INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

H.221

(11/1988)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS
Transmission multiplexing and synchronization

FRAME STRUCTURE FOR A 64 kbit/s CHANNEL IN AUDIOVISUAL TELESERVICES

Reedition of CCITT Recommendation H.221 published in the Blue Book, Fascicle III.6 (1988)

NOTES

1 CCITT Recommendation H.221 was published in Fascicle III.6 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation H.221

FRAME STRUCTURE FOR A 64 kbit/s CHANNEL IN AUDIOVISUAL TELESERVICES

(Melbourne, 1988)

Introduction

The purpose of this Recommendation is to define a frame structure for audiovisual teleservices in a single 64 kbit/s channel which makes the best use of the characteristics and properties of the audio/video encoding algorithms, of the transmission framing structure and of the existing CCITT Recommendations. It offers several advantages:

– It takes into account Recommendations such as G.704, X.30/I.461, etc. It may allow the use of existing hardware or software.

– It is simple, economic and flexible. It may be implemented on a simple microprocessor, using 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 20 ms intervals.

– It needs no return link, since a configuration is signalled by a repeatedly transmitted codeword.

– It is very secure in case of transmission errors, since the BAS is protected by a double error correcting code.

– It allows the control of a higher multiplex configuration, into which the basis 64 kbit/s channel is inserted (in the case of n × 64 kbit/s multimedia services such as videoconference).

– It can be used to derive octet synchronization in networks where this is not provided by other means.

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

– It provides a variety of data bit-rates (from 6.25 bit/s up to 64 kbit/s) to the user.

1 Basic principle

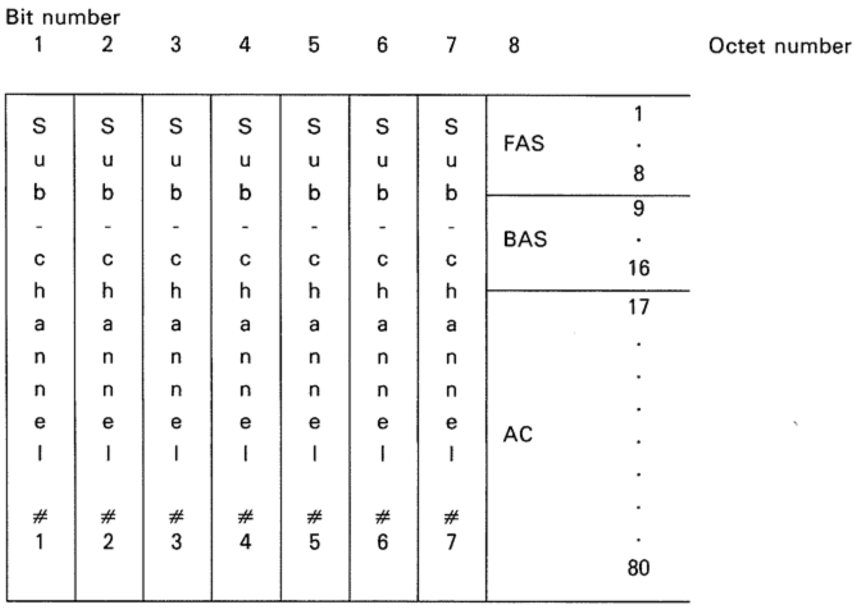
The 64 kbit/s channel is structured into octets transmitted at 8 kHz. The eighth bit of each octet conveys a subchannel of 8 kbit/s. This subchannel, called service channel (SC), provides end-to-end signalling and consists of three parts (see Figure 1/H.221):

– *Frame alignment signal* (FAS): This signal structures the 64 kbit/s channel into frames of 80 octets each and multiframes (MF) of 16 frames each. Each multiframe is divided into eight 2-frame submultiframes (SMF): In addition to framing and multiframing information, control and alarm information may be inserted, as well as error check information to control end-to-end error performance and to check frame alignment validity. The FAS can be used to derive octet timing when it is not provided by the network.

