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Foreword

This European Telecommunication Standard (ETS) has been produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

The attention of the user of this ETS is drawn to the possibility that compliance may require the use of technology covered by patent or similar rights.

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1 Scope

This ETS specifies inband signalling procedures for establishing communication between audiovisual terminals using digital channels of up to 2 048 kbit/s. The system is based on the frame structure and associated syntax as specified in ETS 300 144 [1]. The procedures are required to establish a compatible mode upon call set-up, to switch between modes during a call and to allow for use of supplementary services as described in ETS 300 145 [2].

A separate ETS (DE/TE-04120) is under preparation which specifies the method of testing required to identify conformance to this ETS.

This ETS is applicable to terminals supporting the telephony 7 kHz or videotelephony teleservice and to other terminals designed for audiovisual communication.

NOTE: It is assumed within this ETS that, due to frame synchronisation and signalling overheads, the bit rate which can be used for user data in 2 048 kbit/s transmission systems is limited to 1 920 kbit/s.

2 Normative references

This ETS incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to apply.

[1] ETS 300 144: "Integrated Services Digital Network (ISDN): Audiovisual services, Frame structure for a 64 to 1 920 kbit/s channel and associated syntax for inband signalling".

[2] ETS 300 145: "Integrated Services Digital Network (ISDN): Audiovisual services, Videotelephone systems and terminal equipment operating on one or two 64 kbit/s channels".

[3] CCITT Recommendation G.711 (1988): "Pulse code modulation (PCM) of voice frequencies".

[4] CCITT Recommendation G.722 (1988): "7 kHz audio-coding within 64 kbit/s".

[5] CCITT Recommendation G.725 (1988): "System aspects for the use of the 7 kHz audio codec within 64 kbit/s".

[6] CCITT Recommendation G.728 (1992): "Coding of speech at 16 kbit/s using low-delay code-excited linear prediction".

3 Definitions

For the purposes of this ETS, the definitions given in Clause 3 of ETS 300 144 [1] and the following definition apply:

Capability: Ability to receive, demultiplex and decode the corresponding signal.

4 Symbols and abbreviations

For the purposes of this ETS, the following symbols and abbreviations apply:

BAS	Bit-rate Allocation Signal
C&I	Control and Indication
CIF	Common Intermediate Format
ECS	Encryption Control Signal
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
FAS	Frame Alignment Signal
FAW	Frame Alignment Word
H-MLP	High speed Multi Layer Protocol **1)**
H0	384 kbit/s channel
H11	1 536 kbit/s channel
H12	1 920 kbit/s channel
HSD	High Speed Data
ISDN	Integrated Services Digital Network
ITU-TS	International Communications Union Telecommunications Standardization
LSB	Least Significant Bit
LSD	Low Speed Data
MBE	Multi-Byte Extension
MCC	Multipoint Command Conference
MCS	Multipoint Command Symmetrical Data-transmission
MCU	Multipoint Control Unit
MLP	Multi Layer Protocol **2)**
MPI	Minimum Picture Interval
MSB	Most Significant Bit
QCIF	Quarter Common Intermediate Format
SBE	Single Byte Extension
SC	Service Channel
TEA	Terminal Equipment Alarm
TS	Time Slot
TS1	Time Slot 1
VCF	Video Command "Freeze-picture request"
VCU	Video Command "Fast-update request"
(xxx) [yy]	Symbolism, coded representation of a BAS following table 8 of ETS 300 144 [1]. (xxx) corresponds to the binary attribute of the BAS, and [yy] corresponds to the value of the BAS in decimal

5 Basic principles and rules

The sequences and procedures in this ETS ensure that only those signals are transmitted which can be received and appropriately treated by the remote terminal, without ambiguity. This requires that the capabilities of each terminal to receive and decode be known to the other terminal, and that suitable commands be transmitted to set the demultiplexer and decoders accordingly.

The total capability of a terminal to receive and decode various signals is made known to the other terminal by transmission of its capability set (see subclause 5.1.9).

The frame structure described in ETS 300 144 [1] is used for mode initialisation and dynamic mode switching (see the following subclauses) and, more generally, to transmit capabilities and commands. ETS 300 144 [1] defines a Bit-rate Allocation Signal (BAS) which is used, inter alia, to indicate the coding algorithm(s) and to define the multiplex of the various bit streams (audio, video, data, Encryption Control Signal (ECS), frame structure) within the frame.

BAS codes are classified by attribute and value; the first three bits represent the BAS attribute: each attribute may therefore have up to 32 defined values.

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1) MLP protocols are under discussion in ITU-TS.
2) MLP protocols are under discussion in ITU-TS.

