameters (U.K.)
No.5 : Reference point to define basic parameters (Japan)
No.6 : Revision of TD No.3 (Chairman)
No.7 : Agreements on basic parameters (Chairman)
No.8 : Free use of the INTELSAT space segment (INTELSAT)
No.9 : Draft report of the second meeting in Holmdel (Chairman)
No.10: Examples of arrangements for the videoconference coder (F.R.G.)

3. Part 3 Codec

3.1 Reviewed Documents

16, # 19, # 25, # 29
TD No.2

3.2 Performance Verification Proposed by U.S.A.

The Specialists Group recognized it reasonable that the Part 3 codec specification be proven by means of hardware and demonstration before the end of the plenary and formal inclusion in the recommendation. A delegate of Japan expressed that they were now building codecs to conforming to Document # 19 and demonstrations would be available early next year. Considering these, the Specialists Group agreed to recommend to SGXV next July that Document # 19 be included in Part 3 on the provision that the codec conforming to it would be built and proven by means of demonstrations and field trials by the end of the current plenary.

3.3 Intellectual Property Regarding H.120 and H.130

Considering that

a) there are no general CCITT guidelines on intellectual property issue, nor specific guidance for recommended Part 1 and 2a,

b) the guideline of 'sufficient details with no intellectual property constraints' was agreed at the Tokyo meeting with a reservation of U.S.A. which was cleared due to withdrawal of the related proposal at this meeting,

the Specialists Group confirmed that

1) the same rule should be applied to all the codecs specified in Recommendations H.120 and H.130,

2) 'no constraints' means at least 'granting of non-exclusive licenses on fair and reasonable terms',

3) a request of seeking general CCITT guidance on the intellectual property related to standardization be forwarded to SGXV through the Working Party in charge of visual telephony, and

4) this agreement does not constitute a precedent to the future work of this Specialists Group.

3.4 Text Revision of Recommendations H.120 and H.130

According to the agreements reached at this meeting, the text of the Recommendation should be revised on the following pages of AP VIII-103-E as attached in Annex 1;

pages 115, 131, 133 and 149.

4. Basic Parameters of 384 kbit/s Codec

4.1 Reviewed Documents

17, # 18, # 20, # 21, # 26, # 30, # 31
TD No.4, 5, 6, 7, 10

4.2 Reference Points

Basic parameters are defined at the reference point B in Fig.1 for moving pictures.

As for graphics, their basic parameters are further studied separately from those of moving pictures considering the fact that graphics facilities can be achieved with either of

- full resolution (e.g. 720 pels/line) 625/50 or 525/60 television,
- half resolution (e.g. 360 pels/line, probably the same as for moving pictures) 625/50 or 525/60 television,
- high resolution (e.g. 1728 pels/line) facsimile equipment, or
- other equipment.