– *Bit-rate alloction signal* (BAS): This signal allows the transmission of codewords to describe *the capability* of a terminal to structure the residual 62.4 kbit/s capacity in various ways, and to *command* a receiver to demultiplex and make use of the constituent signals in such structures; if other 64 kbit/s channels are associated, as in the case of n × 64 kbit/s services (e.g. videoconference, videophone), this association may also be defined.

Note – For some countries having 56 kbit/s channels, the net available bit rates will be 8 kbit/s less.

– *Application channel* (AC): This channel allows transmission of binary information of the insertion of message type data channel(s) (e.g. for telematic information) at up to 6400 bit/s. A minimum required command and indication channel should be provided and defined as part of the application channel (for further study). The remaining bit rate for the application channel may be added to the sound data or video channel. In this context, compatibility problems among audiovisual services should be considered.



FAS Frame Alignment Signal (Note)

BAS Bit-rate Allocation Signal

AC Application Channel

Note – The block termed as FAS also contains information other than that used for frame alignment.

FIGURE 1/H.221

Frame structure

The remaining 56 kbit/s capacity (with fully reserved application channel), carried in bits 1 to 7 of each octet, may convey a variety of signals within the framework of a multimedia service, under the control of the BAS and possibly the AC. Some examples follow:

– Voice, encoded at 56 kbit/s using a truncated form of the PCM of Recommendation G.711 (A-law or μ-law).

– Voice, encoded at 32 kbit/s and data at 24 kbit/s or less.

– Voice, encoded at 56 kbit/s with a bandwidth 50 to 7000 Hz (sub-band ADPCM according to Recommendation G.722). The coding algorithm is also able to work at 48 kbit/s. Data can then be dynamically inserted at up to 14.4 kbit/s.

– Still pictures coded at 56 kbit/s.

– Data at 56 kbit/s inside an audiovisual session (e.g. file transfer for communicating between personal computers).

– Sound and video sharing the 56 kbit/s capacity.

2 Frame alignment

2.1 *General*

An 80-octet frame length produces an 80-bit word in the service channel. These 80 bits are numbered 1 to 80. Bits 2-8 of the service channel in every even frame contain the frame alignment word (FAW) 0011011. These bits are completed by bit 2 in the succeeding odd frame to form the complete frame alignment signal (FAS).

So a pattern similar to the one in Recommendation G.704 is used (see Figure 2/H.221).

Successive frames	Bit No. 1	2	3	4	5	6	7	8
Even frames (those containing FAW)	(Note 1)	0	0 (Frame alignment word)	1 (Frame alignment word)	1 (Frame alignment word)	0	1	1
Odd frames	(Note 1)	1 (Note 2)	A (Note 3)	E	C1 (Note 4)	C2 (Note 4)	C3	C4

Note 1 – See § 2.2 and Figure 3/H.221.

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

Note 3 – A – Loss of either frame or multiframe alignment indication (0 = alignment, 1 = loss).

Note 4 – The use of bits E and C1-C4 is described in § 2.6.

FIGURE 2/H.221

Assignment of bits 1-8 of the service channel in each frame

2.2 *Multiframe structure*

Each multiframe contains 16 consecutive frames numbered 0 to 15 divided into eight submultiframes of 2 frames each (Figure 3/H.221). The multiframe alignment signal is located in bit 1 of frames 1-3-5-7-9-11 and has the form 001011. Bits 1 of frames 8-10-12-13-14-15 are reserved for future use. Their value is provisionally fixed at 0.

Bits 1 of frames 0-2-4-6 may be used for a modulo 16 counter to number multiframes in descending order. The least significant bit is transmitted in frame 0, and the most significant bit in frame 6. The receiver may use the mutiframe numbering to determine the differential delay of separate 64 kbit/s connections, and to synchronize the received signals. The use of an additional reserved bit in frame 8 to turn on and off the counting procedure is for further study.

