INTERNATIONAL TELECOMMUNICATION UNION

CCITT

H.221

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

LINE TRANSMISSION OF NON-TELEPHONE SIGNALS

FRAME STRUCTURE FOR A 64 TO 1920 kbit/s CHANNEL IN AUDIOVISUAL TELESERVICES

Recommendation H.221

Geneva, 1990

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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Recommendation H.221 was prepared by Study Group XV and was approved under the Resolution No. 2 procedure on the 14 of December 1990.

CCITT NOTE

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

Recommendation H.221

**FRAME STRUCTURE FOR A 64 TO 1920 kbit/s CHANNEL
IN AUDIOVISUAL TELESERVICES**[1)]

(revised 1990)

Introduction

The purpose of this Recommendation is to define a frame structure for audiovisual teleservices in single or multiple B or H_0 channels or a single H_{11} or H_{12} channel which makes the best use of the characteristics and properties of the audio and video encoding algorithms, of the transmission frame structure and of the existing 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 for audiovisual signal transmission, since a configuration is signalled by repeatedly transmitted codewords.
- It is very secure in case of transmission errors, since the code controlling the multiplex is protected by a double-error correcting code.
- It allows the synchronization of multiple 64 kbit/s or 384 kbit/s connections and the control of the multiplexing of audio, video, data and other signals within the synchronized multiconnection structure in the case of 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 300 bit/s up to almost 2 Mbit/s) to the user.

1 Basic principle

This Recommendation provides for dynamically subdividing an overall transmission channel of 64 to 1920 kbit/s into lower rates suitable for audio, video, data and telematics purposes. The overall transmission channel is derived by synchronizing and ordering transmissions over from 1 to 6 B-connections, from 1 to 5 H_0-connections, or an H_{11} or H_{12} connection. The first connection established is the initial connection and carries the *initial channel* in each direction. The additional connections carry *additional channels*.

The total rate of transmitted information is called the "transfer rate"; it is possible to fix the transfer rate less than the capacity of the overall transmission channel (values listed in Annex A).

A single 64 kbit/s channel is structured into octets transmitted at 8 kHz. Each bit position of the octets may be regarded as a sub-channel of 8 kbit/s (see Figure 1a/H.221). The eighth sub-channel is called the Service Channel (SC), consisting of several parts as described in §§ 1.1 to 1.4 below.

[1)] This Recommendation completely replaces the text of Recommendations H.221 and H.222 published in Fascicle III.6 of the *Blue Book*.

An H_0, H_{11} or H_{12} channel may be regarded as consisting of a number of 64 kbit/s *time-slots* (TS) (see Figure 1b/H.221). The lowest numbered time-slot is structured exactly as described for a single 64 kbit/s channel, while the other TS have no such structure. In the case of multiple B or H_0 channels, all channels have a frame structure; that in the initial channel controls most functions across the overall transmission, while the frame structure in the additional channels is used for synchronization, channel numbering and related controls.

The term “I-channel” is applied to the initial or only B channel, to TS1 of initial or only H_0 channel, and to TS1 of H_{11}, H_{12} channels.

Bit number 1	2	3	4	5	6	7	8 (SC)	Octet number
								1
S	S	S	S	S	S	S	FAS	:
u	u	u	u	u	u	u		8
b	b	b	b	b	b	b		9
-	-	-	-	-	-	-	BAS	:
c	c	c	c	c	c	c		16
h	h	h	h	h	h	h		17
a	a	a	a	a	a	a	ECS	:
n	n	n	n	n	n	n		24
n	n	n	n	n	n	n		25
e	e	e	e	e	e	e		·
l	l	l	l	l	l	l		·
#	#	#	#	#	#	#	#	·
1	2	3	4	5	6	7	8	80

FAS Frame alignment signal

BAS Bit-rate allocation signal

ECS Encryption control signal

FIGURE 1a/H.221

Frame structure of a single 64 kbit/s channel (B-channel)

1.1 *Frame alignment signal (FAS)*

This signal structures the I-channel *and other framed 64 kbit/s* channels into frames of 80 octets each and multiframes (MF) of 16 frames each. Each multiframe is divided into eight 2-frame sub-multiframes (SMF). The term “frame alignment signal” (FAS) refers to bits 1-8 of the SC in each frame. In addition to framing and multiframing information, control and alarm information may be inserted in the FAS, as well as error check information to control end-to-end error performance and to check frame alignment validity. Other time-slots are aligned to the first.

The bits are transmitted to line in order, bit 1 first.

When an 8 kHz network clock is provided, FAS is transmitted and received in the least significant bit of the octet within each 125 microsecond, e.g. in an ISDN basic or primary rate interface.

The FAS can be used to derive receive octet timing when it is not provided by the network. However, in the latter case, the terminal cannot transmit FAS with correct alignment into the octet timed part of the network and cannot intercommunicate with terminals which rely only on network timing for octet alignment.

