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

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Title: Revision of the Specification for the Flexible Prototype Hardware

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1. Introduction

After the last meeting in Tokyo, we have given further consideration for coding systems and prototype hardware. This contribution, which is based on the results of these considerations described in companion Documents #105–#115, is a set of proposals for addition and modification to Report #103R, Annex 4.

2. Main Points of Modification Proposal

The proposals in this contribution is summarized as follows:

(1) Specification is drawn up for the orthogonal transformer in the flexible hardware.
(2) Specification is drawn up for the interface between the coding loop and the control section.
(3) More detailed specification for the video multiplex is drawn up.
(4) The multiplexing procedures for the error correction coding and optional demand refreshing return channels are defined.
(5) More detailed specification for digital interfaces is drawn up.

Note: The parts to be modified or changed are indicated in the annex by vertical lines in the left-hand margin.

Annex : REVISION OF SPECIFICATION FOR THE FLEXIBLE PROTOTYPE 2ND GENERATION VIDEO CONFERENCE CODEC

INTRODUCTION

The aim has been to produce a specification which essentially is the minimum implementation with which all laboratories will comply. The specification will provide considerable scope for optimization and experimentation.

We would expect that the final Recommendation to be produced in early 1988 would be significantly defferent as it would reflect advances made during 1986/87. It would also have the areas of flexibility removed.

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

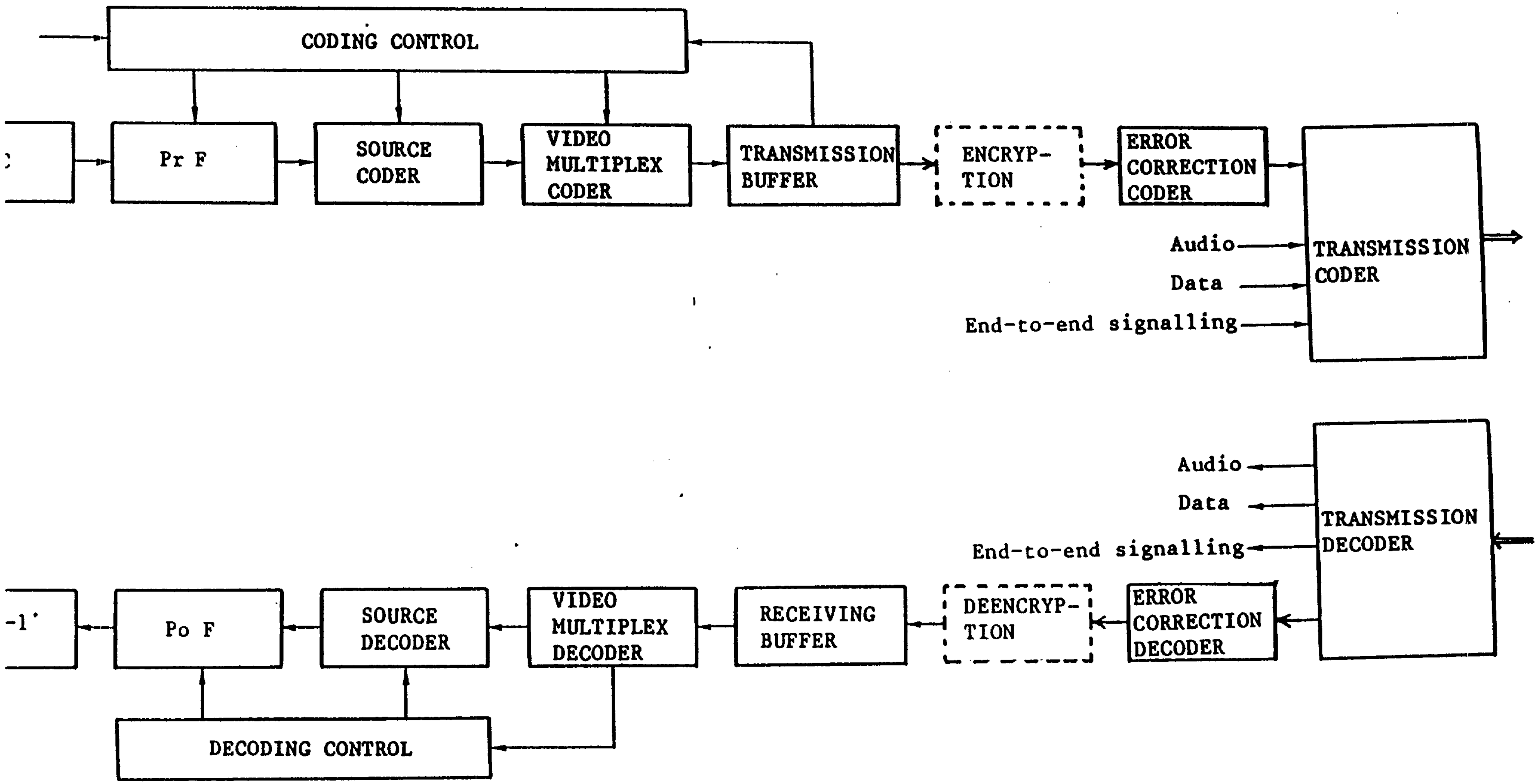


Figure 1 Outline block diagram of the codec

1. Source Coder
2. Video Multiplex Coder
3. Transmission Coder

1. Source coder

Figure 2 shows the source coder and video multiplex parts of the flexible codec. First, to specify the codec, interfaces, e.g., bit length and data format should be clarified. Then, at least blocks excep coding control block should be specified to build a flexible hardware. The coding control part will be precisely specified after the improvement using the flexible hardware. The contents of ROMs in the hardware will be specified to improve the performance. Table 1 shows interface condition which is defined between the blocks.

1.1 Source format

1.1.1 The format to be coded is 288 lines, 30000/1001 (approximately 29.97) non-interlaced pictures per second - the Common Intermediate Format. The tolerance on the picture is +/- 50 ppm.

1.1.2 Pictures are coded in component form, these components being luminance (Y) and two colour difference signals Cr, Cb.

There are 360 luminace pels per line with an orthogonal sampling patterr The colour difference sampling parameters are 180 samples per line, 144 lines, orthogonal. Both Cr and Cb samples are sited such that their block boundaries coincide with luminance block boundaries. (See Table 2 and Figure 3)

1.1.3 As for active area to be coded, smaller size for coder input which is suitable for 8 by 8 pels processing is specified as 352 pels/line for Y signal and 176 pels/line for Cr and Cb signals. The format is shown in Figure 4.

