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

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TITLE : BASIC PARAMETERS OF 384 KBIT/S CODEC

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1. Introduction

In this contribution, basic parameters of 384 kbit/s codec are proposed as a first step of standardization. The aim is in contributing to realize single worldwide standard. The following items are studied in this contribution :

- digital video interface
- color signal treatment
- sampling frequency and structure
- number of pels to be coded
- allocation of television standards conversion
- digital interface

The basic parameters should be determined considering the following principles.

- Digital video standard
  To realize a single worldwide standardization, digital format video standard is pursued.

- Flexibility in conversion from analog format to digital format
  Flexible interface parameters should be selected whereby conversion from conventional analog standards into the digital standard is performed easily.

- Harmonization with the existing systems
  Although it is envisaged that conventional analog television standards will be replaced by CCIR 601 standard in the future, the basic parameters should take into account the harmonization with existing systems required during a transition period.

- Future improvements
  Standardized basic parameters should be able to accept future progress of technology.

2. Interface points

Two interface points of the codec, an analog interface point A and a digital interface point B shown in Figure 1, are taken into consideration. As we have to use conventional analog video standards such as NTSC, PAL, SECAM and their components, it is inevitable to employ multiple standards for the interface point A. Therefore, we should find a possibility of a single digital video standard for the interface point B. Conversion method from A to B is left to codec hardware implementation.

3 Multiplexed format of color signals

3.1 Three baseband signals

Luminance signal (Y) and two color signals (R-Y) and (B-Y).

3.2 Multiplexed format

Time division multiplexed signal. Details are for further study.

3.3 Dynamic range

For further study.

4 Virtual digital video Standard

4.1 Concept

The most important item in the digital video standard is the number of pels to be coded which are defined at the interface point B in Figure 1. Since a suitable number of coded pels are varied with analog TV standards, a concept of virtual digital video standard need be introduced in order to treat the signals the same way even if digitized input signals are having different number of pels. In this method, the picture size of coded pels (N samples by L lines in a field) is given as slightly larger than a range of parameters which are derived from conventional analog standards. The difference of picture size is compensated by inserting 0 level pels in non-picture area. This insertion will not affect the coding efficiency of the source coder.

4.2 Picture size of virtual digital video standard

As for the picture size in virtual digital video standard, the following conditions should be taken into consideration :

- The numbers of samples and lines of Y signal (N_Y and L_Y) and those of C signal (N_C and L_C) should be integral multiples of m-th power of two so as to simplify the coding process.

- All the active pels excluding blanking interval should be coded.

- The picture size of virtual digital video standard should include a family of CCIR 601 standard so as to simplify coding process of such signal. In particular, 360 pels of N_Y which are the half of nominal number of Y pels should be included in the virtual standard.

- The number of coding pels should be the same level as that of the present primary rate codecs so as to enable picture quality improvements when the future technology progress will be applied or when the 384 x n ($n \geq 2$) kbit/s rate transmission will be used.

- The number of C pels should be 1/6 horizontally and 1/2

vertically of Y pels to keep sufficient bandwidth for teleconferencing.

Therefore, the size of virtual digital video standard is proposed as :

Y	:	384 pels and 288 lines per field
B-Y	:	64 pels and 144 lines per field
R-Y	:	64 pels and 144 lines per field.

As for field frequency aspect, no explicit definition is made since source coder processes the signals as they are input accepting both of 50 Hz and 60 Hz.

Virtual digital video signals are 2:1 interlaced.

4.3 Configuration of inter-regional and intra-regional connections

In inter-regional and intra-regional connections of codecs, the following two principles are considered:

- In inter-regional connections, a single number of active pels in a line (360 pels in Y) should be adopted.

- In intra-regional connections, a limited number of varieties should be allowed in order to facilitate local analog standard in the region. In NTSC region at least, 360 pels (which corresponds to 13.5 MHz sampling frequency) and 384 pels (which corresponds to 14.3 MHz sampling frequency) in Y are allowed, because 13.5 MHz sampling will prevail in the future and some facilities which process signals in NTSC format have already been introduced in the network.

(1) Inter-regional connection

Inter-regional connection is shown in Figure 2-a. Only 360 pels picture is transmitted. Therefore, sampling number conversion should be employed in the sending side input video processor if the number of active samples is different from 360 due to different sampling frequency.

(2) Intra-regional connection

In intra-regional connection, three types can be considered as shown in Figure 2,

- Type A: Codec treats only 360 pels picture, which is similar to the inter-regional connection.