4.3 Three Baseband Signals

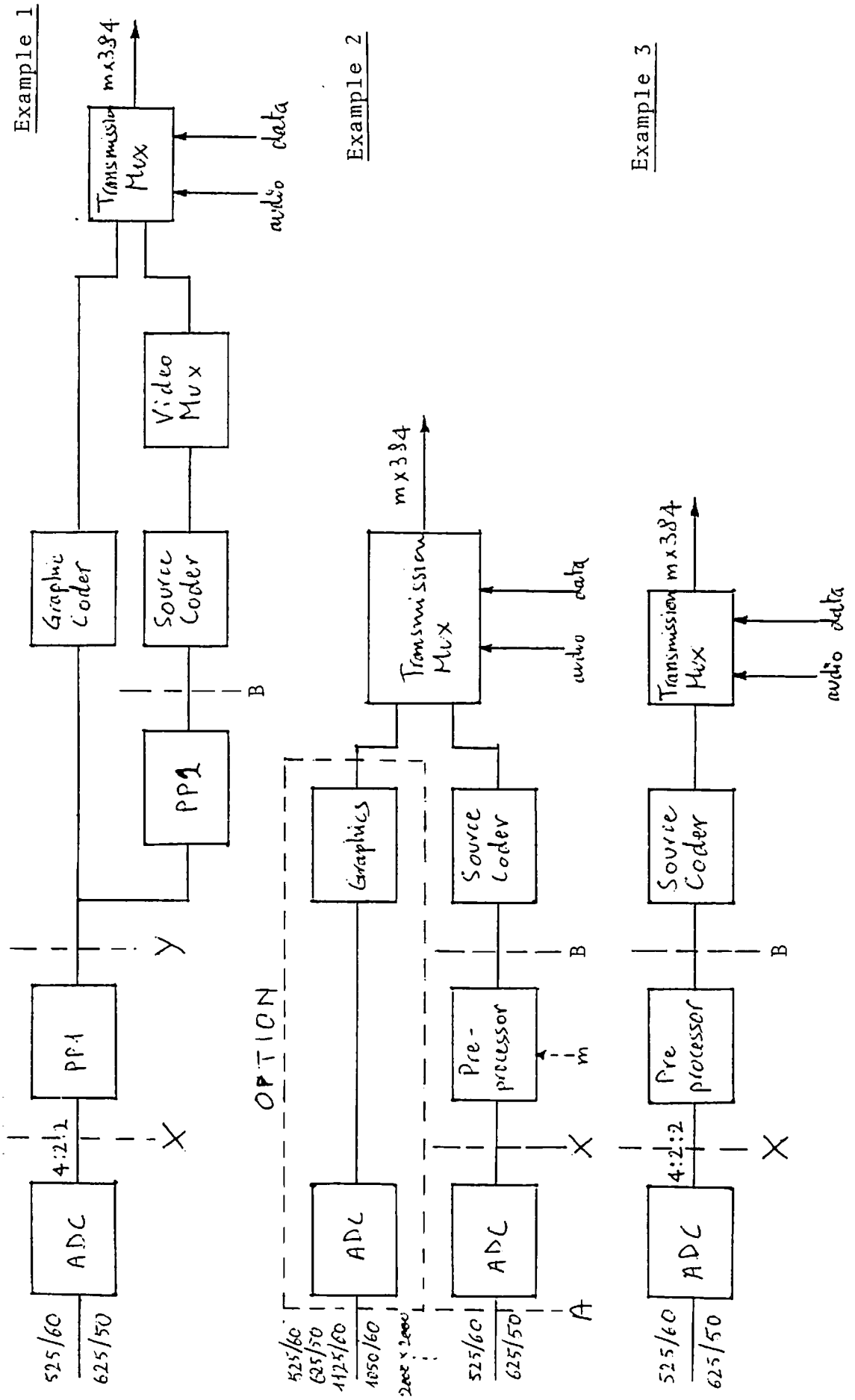


Fig.1 Examples of arrangements for the sub-rate videoconference coder

Luminance signal (Y) and two chrominance signals (R-Y and B-Y) as defined in CCIR Rec. 601.

4.4 Number of Luminance Pels Per Line to Be Coded

It was agreed that the number of samples per line should be simply related to that specified in CCIR Rec. 601 and not exceed 720. At 384 kbit/s there was general consensus that the source coding algorithm would limit the resolution to 360 picture elements, in case of moving pictures. However at higher multiples of 384 kbit/s there was a view that it may be possible to achieve a higher horizontal definition and it was agreed that more study is required. If greater resolution is attainable at higher rates (e.g. primary rates) then this could imply a need for an addressing resolution of 720 picture elements at 384 kbit/s.

It should be noted that the sampling frequency for A/D conversion in Fig. 1 need not be defined because the reference point is B. Possible methods to obtain pels specified at reference point B are illustrated in Annex 2.

4.5 Sampling Structure

In case of 360 pels/line, sampling structure is open for further study. In case of 720 pels/line, orthogonal sampling structure is adopted.

4.6 Number of Lines per Field, Field Frequency and Interlace

The following two approaches exist to define these parameters at the reference point B in Fig. 1.

a. Dual(Note) approach - to define two parameters according to the field frequency difference between 625/50 and 525/60 television systems, including 'virtual digital video' approach.

   Note : The word 'dual' means that the standardized single codec can accept these two types of video signals. An example of implementation of this type of codec is proposed in Documents # 20 and # 21.

b. Single approach - to define 'intermediate' parameters which are common to both 625/50 and 525/60 television systems.

Possible candidates are listed in Table 1. Further study is requested to finalize these parameters based on the discussion at this meeting. Such aspects as follows should be taken into consideration.