1.1.4 Subsampling for chrominance is not introduced.

1.1.5 Source format codes correspond to CCIR Recommendation 601:

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

Codes outside the above ranges will be accepted but may be modified by

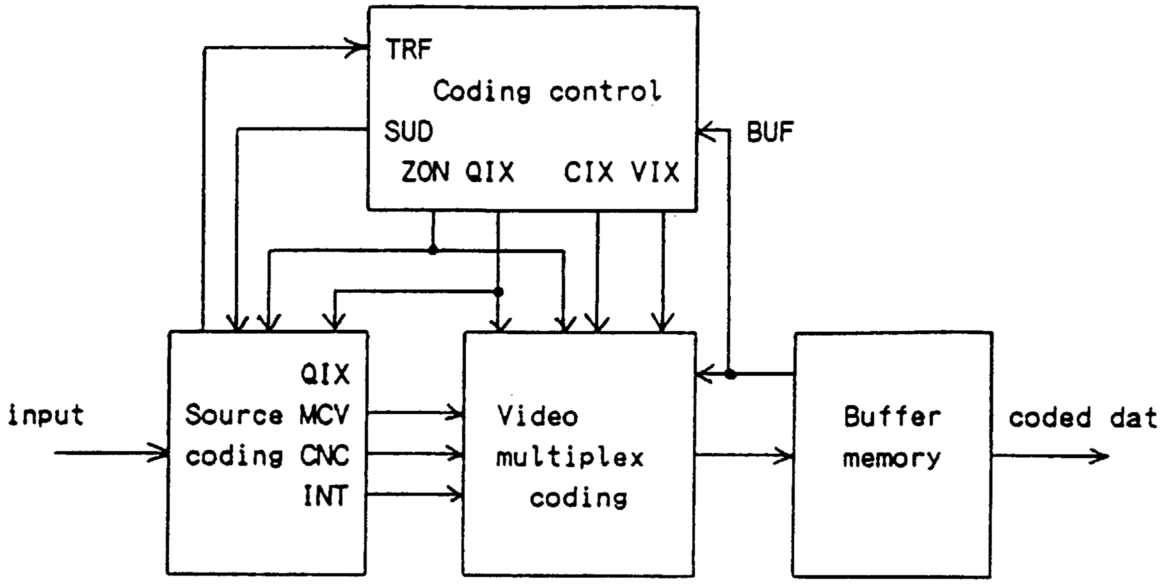


Figure 2 Configuration of main part of the flexible coder

Table 1 Interface between the functional blocks

Name		Bit length	Unit	
Transform coeff's	TRF	12	C	
MC vector	MCV	10	B	Horizontal vector first
Coded/ Non coded	CNC	1	B	
Inter/intra	INT	1	B	
Quantizer index	QIX	5	B	
Zone mask pattern	ZON	1	C	
Class index	CIX	6	B	
VWL set index	VIX	3	C	
Coding stop/ Update	SUD	2	B	
Buffer index	BUF	6	B	

Unit shows the unit of minimum possible change. B indicates block by block change. C indicates coefficient by coefficient change.

Table 2 Basic parameters for the new generation n x 384 kbit/s CODEC

Items	Parameters
1. Reference point	Point B in Fig. 1/Annex 1 to COM XV-R 4
2. Baseband signals and their levels	Y, R-Y, B-Y, as defined in CCIR Rec. 601
3. Number of pels per line	Y: 360 (Note 1) R-Y: 180 B-Y: 180
4. Number of lines per field	Y: 288 (Note 2) R-Y: 144 B-Y: 144
5. Field frequency	Y, R-Y, B-Y: 29.97 Hz
6. Interlace	Y, R-Y, B-Y: 1:1
7. Sampling structure	Y, R-Y, B-Y: orthogonal, positioning of R-Y and B-Y samples share the same block boundaries with Y samples as shown in Fig. 2

Note 1: Active line duration is approximately 53 us.

Note 2: Active field duration is approximately 18.4 ms (for 625/50 systems) and approximately 15.2 ms (for 525/60 systems).

Note 3: 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.

Note 4: 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.

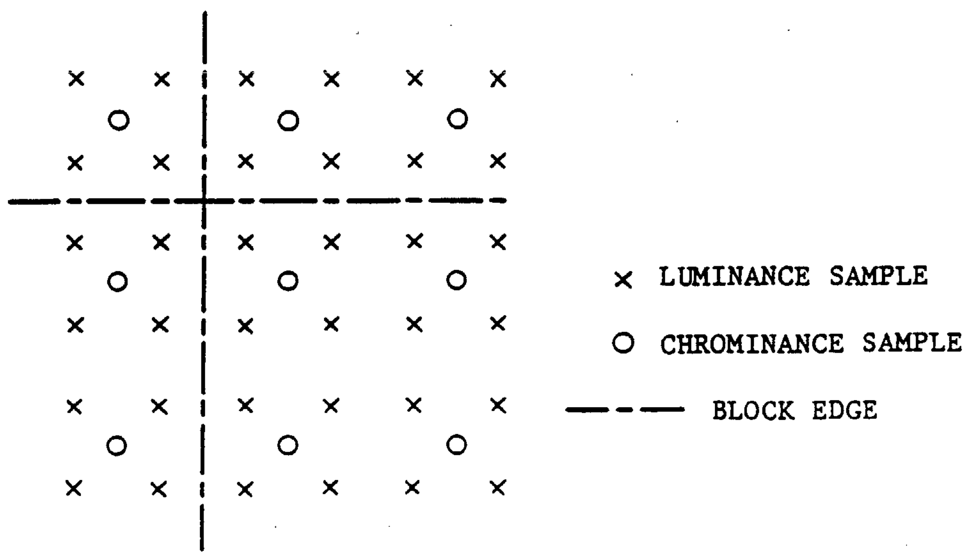


Figure 3 Positioning of Luminance and Chrominance Samples

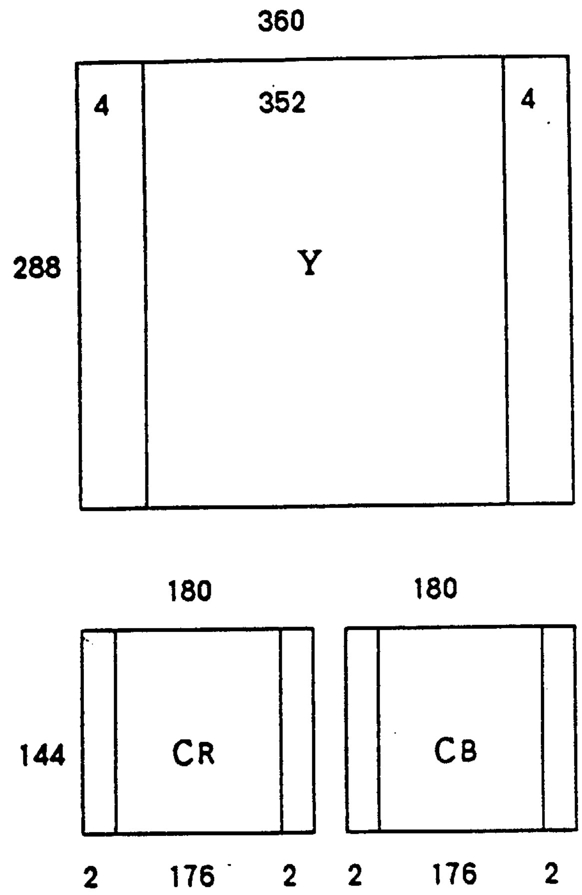


Figure 4 Definition of significant pel area

1.2 Video Coding Algorithm

1.2.1 The video coder algorithm is shown in a generalized form in Figure 5. The coding scheme utilizes a block transform. The predictor may incoporate motion compensation.