Four BAS attributes are commands: they define the multiplex within the next and following sub-multiframes, as well as an audio coding algorithm, and therefore command the distant receiver to treat the signals accordingly. The four attributes are independent; that is, a value of one attribute does not modify that of another.

Further BAS attributes are defined to signal terminal capabilities to the distant terminal. When received, these attributes do not directly affect the current transmission mode. However, they may lead to the initiation of a specific action to be carried out by the terminal. This feature is used in the mode initialisation procedure and in the mode forcing procedure (see Clause 7).

The third bit of the Frame Alignment Signal (FAS) (see ETS 300 144 [1]) in odd frames of the initial channel, called the A-bit, is set to 0 on acquiring frame alignment and, if desired or necessary, multiframe alignment; the A-bit is set to 1 on loss of frame or multiframe alignment. Consequently, a terminal which is receiving a framed signal with the A-bit set to 0 can assume that the distant terminal is able to receive BAS capability sets and act upon changes of BAS.

A terminal having capabilities for single-channel working only, and without encryption capability, does not need to seek and gain multiframe alignment since the latter serves for numbering and synchronising multiple channels.

5.1 Capabilities

Capability values are defined in ETS 300 144 [1].

5.1.1 Audio capabilities

All audiovisual terminals claiming conformance to this ETS shall be capable of transmitting and receiving audio with both A-law and μ-law companding, according to ITU-T Recommendation G.711 [3]. They shall transmit at least one audio capability.

Both ITU-T Recommendation G.711 [3] capabilities shall be sent, unless it is desired to force the remote terminal to transmit a particular one of the two. Receipt of just one value (A or μ) from the remote terminal shall be interpreted as an indication that it cannot decode signals to the other law. Receipt of no ITU-T Recommendation G.711 [3] capabilities shall be interpreted as an indication that it can decode signals to both laws.

Table 1: Meaning of the A-law and μ-law capability inside a capability set

A-law capability received	μ-law capability received	meaning (referring to the transmitting terminal)
No	No	can decode A-law and μ-law
Yes	No	cannot decode μ-law
No	Yes	cannot decode A-law
Yes	Yes	can decode A-law and μ-law

5.1.2 Video capabilities

For the picture format, a terminal may have either Quarter Common Interchange Format (QCIF) capability alone, or both QCIF and Common Intercharge Format (CIF) capabilities.

The QCIF capability shall be followed by one Minimum Picture Interval (MPI) value. The CIF capability shall be followed by two MPI values, the first applicable to QCIF and the other to CIF.

For the MPI, the following are valid values:

- 1/29,97;
- 2/29,97;
- 3/29,97;
- 4/29,97 seconds.

5.1.3 Transfer rate capabilities

The capability to receive a given number of 64 kbit/s channels includes the capability to receive fewer 64 kbit/s channels. Similarly, the capability to receive a given number of 384 kbit/s channels (H0 channels) includes the capability to receive fewer H0 channels. In both cases the receiving terminal shall be able to synchronise the connected additional channels to the initial channel and maintain that synchronism throughout the period of connection.

All other ranges of capability shall be signalled by inclusion in the capability set of more than one transfer rate capability code. For example, a terminal may list its transfer-rate capabilities as [2B and H0 and H11 and H12]; in this case 1B capability is also implied.

All terminals are capable of receiving a single B-channel or 64 kbit/s time-slot of a larger channel; therefore the 1B capability need not normally be transmitted; the exception is when no other transfer-rate capability is included in the set, when higher rates have been in force previously in the same call.

5.1.4 Data capabilities

If a terminal is able to accept more than one data rate of whatever type (Low Speed Data (LSD), High Speed Data (HSD), Multi Layer Protocol (MLP), High-speed Multi Layer Protocol (H-MLP)), then all relevant values shall be included in the capability set. Statement of one value does not include any other values (that is, there is no hierarchy in data rate capabilities).

5.1.5 Restricted networks: capability

A terminal connected to a network whose B-channels are effectively restricted to p x 56 kbit/s (p = 1 to 6), or whose channels at H0, or higher, are restricted by ones-density considerations, shall declare the capability value (100) [22] (restrict capability) as given in ETS 300 144 [1]. All terminals intended for interworking with terminals on restricted networks shall have the capability to respond to this code by using the multiplex and the BAS commands defined for the restricted network as given in ETS 300 144 [1] (see also subclause 8.3, item c).

5.1.6 Encryption and extension-BAS capabilities

These capabilities indicate, respectively, the ability of the terminal to open the Encryption Control Signal (ECS) channel, and to accept Multi-Byte Extension (MBE) messages in the BAS position.