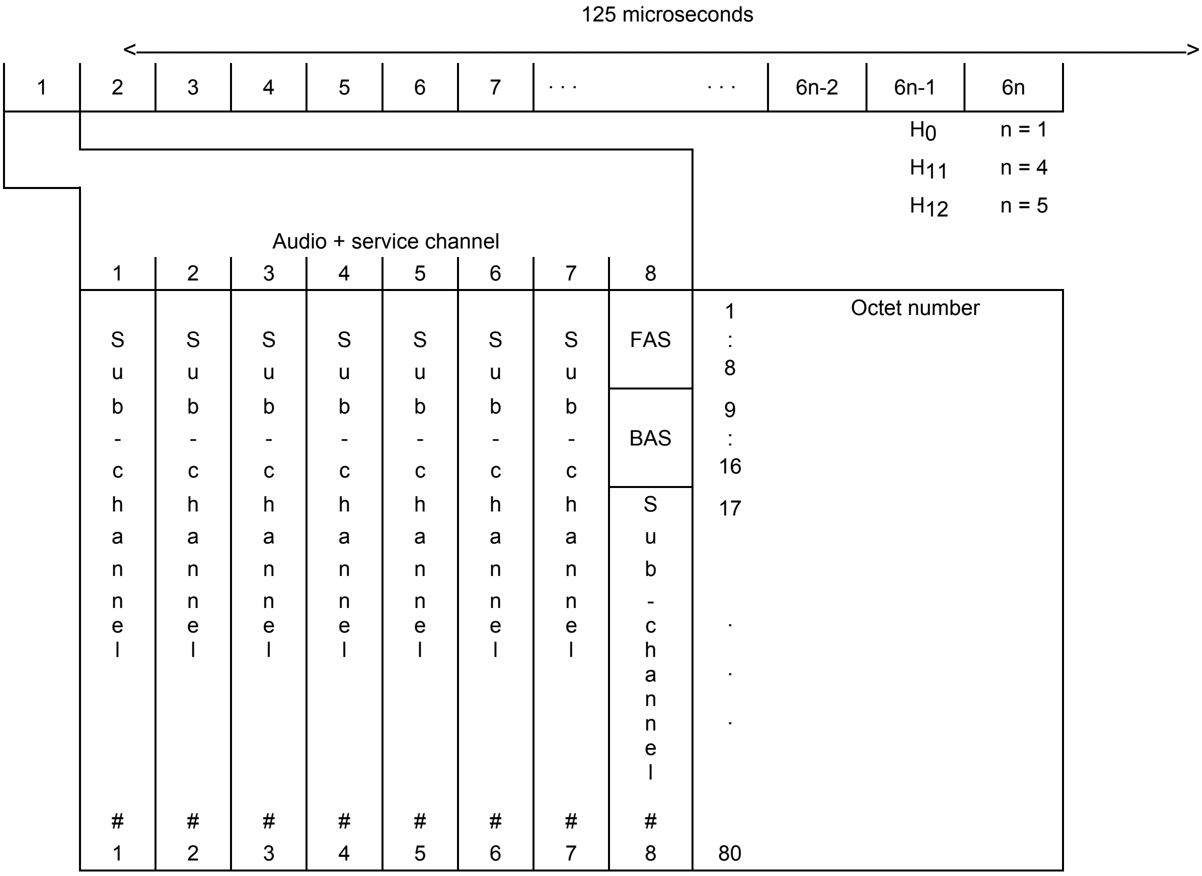

FIGURE 1b/H.221

Frame structure of higher-rate single channels
(H_0, H_{11}, H_{12} channels)

1.2 *Bit-rate allocation signal (BAS)*

Bits 9-16 of the SC in each frame are referred to as BAS. This signal allows the transmission of codewords to describe the capability of a terminal to structure the capacity of the channel or synchronized multiple channels in various ways, and to command a receiver to demultiplex and make use of the constituent signals in such structures. This signal is also used for controls and indications.

Note – For some countries having 56 kbit/s channels, the net available bit rates will be 8 kbit/s less. Interworking between a 64 kbit/s terminal and a 56 kbit/s terminal is established according to the frame structure in Annex B.

1.3 *Encryption control signal (ECS)*

A future encryption capability may require a dedicated transmission channel. It is anticipated that 800 bit/s should be provided when required by allocating the bits 17-24 of the service channel. This reduces variable data and video transmission rates herein by 800 bit/s. The 800 bit/s is referred to as the ECS channel.

1.4 *Remaining capacity*

The remaining capacity (including the rest of the service channel), carried in bits 1-8 of each octet in the case of a single 64 kbit/s connection, may convey a variety of signals within the framework of a multimedia service, under the control of the BAS. Some examples follow:

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

– voice encoded at 16 kbit/s and video at 46.4 kbit/s;

– voice encoded at 56 kbit/s with a bandwidth 50 to 7000 Hz (subband 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).

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 1-80. Bits 1-8 of the service channel in every frame constitute the FAS (see Figure 2/H.221), whose content is as follows:

– multiframe structure (see § 2.2);

– Frame Alignment Word (FAW);

– A-bit;

– E- and C-bits (see § 2.6).

The FAW consists of “0011011” in bits 2-8 of the FAS in even frames, complemented by an “1” in bit 2 of the succeeding odd frame.

The “A-bit” of the I-channel is set to zero whenever the receiver is in multiframe alignment, and is set to “1” otherwise (see § 2.3); for additional channels, see § 2.7.1.

Successive frames \ Bit number	1	2	3	4	5	6	7	8
Even frames	Note 1	0	0	1	1	0	1	1
			Frame alignment word – Note 2					
Odd frames	Note 1	1 Note 2	A Note 3	E Note 4	C1	C2	C3	C4

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

Note 2 – The first seven bits of the frame alignment word are in the even frames. The eighth bit of the FAW in the odd frame is the complement of the first FAW bit in order to avoid simulation of FAW by a frame-repetitive pattern.

Note 3 – A-bit: loss of multiframe alignment indication (0 = alignment; 1 = loss).

Note 4 – The use of bits E and C1-C4 is described in § 2.6 (0 = no error or Cyclic Redundancy Check (CRC) not in use; 1 = error).

FIGURE 2/H.221

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

2.2 *Multiframe structure*

See Table 1/H.221.

Each multiframe contains 16 consecutive frames numbered 0 to 15 divided into eight sub-multiframes of two frames each (see 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. Bit 1 of frame 15 remains reserved for future use. The value is fixed at 0.

Bit 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 uses the multiframe numbering to equalize out the differential delay of separate connections, and to synchronize the received signals.

Bit 1 of frame 8 is set to 1 when multiframes are numbered and is set to 0 when they are not.

Bit 1 of frames 10-12-13 must be used to number each channel in a multiconnection structure so that the distant receiver can place the octets received in each 125 microseconds in the correct order.

Information bits in the multiframe should be validated by, for example, being received consistently for three multiframes.

	Sub-multiframe (SMF)	Frame	Bits 1 to 8 of the service channel in every frame							
			1	2	3	4	5	6	7	8
Multiframe		0	N1	0	0	1	1	0	1	1
	SMF1	1	0	1	A	E	C1	C2	C3	C4
		2	N2	0	0	1	1	0	1	1
	SMF2	3	0	1	A	E	C1	C2	C3	C4
		4	N3	0	0	1	1	0	1	1
	SMF3	5	1	1	A	E	C1	C2	C3	C4
		6	N4	0	0	1	1	0	1	1
	SMF4	7	0	1	A	E	C1	C2	C3	C4
		8	N5	0	0	1	1	0	1	1
	SMF5	9	1	1	A	E	C1	C2	C3	C4
		10	L1	0	0	1	1	0	1	1
	SMF6	11	1	1	A	E	C1	C2	C3	C4
		12	L2	0	0	1	1	0	1	1
	SMF7	13	L3	1	A	E	C1	C2	C3	C4
		14	TEA	0	0	1	1	0	1	1
	SMF8	15	R	1	A	E	C1	C2	C3	C4

L1-L3 Channel number, least significant bit in L1.

Channel	*L3*	*L2*	*L1*
Initial	0	0	1
Second	0	1	0
Third	0	1	1
. . .	. .	. .	. .
Sixth	1	1	0

R Reserved for future use 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.

		N4	N3	N2	N1	
Multiframe number	0	0	0	0	0	(or numbering inactive)
	1	0	0	0	1	
	2	0	0	1	0	
	. .	. .	. .	. .	. .	
	15	1	1	1	1	

N5 Indicates whether multiframe numbering is active (N5 = 1) or inactive (N5 = 0).

TEA The terminal equipment alarm is set to 1 in the outgoing signal 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

2.3 *Loss and recovery of frame alignment*

Frame alignment is defined to have been lost when three consecutive frame alignment words 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 first seven bits of the frame alignment word;

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

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

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

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

2.4 *Loss and recovery of multiframe alignment*

Multiframe alignment is needed to number and synchronize two or more channels, and possibly also for encryption. Terminals such as those having only single-channel capabilities which have no use for the multiframe structure must transmit the multiframe structure, but need not check for multiframe alignment on the incoming signal: they may transmit outgoing A = 0 when frame alignment is recovered.

Note – Such a terminal cannot transmit TEA (see Figure 3/H.221).

After multiframe alignment has been validated the other functions represented by bit 1 of the service channel can be used. When multiframe alignment of the distant terminal has been signalled (A=0 received) the distant terminal is expected to have validated BAS codes and to be able to interpret BAS codes.

