C.C.I.T.T.
STUDY GROUP XV WP XV/1
Specialist Group on Picture Coding
Ipswich 20-24 January 1986

DOC # 58

English Version

Source : FRANCE

Title :

SYNCHRONISATION ASPECTS IN THE FRAMING STRUCTURE

1 - INTRODUCTION

The principles presented at the last meeting are furthermore developed in this contibution. A detailed procedure for frame synchronisation and configuration description is given. Also a first trial in describing side information necessary for a teleconference service is made.

The basic hypothesis of the videoconference frame structure are reminded (please refer to the previous French contribution Doc.#34) :

- The six videoconference time slots of the 384 kbit/s channel are divided into one time slot for audio (including the Service Channel) and five time slots for moving video, one of them capable of being dynamically allocated to data.

- The audio time slot contains an 8 kbit/s Service Channel ~~including 800 bit/s for the Frame Alignment Signal (FAS), 800~~ bit/s for the Bitrate Allocation Signal (BAS) and 6400 bit/s returned to the user as the Application Channel (AC).

- The Application Channel contains all side information necessary for a proper working of the teleconference service, including the Message Channel.

The following paragraphs describe the Service Channel.

.../...

2 - BASIC PRINCIPLE

The 64 kbit/s channel is structured into 8-bit bytes transmitted at 8,000 Hz. The least significant bit (note 1) of each byte conveys a sub-channel of eight kilobits per second. This sub-channel, called Service Channel (SC), provides end-to-end signalling and consists of three parts (see figure 1) :

- Frame Alignment Signal (FAS). This signal allows to structure the 64 kbit/s channel into frames of 80 bytes each and multiframes (MF) of 16 frames each. Each multiframe is divided into two 8-frame submultiframes (SMF).

- Bitrate Allocation Signal (BAS). This signal allows the transmission of Codewords to describe the structure of the residual 56 kbit/s channel, as well as the structure of the primary rate multiplex in which the audio 64 kbit/s channel is inserted, in the case of n x 384 kbit/s videoconference.

- Application Channel (AC) or Service Dedicated Information. This channel allows transmission of binary information or the insertion of message-type data channel(s) up to 6400 bit/s.

The residual 56 kbit/s channel, carried in bits 1-7 of each byte, is used to carry sound, coded at 56 kbit/s with a bandwith 50-7000 Hz (sub-band ADPCM according to CCITT Draft Recommendation G72X). As the coding algorithm is also capable to work at 48 kbit/s (bitrates of 40 or 32 kbit/s with a reduced quality are under study), data can then be dynamically inserted at 8, 16 or 24 kbit/s.

Note 1 : This position could be modified depending on requirements from North-American networks.

3 - FRAME ALIGNMENT

3.1. General

An 80-byte frame length produces an 80-bit word in the Service Channel. Those 80 bits are numbered 1-80. Bits 2-8 of every other frame contain 0011011 and are the Frame Alignment Word (FAW). Those bits are completed by bit 2 in every alternate frame (those not containing the FAW) to form the complete Frame Alignment Signal. The same pattern as in CCITT Recommendation G704 is used (see figure 2).

3.2. Multiframe structure.

Each multiframe contains 16 consecutive frames numbered 0 to 15 thus making 2 submultiframes of 8 frames each. The multiframe alignment signal is located in bit 1 of frames 1-3-5-7-9-11 and contains 001011. Bits 1 of frames 0-2-4-6-8-10-12-13-14-15 are reserved. Their value is provisionally fixed to 0. (figure 3).

The loss and recovery procedures for frame and multiframe alignment may be inspired from G704.

4 - BITRATE ALLOCATION SIGNAL (BAS)

The Bitrate Allocation Signal (BAS) occupies bits 9-16 of every frame. It is repeated 8 times along the same submultiframe. A majority decision (5 out of 8) allows the validation of BAS. The validated value of BAS applies to the next submultiframe. A change in configuration can then occur at submultiframe rate, ie every 80 ms. In case of loss of frame or multiframe alignment, the BAS should keep the same value as the previously validated one, until frame and multiframe alignment are recovered.