Once an ECS capability code has been transmitted it cannot be cancelled by omission from a subsequent capability exchange.

5.1.7 Neutral capability

Neutral capability (100) [0] shall never be transmitted.

It may be received from other terminals conforming to ITU-T Recommendation H.242. If it is not enclosed between BAS capability markers, the sequence is invalid.

If neutral capability is included in a capability set together with other capabilities, the sequence is invalid.

5.1.8 Hierarchy in capabilities

The following capability codes are hierarchically structured:

- G.711 (A or μ or both) < G.722-48;
- G.711 (A or μ or both) < G.728;
- 1B < 2B < 3B < 4B < 5B < 6B;
- 1H0 < 2H0 < 3H0 < 4H0 < 5H0;
- QCIF < CIF;
- 4/29,97 < 3/29,97 < 2/29,97 < 1/29,97.

The meaning of these expressions is that, in every case, a terminal having the capability to the right of a "<" sign shall also have all the capabilities to the left thereof.

5.1.9 Rules for capability sets

A capability set is valid if it conforms to the rules set out in this Clause. If a received capability set is found to have broken one or more of these rules it shall be considered invalid and consequently ignored. The capability set consists of the capability marker (111) [24] followed by all currently valid values, in any order (except for MPI values). No values should be repeated within a set (except for MPI values, see subclause 5.1.2).

All codes included in the capability set shall correspond, by the definitions given in ETS 300 144 [1], to properties which can be activated in the terminal at the appropriate moment following the receipt of a relevant command.

Allowed capability set values are capability marker (111) [24], capabilities (100) [1-31] and (101) [0-31] and escape table capability values. No commands are permitted in a capability set. Neutral capability shall not be included in a capability set.

The capability set shall conform to table 2, which summarises the capabilities that can be simultaneously valid.

Table 2: BAS capabilities that can be simultaneously valid

Audio	One or more values from {A-law, μ-law, G.722-48, Au-16 kbit/s(G.728), Au-ISO}
Video	Absent, or { [(QCIF plus one MPI value) or (CIF plus two MPI values)] and/or video-ISO and/or AV-ISO}
Transfer rate	Absent (meaning rate = 64 kbit/s only [3)]), or { no or one value of {1B; 2B; 3B; 4B; 5B; 6B}, and/or no or one value of {1H0; 2H0; 3H0; 4H0; 5H0}, and/or H11, and/or H12, and/or any relevant values from {128, 192, 256, 512, 768, 1 152, 1 472 kbit/s}}
Restricted network	Absent or present
Low-Speed Data (LSD)	Absent or all relevant values
High-Speed Data (HSD)	Absent or all relevant values
Low-speed MLP	Absent or all relevant values
High-speed MLP	Absent or all relevant values
Applications in data channel	Absent or all relevant values
Capabilities defined in ITU-T Recommendation H.230	Absent or all relevant values
Encryption	Absent or all relevant values
Multiple-Byte Extension	Absent or all relevant values

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3) When reducing the transfer-rate capability to 64 kbit/s from an higher rate, the value (001)[0] shall be included.

A capability set shall always be followed by either:

- one or more repetitions of the set; or

- capability marker and at least one of the commands (000) [0 to 31] or (001) [0 to 31] or (010) [0 to 31] or (011) [0 to 31], according to the received capability set.

The number of repetitions of the capability set is not limited.

A capability set shall never be empty. A minimum of one valid capability value other than capability marker shall be present in a capability set. There shall never be two capability markers in consecutive BAS positions.

If it is desired to change the capability set during its transmission, the existing set shall first be completed without change, followed by a capability marker and at least one command; thereafter, a changed set may be sent.

A capability set shall not include any HSD/H-MLP capabilities whose bit rates exceed the transfer rate capability (e.g. 256 kbit/s HSD rate for 2B transfer rate).

A neutral capability set is defined as: [capability marker + neutral capability]. If a terminal receives a neutral capability set while already transmitting in a framed mode and receiving A=0, it shall ignore it.

5.2 Commands

5.2.1 Audio commands

Audio cannot penetrate into fixed rate data (LSD or MLP) bit positions. It can expand its capacity into vacant, or video or variable data bit positions. It can reduce its capacity within the audio bit positions currently occupied.

5.2.2 Video commands

The video transmission is governed by the video-on and video-off commands. When switched on, the video signal occupies all the capacity, both in the initial channel and in any additional channels, which is not specifically allocated to other signals by other commands (ECS, Audio, LSD/MLP regardless of being fixed rate or variable rate). Thus, different video bit rates shall result from audio, transfer-rate, ECS and data commands, the resultant video bit rate being:

> transfer rate, less audio rate, less data rate [4)], less encryption control channel [5)], less FAS and BAS [6)].