2.3 *Loss and recovery of frame alignment*

Frame alignment is defined to have been lost when three consecutive frame alignment signals have been received with an error.

Frame alignment is defined to have been recovered when the following sequence is detected:

– for the first time, the presence of the correct frame alignment word;

– the absence of the frame alignment signal in the following frame detected by verifying that bit 2 is a 1;

– for the second time, the presence of the correct frame alignment word in the next frame.

When the frame alignment is lost, bit 3 (A) of the next odd frame is set to 1 in the transmit direction.

If frame alignment is achieved, but multiframe alignment cannot be achieved, then frame alignment should be sought at another position.

	Sub multiframe	Frame	Bits 1 to 8 of the service channel in every frame							
			1	2	3	4	5	6	7	8
Multiframe	SMF 1	0	N1	0	O	1	1	0	1	1
		1	0	1	A	E	C1	C2	C3	C4
	SMF 2	2	N2	0	O	1	1	0	1	1
		3	0	1	A	E	C1	C2	C3	C4
	SMF 3	4	N3	0	O	1	1	0	1	1
		5	1	1	A	E	C1	C2	C3	C4
	SMF 4	6	N4	0	O	1	1	0	1	1
		7	0	1	A	E	C1	C2	C3	C4
	SMF 5	8	N5	0	O	1	1	0	1	1
		9	1	1	A	E	C1	C2	C3	C4
	SMF 6	10	R1	0	O	1	1	0	1	1
		11	1	1	A	E	C1	C2	C3	C4
	SMF 7	12	R2	0	O	1	1	0	1	1
		13	R3	1	A	E	C1	C2	C3	C4
	SMF 8	14	TEA	0	O	1	1	0	1	1
		15	R4	1	A	E	C1	C2	C3	C4

R1-R4 Reserved for future use (provisionally set to 0).

A, E, C1-C4 As in Figure 2/H.221.

N1-N4 Used for multiframe numbering as described in § 2.2. Set to 0 while numbering is inactive.

N5 Reserved for an indicator of whether multiframe numbering is active or inactive. Currently set to 0.

TEA The terminal equipment alarm is set to 1 while an internal terminal equipment fault exists such that it cannot receive and act on the incoming signal. Otherwise it is set to 0.

FIGURE 3/H.221

Assignment of bits 1-8 of the service channel in each frame in a multiframe

2.4 *Loss and recovery of multiframe alignment*

Multiframe alignment is needed to validate the bit-rate allocation signal (see § 3). The criteria for loss and recovery of multiframe alignment described below are provisional.

Multiframe alignment is defined to have been lost when three consecutive multiframe alignment signals have been received with an error. It is defined to have recovered when the multiframe alignment signal has been received with no error in the next multiframe. When multiframe alignment is lost, even when an unframed mode is received, bit 3 (A) of the next odd frame is set to 1 in the transmit direction. It is reset to 0 when multiframe alignment is regained again.

2.5 *Procedure to recover octet timing from frame alignment*

When the network does not provide octet timing, the terminal may recover octet timing in the receive direction from bit timing and from the frame alignment. The octet timing in the transmit direction may be derived from the network bit timing and an internal octet timing.

2.5.1 *General rule*

The receive octet timing is normally determined from the FAS position. But at the start of the call and before the frame alignment is gained, the receive octet timing may be taken to be the same as the internal transmit octet timing. As soon as a first frame alignment is gained, the receive octet timing is initialized as the new bit position, but it is not yet validated. It will be validated only when frame alignment is not lost during the next 16 frames.

2.5.2 *Particular cases*

a) When, at the initiation of a call, the terminal is in a forced reception mode, or when the frame alignment has not yet been gained, the terminal may temporarily use the transmit octet timing.

b) When frame alignment is lost after being gained, the receive octet timing should not change until frame alignment is recovered.

c) As soon as frame and multiframe alignment have been gained once, the octet timing is considered as valid for the rest of the call, unless frame alignment is lost and a new frame alignment is gained at another bit position.

d) When the terminal switches from a framed mode to an unframed mode (by means of the BAS), the octet timing, previously gained, must be kept.

e) When a new frame alignment is gained on a new position, different from that previously validated, the receive octet timing is reinitialized to the new position but not yet validated and the previous bit position is stored. If no loss of frame alignment occurs in the next 16 frames, the new position is validated; otherwise the stored old bit position is reutilized.