- single source coder/decoder hardware
- equal burden of television standards conversion
- quality and hardware for inter- and intra-regional connections
- coding efficiency

4.7 Parameters for Chrominance Signals

For further study.

Table 1 Parameters related to line number and field frequency

Parameter / Approach	L_Y (lines/field)	F (fields/sec)	Interlace
Dual	288/240 256	50/60	2:1
Single	288 480 512 576	20 25 30 50 60	2:1 / 1:1

5. Coding Algorithm for 384 kbit/s Codec

5.1 Reviewed Documents

18, # 22, # 27

5.2 Coding Algorithms Being Studied

The following approaches were introduced as being studied by various organizations.

1) Various forms of hybrid coding using discrete cosine transform
2) Human observer oriented transform
3) Hybrid coding using pyramid transforms
4) Vector quantization
5) Recursive binary nesting combined with predictive coding
6) Conditional replenishment
7) Classical transform coding
8) Combination of DCT and motion-compensated interframe prediction
9) Extension of 8) with vector quantization
10) Extension of 8) with spatial subsampling, temporal subsampling and interpolation
11) Interpolative/extrapolative parallel prediction coding

5.3 Methods of Choosing the Most Effective Algorithm

5.3.1 Common test materials

The meeting recognized the need to have agreed common test materials both for 625/50 and 525/60 standards, available as early as possible.

It was agreed that in the first stage, 625/50 countries will use the test material already agreed in that region and 525/60 countries will use the same test material available in magnetic tape in the same agreed format.

At a second stage, when 525/60 test material will be available, both regions will perform computer simulation on the old and new sequences.

5.3.2 Comparison Method

For the next meeting of the Specialists Group, submission of candidate coding algorithms for 384 kbit/s will be made. These submission will include a reasonably detailed description of the algorithm plus preliminary performance information which will enable the specialists to reduce the number of candidate algorithms to a small number.

The performance information will include processed test images. For computer simulation purposes, standard test sequences described above will be used.

The processed images will show the results of redundancy reduction coding plus quantization of pel values or data derived therefrom. It will be preferable to simulate adaptive control enforcing an exact constant data rate of 384 kbit/s.

The performance information can also include entropy estimation of short-time bitrates. Also to be provided are estimates of luminance and chrominance SNR as well as buffer size and codec delay.

6. Frame Structure for 384 kbit/s Codec

6.1 Reviewed Document

23

6.2 Discussion

The Specialists Group will continue the study on the videoconferencing aspects of the frame structure.

Although the terms of reference of the Group include a recommendation for the frame structure of sub-rate codecs, the Group needs some guidelines from the Working Party since the design of this frame structure may be related to other teleconferencing services, e.g. audioconferencing.

7. Test Tapes for 525/60 Signals

Document # 28 was presented to introduce test tape-related activities in U.S.A. Similar activities in Japan were also introduced.

8. International Field Trial

As to the free use of the INTELSAT space segment, the following policy and suggestions were given by an INTELSAT delegate. It was suggested that these be applied in principle to field trials and technical discussions to further advancements of the work of the second generation codecs.

Members of the Specialists Group will speak with an appropriate person in their Signatory organization.

1) As a general policy, INTELSAT can permit the free use, through approved earth stations, of its equipment and facilities for experiments

and demonstrations proposed or sponsored by Signatories, which are designed to advance the satellite communication technology and enhance the use of telecommunications satellites.

2) Any proposed experiment or demonstration must be compatible with the above policy and meet the following conditions:

(i) be designed to achieve effectively the stated objectives;
(ii) not interfere with the operations of, or be otherwise hamful to, the space segment;
(iii) results of the experiment or demonstrations be made available to INTELSAT; and
(iv) any report or statement relating to the experiment or demonstration intended for the general public or for publication be submitted to INTELSAT prior to its release.

In cases of special interest, Signatories shall make appropriate reports to INTELSAT concerning experiments or demonstrations. In addition, Signatories shall submit to INTELSAT the complete details of, and data derived from, such experiments or demonstrations, and reports will be made to the Board of Governors of INTELSAT concerning such data as appropriate.

3) Each participating party should have contact with its Signatory of INTELSAT specifying all requirements for the experiments. The items that must be specified are: Transmission earth station, Receive earth station, Carrier frequency, Carrier size, Modulation method, Bit rate, Required C/N dB, Time schedule, etc. INTELSAT will make appropriate arrangements according to the requests from the Signatories.