Video can be turned on at any time even if the available capacity for video is zero at the corresponding sub-multiframe; (it may happen, for example, that video is switched on just before the variable rate LSD or MLP channel is closed); the decoder shall not ignore "video on" even in this case, otherwise a mode mismatch occurs.

5.2.3 LSD/MLP commands

Fixed rate LSD/MLP cannot penetrate into Audio bit positions nor into fixed rate MLP/LSD bit positions. It can expand its capacity into vacant, or video, or variable-MLP, or variable-LSD bit positions. It can reduce its capacity within the data bit positions currently occupied.

Both **fixed and variable-rate LSD/MLP** may be changed without first closing the data channel.

> NOTE: There can only be one LSD and one MLP channel at any instant.

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4) If present.
5) If present.
6) In all the channels/time-slots where they are present.

Variable rate LSD/MLP occupies all bit positions which are not assigned by other fixed rate commands (ECS, Audio, fixed rate MLP/LSD). If video has been on, it is excluded from the same channel when variable-LSD or variable-MLP is turned on. If variable-LSD/MLP has been on, opening a variable rate MLP/LSD channel should be preceded by closing the existing variable-LSD/MLP channel. Variable rate LSD or MLP can be turned on even if the available capacity for it is zero at the corresponding sub-multiframe; (it may happen, for example, that the variable MLP is switched on just before closing the LSD channel which has been occupying all the capacity other than audio) the decoder shall not ignore "variable rate LSD or MLP on" even in this case, otherwise a mode mismatch occurs.

5.2.4 Rules for commands

The mode of transmission is completely defined by a set of BAS commands, each of which takes effect from the next submultiframe and remains in force until countermanded (see below). They may be transmitted in any suitable order, and may be repeated at any time. The set of BAS commands may be different for the two transmission directions (see subclause 6.2).

Table 3 summarises the BAS commands. Only one value in each row can be in force at a time. It is not necessary to transmit one value of each row; the table also defines the default value to be assumed when no value from a particular row has been sent.

However, the rows are not independent - many of the combinations are precluded by the fact that they would affect the same bits of the channel (for example, (011) [31] and (011) [19] cannot coexist).

Table 3: Command summary

Attribute	Alternative values (value sent last is valid only)	Default assumed	Comments
Audio (000)	[0, 4-7, 13-19, 24-31]	[18]	
Transfer rate (001)	[0-15, 23, 24, 26, 29] [17] [18-22]	[0]	 See subclause 7.5 Additional channels only
Video and other (010)	[0-4] [6, 7] [16] [17] [18, 21] [19, 21] [20, 21] [25, 26] [27, 28]	[0] [7] [21] [21] [21] [26] [28]	 Cancelled by command in video frame Expires after fast update completed
LSD and MLP (011)	[0-15, 31] [16-19]	[0] [16]	
HSD and H-MLP	[0, 17-22] [2-8, 13, 14]	[0] [14]	Reached by Escape table (111) [16]

BAS commands which exceed the current transmission capacity shall not be transmitted (e.g. transmission of 2B transfer rate command before the second channel is established).

If a terminal receives a BAS code which is unrecognised or unexpected, a mode mismatch may result (see subclause 8.3).

5.3 Sequencing of BAS codes

When there is no other demand for use of the BAS position, the transmitter shall cycle through all the valid BAS commands, so that if there is a temporary disturbance the proper mode shall be restored as soon as possible thereafter.

Capability exchanges (see subclause 6.1) shall not be initiated, other than when there is an operational need to do so, to indicate a changed capability set, or as part of a fault recovery procedure, or when all or a part of the capability set of the remote terminal has been lost.

5.4 Values of unoccupied bits

Any code can be sent in bit positions which have not yet been occupied by the BAS commands. In a 2B communication, for example, the additional channel may be filled with "0" or "1" or any combinations in all bit positions except those for FAS and BAS, until a 2B transfer rate command is sent.

NOTE: Although the terminal may set the unoccupied bits to any values, there is no assurance that those bits will be delivered to other terminals in a multipoint conference.

6 Basic sequences

Three basic signalling sequences are defined in this Clause:

- capability exchange (sequence A);
- mode switching (sequence B);
- frame reinstatement (sequence C);

These sequences are used as the building blocks for the procedures defined in Clauses 7 and 8.