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 been 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, the A-bit of the next odd frame is set to 1 in the transmit direction. It is reset to 0 when multiframe alignment is regained. It is reset in additional channels when multiframe alignment and synchronism with the initial channel is regained.

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 at 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 connection, a 4-bit Cyclic Redundancy Check (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, the E-bit, is used to transmit an indication as to whether the most recent CRC block, received in the incoming direction, contained 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.

2.6.1 *Computation of the CRC4 bits*

The CRC4 bits C1, C2, C3 and C4 are computed for each $B/H_0/H_{11}/H_{12}$ channel[2] , for a block made of two frames: one even frame (containing the first seven bits of FAW) followed by one odd frame (containing the eighth bit of FAW). The CRC4 block size is then 160/960/3840/4800 octets for a $B/H_0/H11/H_{12}$ channel[2] and the computation is performed 50 times per second.

Note – This is still valid for the case of H_0/H_{11} in restricted networks, the stuffed bits being included in the computation. For restricted B, see Annex B.

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 polynomial $x^4 + x + 1$ of the polynomial representation of block (N − 1).

When representing contents of a block as a polynomial, 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 the 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 to 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 if 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 set to zero.

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[2] If the transfer rate is such that a part of any $H_0/H_{11}/H_{12}$ channel is unoccupied, then the computation is made only for that part covered by the transfer rate.

2.6.2.2 *Monitoring for incorrect frame alignment* (see Note)

In the 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 CRC blocks in error within two seconds (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 reinitiated.

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

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

– In case of simulation of frame alignment, the probability of not reinitiating a search of frame alignment after a two-second period should be less than 2.5%.

Note – Values in this and the next section exemplify the case of a 64 kbit/s channel. For H_0, H_{11} or H_{12} channels the details will differ but the principles are still applicable.

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, Table 1/H.221 gives the proportions of CRC block in error can be computed for randomly distributed errors of error rate P_e.

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

TABLE 1/H.221

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

2.7 *Synchronization of multiple connections*

Some audiovisual terminals will be able to communicate over multiple B or H_0 connections (see Note). In this case, a single B or H_0 initial connection is established, the possibility for more connections is determined from the transfer rate capability BAS of Annex A and the additional connections are then established and synchronized by the terminal using the multiframe structure.

Note – A connection is an individual call between the terminals. A channel is the transmission in one direction over the connection.

2.7.1 *Multiple B-connections*

FAS and BAS are transmitted in each B-channel.

FAS operation is as follows:

– multiframe numbering is used to determine relative transmission delay between B-channels as described in § 2.2;

– the channel numbers are transmitted as described in § 2.2 with the channel of the initial connection being numbered 1 and there being up to five additional connections;

– the outgoing A-bit is set to 1 in the additional B-channel of the same connection whenever the received additional channel is not synchronized to the initial channel;

– when receive synchronization is achieved between the initial and additional channels by introducing delay to align their respective multiframe signals, the transmitted A-bit is set to 0;

– the E-bit for each additional B-channel is transmitted in the additional B-channel in the same connection, because it relates to a physical condition of the transmission path.

The BAS operation in additional connections is restricted to the transmission of the additional channel number (thus the channel numbering must be sent both in BAS according to Annex A and in the FAS as in § 2.2).

The distant terminal, upon receiving the A-bit set to zero with respect to sequentially numbered channels, can add their capacity to the initial connection by sending the transfer rate BAS in Annex A. The order of the bits transmitted in the channels is in accordance with the examples given in Figure 4/H.221.

2.7.2 *Multiple H_0 connections*

FAS and BAS are transmitted in the first time-slot of each H_0.

FAS operation is as in § 2.7.1 except that the channel number is used to order the six octets received each 125 microseconds with respect to the six octet groups received in other channels.

The BAS operation in additional channels is as specified in § 2.7.1.

3 Bit-rate allocation signal

3.1 *Encoding of the BAS*

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. The bits of the BAS code or the error correction are transmitted in the order shown in Table 2/H.221 to avoid emulation of the frame alignment word.

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 FAW in the same sub-multiframe was received with two or fewer bits in error.

Otherwise the decoded BAS value is ignored.

When the receiver actually looses frame alignment, it may be advisable to undo any changes caused by the three previously decoded values as they may well have been erroneous even after correction.

3.2 *Values of the BAS*

The encoding of BAS is made according to a hierarchical attribute method. This consists of attribute *class* (8 classes), attribute *family* (8 families), *attribute* (8 attributes) and *value* (32 values). The first three bits of an attribute represent its number describing the general command or capability, and the other five bits identify the “value” – the specific command or capability.

The following attributes are defined in the Class (000) and Family (000):

Attribute	*Significance*
000	Audio coding command
001	Transfer rate command
010	Video and other command
011	Data command
100	Terminal capability 1
101	Terminal capability 2
110	Reserved
111	Escape codes

The values of these attributes are listed and defined in Annex A. They provide for the following facilities:

- transmission at various total rates and on single and multiple channels, on clear channels and on networks subject to restrictions to 56 kbit/s and its multiples;
- audio transmission, digitally encoded to various recommended algorithms;
- video transmission, digitally encoded to a recommended algorithm, with provision for future recommended improvement;
- Low-Speed Data (LSD) within the I-channel, or TS1 of a higher rate initial channel;
- High-Speed data (HSD) in the highest-numbered 64 kbit/s channel or time-slots (excluding the I-channel);
- data transmission within a multilayer protocol, either in the I-channel (MLP) or in capacity other than the I-channel (H-MLP);
- an encryption control signal;
- loopback towards the network for maintenance purposes;
- signalling for control and indications;
- a message system for, *inter alia*, conveying information concerning equipment manufacturer and type.

The *command* BAS attributes have the following significance: on receipt of a BAS command code in one (even) frame and its error-correcting code in the next (odd), the receiver prepares to accept the stated mode change beginning from the subsequent (even) frame; thus a mode change can be effected in 20 milliseconds. The command remains in force until countermanded (see Recommendation H.242, § 12). The bit positions occupied by combinations of BAS commands are exemplified in Figures 4a/H.221 to 4g/H.221.