2.5.3 *Search for frame alignment signal (FAS)*

Two methods may be used: sequential or parallel. In the sequential method, each of the eight possible bit positions for the FAS is tried. When FAS is lost after being validated, the search must resume starting from the previously validated bit position. In the parallel method, a sliding window, shifting one bit for each bit period, may be used. In that case, when frame alignment is lost, the search must resume starting from the bit position next to the previously validated one.

2.6 *Description of the CRC4 procedure*

In order to provide an end-to-end quality monitoring of the 64 kbit/s connection, a CRC4 procedure may be used and the four bits C1, C2, C3 and C4 computed at the source location are inserted in bit positions 5 to 8 of the odd frames. In addition, bit 4 of the odd frames, noted E, is used to transmit an indication about the received signal in the opposite direction whether the most recent CRC block has been received with errors or not.

When the CRC4 procedure is not used, bit E shall be set to 0, and bits C1, C2, C3 and C4 shall be set to 1 by the transmitter. Provisionally, the receiver may disable reporting of CRC errors after receiving eight consecutive CRCs set to all 1s, and it may enable reporting of CRC errors after receiving two consecutive CRCs each containing a 0 bit. (This method of eanbling and disabling CRC error reporting must be verified and is for further study.)

2.6.1 *Computation of the CRC4 bits*

The CRC4 bits C1, C2, C3 and C4 are computed from the whole 64 kbit/s channel, for a block made of two frames: one even frame (containing the FAW) followed by one odd frame (not containing the FAW). The CRC4 block size is then 160 octets, i.e. 1280 bits, and the computation is performed 50 times per second.

2.6.1.1 *Multiplication division process*

A given C1-C4 word located in block N is the remainder after multiplication by x^4 and then division (modulo 2) by the generator polynominal $x^4 + x + 1$ of the polynomial representation of block (N – 1).

When representing contents of a block as a polynominal the first bit in the block should be taken as being the most significant bit. Similarly C1 is defined to be the most significant bit of the remainder and C4 the least significant bit of the remainder.

This process can be realized with a four-stage register and two exclusive-ors.

2.6.1.2 *Encoding procedure*

i) The CRC bit positions in the odd frame are initially set at zero, i.e. C1 = C2 = C3 = C4 = 0.

ii) The block is then acted upon by the multiplication-division process referred to above in § 2.6.1.1.

iii) The remainder resulting from the multiplication-division process is stored ready for insertion into the respective CRC locations of the next odd frame.

Note – These CRC bits do not affect the computation of the CRC bits of the next block, since the corresponding locations are set at zero before the computation.

2.6.1.3 *Decoding procedure*

i) A received block is acted upon by the multiplication division process, referred above in § 2.6.1.1, after having its CRC bits extracted and replaced by zeros.

ii) The remainder resulting from this multiplication-division process is then stored and subsequently compared on a bit-by-bit basis with the CRC bits received in the next block.

iii) If the decoded calculated remainder exactly corresponds to the CRC bits sent from the encoder, it is assumed that the checked block is error-free.

2.6.2 *Consequent actions*

2.6.2.1 *Action on bit E*

Bit E of block N is set to 1 in the transmitting direction of bits C1-C4 detected in the most recent block in the opposite direction have been found in error (at least one bit in error). In the opposite case, it is at zero.

2.6.2.2 *Monitoring for incorrect frame alignment*

In case of a long simulation of the FAW, the CRC4 information can be used to re-invite a search for frame alignment. For such a purpose, it is possible to count the number of blocks CRC in error within 2 s (100 blocks) and to compare this number with 89. If the number of CRC blocks in error is greater than or equal to 89, a search for frame alignment should be re-initiated.