4) It was suggested that the Specialists Group should delegate a Signatory to organize the participants and to contact INTELSAT on this matter and that the Signatory requests should be addressed to Operation Service Department, Mr. Sebastian Lasher, Manager, INTELSAT.

9. Work Plan for 64 kbit/s Codec

Document # 24 was reviewed. It was agreed that the efforts of the Specialists Group be first focused on the 384 kbit/s and then the study on 64 kbit/s codec be followed with a delay of several months but with the same milestones.

10. Next Meeting

10.1 Time

September 17 (TU) - 20 (FR), 1985

10.2 Place

CSELT in Torino

10.3 Topics (384 kbit/s codec)

10.3.1 Finalization of the basic parameters
10.3.2 Extensive investigation of coding algorithm
10.3.3 Further study of frame structure
10.3.4 Preliminary study of transmission coding

recommends

that the codecs having signal processing and interface characteristics described in Parts 1,2, and 3, below, should be used for international videoconference connections.

Note: Codecs of types other than those described in this Recommendation are not precluded.

Introduction

Part 1 of this Recommendation specifies the codec, developed for operation with the 625-line, 50 field/s television standard and the 2048 kbit/s primary digital group. Its architecture has been chosen to permit variations in the detailed design of certain of the functional elements having the greatest influence on the picture quality. This enables future developments, aimed at improving the performance, to be incorporated without affecting the ability of different codecs and decoders to interwork. For this reason, no details are given of such items as motion detectors or spatial and temporal filters. The Recommendation confines itself to the details necessary to enable a decoder correctly to interpret and decode the received signals.

The Annexes to Part 1 give details of some additional optional features which may be provided to supplement the basic design.

Part 2a describes a version of the codec for 525-line, 60 field/s and 1544 kbit/s operation which also provides automatic television standards conversion when connected to the version of the codec described in Part 1 via a remultiplexing unit (to convert between G.732 and G.733 frame structures) at the junction of the 2048 and 1544 kbit/s digital paths. *This codec is also suitable for use within regions using the 525-line, 60 field/s television standard and 1544 kbit/s transmission.*

Other implementations of Part 2 are to be studied, for example :

- a version of the codec for 625-line, 50 field/s and 2048 kbit/s operation capable of interworking with the codec described in Part 3;

- a version of the codec for 525-line, 60 field/s and 2048 kbit/s operation capable of interworking with the codec described in Part 1.

Part 3 of the Recommendation ~~is intended to~~ describes a codec for regional use in 525-line, 60 field/s and 1544 kbit/s region. ~~The detailed implementation is for further study.~~

The frame structures associated with the codecs described in this Recommendation are to be found in Recommendation H.130.

As the codecs are complex items using combined intraframe and interframe picture-coding techniques which tend to be known only to specialists, an Appendix is provided giving a brief outline of the principles involved in the codecs of Part 1 and Part 2a.

Annex 1

(to Part 1)

Graphics option - 625-line

Under study (see Question D/XV).

Annex 2

(to Part 1)

Encryption option - 625-line

Under study (see Question D/XV).

PART 2

~~CODEC FOR INTERREGIONAL USE NOT REQUIRING SEPARATE TELEVISION STANDARDS CONVERSION~~

CODECS NOT REQUIRING SEPARATE TELEVISION STANDARDS CONVERSION WHEN USED ON INTERREGIONAL CONNECTIONS

PART 2a

A CODEC FOR ~~VERSION USING~~ 525-LINES, 60 FIELD/S AND 1544 kbit/s *(FOR INTRA-REGIONAL USE AND)* TRANSMISSION CAPABLE OF INTERWORKING WITH THE CODEC OF PART 1

1. Introduction

Part 2a indicates the changes and additions which must be made to the text of Part 1 in order to define the version of the codec for use with 525-line 60 fields/s television standards and transmission at 1544 kbit/s. The two versions are capable of interworking via a re-multiplexing unit which can convert the G.733-compatible frame structure on one side to the G.732-compatible frame structure (with 6 Time Slots empty) on the other.