1.2.2. Motion compensation is optional at the coder. The decoder will accept one motion vector for each luminance block of size 8 pels by 8 lines. The maximum motion vector is +/- 15 pels and +/- 15 lines. Only integer values of the horizontal and vertical components of the vector are considered. (Note: The encoding method for transmission of motion vectors may restrict the vectors to a subset of all these possible values that the decoder hardware can accommodate. This will be specifi[illegible] later.)

One line deleted

A positive value of the horizontal component of the displacement vecto[illegible] signifies that the prediction is formed from pels in the previous picture which are spatially to the right of the pels being predicted.

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

The range of motion vector is limited in a picture area. For example, the blocks on the left edge cannot have plus vectors for horizontal direction.

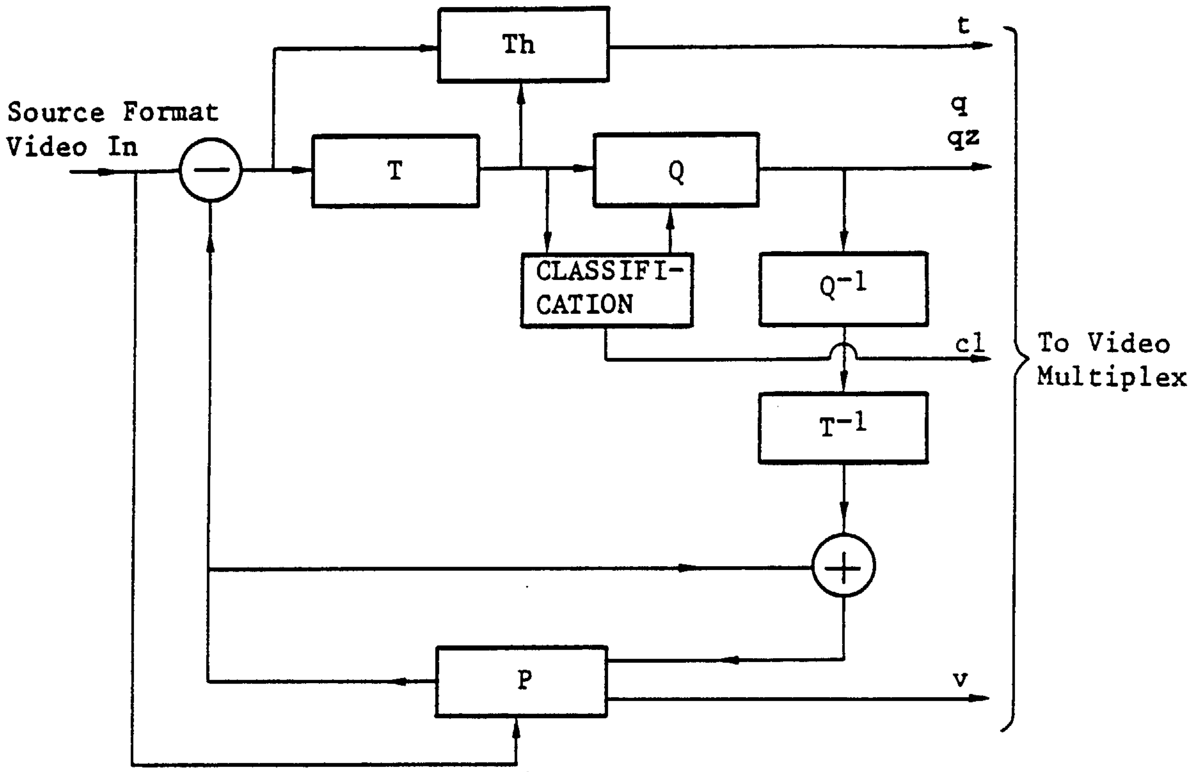
Motion compensation for chrominance signals is not employed.

1.2.3 Coder

After prediction, the resulting difference picture or the original picuture is subdivided into blocks which are segmented as transmitted o[illegible] non-transmitted. The segmentation criterion is not part of the specification, being left free to equipment designers and may be varied dynamically as part of the data rate control strategy. Transmitted blocks are coded by a transform based scheme. Coding block size for luminance is 8 by 8 sample values.

Chrominance transform blocks contain the same number of pels as luminance ones.

1.2.4. Transform



Th	Threshold
T	Transform
Q	Quantizer
Q^{-1}	Inverse Quantizer
T^{-1}	Inverse Transform
P	Predictor
t	Flag for transmitted/not transmitted block
q	Quantizing index for transform coefficients
qz	Quantizer indication
v	Motion vector
cl	Classification index

Figure 5 Video coding part of the coder

transform in terms of bits per stage, can be investigated. All hardwar should be equivalent in performance to classical matrix multiplicatior so fast algorithms are not excluded provided they can be constructed t be as flexible.

Forward transform can be decribed as :

$$F(i,j) = (1/L)\ [Ac(i,j)]\ [f(i,j)]\ [Ar(i,j)]^{t} \ .$$

Inverse transform is described as :

$$f(i,j) = (1/M)\ [Bc(i,j)]^{t}\ [F(i,j)]\ [Br(i,j)] \ ,$$

where,

- $[F(i,j)]$: Transformed data matrix. 12bit accuracy,
- $[f(i,j)]$: Original data matrix. 9bit accuracy,
- $[Ac(i,j)], [Ar(i,j)], [Bc(i,j)], [Br(i,j)]$: Transform coefficient matrix,
- $1/L$, $1/M$: Normalization factor,
- $[X]^{t}$: Transpose of matrix $[X]$.

All transform coefficient matrices and normalization factors are independently programmable.

The 2D transform is implemented as the equivalent of 2 independent 1-D transforms.