These values of 100 and 89 have been chosen in order that:

– for a random transmission error rate of 10^{-3}, the probability of incorrectly re-initiating a search for frame alignment because of 89 or more blocks in error, be less than 10^{-4};

– in case of simulation of frame alignment, the probability of not re-initiating a search of frame alignment after a 2 s period be less than 2.5%.

2.6.2.3 *Monitoring for error performance*

The quality of the 64 kbit/s connection can be monitored by counting the number of CRC blocks in error within a period of one second (50 blocks). For instance, a good evaluation of the proportion of seconds without errors as defined in Recommendation G.821 can be provided.

For information purposes, the following proportions of CRC block in error can be computed for randomly distributed errors of error rate Pe, as shown in Table 1/H.221.

TABLE 1/H.221

Pe	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}
Proportion of CRC blocks in error	70%	12%	1.2%	0.12%	0.012%

By counting the received E bits, it is possible to monitor the quality of the connection in the opposite direction.

3 Bit-rate allocation signal (BAS) and switching between configurations

The bit-rate allocation signal (BAS) occupies bits 9-16 of the service channel in every frame. An eight bit BAS code (b_0, b_1, b_2, b_3, b_4, b_5, b_6, b_7) is complemented by eight error correction bits (p_0, p_1, p_2, p_3, p_4, p_5, p_6, p_7) to implement a (16,8) double error correcting code. This error correcting code is obtained by shortening the (17,9) cyclic code with generator polynomial:

$$g(x) = x^8 + x^7 + x^6 + x^4 + x^2 + x + 1$$

The error correction bits are calculated as coefficients of the remainder polynomial in the following equation:

$$p_0x^7 + p_1x^6 + p_2x^5 + p_3x^4 + p_4x^3 + p_5x^2 + p_6x + p_7$$

$$= RES_{g(x)}\,[b_0x^{15} + b_1x^{14} + b_2x^{13} + b_3x^{12} + b_4x^{11} + b_5x^{10} + b_6x^9 + b_7x^8]$$

where $RES_{g(x)}\,[f(x)]$ represents the residue obtained by dividing $f(x)$ by $g(x)$.

The BAS code is sent in the even-numbered frame, while the associated error correction bits are sent in the subsequent odd-numbered frame. Each bit of BAS code or the error correction is transmitted in the order shown in Table 2/H.221, to avoid emulation of the frame alignment signal.

TABLE 2/H.221

Bit position	Even frame	Odd frame
9	b_0	P_2
10	b_3	P_1
11	b_2	P_0
12	b_1	P_4
13	b_5	P_3
14	b_4	P_5
15	b_6	P_6
16	b_7	P_7

The decoded BAS value is valid if:

– the receiver is in frame and multiframe alignment, and

– the FAS in the same submultiframe was received with 2 or fewer bits in error.

Otherwise, the decoded BAS value is ignored. When the receiver actually loses frame alignment, it should undo any changes caused by the three previously decoded BAS values and revert to the state determined by the fourth previously decoded BAS value.

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

The first three bits (b_0, b_1, b_2) represent the attribute number, which describes the general command or capability, and the next five bits (b_3, b_4, b_5, b_6, b_7) identify the specific command or capability. The following attributes are defined:

000 Audio coding command: values defined in Annex A

001 Transfer rate command: values defined in Annex B

010 Video and other command: values defined in Annex D

011 Data command: values defined in Annex E

100 Terminal capability: values defined in Annex C

Annex A defined a number of modes, according to the audio coding type and bit rate. Since a validated value of BAS command code applies to the next submultiframe, a change in configuration can occur every 20 ms. This applies equally to the use of video and data command BAS, controlling sub–modes of various configurations of the remaining capacity.

When the incoming bit A (see § 2.3) is set to 1, the distant rceiver is not in multiframe alignment and will not immediately validate a new BAS value.