- Type B: The output video processor in the receiving side is equipped with 360 pels interface and 384 pels interface. The sending side input video processor is allowed to have only 384 pels interface. In this arrangement, however, optional interface enabling inter-regional connection have to be introduced, when inter-regional operation is needed.

- Type C: Both the video input processor and the video output processor in the system are equipped with 360 pels interface. Type A is included in Type C as a subset.

Type C is proposed because of the following reasons:

- It gives a solution to the transition problem from the present analog composite video standard to the future CCIR 601 digital component standard.

- It can provide better picture quality for intra-regional connections using 384 pels format without sample number conversion.

4.4 Facility information transmission regarding picture size

Facility information which defines coding picture size (e.g. 360 pels and/or 384 pels in Y signals) need be transmitted. When a size, other than 360 and 384, is introduced, it should be also included in this facility information. If two picture sizes, e.g. 360 and 384 pels sizes are defined, two bit information, which represents whether the codec is able to operate in 360 size or 384 size or both, is transmitted through codec-to-codec information channel. Operation mode of codec is set by handshaking between codecs. Relationship between operation mode and facility information is shown in Table 1.

5 Sampling frequency and codec operation rate

Limited number of sampling frequencies of video input processor are defined. In inter-regional connection only 13.5 MHz sampling frequency is used and in intra-regional connection 13.5MHz and 14.3 MHz frequencies are used in NTSC region, considering that the suitable sampling frequency is varied according to which of composite or component analog standard is employed. Precise sampling frequency information is need to be transmitted for synchronous operation in order to avoid frame slip due to sampling frequency difference between coder and decoder.

Codec operation rate need not be strictly defined. Codec operates in variable rate corresponding to the input picture standard. The relationship between sampling frequency and codec operation frequency will be described in detail in the companion document concerning the basic architechture.

6. Pel alignment

The pel alignment needs further study. In Y signal, three possibilities shown in Table 2 are taken into consideration. Pels need be located on the identical positions between the frames.

7. Allocation of Television Standards Conversion

Conversion is made by

- providing Television Standard Converter function in video output on an optional basis, and

- transmitting facility information indicating 625/50 or 525/60

signal through codec-to-codec information channel.

Variety of interconnections are shown in Figure 3. The line number converter performs line interpolation by means of line memories. Video output processor converts field frequency by means of frame elastic memory. Therefore, we can say that a single standard and a single hardware codec is attained because sample number conversion, television standard conversion and other required functions derived from different analog standards are provided in the video input and output processors.

8. Digital interface

8.1 Codec allocation

The digital interface of the codec should be defined for the following cases:

- When codecs are installed in the customer equipment, and
- When codecs installed inside the network.

8.2 Interface of cumtomer codec

Recommendation I.431 "Primary Rate User-network Interface - Layer 1 Specification" should be applied to user-network interface.

8.3 Interface of network codec

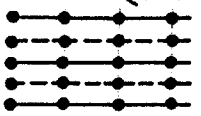
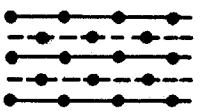
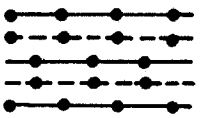
Interface of 384 kbit/s rate between codec and transmission equipment such as multiplexer has not been recommended at present. SGXVIII (Question 23/XVIII General Aspects of Interfaces) is requested to study this item. When primary-rate interface is used in which 384 kbit/s channel rate is allocated for coded data, Recommendation G.703 "Physical/electrical characteristics of hierachical digital interfaces" and G.704 "Functional characteristics of interfaces associated with network nodes" are applied.

Table 1 Facility information and codec operation

COD facility \ DEC facility	360	360 and 384
360	360	360
360 and 384	360	384

Note : Number represents coding picture size of Y signal

Table 2 Pel alignment in Y signal

NUMBER	Phase between lines	Phase between fields	Pel alignment
1	0°	0°	(note) 
2	0°	180°	
3	180°	—	

Note : Pels on dotted lines are in the first field and pels on solid lines are in the second field.