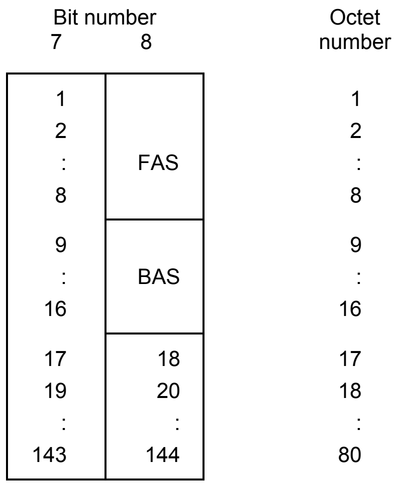

FIGURE 4a/H.221

Bit numbering and position for 14.4 kbit/s LSD

Bit number 1	2	3	4	5	6	7	8	Octet number
1	2	3	4	5	6	7	FAS	1
:	:	:	:	:	:	:		2
:	:	:	:	:	:	:		:
50	51	52	53	54	55	56		8
57	58	59	60	61	62	63	BAS	9
:	:	:	:	:	:	:		:
:	:	:	:	:	:	:		:
106	107	108	109	110	111	112		16
113	114	115	116	117	118	119	Sub-channel 8	17
120	121	122	123	124	125	126		18
:	:	:	:	:	:	:		:
:	:	:	:	:	:	:		:
554	555	556	557	558	559	560		80

FIGURE 4b/H.221

56 kbit/s LSD

Bit number 1	2	3	4	5	6	7	8	Octet number
1	2	3	4	5	6	7	FAS	1
:	:	:	:	:	:	:		2
:	:	:	:	:	:	:		:
50	51	52	53	54	55	56		8
57	58	59	60	61	62	63	BAS	9
:	:	:	:	:	:	:		:
:	:	:	:	:	:	:		:
106	107	108	109	110	111	112		16
113	114	115	116	117	118	119	120	17
121	122	123	124	125	126	127	128	18
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
617	618	619	620	621	622	623	624	80

FIGURE 4c/H.221

62.4 kbit/s LSD

Audio bit rate	Bit number							
	1	2	3	4	5	6	7	8
Rec. G.711	MSB	. . .	. . .	. . .	. . .	. . .	. . .	LSB
Rec. G.722, 64 kbit/s	H	H	L	L	L	L	L	L
Rec. G.722, 56 kbit/s	H	H	L	L	L	L	L	
Rec. G.772, 48 kbit/s	H	H	L	L	L	L	–	–
16 kbit/s	A1	A2	–	–	–	–	–	–

A Audio bits

H High-band audio

L Low-band audio

FIGURE 4d/H.221

Bit positions for audio

Initial channel								Additional channel							
Bit 1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
A1	A2	A3	A4	A5	A6	V1	FAS	V2	V3	V4	V5	V6	V7	V8	FAS
A	· ·			· ·	A	V9		V10						V16	
·					·										
·					·										
							BAS								BAS
						V121		V122						V128	
						V129	V130	V131						V137	V138
						V139									V148
·					·	·									·
·					·	·									·
·					·	·									·
A	· ·			· ·	A	V759	· ·							· ·	V768

FIGURE 4e/H.221

Bit positions for video in two B-channels

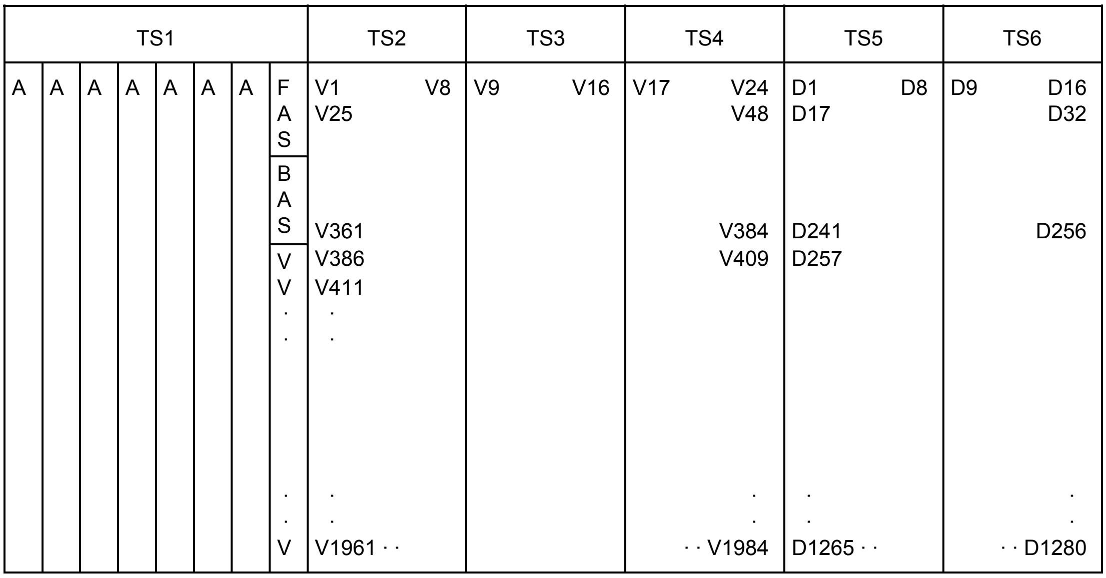

FIGURE 4f/H.221

128 kbit/s HSD in H_0 channel

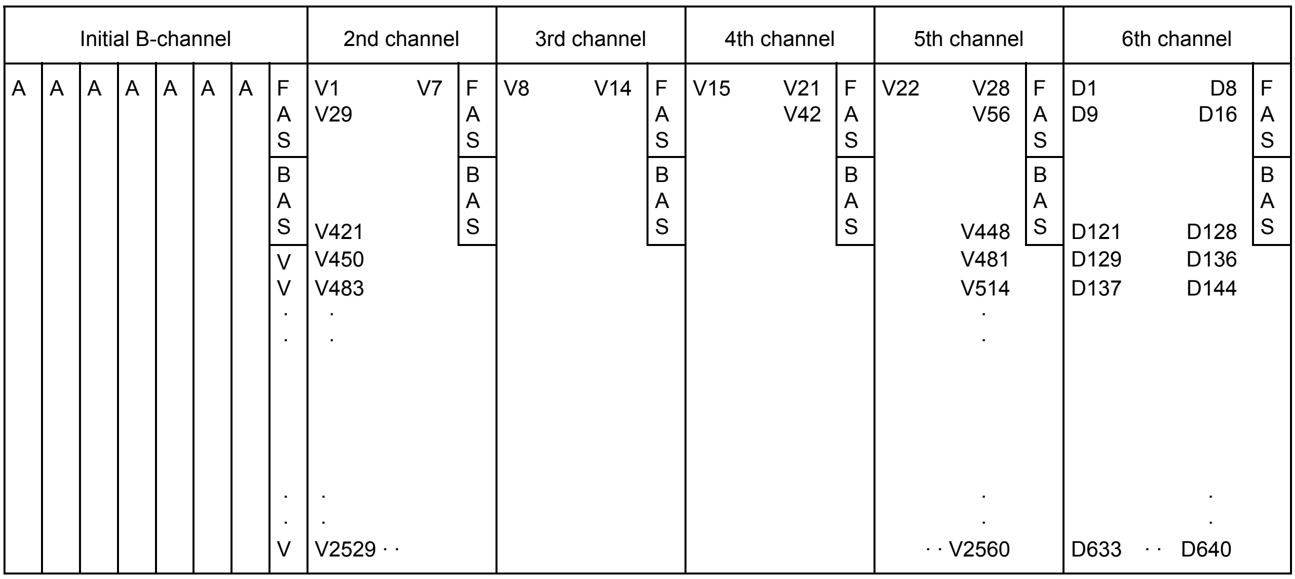

FIGURE 4g/H.221

64 kbit/s HSD in 6 × 64 kbit/s channels

The *capability* BAS attributes have the following significance: they indicate the ability of a terminal to receive and properly treat the various types of signal. It follows that having received a set of capability values from the remote terminal Y, terminal X must not transmit signals lying outside that declared range.