Capability BAS require a response from the distant terminal and should not be sent unnecessarily when the incoming signal is unframed.

See Recommendations G.725 for further information on signalling procedures.

4 Application channel (AC)

It occupies bits 17-80 of the service channel in each frame, providing a user available bit rate of 6.4 kbit/s. According to the application, different kinds of information may be inserted herein. In particular, information concerning forward error correction or end-to-end encryption which both depend on the application, could take place in the application channel.

The AC may be used to convey a message channel conforming to the OSI protocols where appropriate. With this message channel, a transport and a session protocol may be used to control the use of audio and data channels. For example, once the command/response procedure has agreed to open a connection, if necessary, the BAS is used to adjust the capability available for data.

Examples for the use of AC are given in Appendix I.

5 Access to non-audio information within bits 1-7

Use of attribute (000) according to Annex A provides for the static or dynamic allocation of “data channels” of up to 56 kbit/s capacity; in some applications, it may be desirable to combine the application channel with the data channel in order to have a single user-data path, of capacity up to 62.4 kbit/s.

Unless BAS codes (010), (011) are used to direct otherwise, the “data channel” is treated as a single stream of non-video information; in this case access may be realised according to standardised procedures (e.g. Recommendations I.461, I.462, I.463). Data is transmitted in the order received from the data terminal equipment or data terminal adaptator.

In the presence of a non-zero video command BAS (010) the data channel is assigned to moving picture information, except that some part may be subtracted for other data purposes by application of a non-zero data command BAS (011).

ANNEX A

(to Recommendation H.221)

Attribute 000 used for BAS encoding

Attribute Bits b_0 - b_2	Attribute value Bits b_3 - b_7	Meaning	
000 Audio coding	00000	Neutralised channel (the 62.4 kbit/s user date are unused) PCM [G.711] (truncated to 7 bits)	(Note 1) (Note 2)
	S0010	A-law; data at 0 or 6.4 kbit/s	Mode OF
	S0011	μ-law; data at 0 or 6.4 kbit/s	Mode OF
	S0001	32 kbit/s ADPCM data at 24 or 30.4 kbit/s	(Note 3)
		64 kbit/s unframed mode	(Note 4)
	00100	PCM A-law	Mode 0
	00101	PCM μ-law	Mode 0
	00110	SB-ADPCM [G.722]	Mode 1 (Note 5)
	00111	0 kbit/s; data at 64 kbit/s	Mode 10
		Variable bit-rate audio coding	
	S1000	G.722 56 kbit/s; data at 0 or 6.4 kbit/s	Mode 2
	S1001	G.722 48 kbit/s; data at 8 or 14.4 kbit/s	Mode 3
	S1010 . . . S1110	} Reserved for audio coding at bit rates less than 48 kbit/s	(Note 6)
	S1111	0 kbit/s; data at 56 or 62.4 kbit/s	Mode 9 (Note 7)
	10000	Free	
	101xx	Free	

Note 1 – The 8th bit is fixed to 0 in the audio PCM decoder.

Note 2 – The S bit set to 1 indicates that the application channel is merged with the data channel to form a single user-data path. The method for merging the two channels is shown in Figure A-1/H.221 for the 14.4 kbit/s case.

Note 3 – The coding law and respective place of data and audio in each byte of the 64 kbit/s channel is under study.

Note 4 – Attribute values 001xx imply the switching to an unframed mode. In the receive direction, reverting to a framed mode can only be achieved by recovering frame and multiframe alignment, which might take up to 2 multiframes (i.e. 320 ms).

Note 5 – The allocation of bits in each byte of the 64 kbit/s channel is as follows:

Audio bit-rate	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

S Service channel
D Data channel
H High band audio
B Low band audio

Bit-rates of 56 and 48 kbit/s are respectively modes 2 and 3 of Recommendation G.722.

Note 6 – Audio coding bit-rates 40-32-24-16-8 kbit/s require further study.

Note 7 – The whole of the 56 (or 62,4) kbit/s is used for data and the audio channel is not available.