The encoding of BAS is made in accordance with the attribute method :

The three first bits (bits 9-10-11) represent the attribute number relevant to the description of the configuration. For teleconference, two attributes are defined: the Audio Coding (attribute 000) and the Transfer Rate (attribute 001). Other attributes may be defined if needed.

Bits 12-16 of each frame represent the values of the attributes and describe the used configuration.

Figure 4 gives the coding of BAS for attributes 000 and 001.

5 - APPLICATION CHANNEL (AC)

It occupies bits 17-80 of each frame, making a user-available bitrate of 6400 bit/s. The contents of this channel depends on the definition of the audio- and the videoconference services. They must be common to both in order to ensure compatibility between them. The following arrangement might be taken as a working basis :

- Bits 17-24 : Telewriting at 800 bit/s. This real-time interactive facility needs a permanent dedicated path since it requires no or very little transmission delay. The use of a dynamically allocated path would introduce some delay for channel opening/releasing. Also the mixing with other information in a packet-type channel would require layer 3-4-5 protocols, which would also introduce delay, unneeded complexity and bitrate wasting. A dedicated path requires at most a layer 2 protocol (eg HDLC).

- Bits 25-32 : Audio identifier. This word contains information about the microphone number and the speech power. This may be used for speaker identification and switched audio systems (as in ciphered multipoint).

- Bits 33-40 : Videoconference information. Both previous bytes are common to audio- and video-conference. However it may be needed to transmit information specific to videoconference as those related to video equipment. As much as possible of this information should be carried together with the video multiplex at block rate or frame rate (eg codec-to-codec information or split-screen indication). But this is not always possible, if much lower bit rates are needed than at frame rate. By using multiframing, each of bits 33-40 may represent up to sixteen binary elements of information. Their structure is of the form a.b where a is the bit number (33 to 40) and b is the frame number (0 to 15) in a multiframe. Examples of such information might be :

  Error correction,
  Encryption parameters,
  Graphics mode indication,
  Synchronisation of the transmit clock onto the receive clock,
  Loop order, etc.

- Bits 41-80 : Message Channel as in H130.

6 - ACCESS TO DATA IN THE 56 KBIT/S RESIDUAL CHANNEL

The 56 kbit/s residual channel, when used with sound coded according to draft Recommendation G72X, allows the static or dynamic allocation of data channels at nx8 kbit/s. The access to those channels could be done according to standardised procedures (eg I461, I462, I463 or ECMA-TAxx...).

The 56 kbit/s residual channel may also be used to transmit data only.

7 - CONCLUSION

A very reliable frame structure for audio- and videoconference has been defined which makes the best use of the characteristics and properties of the audio compression algorithm, of the transmission framing structure and of the existing CCITT recommendations. It offers several advantages :

- It takes into account CCITT recommendations as G704, X30/I461, etc... and may make use of existing hardware or software.

- It is simple, economic and flexible. It may be implemented on a simple microprocessor with very well known hardware principles.

- It is a synchronous procedure. The exact time of a configuration change is the same in the transmitter and the receiver. Configurations can be changed at 80 ms intervals.

- It needs no return link, since a configuration is signalled by a continuously transmitted codeword.

- It is very secure in case of transmission errors, since the BAS is repeated 8 times with a majority logic decision.

- It may be used compatibly with audio- and videoconference.

- It can be used to derive byte sync in IDN's when it is not available.

- It can be used in multipoint, where no dialogue is needed to negociate the use of a data channel.

- It provides a variety of data bitrates (from 6.25 bit/s up) to the user.