Values [0-7] of the attribute (111) are reserved for setting the class, and [8-15] for setting the family; the default value is (000) for both.

The next eight attribute values of the attribute (111) are temporary escape BAS codes of Single Byte Extension (SBE). The last three bits of the temporary escape BAS form a pointer to one of eight possible escape BAS tables of 224 entries each (codes beginning with 111 are not used in the escape BAS tables). Then the next received BAS indicates the specific entry in the escape BAS table.

The value (111) [24] is the capability marker (see Recommendation H.242, § 2) which is followed by normal BAS codes, not by any escape values.

The last seven attribute values of the attribute (111) are of Multiple Byte Extension (MBE) and are used to send messages as specified in the Notes to the table in Annex A.

3.3 *Procedures for the use of BAS*

The use of BAS codes is specified in Recommendation H.242.

ANNEX A

(to Recommendation H.221)

Definitions and tables of BAS values

The definitions of BAS values are given below, and the corresponding numerical values are listed in Tables A-1/H.221 and A-2/H.221.

A.1 *Audio command values (000)*

For bit position illustrations see Figure 4/H.221. Abbreviations "G.711" and "G.722" refer to Recommendations.

Neutral — Neutralized I-channel, containing only FAS and BAS; all other bits are to be ignored at the receiver.

Au-off, U — No audio signal, no frame (mode 10); all the I-channel is available for use under other commands [3].

Au-off, F — No audio signal, FAS and BAS in use (mode 9); 62.4 kbit/s available for use under other commands.

A-law, OU — G.711 audio at 64 kbit/s, A-law, no framing (mode OU) [3].

A-law, OF — G.711 audio at 56 kbit/s, A-law, truncated to 7 bits in bits 1-7, with FAS and BAS in bit 8; bit 8 is set to zero at the PCM audio decoder (mode OF).

μ-law, OU — G.711 audio at 64 kbit/s, μ-law, no framing (mode OU) [3].

μ-law, OF — G.711 audio at 56 kbit/s, μ-law, truncated to 7 bits in bits 1-7, with FAS and BAS in bit 8; bit 8 is set to zero at the PCM audio decoder (mode OF).

---

[3] These attribute values designate unframed modes. In the receive direction reverting to a framed mode can only be achieved by recovering frame and multiframe alignment which might take up to two multiframes (320 ms).

G.722, m1	G.722 7 kHz audio at 64 kbit/s, no framing (mode 1) [3].
G.722, m2	G.722 7 kHz audio at 56 kbit/s, in bits 1-7 (mode 2).
G.722, m3	G.722 7 kHz audio at 48 kbit/s, in bits 1-6 (mode 3).
Au-40k	Reserved for audio at less than 48 kbit/s (for example 40 kbit/s in bits 1-5).
Au-32k	Reserved for audio at less than 48 kbit/s (for example 32 kbit/s in bits 1-4): the algorithm of "Au-16k" below may be extended to code a wider speech bandwidth at 32 kbit/s as a result of further studies.
Au-24k	Reserved for audio at less than 48 kbit/s (for example 24 kbit/s in bits 1-3).
Au-16k	Audio at 16 kbit/s to Recommendation H.200/AV.254 in bits 1 and 2 (mode 7).
Au-<16k	Reserved for audio at less than 48 kbit/s (for example 8 kbit/s in bit 1).
Au-ISO-64/128/192/256	Audio to ISO standard at 64/128/192/256 kbit/s, in the lowest-numbered time-slots (other than TS1) of an H_0 or greater channel.
Au-ISO-384	Audio to ISO standard at 384 kbit/s in time-slots 2-7 of a channel greater than H_0.

A.2 *Transfer-rate command values* (001)

Note – If the transfer-rate command is less than the available connected capacity, the information occupies the lowest-numbered channel(s)/time-slot(s).

64	Signal occupies one 64 kbit/s channel.
2 × 64	Signal occupies two 64 kbit/s channels, with FAS and BAS in each.
3 to 6 × 64	Signal occupies three to six 64 kbit/s channels, with FAS and BAS in each.
384	Signal occupies 384 kbit/s, with FAS and BAS in the first 64 kbit/s time-slot; the effective channel may be the whole of an H_0 channel or the lowest numbered time-slots of an H_{11} or H_{12} channel.
2 × 384	Signal occupies two channels of 384 kbit/s, with FAS and BAS in each.
3 to 5 × 384	Signal occupies three to five 384 kbit/s channels, with FAS and BAS in each.
1536	Signal occupies 1536 kbit/s, with FAS and BAS in the first 64 kbit/s time-slot. The effective channel occupies the whole of an H_{11} channel or the lowest numbered time-slots of an H_{12} channel.
1920	Signal occupies 1920 kbit/s, with FAS and BAS in the first 64 kbit/s time-slot. The effective channel occupies the whole of an H_{12} channel.
128/192/256	Signal occupies 128/192/256 kbit/s, with FAS and BAS in the first 64 kbit/s time-slot. The effective channel occupies the lowest numbered time-slots of an H_0 or larger channel.
512/768/1152/1472	Signal occupies 512/768/1152/1472 kbit/s, with FAS and BAS in the first 64 kbit/s time-slot. The effective channel occupies the lowest numbered time-slots of an H_{11} or H_{12} channel.
Loss-i.c.	Designated "Initial channel", especially used following loss of the channel previously so designated (see H.242, § 7.2.3)
Channel No. 2-6	Numbering of additional channels – see § 2.7.1.

A.3 *Video, encryption, loop and other commands* (010)

Video-off	No video; video switched off.
H.261	Video on, to Recommendation H.261: video occupies all capacity not otherwise allocated by other commands; video cannot be inserted in the I-channel when var-LSD or var-MLP is in force; examples are given in Figure 4e/H.221. Specifically, the video rate in initial B-channel (framed) or TS1 is: 62.4 kbit/s – audio rate – {800 bit/s if ECS is ON} – {MLP rate if ON} – {LSD rate if ON}.
Vid-imp.(R)	Reserved for video on, to improved recommended algorithm.
Video-ISO	Video on, to ISO standard: video occupies the same capacity as stipulated above for the case of H.261 video.
AV-ISO	Composite audio/video to ISO standard: the composite signal occupies the same capacity as stipulated above for the case of H.261 video.
Freeze-pic.	Freeze-picture request (see Recommendation H.230, VCF).
Fast-update	Fast-update request (see Recommendation H.230, VCU).
Encryp-on	ECS Channel active. *Note* – When encryption is active, it applies to all information bits in all channels of the connection, except bits 1-24 of the SC in the I-channel and the FAS and BAS positions of the other channels; use of encryption in conjunction with MLP is for further study.
Encryp-off	ECS channel off.
Au-loop	Audio loop request (see Recommendation H.230, LCA).
Vid-loop	Video loop request (see Recommendation H.230, LCV).
Dig-loop	Digital loop request (see Recommendation H.230, LCD).
Loop-off	Loop off request (see Recommendation H.230, LCO). *Note* – Loopback requests are intended for use by maintenance staff.
6B-H_0-comp	To provide for compatibility between terminals connected to single H_0 channel and six B-channel accesses, the least significant bits of the first 16 octets of all time-slots of the H_0 channel, except TS1, are not used; the H_0 terminal must discard these bits from the incoming signal on receipt of this code, and must set the same bits to "1" in the outgoing signal.
Not-6B-H_0	Negates the command "6B-H_0-comp". *Note* – Used, for example, in testing.
Restrict	To provide for operation on a restricted network, and for interconnection between a terminal on restricted and unrestricted networks: on receipt of this code, a terminal must treat the SC as being in bit 7 of the I-channel, and discard bit 8 of every other channel and/or time-slot; in the outgoing direction these bits are set to "1".
Derestrict	On receipt of this code, a terminal must revert to "unrestricted network" operation, treating the SC as being in bit 8 of the I-channel.