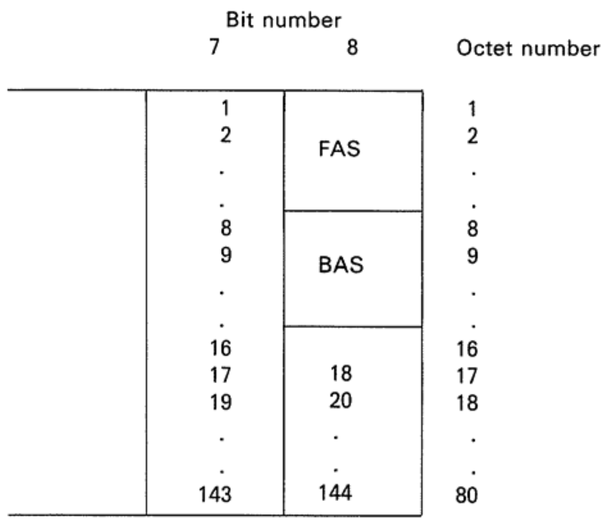


FIGURE A-1/H.221

Bit number for a merged 14.4 kbits/s data

ANNEX B

(to Recommendation H.221)

Attribute 001 used for BAS encoding

Attribute Bits b_0 - b_2	Attribute value Bits b_3 - b_7	Meaning
001 Transfert rate	00000	64 kbit/s
	00001	64 kbit/s (audio) + 64 kbit/s (data/video)
	00010	64 kbit/s (audio) + 64 kbit/s (data/video) treated as a single 128 kbit/s channel
	01010 01011	384 kbit/s: 64 (audio) + 320 (video) 384 kbit/s: 64 (audio) + 256 (video) + 64 (data)
	01100 01101	768 kbit/s: 64 (audio) + 704 (video) 64 (audio) + 640 (video) + 64 (data)
	01110 01111	1152 kbit/s: 64 (audio) + 1088 (video) 64 (audio) + 1024 (video) + 64 (data)
	10000 10001	1536 kbit/s: 64 (audio) + 1472 (video) 64 (audio) + 1408 (video) + 64 (data)
	10010 10011	1920 kbit/s: 64 (audio) + 1856 (video) 64 (audio) + 1792 (video) + 64 (data)

ANNEX C

(to Recommendation H.221)

Attribute 100 used for BAS encoding

Attribute Bits b_0 - b_2	Attribute value Bits b_3 - b_7	Meaning
100	00000	Neutral (Note 1)
Terminal	00001	G.725 Type 0 – A-law (Note 2)
capability	00010	G.725 Type 0 – μ-law
	00011	G.725 Type 1 – G.722
	00100	G.725 Type 2 – G.722 + data
	00101 … 00110	Reserved for audio capabilities
	00111	Reserved for national use
	01000	Non-standard video capability (Note 3)
	01001 … 01110	Reserved for video capabilities
	01111	Reserved for national use
	10000	Non-standard video capability (Note 3)
	10001	2B transfer rate capability (Note 4)
	10010	3B transfer rate capability (Note 4)
	10011	4B transfer rate capability (Note 4)
	10100	5B transfer rate capability (Note 4)
	10101	6B transfer rate capability (Note 4)
	10110	Reserved for transfer rate capability
	10111	Reserved for national use
	11000	300 bit/s data capability (Note 5)
	11001	1200 bit/s data capability (Note 5)
	11010	2400 bit/s data capability (Note 5)
	11011	4800 bit/s data capability (Note 5)
	11100	6400 bit/s data capability (Note 5)
	11101	8000 bit/s data capability (Note 5)
	11110	9600 bit/s data capability (Note 5)
	11111	14 400 bit/s data capability (Note 5)

Note 1 – The neutral value indicates no change in the current capabilities of the terminal.

Note 2 – Types 0, 1 and 2 are defined according to Recommendation G.725 § 2.

– Type 0 terminal can work in mode 0 (PCM) only.