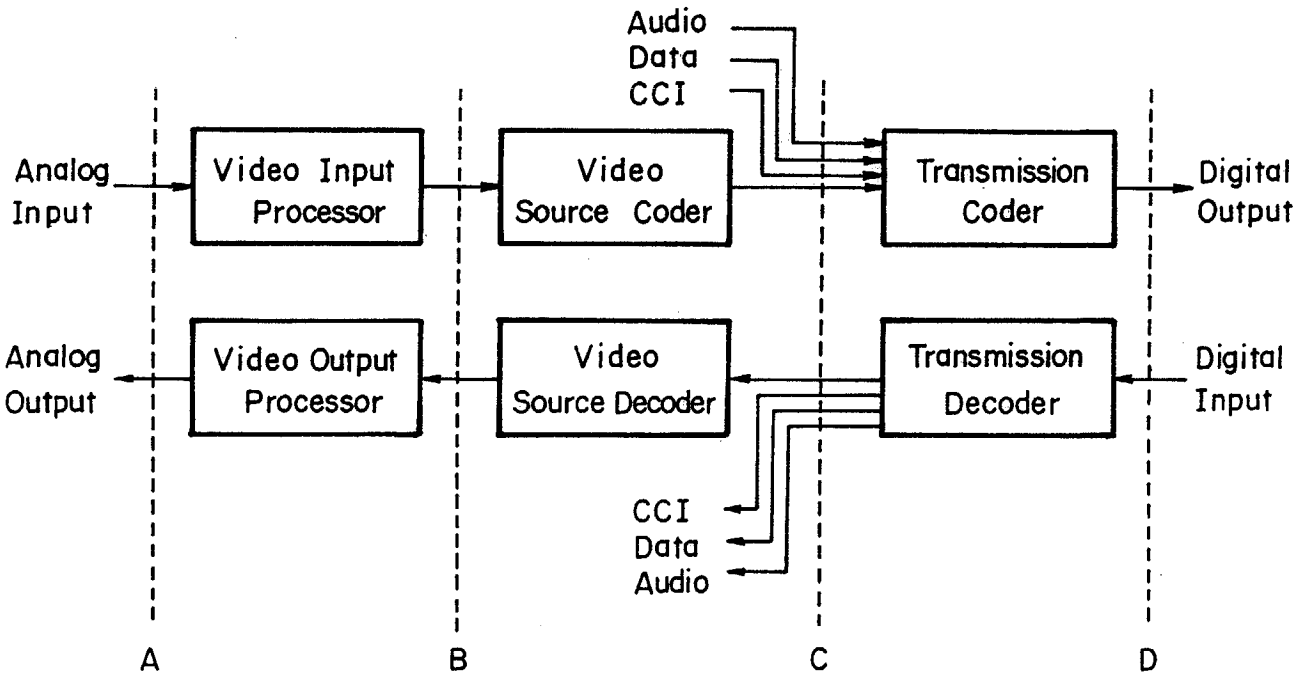


Figure 1 A basic configuration of sub-rate codec and signal interfaces.

Note 1 : Video source coder (decoder) consists of video compression coder (decoder) and data compression coder (decoder).