For the purposes of compatibility it is only necessary to specify the inverse transform. As a preliminary specification the hardware should allow for 12 bit resolution in (i.e., coefficients) and 9 bit out. (Thi is subject to verification that it does not imply a greater accuracy than 16 by 16 bit multiplications.)

The order of the operation for inverse transform need be specified for compatibility. First operation of inverse transform is presented as

$$[X] = [F(i,j)]\ [Br(i,j)] \ .$$

Then, as the second operation,

$$[Y] = [Bc(i,j)]^{t}\ [X] \ .$$

Finally, the output is obtained by the operation of,

$$[f(i,j)] = 1/M\ [Y]$$

and

L = M = 4.

Coefficients have 12 bit accuracy.

Namely,

$$[A(i,j)] = (1/2048) *$$

1448	1448	1448	1448	1448	1448	1448	1448
2009	1703	1138	400	-400	-1138	-1703	-2009
1892	784	-784	-1892	-1892	-784	784	1892
1703	-400	-2009	-1138	1138	2009	400	-1703
1448	-1448	-1448	1448	1448	-1448	-1448	1448
1138	-2009	400	1703	-1703	-400	2009	-1138
784	-1892	1892	-784	-784	1892	-1892	784
400	-1138	1703	-2009	2009	-1703	1138	-400

Figure 6 shows the order of processing and bit accuracy in case of Discrete Cosine Transform.

2 lines deleted

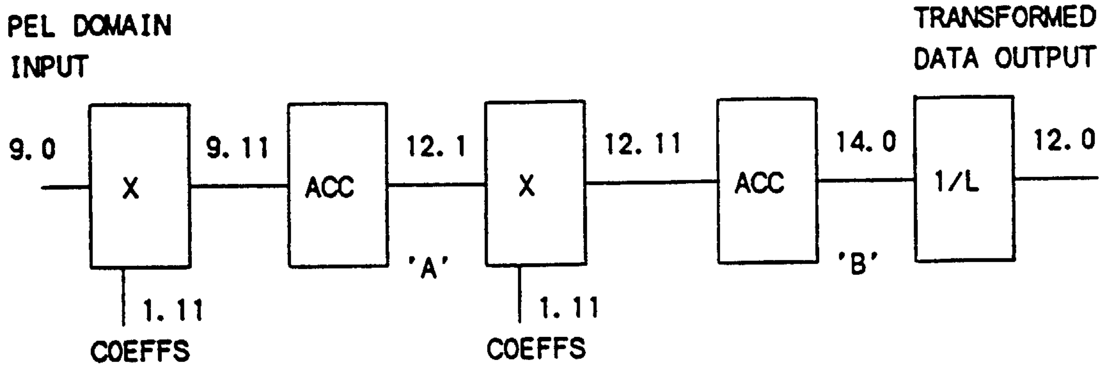
1.2.5 Adaptive coding

Adaptive coding technique is introduced in the flexible hardware. Fixe scanning is employed in which only inside the zone is scanned. Documen #108 describes the adaptive coding technique.

All control parameters should be stored in the ROM table so that furth improvement can be obtained by changing ROM. Figure 7 shows input and output of ROM table.

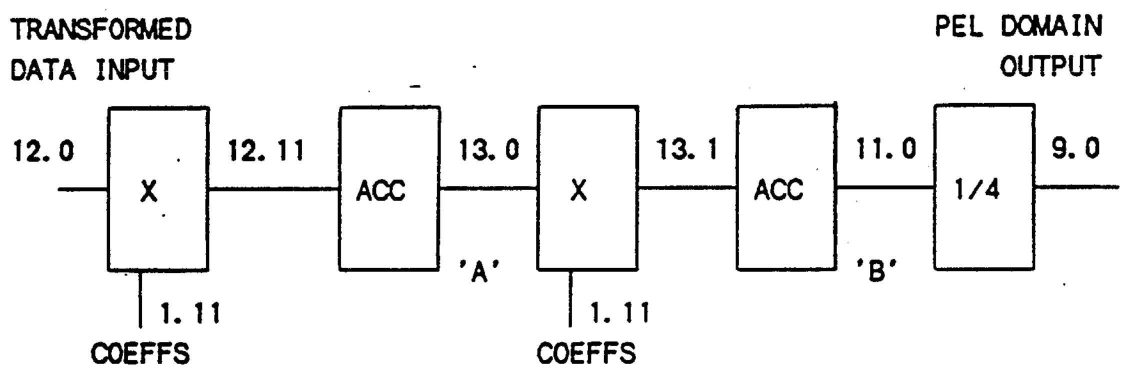
A VLC code set is specified for each transform coefficient when inter/intra mode index, class index (max 64 classes), distortion (or quantizer step, max 32 quantizer indexes) and sequency in DCT (64 coefficients) are given. Therefore, VLC code set can be varied coefficient by coefficient. Zonal mask pattern which indicates coding area is also specified by class index, distortion and sequency in DCT. Therefore, ROM table has 18 bit (262144) address input and 4 bit outpu

Output of the ROM controls the zonal mask pattern and VWL code set. The three bit information indicates VLC code set. The lower value show VWL set which is suitable for narrow dynamic range coefficient. The lowest value '000' indicates coefficient to be eliminated. The other values indicates active zone in which coefficient is coded. It seems that four VWL code sets are sufficient for a.c. coefficients. The valu from '001' to '100' indicates the VWL code sets. The values from '101' to '111' is for further study.



Rounding operation is performed at point 'A' and 'B'.
All coefficients are in the rage of +1/-1.
Since dynamic range increases 5.66 times at point 'A' considering coefficient range, fraction point shift 3 bits to left and output is rounded off to 13 significant bits.
At point 'B', since dynamic range increases 32 times that of input, fraction point shift 2 bits futher to left and output of the accumulator is rounded off to 12 significant bits.

(A) FORWARD TRANSFORM



Rounding operation is performed at point 'A' and 'B'.
At point 'A', since dynamic range decreases 5.66 times, fractional point shift 2 bit to right and output is rounded off to 13 significant bits.
At point 'B', since dynamic range decreases 32 times, fraction point shift 3 bits more to right and output is rounded off to 9 significant bits.

(B) INVERSE TRANSFORM

In the presentation of n.m, n indicates the number of significant digits in integar part and m indicates that of fractional part.

indicates active zone in which coefficient is coded, '0' indicates elimination of coefficient). This information is obtained by decodinɛ VWL code set information.

Since quantizer (max 32) is also controlled in some adaptive way, interface code is need to be specified. The lower value shows fine quantizer and higher shows coarse quantizer. Five bit code is used.