1	2	3	4	5	6	7	8	
Sub-Channel 1 # 1	Sub-Channel 1 # 2	Sub-Channel 1 # 3	Sub-Channel 1 # 4	Sub-Channel 1 # 5	Sub-Channel 1 # 6	Sub-Channel 1 # 7	FAS	1 . 8
							BAS	9 . 16
							AC	17 80

Figure 1. Frame structure

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

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

SUCCESSIVE FRAMES / Bit #	1	2	3	4	5	6	7	8
Even frames (those containing FAW)	Mi Note1	0	0	1	1	0	1	1
		Frame Alignment Word						
Odd frames	Mi	1	A	E	C1	C2	C3	C4
	Note1	Note2	Note3	Note 4				

Figure 2. Assignment of bits 1-8 of each frame.

Note 1 : Mi - Bits reserved for multiframing.

Note 2 : Bit used to avoid simulation of FAW by a frame-repetitive pattern.

Note 3 : A - Remote Alarm Indication. This bit is set to 1 to signal the following fault conditions:
- Failure of power supply.
- Failure of equipment (to be further studied).
- Loss of frame alignment.

Note 4 : The use of bits E and C1-C4 is under study.

.../...

	Sub-Multi-Frame	Frame	Bits 1 to 8 in every frame							
			1	2	3	4	5	6	7	8
Multiframe	SMF 1	0	R1	0	0	1	1	0	1	1
		1	0	1	A	E	C1	C2	C3	C4
		2	R2	0	0	1	1	0	1	1
		3	0	1	A	E	C1	C2	C3	C4
		4	R3	0	0	1	1	0	1	1
		5	1	1	A	E	C1	C2	C3	C4
		6	R4	0	0	1	1	0	1	1
		7	0	1	A	E	C1	C2	C3	C4
	SMF 2	8	R5	0	0	1	1	0	1	1
		9	1	1	A	E	C1	C2	C3	C4
		10	R6	0	0	1	1	0	1	1
		11	1	1	A	E	C1	C2	C3	C4
		12	R7	0	0	1	1	0	1	1
		13	R9	1	A	E	C1	C2	C3	C4
		14	R8	0	0	1	1	0	1	1
		15	R10	1	A	E	C1	C2	C3	C4

Figure 3. Assignment of bits 1-8 of each frame in a multiframe

R1-R10 : Reserved - Provisionally set to 0

A, E, C1-C4 : As in figure 2.

Attribute Bits 9-11	Attrib. value Bits 12-16	Meaning
000 Audio Coding	00000	A-law PCM (truncated to 7 bits)
	00001	u-law PCM (truncated to 7 bits)
	01000	56 kbit/s SB-ADPCM G72X (note 1)
	01001	48 kbit/s SB-ADPCM G72X
	01010	40 kbit/s
	01011	32 kbit/s
	01111	0 kbit/s data at 56 kbit/s (note 2)
001 Transfer Rate (Provisional values)	00000	64 kbit/s
	00001	64 kbit/s(audio)+64 kbit/s(data or video)
	00010	384 kbit/s : 64(audio)+ 320(video)
	00011	64 " 256 " +64(data)
	00100	768 kbit/s : 64 " 704 "
	00101	64 " 640 " 64 "
	00110	1152 kbit/s : 64 " 1088 "
	00111	64 " 1024 " 64 "
	01000	1536 kbit/s : 64 " 1472 "
	01001	64 " 1408 " 64 "
	01010	1920 kbit/s : 64 " 1856 "
	01011	64 " 1792 " 64 "

Figure 4. Attributes used for BAS encoding

Note 1 : The allocation of bits in each byte of the 64 kbit/s channel is as following:

Audio bitrate	1	2	3	4	5	6	7	8
64 kbit/s	H	H	L	L	L	L	L	L
56 kbit/s	H	H	L	L	L	L	L	S
48 kbit/s	H	H	L	L	L	L	D	S
40 kbit/s	D	D	L	L	L	L	L	S
32 kbit/s	D	D	L	L	L	L	D	S

S = Service channel
H = High band audio
L = Low band audio
D = Data channel

Bitrates of 56 and 48 kbit/s are respectively modes 2 and 3 of draft recommendation G72X.
Bitrates of 40 and 32 kbit/s are not taken into account by G72X.

Note 2 : The whole of the 56 kbit/s is used for data and the audio channel is muted.