A.4 *LSD/MLP commands* (011)

For bit position illustrations see Figure 4/H.221.

#	These LSD rates are not allowed if ECS channel is in use.
*	In restricted cases, the starred bit numbers are reduced by one.
LSD off	LSD switched off.
300	Low-speed data at 300 bit/s in SC, octets 38-40.
1200	Low-speed data at 1200 bit/s in SC, octets 29-40.
4800	Low-speed data at 4800 bit/s in SC, octets 33-80.
6400	Low-speed data at 6400 bit/s in SC, octets 17-80#.
8000	Low-speed data at 8000 bit/s in bit 7*.
9600	Low-speed data at 9600 bit/s in bit 7* and octets 25-40 of SC.
14400	Low-speed data at 14400 bit/s in bit 7* and octets 17-80 of SC#.
16k	Low-speed data at 16 kbit/s in bit 6* and bit 7*.
24k	Low-speed data at 24 kbit/s in bits 5*, 6* and 7*.
32k	Low-speed data at 32 kbit/s in bits 4*-7*.
40k	Low-speed data at 40 kbit/s in bits 3*-7*.
48k	Low-speed data at 48 kbit/s in bits 2*-7*.
56k	Low-speed data at 56 kbit/s in bits 1-7 (no framing in restricted case).
62.4k	Low-speed data at 62.4 kbit/s in bits 1-7 and octets 17-80 of SC. If ECS channel i in use the data rate is reduced to 61.6 kbit/s, but returns to 62.4 kbit/s if ECS channel is closed.
64k	Low-speed data at 64 kbit/s in bits 1-8, no framing.
Var-LSD	Low-speed data occupying all I-channel capacity not allocated under other fixed-rate commands; cannot be invoked when other LSD is on, or when variable-MLP is on (may also be impractical when video is on in I-channel alone). Exact var-LSD rate: 62.4 kbit/s – audio rate – {800 bit/s if ECS in ON} – {fixed-MLP if ON}.
DTI(R)	Three codes reserved for communicating the status of the data terminal equipment interfaces.
MLP-off	MLP off in all channels.
MLP-4k	MLP on at 4 kbit/s in octets 41-80 of SC.

MLP-6.4k	MLP on at 6.4 kbit/s in octets 17-80 of SC; if ECS channel is in use, the data rate is reduced to 5.6 kbit/s in octets 25-80, but returns to 6.4 kbit/s if ECS channel is closed.
Var-MLP	MLP occupying all I-channel capacity not allocated under other fixed-rate commands: cannot be invoked when other MLP is on, or when variable-LSD is on (may also be impractical when video is on in I-channel alone). Exact var-MLP rate: 62.4 kbit/s – audio rate – {800 bit/s if ECS is ON} – {fixed-LSD if ON}.

A.5 *Audio capabilities (100)*

Neutral	Neutral capability: no change in the current capabilities of the terminal.
A-law	Capable of decoding audio to Recommendation G.711, A-law.
μ-law	Capable of decoding audio to Recommendation G.711, μ-law.
G.725-T1	Terminal type 1 defined in Recommendation G.725, § 2.
G.725-T2	Terminal type 2 defined in Recommendation G.725, § 2.
Au-16k	Capable of decoding audio, both to Recommendation H.200/AV.254 and Recommendation G.711.
Au-ISO	Capable of decoding audio to ISO standard at all rates up to 384 kbit/s.

A.6 *Video, MBE and encryption capabilities* (101)

QCIF	Can decode video to QCIF picture format, but not CIF (see Recommendation H.261) – this code must be followed by one of the four minimum picture interval (MPI) values below.
CIF	Can decode video to CIF and QCIF formats (see Recommendation H.261) – this code must be followed by two MPI values, the first applicable to QCIF and the other to CIF format. Minimum picture interval (MPI) codes are as follows:
1/29.97	Can decode video, having a minimum picture interval of 1/29.97 seconds, to Recommendation H.261.
2/29.97	Can decode video, having a minimum picture interval of 2/29.97 seconds, to Recommendation H.261.
3/29.97	Can decode video, having a minimum picture interval of 3/29.97 seconds, to Recommendation H.261.
4/29.97	Can decode video, having a minimum picture interval of 4/29.97 seconds, to Recommendation H.261.
Vid-imp(R)	Reserved for future improved recommended video algorithm.
Video-ISO	Can decode video to ISO standard.
AV-ISO	Can decode composite audio/video signal to ISO standard.
MBE-cap	Can handle multiple-byte extensions messages in the BAS position, those beginning with codes in the range (111) [25-31], in addition to other values.
Esc-CF(R)	Reserved for capability to accept non-zero class/family escape codes.
Encryp.	Capable of handling signals on the ECS channel.

A.7 *Transfer-rate capabilities* (100)

64, 384	Can accept signals only on one 64 kbit/s channel, one 384 kbit/s channel.
2 × 64	Can accept signals on one or two 64 kbit/s channels, and synchronize them.
...	...
6 × 64	Can accept signals on one to six 64 kbit/s channels, and synchronize them.
2 × 384	Can accept signals on one or two 384 kbit/s channels, and synchronize them.
...	...
5 × 384	Can accept signals on one to five 384 kbit/s channels, and synchronize them.
1536/1920	Can accept signals on a 1536 kbit/s channel, a 1920 kbit/s channel.
Restrict	Can work only at p × 56 kbit/s, rate-adapted to p × 64 kbit/s by moving the SC to bit position 7 and setting bit 8 to "one" in every channel or time-slot; a constant "one", however, may be set in bit 8 if it is known by out-of-band signalling prior to the connection that the restriction exists; this code has the effect of forcing the remote terminal to work in the p × 56 kbit/s mode (see Annex B).
6B-H_0-comp	Capable of acting upon the corresponding command.
128/192/256	Capable of accepting the transfer rate specified by the corresponding command.
512/768/1152/1472	Capable of accepting the transfer rate specified by the corresponding command.

A.8 *LSD/MLP capabilities* (101)

300 (to 64k)	Can accept LSD at 300 bit/s (to 64 kbit/s) in the bit positions specified against the corresponding commands.
Var-LSD	Can accept LSD variable rate in the bit positions specified against the corresponding command.
MLP-4k	Can accept MLP at 4 kbit/s in the SC.
MLP-6.4k	Can accept MLP at up to 6.4 kbit/s in the SC.
Var-MLP	Can accept MLP at up to 64 kbit/s in the I-channel.