1.2.6 Quantizer

The number of inverse quantizers provided in the decoder shall be 32. Each quantizer has 12 bits input an up to 12 bits out.

1.2.7 VLC

- Each VLC code set is characterized by the quantization index vs coc word.
- According to the variable length code table, variable length codinɛ is performed. Code set is for further study.
- Plural (four at maximum) VLC table is used for coding of a.c. coefficients.

1.3 Data rate Control and Subsampling Modes

The exact method of assesing the encoder data generation rate need not be specified but the specified maximum size of encoder buffer must incorporate an allowance for latency in the assesment and control loop Hence, any requirement to constrain overall system delay may effective preclude some schemes.

To improve picture quality for scene change and rapid motion pictures, it is expected to have input buffer before coding loop in the coder an display buffer after decoding loop in the decoder. Since the time that one picture is coded is not restricted by introducing these buffers, i can give sufficient amount of information for one picture of rapid sce It does not mean further signal delay for moderate and intermediate motion pictures.

Control information is carried by side information - not derived recursively from received data.

Horizontal subsampling - not included.
Vertical subsampling - not included.
Temporal subsampling - picture basis only. Interpolated pictures are not placed in the picture memor
Quantizer selection - see also Section 1.4.

The coding algorithm will automatically permit the full quality of the source format specified in Section 1.1 to be realized on still pictures.

1.4 Forced Updating

There is no separate coding scheme for forced update. This function is achieved merely by forcing the use of the intra-picture mode of the coding algorithm. Since the decoder cannot distinguish between normal and forced update blocks, then there are no parameter to specify which are unique to forced update. The bitrate alotted to forced updating, the sequence in which blocks are updated etc, are not specified.

In order that the quality of forced update blocks can be sufficienty high at all times, quantizer selection must not be dependent solely on buffer fill state.

Forced updating by demand refreshing is employed on an optional basis in the two-way communication. If decoding error is detected in the decoder, the decoder send DRR = 1 (Demand refreshing request) to the coder using codec-to-codec information. Then, the coder will perform intraframe coding during one-frame period. The intraframe coding mode sends through type 1 information in the Picture attribute.

1.5 CMI and F-coder

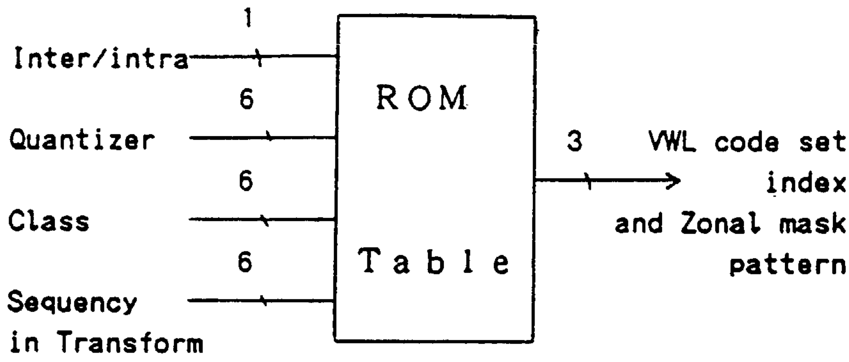
For further study.

1.6 Filter inside the coding loop

Adaptive filtering is used. Filter type and provision of adaptivity is for further study.

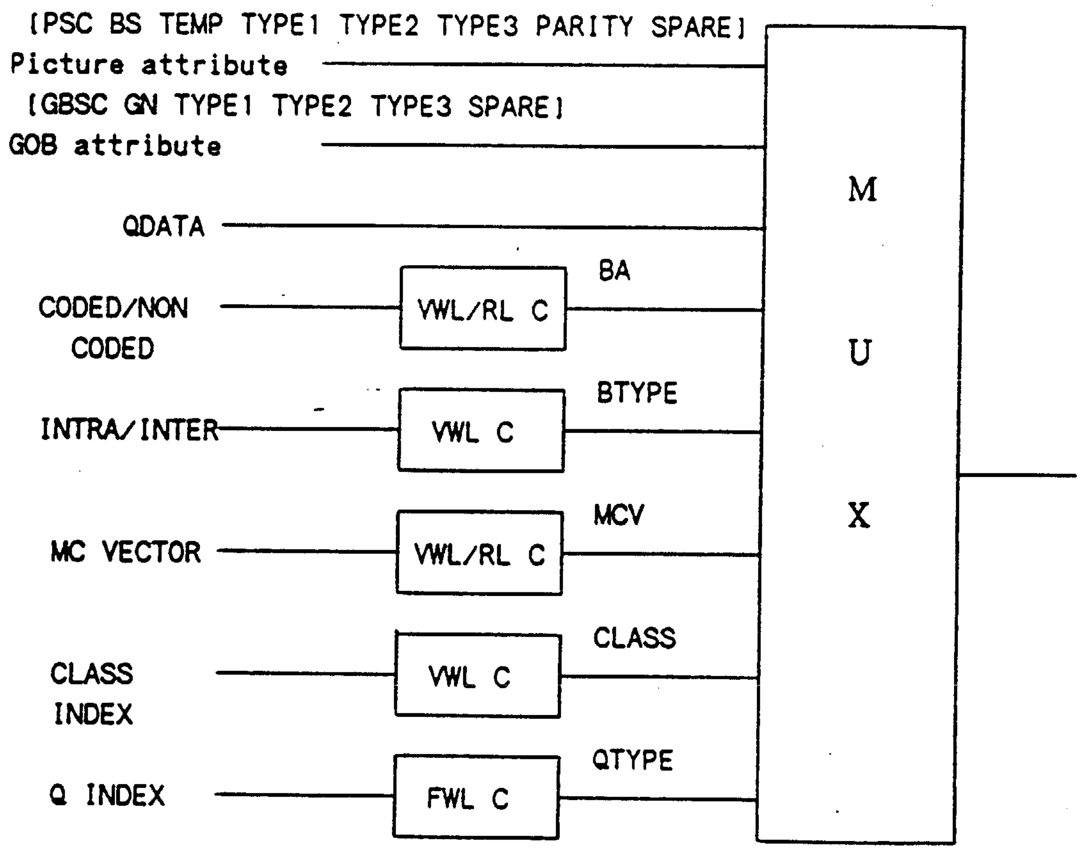
1.7 Post processing

For further study.



The number indicates bit length

Figure 7 The input and output of ROM table



VWL C : Variable word length coder
FWL C : Fixed word length coder
VWL/RL C : Variable word length and run length coder

Figure 8 Configuration of video multiplex coder

2. Video multiplex Coder

2.1 Tasks

The video multiplex coder has the following tasks:

1) Block address coding
2) Video data formatting and serializing
3) Synchronization - picture/line
4) Motion vector coding
5) Side channels for indicating dynamic coding parameters e.g., subsampling modes, quantizers, buffer state etc. (Permanent or transient channels? Transient channels require care in switched multipoint.)