6.1 Capability exchange (sequence A)

This sequence involves the transmission by both terminals of their current capability sets. Either terminal may initiate the sequence and there is no problem caused by both doing so simultaneously or nearly simultaneously. The sequence is used in various procedures, in which the initiating terminal wishes to inform the other of its own capability set (for example at the start of the call or when the capability set has been changed), or wishes to check the current capability set of the other (for example in a fault recovery procedure), or both.

When a terminal activates sequence A during a call, it shall maintain the current mode of multimedia multiplexing, including FAS and BAS in additional channels if relevant.

6.1.1 Initiating terminal

A terminal X wishing to initiate the capability exchange sequence shall be transmitting in a framed mode: thus, if currently transmitting unframed, it shall first reinstate framing by using sequence C (see subclause 6.3). It sets a timer T1 (value 10 seconds), switches to a framed mode if not already transmitting framed, and transmits its current capability set repetitively.

X shall continue repetitive capability set transmission until the following conditions a, b and c, are met:

a) if X was initially receiving in an unframed mode, it detects an incoming mode switch to a framed mode;
b) X has detected incoming capability marker, followed by at least one of the capability codes (100) [1 to 31] or (101) [0 to 31];
c) incoming A=0.

When the conditions a), b) and c) are met, then:

d) X completes transmission of the capability set that it has already started transmitting, followed by, at least, another complete capability set, and a capability marker. The A-bit shall never have been received as equal to 1 during this time, otherwise the transmission of capability sets shall continue;
e) after this capability marker of d), X shall send at least one of the BAS commands (000) [0 to 31] or (001) [0 to 31] or (010) [0 to 31] or (011) [0 to 31] according to the received capability set.

If X is in phase e) but has not yet received a complete capability set from the remote terminal, it is allowed to send commands but not to change the current mode. So, these commands can only describe the current mode.

If the incoming capability set includes the restricted capability (100) [22], and if the rules for interworking with restricted networks are implemented in the terminal X, then its outgoing transmission shall obey these rules (see also subclause 8.3, item c).

If X receives any further capability sets before expiry of timer T_1, it shall not respond to this by repeating its own capability set, as would otherwise be required by the rules in subclause 6.3.2.

6.1.2 Terminal not initiating

When terminal Y, not having itself initiated the sequence A, first detects an incoming capability marker, it shall act as follows:

If Y is transmitting in an unframed mode, it shall switch its transmitter to a framed mode according to subclause 6.3.1.

Y then examines the next BAS:

a) if this is neutral capability, it shall be ignored;
b) if this is any other capability, and the incoming A-bit is set to 0, Y transmits a single capability set followed by a capability marker and at least one of the commands (000) [0 to 31] or (001) [0 to 31] or (010) [0 to 31] or (011) [0 to 31], according to the received capability set;
c) if this is any other capability, and the incoming A-bit is set to 1, Y transmits capability sets repetitively until, after incoming A=0, a whole capability set has been sent, following this with the capability marker and at least one of the commands (000) [0 to 31] or (001) [0 to 31] or (010) [0 to 31] or (011) [0 to 31], according to the received capability set;
d) if this is a command, the capability marker shall be assumed due to a transmission error, and no action shall be taken (see subclause 8.3).

6.1.3 Identification of the end of sequence A

- Outcome A-I: the sequence A is considered to be completed successfully when all the following conditions (a) to f)) are met:

  a) outgoing transmission is framed;
  b) frame alignment (and multiframe alignment, if desired) has been achieved;
  c) the terminal's own complete capability set plus the capability marker has been transmitted while incoming A=0;
  d) a complete and valid capability set plus capability marker has been received (see NOTE 1);
  e) the incoming capability set includes (100) [22] and the outgoing transmission obeys "restricted" rules, or the incoming capability set excludes (100) [22] and the outgoing transmission obeys "normal" rules (see ETS 300 144 [1]);
  f) the timer T1 has not expired.

  NOTE 1: If, instead of a capability set, a terminal detects the repetition of the capabilities such as G722-64 (100) [3], G722-48 (100) [4] or neutral capability (100) [0], this indicates that the remote terminal follows ITU-T Recommendation G.725 [5]. To assume the compatibility with these G.725 terminals, the terminal X may behave as a terminal in conformance to the ITU-T Recommendation G.725 [5].

- Outcome A-II: the timer has expired without conditions b) to e) (above) being met. In this case, the sequence failed.

- Outcome A-III: the timer has expired with frame (for 1B terminal) or multiframe alignment achieved, but without either or all conditions c), d) or e) (above). In this case, the sequence did not finish successfully.

  NOTE 2: Further actions in the event of outcome A-II and A-III are specified in subclause 7.1.1.