– Type 1 terminal preferably works in mode 1 (G.722) but is able to work in mode 0.

– Type 2 terminal preferably works in mode 2 (G.722 + H.221) but is able to work in modes 1 and 0.

Note 3 – If sent (additional), an improved video algorithm decoding or whole system capability is indicated; it is specified elsewhere.

Note 4 – A capability to use several B channels implies the capability to use fewer channels.

Note 5 – A data capability specifies only one rate; if multiple rates are possible the capabilities are sent individually.

ANNEX D

(to Recommendation H.221)

Attribute 010 used for BAS encoding

Attribute Bits b_0 - b_2	Attribute value Bits b_3 - b_7	Meaning
010	00000	No video; video switched OFF
Video and other command	00001	Standard video for m × 64 kbit/s
	00010	Video ON, using improved algorithm
	00011	Standard video to Recommendation H.261
	. . .	
	11111	Transfer to non-standard system mode

ANNEX E

(to Recommendation H.221)

Attribute 011 used for BAS encoding

Attribute Bits b_0-b_2	Attribute value Bits b_3-b_7	Meaning
011	00000	No data; data switched OFF
Data command	00001	300 bit/s in AC assigned to data (bit 8 of last three octets in each frame)
	00010	1200 bit/s in AC assigned to data (bit 8 of last 12 octets in each frame)
	00011	4800 bit/s in AC assigned to data (bit 8 of last 48 octets in each frame)
	00100	6400 bit/s in AC assigned to data (whole of AC)
	00101	8000 bit/s assigned to data (bit 7)
	00110	9600 bit/s assigned to data (bit 7 + bit 8 of last 16 octets in each frame)
	00111	14.4 kbit/s assigned to data (bit 7 + AC)
	. . .	
	10000 to 10111	Reserved for communicating the status of the data terminal equipment interfaces
	. . .	
	11111	Variable rate data; data switched ON (Note)

Note – When video is switched on, the entire variable data capacity is used for video.

APPENDIX I

(to Recommendation H.221)

Examples for the use of the application channel

I.1 *Binary information*

Each bit of the application channel may be used to convey the information of a 100 kbit/s channel, repeated 100 times per second. If odd and even frames are identified, each bit may carry the 150 Hz bit/s channels. If multiframing is used, each bit may carry the information of 16 channels, each at 6.25 bit/s.

An example of this kind of information is, in teleconference, the use of a bit to synchronize the encoder clock on the receive clock, or to indicate the microphone number, or to signal the use of the grahics mode, etc.

I.2 *Synchronous message-type channel*

As each bit of the application channel represents a bit-rate of 100 bit/s, any synchronous channel working at $n \times 100$ bit/s may be inserted in the application channel. An example is, in videoconference, the message channel at 4 kbit/s which is used for multipoint management.

Another possibility is the insertion of data channels at one of the bit rates defined in Recommendation X.1, according to Recommendations X.30/I.461: "Support of X.21 and X.21*bis* based DTEs by an ISDN". The present frame structure is consistent with the Recommendations X.30/I.461 frame structure in a double way:

- it has the same length (80 bits by bearer channel at 8 kbit/s);
- it needs 63 bits per frame (17 bits are used for framing information not to be transmitted), which fits into the 64 bits available in this frame structure.

I.3 *Asynchronous message-type channel*

In case of asynchronous terminals, Recommendation X.1 bit-rates are relevant, too. The applicable standard is that specified in [1]. This standard also uses the same 80-bit frame structure as Recommendations X.30/I.461 mentioned above. The application channel will therefore allow adoption of this ECMA standard if needed.

I.4 *Error correction and encryption*

When needed, forward error correction and encryption information may be transmitted in the application channel. The bit-rate and the protocol to be used will depend on the application.

Reference

[1] ECMA-TAxx *Bit-rate adaption for the support of synchronous and asynchronous terminal equipment using the V-Series interfaces on a PSTN.*

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Printed in Switzerland
Geneva, 2006