The two versions of the codec are identical in most respects, the important differences (apart from the obvious ones arising from different input and output signals) being confined to the digital pre- and post-filters and the signals for the control of the buffers. Moreover, the detailed algorithms of the pre- and post-filters do not need to be specified to permit interworking. Only an outline of their mode of operation together with the few necessary specifications are therefore provided.

The sections in Part 2a carry the same numbering as used in Part 1. Sections omitted in Part 2a can be assumed to be identical with the same-numbered Sections in Part 1, except in a few cases where references to 625-lines, 50 field/s or 2048 kbit/s should be changed to 525-line, 60 field/s and 1544 kbit/s.

In the decoder, the digital post-filter incorporates a frame store in some versions of the 625-line codec where it is used in the line interpolation process. In the 525-line version, in addition to its use for line interpolation, it is used as a temporal interpolator with variable coefficients to provide an extra output frame during those periods when the decoding is temporarily suspended.

5. Buffer control

The amount to which the transmitting buffer is filled is used to control various coding algorithms (sub-sampling, etc.) and is signalled to the decoder to enable it correctly to interpret the received signals. In the 525-line coder, the transmission rate is less than the video input rate and hence the buffer tends to fill more rapidly than would be determined by the movement in the picture, only to empty again when the interpolator suspends the coding process.

To avoid incorrect changes in coding algorithms, the buffer-state signal is modified to take account of the progressively changing coefficients of the interpolator in the pre-filter. The buffer then operates as though the data is coming from a video source whose frame rate is uniform and the same as the transmitted frame rate.

5.1 Transmission framing

The frame structure, compatible with Recommendation G.733 and also compatible with that of the 625-line version in Part 1, is given in Part 2 of Recommendation H.130.

Annex 1

(to Part 2a)

Graphics option - 525-line

Under study (see Question D/XV).

Annex 2

(to Part 2a)

Encryption option - 525-line

Under study (see Question D/XV).

PART 3

A CODEC FOR 525-LINES, 60 FIELD/S AND 1544 kbit/s TRANSMISSION FOR INTRA-REGIONAL USE

~~Under study (see Question D/XV).~~
(Insert the text of ANNEX 1/Document # 19 with modifications in 3.6 (p.4) and 7. (p.19).)*

(3624)

PART 3

CHARACTERISTICS OF A 1544 KBIT/S (n = 4) FRAME STRUCTURE FOR USE WITH CODECS DESCRIBED IN PART 3 OF RECOMMENDATION H.120

~~Under study (See Question D/XV)~~

(Insert the text of ANNEX 2/Document # 19.)

* *Replace the original text with the following.*

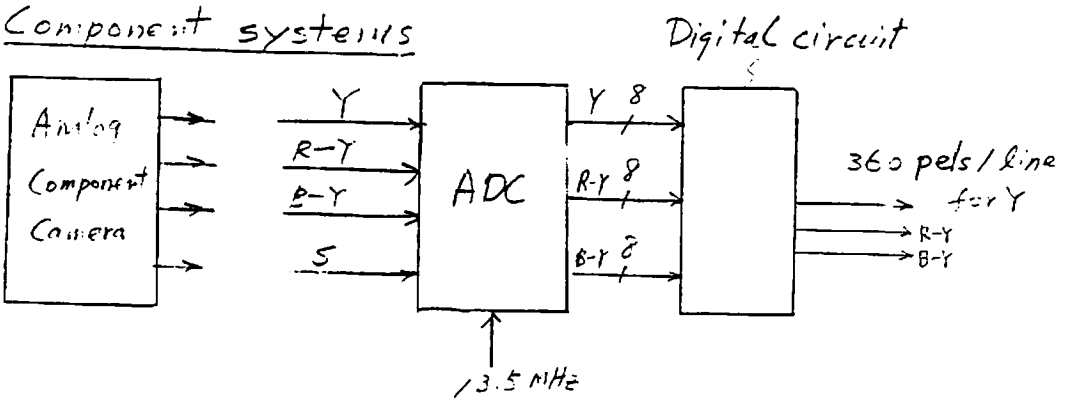
An audio channel using 64 kbit/s is included. The audio coding algorithm is under study in CCITT SGXVIII Rapporteur Group on Wideband Speech Coding.