Figure 8 shows the configuration of video multiplex coder. Layer structure is introduced in the multiplex coder for defining the following coding parameters.

(1) Intra/interframe mode,
(2) coded/non-coded,
(3) quantizer type and
(4) motion vectors

are multiplexed as the block attribute. As for the first three items, they are defined exclusively in the layers, namely, when all attributes in a GOB/Picture have the same value, the attributes are defined in the GOB/Picture and not defined in each block. As for motion vectors, on the other hand, they are provisionally defined in GOB and Picture basis, then re-defined in the lower layer, e.g., in block and GOB.

2.2 Video multiplex arrangement

9 lines deleted

2.2.1 Picture header

Configuration of the codes is shown in Figure 9.

	40 bits (8 x integer)								
PSC	BS	TEMP	TYPE1	TYPE2	TYPE3	SP	SI	PARITY	SPARE2
24 bits	6 bits	3 bits	4 bits	10 bits	6 bits	1 bit	2 bits	8 bits	24 bits

(1) PICTURE START CODE (PSC)
Provisionally, it is a unigue code of 24 bits.
[1000 0000 0000 0000 0000 0000]

(2) Buffer state (BS)
Coder buffer fullness information expressed in the unit of 1 Kbit. The value is sampled at the time of the top of the frame. (Six bits, MSB first)

(3) Temporal reference (TEMP)
Temporal reference is a 3 bit number representing the time sequence, in Common Intermediate Format picture periods, of a particular picture. MSB first.

(4) Type information
Three type information is used. Fixed length codes are employed.

-TYPE1
Type 1 indicates (1) Type 1 on/off, (2) Intra/interframe mode, (3) coded/non-coded mode. First bit indicates an insertion on/off. When the bit is 1, the type information is not defined in the picture attribute, but defined in the lower attributes, such as GOB and Block attributes. When the bit is 0, consecutive 2 bits indicates the modes of specific picture. Fixed length codes defined in Table 3 is employed.

-TYPE2
Type 2 indicates motion vector 'V'. Picture motion vector is inserted as 10 bit fixed codes. Ten bit informatin can be devided into first five bits and second five bits. First five bit code indicates horizontal motion and second indicates vertical motion, each in two's complement representation. MSB first. Type 2 informtion can be overridden (or redefined) in the lower attributes (GOB or Block).

-Type 3
Type 3 indicates quantizer type information. First bit indicates an insertion of the information. When the first bits is 1, the quantizer type is not defined in the picture attribute, but defined in the lower attributes. When the bit is 0, consecutive 5 bit code indicates the quantizer type as picture attribute.

(5) Spare information 1 (SPARE1)
For future use, spare bits are reserved. Definision is for further study

(6) Spare bit insertion information (SI)
The two bit code indicates PARITY and SPARE2 insertion. When the first

information is added. When the second bit is 1, spare information 2 is not inserted and no bit is reserved. When the bit is 0, 24 bit information is inserted.

(7) Parity information (PARITY)
For demand refreshing, parity information consisting of 8 bit code are inserted on an optional basis. Eight bit parity is inserted. MSB plane first. Each bit represents odd parity of each bit plane from the local decoded signals in the previous frame period.

(8) Spare information (SPARE2)
For future use, spare bits are reserved. Definition of the spare information needs further study.

9 lines deleted

2.2.2 Group of Block (GOB) header

32 bits (8 x integer)

GBSC	GN	TYPE1	TYPE2	TYPE3	SPARE1	SI	SPARE2
24 bits	5 bits	4 bits	10 bits	6 bits	6 bits	1 bit	16 bits

Figure 10 Configuration of the GOB attribute

The structure of GROUP OF BLOCK (GOB) is shown in Figure 10. Each GOB consists of two block-lines of Y signal with 8 lines by 352 pels and a block line of Cr and Cb with 8 lines by 176 pels.

The following data are inserted.

(1) Group of block start code (GBSC)
Provisionally, a unigue code of 24 bits.
[1000 0000 0000 0000 0000 1111]

(2) Number of group (GN)
The group number is a five bit number representing the vertical spatial position, in units of groups, of the current group of block. MSB first.

(3) Type information
-TYPE1
Type 1 indicates (1) intra/interframe mode and (2) coded/non-coded mode. This information is not inserted when defined in a higher (or picture) attribute. In the case that the information is not defined in the picture attribute, the GOB attributes work and the first bit indicates an insertion on/off. When the bit is 1, the mode information is not

defined in the GOB attribute, but defined in the lower (or block) attributes. When the bit is 0, consecutive 2 bit code indicates the modes as GOB attribute. Fixed length codes defined in Talbe 3 is employed.

-TYPE2

Type 2 indicates motion vector 'V'. Motion vector is inserted in 10 bit fixed codes. The same code pattern is used as the picture attribute. When the picture and GOB values are different, GOB vector is effective. Type 2 information can be overridden (or redefined) in the lower (or block) attributes.

-Type 3

Type 3 indicates quantizer type information. This information is not defined when the information is defined in a higher picture attribute. In the case that the information is not defined in the picture attribut(the GOB attributes work and the first bit indicates an insertion on/off. First bit indicates an insertion of the information. When the first bit: is 1, the quantizer type is not defined in the GOB attribute, but defined in the lower attribute. When the bit is 0, consecutive 3 bit code indicates the quantizer type as GOB attribute. The same code pattern as the block attribute is employed.

(4) Spare information 1 (SPARE1)

For future use, spare bits are reserved. Definision is for further study

(5) Spare bit insertion information (SI)

This bit indicates SPARE2 insertion. When the bit is 1, SPARE2 information is not inserted. When the bit is 0, 16 bit information is inserted.

(6) Spare information 2 (SPARE2)

For future use, additional spare bits are reserved. Definition of the information needs further study.

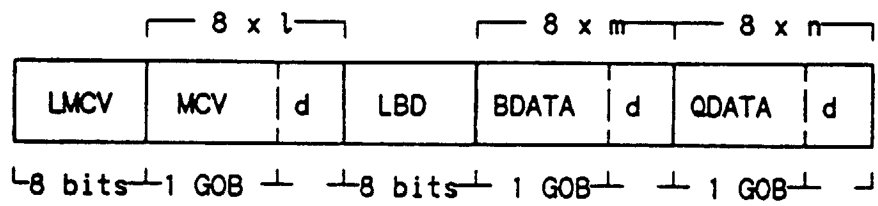
(7) Block data alignment

The data of block is inserted after the data of (1) to (6). Each data is constructed in a concentrated format of GOB unit. The order of the information is shown in Figure 11.