6.1.4 Change of capability set

At any time during a call, the terminal can initiate sequence A, to inform the other terminal of a changed capability set.

It is, however, forbidden to send a changed capability set immediately following the previous capability set: The previous capability set shall first be completed without change, followed by a capability marker and at least one of the commands (000) [0 to 31], or (001) [0 to 31], or (010) [0 to 31], or (011) [0 to 31],

according to the received capability set. Then, sequence A can be initiated with the changed capability set (see subclause 6.1.2).

When a terminal has received such a capability set from the remote terminal during the call, it shall respond by sending its own capability set, but the set need not be changed in response to the remote terminal's new capability.

6.2 Mode switching (sequence B)

Mode switching includes:

- switching of the audio mode;
- turning video off or on;
- the adoption/cessation of use of additional channels;
- the opening/closing of the encryption control channel;
- the opening/closing of a data channel.

Mode switching is performed using BAS command codes, each being effective from the beginning of the even frame following the sub-multiframe in which the code is first transmitted, i.e. from the beginning of the next submultiframe. Mode switching is possible at any time during a communication.

It is important to bear in mind that transmitted signals shall always be according to the known capabilities of the remote terminal to receive and decode; in the absence of such knowledge, only mode 0F or 0U (audio to ITU-T Recommendation G.711 [3]) may be sent. If a change of capability, indicated in performing sequence A, has the outcome that the current mode is no longer receivable/decodable by the remote terminal, there shall be a switch as soon as possible to a mode which can be received and decoded.

In general, a BAS code which is invalid or which contravenes the provisions of table 3, or otherwise indicates an impossible frame structure or system status, shall not be transmitted.

At the transmitting terminal, if a BAS command is transmitted to signal a new mode, the transmitter shall operate in the appropriate mode from the first octet of the next sub-multiframe. Similarly, at the receiving terminal, if the received BAS signals a new mode, the receiver shall operate in the appropriate mode from the first octet of the next sub-multiframe.

6.2.1 Symmetry/asymmetry (point-to-point)

In point-to-point communication, the mode switching is in principle performed independently for the two transmission directions; some applications may be fundamentally asymmetric. For conversational services the terminal procedures may generally be such as to provide symmetrical transmission, though this is not mandatory.

6.2.2 Symmetry/asymmetry (multipoint)

In a multipoint conference, a terminal receiving Multipoint Command Conference (MCC) or Multipoint Command Symmetrical Data-transmission (MCS) to ETS 300 144 [1] shall, as soon as possible, switch the outgoing signal to a mode conforming to the following conditions: transfer rate identical to that incoming, audio rate equal to that incoming, data rate equal to that incoming. If video is on, its bit rate may change as a consequence of changes to transfer or audio or data rate. Conformance of the outgoing mode to these conditions shall be maintained throughout the remainder of the call or until receipt of cancel-MCC or cancel-MCS (see ETS 300 144 [1]).

6.3 Frame reinstatement (sequence C)

6.3.1 Outgoing framing

In the transmitted channels, frame reinstatement consists of the insertion of Frame Alignment Signal (FAS) and BAS into the first 16 bits of the service channel.

Three outcomes are defined:

- Outcome FR-I: the incoming signal is framed, the incoming A-bit is received with a value of "0". In this case, the frame reinstatement is successful;

- Outcome FR-II: the incoming signal is unframed, hence no incoming A-bit can be monitored. In this case, the frame reinstatement is assumed as successful;

- Outcome FR-III: the incoming signal is framed, the incoming A-bit is received with a value of "1". In this case, the frame reinstatement is not successful. A fault recovery according to subclause 8.2.1 shall be started.

6.3.2 Incoming framing

A terminal X which is receiving unframed may wish the remote terminal Y to reinstate framing. To do this, X shall act as follows:

1) first, itself reinstate framing if it is not already transmitting framed;

2) start sequence A. Y shall respond by switching to a framed mode in order to return its capability set and A = 0, and continuing until it receives A = 0 itself, again concluding with capability marker.

For the terminal X, sequence C is terminated successfully when it is receiving in a framed mode, and the incoming A-bit is received with the value of "0".

7 Procedures

7.1 Mode initialisation procedure (inband)

Audiovisual terminals shall be connected to digital networks where other kinds of terminals are also connected to: G.711-only terminals, but also data terminals, telematic terminals, servers, etc. For compatibility between the different services involving those terminals, an initialisation procedure is necessary.

Also, the terminals involved in a call may change during the call (e.g. due to addition or removal of a data equipment such as facsimile, or due to a change of capabilities prior to the invocation of supplementary services, etc.). This may require re-initialisation in order to identify the terminal type and to re-establish the desired mode of operation. Re-initialisation is also necessary after performance of the mode mismatch recovery procedure.