ANNEX 2

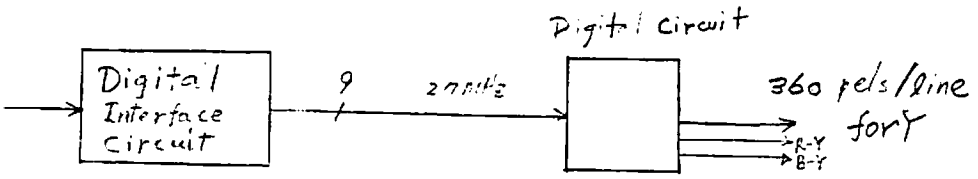
Digitization methods to obtain 360 pels per line

(A) Component systems

(A1)

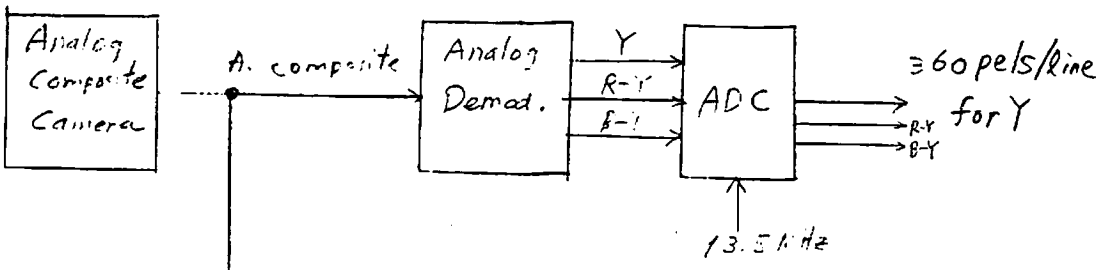


(A2)

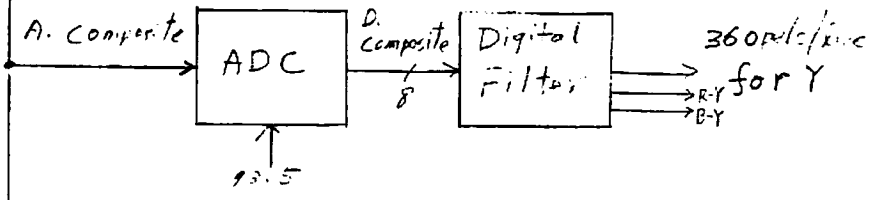


(B) Composite systems

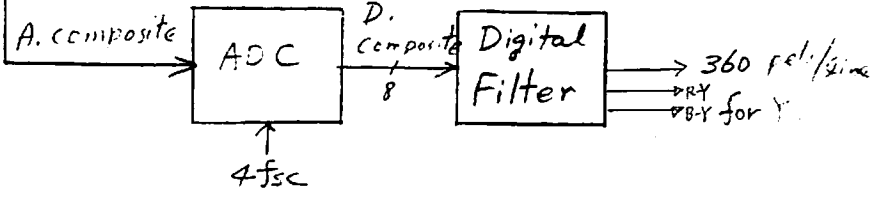
(B1)



(B2)



(B3)



LIST OF PARTICIPANTS

Chairman	S.Okubo	- NTT
Core Members		
F. R. of Germany	J. Speidel	- PKI/TEKADE
	G. Zedler	- FTZ
Canada	S. Sabri	- BNR
U.S.A.	D. Crawford	- Bellcore
	B. G. Haskell	- AT&T Bell Lab.
	R. A. Schaforst	- DIS
Italy	L. Chariglione	- CSELT
	A. D'Ottavio	- SIP
France	J. Guichard	- CNET
	J. P. Temime	- CNET
Japan	Y. Hatori	- KDD
	N. Mukawa	- NTT
Netherlands	F. Booman	- DNL
United Kingdom	D. Bonnie	- GEC Mcmichael
	R. Nicol	- BT
Sweden	H. Brusewitz	- EVA
	(acting for R. V. Campenhausen)	
	P. Weiss	- Swedish Telecom
INTELSAT	K. Kinuhata	
Assisting Experts		
U.S.A.	P. Bryan	- AT&T Communications
	G. Pearson	- CLI
	K. R. Rao	- University of Texas at Arlington
	T. White	- NEC America
France	J. C. Jolivet	- SAT
Japan	M. Hiraoka	- FUJITSU
	K. Iinuma	- NEC