(1) MCV : Motion vector
(2) BDATA : Block data consisting of
  BA : Block address
  BTYPE : Block type
  CLASS : Classification index
  QTYPE : Quantizer type
(3) QDATA : Quantizing data

A Group of Blocks ...

Cr blocks and one line of Cb blocks. See Figure 12. In each GOB, e.g., MCV, BA, BDATA and QDATA, the information is arranged in the order as shown in Figure 12, in which two block lines of Y appear first, then C and Cb follow.



BDATA includes BA, BTYPE, CLASS, QTYPE and SPARE.
'l', 'm' and 'n' are integer values.
Dummy bits 'd' are inserted so that the length of data equals to 8 by integer.

Figure 11 The configuration of GOB data.

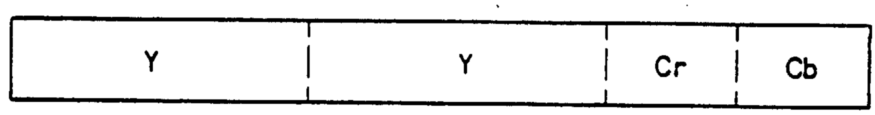


Figure 12 A group of blocks

2.2.3 Motion vector information (MCV)

LMCV is binary code word which indicates the Byte number 'l' of the following MCV (MSB first). Dummy '1' bits are added at the end of the information so that total length becomes a multiple of 8 bits.

- Coding method

Motion vector 'V' is first previous block predicted and the difference is variable length coded on a block by block basis. The prediction function is described as :

$$dv=v-v1,$$

where v and v1 indicates motion vector of current block and that of previous block. As the result of the prediction, the motion vector of horizontal and vertical direction is derived separately. As for Picture and GOB attribute, the motion vector is represented in fixed length cod of 10 bits, namely, 5 bits for horizontal and 5 bits for vertical. MSB first.

For the first block in a GOB, Picture motion vector or GOB motion vecto is used for predictive value v1.

- Variable length coding

The value of 'dv' is variable length coded. 88 vectors corresponding to the blocks of luminance signals are transmitted. Motion vectors for chrominance are not transmitted. The code set for motion vector is for further study. Maximum code length is 15. 961 codes are neccesary.

- Run length coding

Zero motion vectors are run length coded. Maximum code length is 15.

2.2.4 Block attribute information (BDATA)

LBD is binary code word which indicates the Byte number 'm' of the following BDATA (MSB first). Dummy '1' bits are added at the end of the information so that total length becomes a multiple of 8 bit.

Data specifying block address, block type, classification index and quantizer type are multiplexed on a block by block basis.

6 lines deleted

(1) Block address information (BA)

BA information is address information which indicates the position of coded/non-coded block. Address is generated when the block changes from coded block to non-coded or vice versa. Relative address which indicates the distance from the previous change position to the current change position is used. On the top of the GOB, absolute address from the first block to the current block is used. Variable length codes have 12 bit length at maxmum for relative address. For absolute address, 8 bit fixed codes are used, since 1 GOB has 132 blocks.

1. Address is continuous from luminace to chrominance.
2. The first block of GOB is assumed as Fixed (Not coded + interframe). BA alternates the mode.
3. VWL code pattern is for further study. 12 bits maximum.

7 lines deleted

(2) Block type information (BTYPE)

This variable length code indicates block attributes, such as intra-picture coded block, inter-picture coded block, future expansion on, future expansion off. As for the last two items, further study will be needed. The code pattern for block type is shown in Table 3. The decoder shall be designed to ignore all data between types 'future expansion on' and 'future expansion off' and also between 'future expansion on' and the next GBSC.

(3) Classification index (CLASS)

Classification index is variable length coded. The code pattern is for further study. Maximum code length is 8.

(4) Quantizer type (Q TYPE)

Fixed length code of five bits indicates quantizer type. The code '0' represents the finest quantizer. The code '31' represents the coarsest quantizer. MSB first.

Table 3 Code pattern of block type information

Block type information	(Fixed code)	VWL code
NOT CODED + INTER (FIX)	1 0	————
CODED + INTER	1 1	1
CODED + INTRA	0 1	0 1
FUTURE EXPANSION ON	—	0 0 1
FUTURE EXPANSION OFF	—	0 0 0 1

* Fixed codes are used in picture and GOB attributes.

2.2.6 Quantization data (Q DATA)

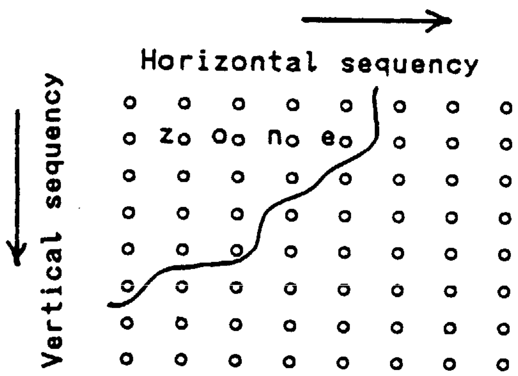
6 lines deleted

Dummy '1' bits are added at the end of the information so that total length becomes a multiple of 8 bits.

Horizontal scan is employed for multiplexing the coded data as shown in Figure 13. The outside area is skipped and not transmitted. It should be noted that even inside the zone, some coefficients are skipped according to the VWL code set assignment table. They are logically regarded as outside area.

2.3 Multipoint considerations

For further study.



3. Transmission Coder

3.1 The transmission coder assembles all data and interfaces to the digital line transmission system.

3.1.1 The data rate is n x 384 kbit/s where n is an integer between 1 and 5, both inclusive.

3.1.2 The coder channel output clock rate source shall be switchable between either a free running internal source or a source synchronized to the received data from the network. The mechanism for this switching is provisionally inslot signalling.

3.1.3 When in free running mode the tolerance on output clock rate will be +/- 50 ppm of nominal.

3.1.4 When in synchronized mode the synchronism should be maintained when the frequency of the received data clock is within +/- 50 ppm of nominal.