A.9 *Escape table values* (111)

HSD	High-speed data: a 32-code table containing HSD capabilities and commands.
H.230	Control and indications: a 32-code table with definitions in Recommendation H.230.
Start-MBE	First byte of (N+2) octet BAS message; the message format is: start-MBE//value of N (max=255)//N bytes.
NS-cap	First byte of non-CCITT capabilities message; the message format is: NS-cap//value of N (max=255)//country code[4]//manufacturer code*//(N – 4) bytes.

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[4] Country code consists of two bytes, the first being according to Recommendation T.35; the second byte and the terminal manufacturer code of two bytes are assigned nationally.

NS-comm	First byte of non-CCITT command message; the message format is:
	NS-comm//value of N (max=255)//country code[4] //manufacturer code*//(N-4) bytes.
Cap-mark	Capability marker – the first item in a capability set – see Recommendation H.242, § 2.
Data-apps	Applications within LSD/HSD channels: a 32-code table – see Table A-3/H.221.

Note 1 – The value of N is coded by its binary representation.

Note 2 – The most significant bit of each MBE message byte is transmitted as the b_0 bit of BAS.

A.10 *HSD/H-MLP capabilities* (111) [10000]-(101)

64k to 1536k	Can accept HSD at the specified rate in the bit positions specified against the corresponding commands.
HSD-other	Reserved for other HSD rates.
Var-HSD	Can accept HSD variable rate in the bit positions specified against the corresponding command.
H-MLP-62.4k	Can accept MLP at 62.4 kbit/s in the bit positions specified against the corresponding command.
H-MLP-r	Can accept MLP at r = 64/128/192/256/320/384 kbit/s in the bit positions specified against the corresponding command.
Var-H-MLP	Reserved for capability to accept H-MLP variable rate in the bit positions specified against the corresponding command.

A.11 *HSD/H-MLP commands* (111) [10000]-(011)

Note – In the cases of multiple channels, the term "highest-numbered time-slot" refers to the highest-numbered channel.

HSD-off	HSD switched off; FAS and BAS restored in additional channels.
64k	HSD on, in highest numbered channel/time-slot; FAS and BAS are removed in the case of multiple B-channels.
128/192/256k	HSD on in highest-numbered time-slots of an H_0 or greater channel.
320k	HSD on in highest-numbered time-slots of an H_0 or greater channel.
384k	HSD on in highest-numbered H_0 channel, or highest-numbered time-slots of a greater channel; FAS and BAS are removed in the case of multiple-H_0 channels.
HSD-other	Reserved for other HSD rates.
Var-HSD	Reserved for high-speed data occupying all capacity, other than in the I-channel, not allocated under other commands: cannot be invoked when other HSD is on, or when var-H-MLP is on (may also be impractical when video is on, the latter then being confined to the I-channel).

[4] Country code consists of two bytes, the first being according to Recommendation T.35; the second byte and the terminal manufacturer code of two bytes are assigned nationally.

H-MLP-off	H-MLP switched off (this does not affect I-channel MLP).
H-MLP-62.4	H-MLP on at 62.4 kbit/s, occupying second 64 kbit/s channel except FAS and BAS positions.
H-MLP-64k H-MLP-28k H-MLP-192k H-MLP-256k H-MLP-320k	H-MLP on at 64/128/192/256/320 kbit/s in the lowest-numbered time-slots, (other than TSI) of an H_0 or greater channel.
H-MLP-384k	H-MLP on at 384 kbit/s in time-slots 2-7 of a greater channel than H_0.
Var-H-MLP	Reserved for MLP occupying all capacity, other than in the I-channel, not allocated under other commands: cannot be invoked when other MLP is on, or when var-HSD is on.

Note – When the "restrict" command is in force the least significant bit of all octets covered by the HSD and H-MLP commands is set to "1", so the effective data rate is less than that indicated by the command.

A.12 *Applications within LSD/HSD channels – capabilities* (111) [10010]-(101)

ISO-SP baseline on on LSD	Can accept ISO-still picture (SP) baseline mode on specified LSD rate.
ISO-SP baseline on HSD	Can accept ISO-still picture baseline mode on specified HSD rate.
ISO-SP spatial	Can accept ISO-still picture baseline and spatial modes.
ISO-SP progressive	Can accept ISO-still picture baseline and progressive modes.
ISO-SP arithmetic	Can accept ISO-still picture baseline and arithmetic modes.
Graphics cursor	Can handle graphics cursor data.
Group 3 Fax	Can accept group 3 Fax.
Group 4 Fax	Can accept group 4 Fax.
V.120 LSD	Can accept V.120 terminal adaptation within an LSD channel.
V.120 HSD	Can accept V.120 terminal adaptation within an HSD channel.

A.13 *Applications within LSD/HSD channels – commands* (111) [10010]-(011)

ISO-SP on in LSD	ISO-still picture switched on in specified LSD.
ISO-SP on in HSD	ISO-still picture switched on in specified HSD.
Cursor data on in LSD	Cursor data switched on in specified LSD.
Fax on in LSD	Fax switched on in specified LSD.
Fax on in HSD	Fax switched on in specified HSD.
V.120 LSD	V.120 switched on in specified LSD.
V.120 HSD	V.120 switched on in specified HSD.

TABLE A-1/H.221

BAS numerical values

	(000) Audio command	(001) Transfer rate command	(010) Other command	(011) LSD/MLP command	(100) Audio/ transfer rate capability	(101) Data/video capability	(111) Escape
[0]	neutral	64	video off	LSD off	neutral	var-LSD	
[1]		2 × 64	H.261	300	A-law	300	
[2]		3 × 64	vid-imp(R)	1200	μ-law	1200	
[3]		4 × 64	video-ISO	4800	G.725-T1	4800	
[4]	A-law, OU	5 × 64	AV-ISO	6400	G.725-T2	6400	
[5]	μ-law, OU	6 × 64		8000	Au-16 kbit/s	8000	
[6]	G.722, m1	384	encryp-on	9600	Au-ISO	9600	
[7]	Au-off, U	2 × 384	encryp-off	14 400		14 400	
[8]	Note 2	3 × 384		16k	128	16k	
[9]	Note 2	4 × 384		24k	192	24k	
[10]		5 × 384		32k	256	32k	
[11]		1536		40k		40k	
[12]		1920		48k	512	48k	
[13]	Au-ISO-64	128		56k	768	56k	
[14]	Au-ISO-128	192		62.4k		62.4k	
[15]	Au-ISO-192	256		64k	1152	64k	
[16]	Au-ISO-256		freeze-pic	MLP-off	1B	MLP-4k	HSD
[17]	Au-ISO-384	loss i.c.	fast-update	MLP-4k	2B	MLP-6.4k	H.230
[18]	A-law, OF	channel No. 2	Au-loop	MLP-6.4k	3B	var-MLP	Data-apps.
[19]	μ-law, OF	channel No. 3	Vid-loop	var-MLP	4B		(R-SBE)
[20]		channel No. 4	Dig-loop		5B	QCIF	(R-SBE)
[21]		channel No. 5	Loop-off	dti-1 (R)	6B	CIF	(R-SBE)
[22]		channel No. 6		dti-2 (R)	restrict	1/29.97	(R-SBE)
[23]		512		dti-3 (R)	6B-H_0-comp	2/29.97	(R-SBE)
[24]	G.722, m2 (Note 3)	768			H_0	3/29.97	cap-mark
[25]	G.722, m3 (Note 3)		6B-H_0-comp		$2H_0$	4/29.97	start-MBE
[26]	(Au-40k)	1152	Nct-comp 6B-H_0		$3H_0$	V-imp(R)	
[27]	(Au-32k)		restrict		$4H_0$	Video-ISO	
[28]	(Au-24k)		derestrict		$5H_0$	AV-ISO	
[29]	(Au-16 kbit/s	1472			1472	esc-CF (R)	
[30]	(Au-<16k)				H_{11}	encryp.	ns-cap
[31]	Au-off, F			var-LSD	H_{12}	MEB-cap	ns-com

Note 1 – The column header gives the attribute designation as bits (b_0, b_1, b_2); the left-hand column gives the decimal value of bits [b_3, b_4, b_5, b_6, b_7]; for example, "channel No. 6" has the value (001) [10110]. All unassigned values are reserved, as are values marked (R).