7.1.1 Initial channel

The initialisation procedure shall begin as soon as a physical connection is established; re-initialisation may be required during the communication for some of the supplementary services such as call transfer (see ETS 300 145 [2]).

a) At the beginning of mode initialisation, the terminal shall transmit in mode 0F(A).

b) The receive part of the terminal shall be in frame search and the audio decoding in mode 0(A).

c) Sequence A is started.

d) Upon completion of sequence A according to outcome A-I, sequence B shall commence. The BAS codes sent in sequence B shall be such that the transmitted mode always remains within the declared capabilities of the distant terminals, and results in a suitable working mode. This process may involve terminal procedures affecting choices made by the user or pre-set in the terminal. If the A/μ-law detector algorithm according to ITU-T Recommendation G.725 [5] is implemented, and if it indicates incoming speech in the other law, then it shall switch its decoder to the other coding law.

   In the event of outcome A-II, the terminal shall switch its transmission and reception to mode 0U. The receive part of the terminal shall remain in frame search throughout the call. If the A/μ-law

detector algorithm according to ITU-T Recommendation G.725 [5] is implemented, the decoder and the encoder shall be switched to the detected law.

NOTE 1: This is the expected case of connection to a PCM telephony terminal, so the communication continues verbally from here.

In the event of outcome A-III, the sequence is either restarted [7)] , or a fault recovery procedure (such as that of subclause 8.3 (item C) may be performed, depending on which of the condition(s) c) to e) have not been met. Capability sets shall not be transmitted continuously for more than 10 seconds while incoming A=0.

NOTE 2: Outcome A-III can occur if the terminal is connected to a terminal working to ITU T Recommendation G.725 [5].

The initialisation procedure is completed when each terminal has switched to its desired working mode(s). BAS commands may be sent before the completion of the initialisation procedure, but in this case no mode change shall be performed.

7.1.2 Additional channels

If the incoming capability set has included a multiple-channel transfer-rate value, the calling terminal may then immediately begin establishing the additional connections. When each is established, it transmits only FAS and BAS on that channel, setting a timer, T2, with a value of 10 seconds. Synchronisation with the initial channel shall be performed according to ETS 300 144 [1]. When the incoming A bits on additional channels are observed to be 0, mode switching to occupy sequentially numbered channels shall be initiated by an appropriate transfer-rate command BAS. If the timer T2 has expired without receiving A = 0, it shall be dealt with as a fault condition, according to subclause 8.2.2.

As additional channels achieve synchronisation, the calling terminal shall sequentially number the channels using both FAS and BAS numbering as provided in ETS 300 144 [1].

The called terminal shall use the same numbering.

NOTE: This principle is not used in ITU-T Recommendation H. 242.

As the buffering process may involve the insertion of additional delay in the channel(s), which may already be carrying user information (speech, video, data), it may be necessary for some applications to make some provision for this interruption (e.g., short-term muting of audio output).

The calling terminal shall not transmit in an unframed mode during the establishment of additional connections. If the called terminal is transmitting in an unframed mode when an additional connection is being established, it shall immediately switch to a framed mode.

7.2 Mode switching

When a terminal wishing to make a mode switch is transmitting and receiving in a framed mode, but the incoming A-bit is set to "1", a mode switch shall not be made until the A-bit returns to "0". If this does not occur, it shall be dealt with as a fault condition.

When the terminal X wishing to make a mode switch is receiving unframed signals, the capability exchange sequence may be used first to force the other terminal Y to a framed mode in order that terminal X can check for incoming A = 0. This use of sequence A is particularly necessary if X was previously transmitting unframed signals, since Y would not be able to deal with a mode change from X until it had regained frame alignment (see subclause 6.2.3). If X had previously been transmitting framed signals, the capability exchange sequence may be omitted because if Y had unexpectedly lost frame alignment it has already attempted a recovery.

7.2.1 Dynamic mode switching from a framed mode to another mode

The basic sequence mode switching as described in subclause 6.2.2 is used.

[7)] It shall be avoided that the sequence be restarted over and over again.

7.2.2 Dynamic mode switching from an unframed mode to another mode

The basic sequences frame reinstatement (sequence C) and mode switching according to sequence B are sequentially transmitted.

7.3 Mode forcing procedures

Where it is necessary to change the mode transmitted from the remote end, this procedure is used.

A mode forcing procedure may be required for some supplementary services (see ETS 300 145 [2]) and can take place as a building block in some of the recovery procedures (see subclause 8.1).