3.2 Framing Structure (See Fig. 14)

As per CCITT Study Group XV WP XV/1 Doc. #58 plus the following coding for the applications channel (8-th bit in Audio channel):

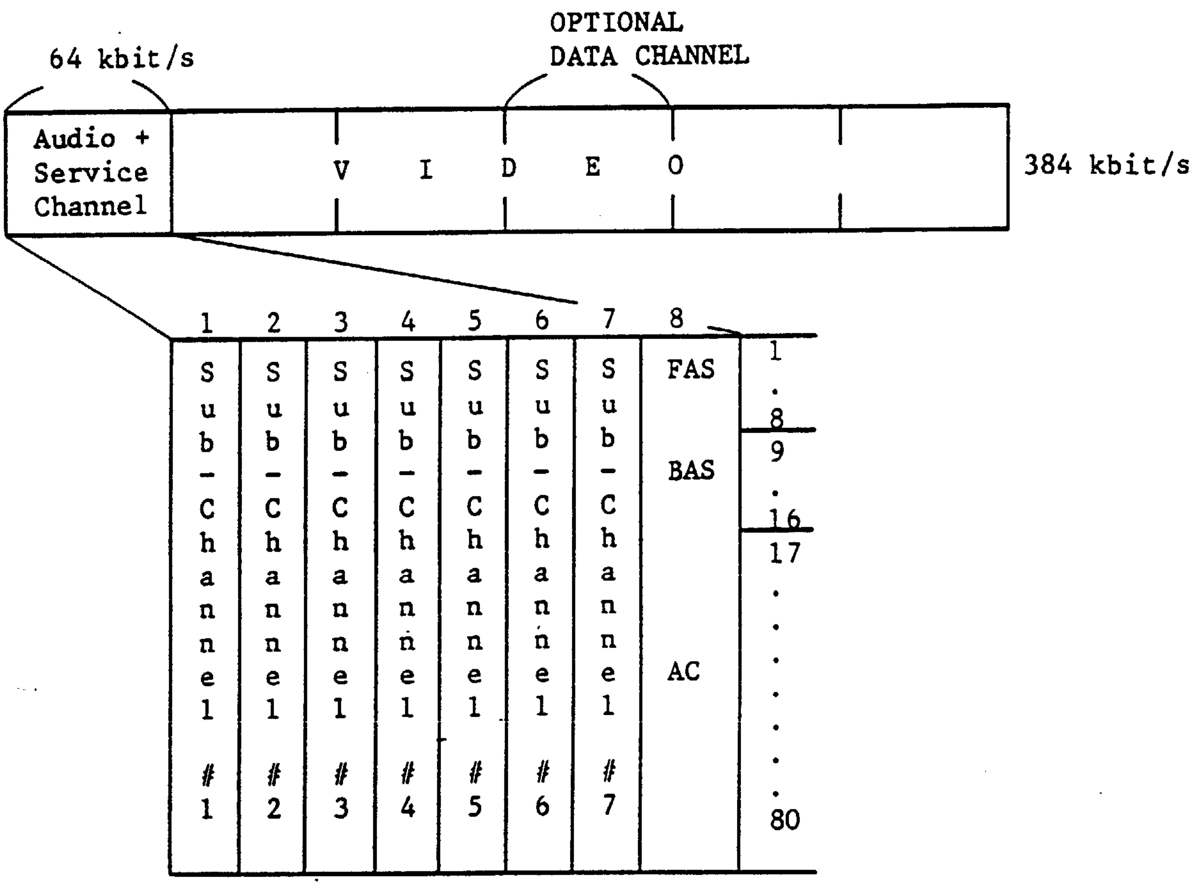
List of codec attributes/facilities/parameters needing transmission from transmitter to receiver is shown Table 4. The position of the information is for further study. No return path is assumed to confirm these attributes/facilities/ parameters.

One line deleted

Operability with audioconferencing. Timeslot positioning to CCITT Rec. I.431.

3.3 Video data buffering

The size of the transmission buffer at the transmitter is switchable from 8 Kbits to 64 Kbits, both inclusive, in steps of 8 Kbits. Buffer size should be related to the transmission rate (overall - not video) to ensure acceptable system delay.



FAS: Frame Alignment Signal (note 1)
BAS: Bitrate Allocation Signal
AC: Applicaion Channel

Note 1: The block termed as FAS contains also other information than for frame alignment purposes.

Figure 14 Frame Structure for n x 384 kbit/s codec (in case of n = 1)

Table 4 Codec attribute/facility/parameters in codec-to-codec information

Item	information		
CODEC ATTRI-BUTE	Video encryption	AVE	'1' : on
	Audio enctyption	AAE	'1' : on
	Error correction	AEC	'1' : on
	Backward channel	ABC	'1' : on
CODEC FACIL-ITY	Video encryption	FVE	'1' : provided
	Audio encryption	FAE	'1' : provided
	Error correction	FEC	'1' : provided
	Backward channel	FBC	'1' : provided
CODEC PARAM-ETERS			

The size of the transmission buffer shall be multiplied by the increase of transmission rate.

3.4 Video clock justification

Not provided.

3.5 Optional full spatial resolution mode data for quasi-stationary pictures. To be specified later if required.

3.6 Audio

As per CCITT Draft Rec. G.72Y type 2 terminal.

The audio channel is carried by the first time slot.

Flexible testbed hardware need only incorporate?
(64 kbit/s A-law
64 kbit/s u-law
56 kbit/s sub-band ADPCM according to CCITT Draft Rec. G.72X)

3.7 Error handling

3 lines deleted

A error correction coding is introduced. (4095,4035) BCH code may be suitable considering efficiency of the code. Error correction code design is for further study.

Besides forced refreshing, demand refreshing is implemented on an optional basis. Note that demand refresh for error correction requires back channel.

3.8 Encryption

Encryption is included on an optional basis. Its algorithm is for further study.

3.9 Data transmission

Framing structure to allow 2 data ports of 64 kbit/s each, though picture quality constraints may require only one to be available at 384 kbit/s. In this case time slot 4 is used.

3.10 Network interface (Table 5)

Access will be at the primary rate interface with vacated time slots.

(1) 2048 kbit/s interface
The digital interface is of CCITT Rec.G703/704. The interface code is B8ZS.

(2) 1544 kbit/s interface
The digital interface is of CCITT Rec.G703/704. The interface code is B8ZS and AMI.

Table 5 Time slot assignment for H0-channel
(1) 2048 kbit/s interface

H0 channel	a	b	c	d	e
Time slots used	1-2-3 17-18-19	4-5-6 20-21-22	7-8-9 23-24-25	10-11-12 26-27-28	13-14-15 29-30-31

(2) 1544 kbit/s interface

H0 channel	a	b	c	d
Time slots used	1 to 6	7 to 12	13 to 18	19 to 24

For each videoconferencing signal transmitted in an H0 channel of the table, the first time slot of the H0 channel is allocated to the audio/service channel and the fourth time slot may dynamically be allocated to a data channel. For video conferencing signals occupying n >= 2 H0 channels, a group of n adjacent H0-channel in the table is used. In this case only the leftmost channel of the group can carry an audio/service-signal and a data signal.