Note 2 – These codes are listed in Recommendation G.725 with reference to an "application channel"; such a channel has not been defined, the concept having been superseded by that of LSD/MLP; therefore these codes should not be used.

Note 3 – These codes are listed in Recommendation G.725 with reference to "data"; however, the nature of such data (video, LSD, MLP, ECS) must be specified by further commands (001), (010), (011).

TABLE A-2/H.221

HSD/H-MLP numerical values

	Capabilities (101)	Commands (011)
[0]		HSD-off
[1]	var-HSD(R)	var-HSD(R)
[2]	H-MLP-62.4	H-MLP-62.4
[3]	H-MLP-64	H-MLP-64
[4]	H-MLP-128	H-MLP-128
[5]	H-MLP-192	H-MLP-192
[6]	H-MLP-256	H-MLP-256
[7]	H-MLP-320	H-MLP-320
[8]	H-MLP-384	H-MLP-384
[9]		
[10]		
[11]		
[12]		
[13]	var-H-MLP(R)	var-H-MLP(R)
[14]		H-MLP-off
[15]		
[16]		
[17]	64k	64k
[18]	128k	128k
[19]	192k	192k
[20]	256k	256k
[21]	320k	320k
[22]	384k	384k
[23]	512k(R)	512k(R)
[24]	768k(R)	768k(R)
[25]	1152k(R)	1152k(R)
[26]	1536k(R)	1536k(R)
[27]		
[28]		
[29]		
[30]		
[31]		

Note 1 – The column header gives the attribute designation as bits (b_0, b_1, b_2); the left-hand column gives the decimal value of bits [b_3, b_4, b_5, b_6, b_7]. All assigned values are reserved, as are values marked (R).

Note 2 – Escape table reached by BAS (111) [16].

TABLE A-3/H.221

Numerical values for applications in LSD/HSD channels

	Capabilities (101)	Commands (011)
[0]	ISO-SP baseline on LSD	ISO-SP on in LSD
[1]	ISO-SP baseline on HSD	ISO-SP on in HSD
[2]	ISO-SP spatial	
[3]	ISO-SP progressive	
[4]	ISO-SP arithmetic	
[5]		
[6]		
[7]		
[8]		
[9]		
[10]	Graphics cursor	Cursor data on in LSD
[11]		
[12]		
[13]		
[14]		
[15]		
[16]	Group 3 Fax	Fax on in LSD
[17]	Group 4 Fax	Fax on in HSD
[18]		
[19]		
[20]	V.120 LSD	V.120 LSD
[21]	V.120 LSD	V.120 HSD
[22]		
[23]		
[24]		
[25]		
[26]		
[27]		
[28]		
[29]		
[30]		
[31]		

Note 1 – The column header gives the attribute designation as bits (b_0, b_1, b_2); the left-hand column gives the decimal value of bits [b_3, b_4, b_5, b_6, b_7]. All assigned values are reserved, as are values marked (R).

Note 2 – Escape table reached by BAS (111) [18].

ANNEX B

(to Recommendation H.221)

Frame structure for interworking between a 64 kbit/s terminal and a 56 kbit/s terminal

B.1 *Sub-channel arrangement*

The sub-channel arrangement is given in Table B-1/H.221.

TABLE B-1/H.221

Bit number 1	2	3	4	5	6	7 (SC)	8	
							1	1 Octet number
S	S	S	S	S	S	FAS	1	:
u	u	u	u	u	u		1	8
b	b	b	b	b	b		1	9
-	-	-	-	-	-	BAS	1	:
c	c	c	c	c	c		1	16
h	h	h	h	h	h		1	17
a	a	a	a	a	a	(ECS)	1	:
n	n	n	n	n	n		1	24
n	n	n	n	n	n		1	25
e	e	e	e	e	e		1	·
l	l	l	l	l	l		1	·
#	#	#	#	#	#	#	1	·
1	2	3	4	5	6	7	1	80

Note – C1, C2, C3 and C4 in the FAS are computed for the 160 septets, or 1120 bits.

B.2 *Operation of the 64 kbit/s terminal*

The transmitter fills the eighth sub-channel with “1”, while the receiver searches FAS at every sub-channel.

B.3 *Restriction against some communication modes*

Since the interworking bit rate becomes 56 kbit/s, the transmission modes using more than 56 kbit/s are forbidden (receivers ignore these command BAS codes). Facilities using the original seventh sub-channel move to the sixth sub-channel.

B.4 *Audio Command Codes* (000)

The following are applicable instead of those in Annex A.

Neutral — Neutralized I-channel, containing only FAS and BAS; all other bits are to be ignored at the receiver.

Au-off, *U* — No audio signal, no framing; bits 1-7 of the I-channel are available.

Au-off, *F*	No audio signal, FAS and BAS in use; 54.4 kbit/s available for use under other commands.
A-law, U7	G.711 audio at 56 bit/s, A-law truncated to 7 bits, no framing (mode OU).
A-law, F6	G.711 audio at 48 kbit/s, A-law truncated to 6 bits, with FAS and BAS in bit 7.
μ-law, U7	G.711 audio at 56 kbit/s, μ-law truncated to 7 bits, no framing (mode OU).
μ-law, F6	G.711 audio at 48 kbit/s, μ-law truncated to 6 bits, with FAS and BAS in bit 7.
G.722, U8	not possible to transmit 8 bits per octet.
G.722, U7	G.722 7 kHz audio in bits 1-7, 56 kbit/s (unframed).
G.722, F6	G.722 7 kHz audio at 48 kbit/s, in bits 1-6 (mode 3).
Au-16 kbit/s	Audio at 16 kbit/s to Recommendation H.200/AV.254 in bits 1,2 (mode 7).
[Other]	All other values reserved.

The following (000) values are assigned maintaining the same number of audio bits per octet between the 64 kbit/s and 56 kbit/s environments:

[0]	Neutral
[6]	*not possible*
[7]	Au-off, *U*
[18]	A-law, U7
[19]	μ-law, U7
[20]	A-law, F6
[21]	μ-law, F6
[24]	G.722, U7
[25]	G.722, F6
[29]	Au-16 kbit/s
[31]	Au-off, *F*

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