Note 2 : CCI represents Codec-to-codec information

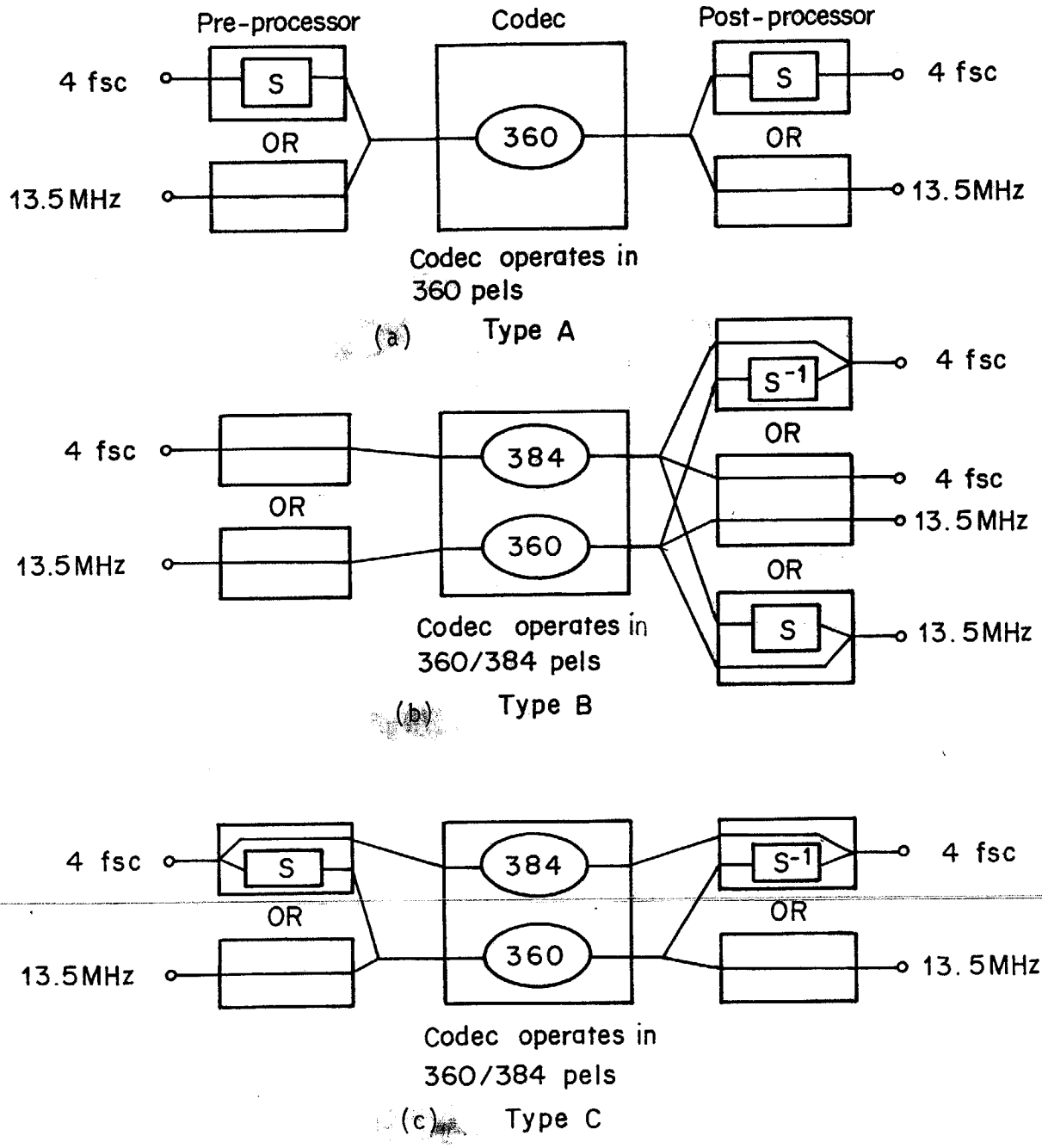


Figure 2 Three types of connections focusing on codec picture size

Note 1 : CODEC includes source coder/decoder, transmission coder/decoder and transmission line. Since this codec works transparently for input video signals, Video I/O Processor compensates the difference of picture size.

Note 2 : S represents Sample number conversion (from 384 to 360) and S^{-1} represents Sample number inverse conversion (from 360 to 384).

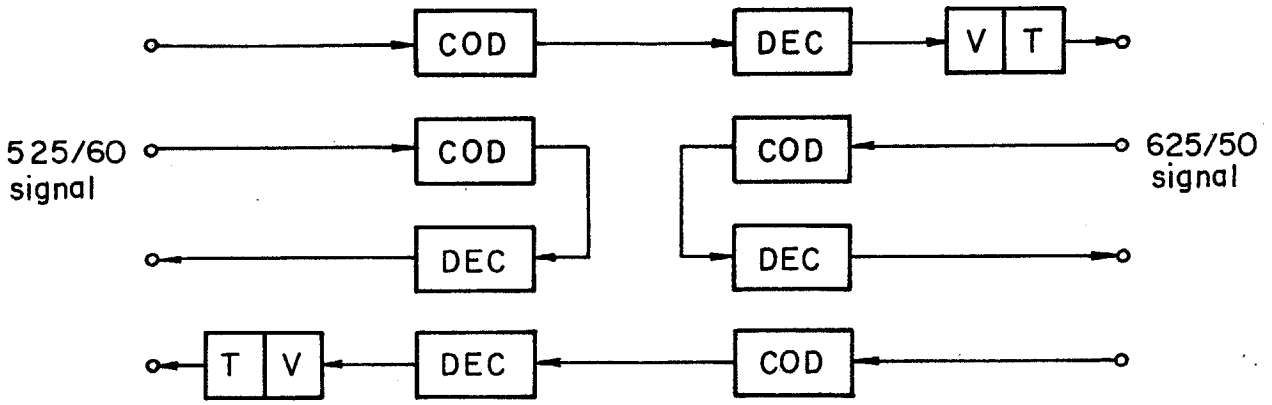


Figure 3 Interconnections between 525/60 and 625/50 conversion systems

Note : COD, DEC, V and T indicate coder, decoder, vertical line converter and temporal field converter, respectively.