If 1B transfer rate is included in the capability set of the forcing terminal, the content of the additional channel(s) is not concerned; they may include only FAS and BAS with any bits in other bit positions, or may even become vacant without FAS and BAS.

By omitting a capability (video, or one of the types/rates of data), the transmission of a signal stream from the remote terminal can be caused to be switched off. In the case of hierarchical capabilities, a restriction to a lower range can be imposed.

A mode forcing procedure consists of:

1) sending commands to reduce the current mode to the mode wanted;

2) sequence A, containing reduced capabilities: on receipt of a reduced capability set, the remote terminal is obliged to answer by sending its own capability set according to the rules of sequence A. Before answering with capabilities, the remote terminal may send commands to switch its outgoing mode to the mode desired by the forcing terminal.

The procedure is completed successfully when the forcing terminal detects the incoming mode switched to the mode desired.

7.3.1 Mode forcing

Mode forcing generally restricts the mode transmitted from the remote terminal.

The range of forcing is limited:

- it is impossible to force ITU-T Recommendations G.722 [4] or G.728 [6] audio. Only ITU-T Recommendation G.711 [3] audio can be forced;
- it is impossible to force CIF video.

7.3.2 Mode-0 forcing

Mode-0 forcing is a mode forcing which restricts the transmitted mode only to audio ITU-T Recommendation G.711 [3] A-law or μ-law, framed.

The content of the reduced capability set is:

- single channel in use [capability marker, G.711(A) or/and G.711(μ)];

- two or more channels in use:
  [capability marker, A-law and/or μ-law,1B]; or
  [capability marker, A-law and/or μ-law,H0].

7.4 Procedure for use of Encryption Control Signal (ECS) channel

Each terminal shall transmit the encryption capability code according to ETS 300 144 [1] if it is able to handle the ECS channel. No terminal may activate the channel without first receiving the corresponding capability code. Once an ECS capability code has been transmitted it cannot be cancelled by omission from a subsequent capability exchange. That is to say, a terminal having once received, stored and made use of an ECS capability code may assume continued validity until cancelled by the local user. Thus

encryption can be discontinued by the users themselves, but not by a third party tampering with the BAS-capability exchange.

The initiating terminal transmits the command "ECS channel ON"; from the next multiframe it opens the 800 bit/s ECS channel, as defined in ETS 300 144 [1]. FAS, BAS and the ECS channel itself are not, in any case, encrypted.

When encryption has been turned off by user action, the BAS command "ECS channel OFF" is used to close the ECS channel.

7.5 Procedure for activation and de-activation of data channels

7.5.1 Activation of data channels

Each terminal shall transmit a data-rate capability code (see ETS 300 144 [1]) for each data rate it is able to receive. This may be done during the capability exchange sequence at the start of the call or, later, by initiating a new capability exchange.

A terminal may transmit data at any rate which has been indicated in the data-rate capability codes it has received from the other terminal (see NOTE below). The appropriate data command (in accordance with ETS 300 144 [1]) is sent, and in the following sub-multiframe, the data transmission is commenced, occupying the bits within each frame as defined in ETS 300 144 [1]. However, at the time the data command is first sent, these bits shall be unoccupied or contain only video or other variable rate information; therefore, for example, audio or other fixed data rate signals shall be removed from this part of the frame with the prior transmission of an appropriate command. In the case of occupancy by video information, commands are not available to reduce the video rate.

At any time during data transmission the rate may be changed by an appropriate data command, subject to the provisions given above.

NOTE: Sometimes symmetrical data transmission is required, e.g. in data transmission through the V.24/V.28 interface. If more than one data rate have been identified as common between two terminals, asymmetrical data transmission may take place according to different terminal procedures. This can be avoided by e.g., declaring only one rate as a data capability.

7.5.2 De-activation of data channels

At the conclusion of the data transmission the data OFF command (in accordance with ETS 300 144 [1]) is sent. If video is ON, it shall then occupy the freed bits in the next sub-multiframe and thereafter; otherwise those bits remain unoccupied, if no variable rate data command is in force.

7.5.3 Simultaneous transmission of Low Speed Data (LSD) and MLP

LSD and MLP may be active simultaneously, provided that no overlap is implied by the commands in force. No more than one LSD channel and one MLP channel may be active at any time.

Variable LSD and variable MLP cannot coexist.

7.6 Procedure for use of BAS-extension codes

ETS 300 144 [1] provides the attribute (111) for extension of the use of the BAS position in the subsequent sub-multiframe(s) for other various purposes; there are 32 values of this attribute, the meanings of these being defined in ETS 300 144 [1].

Values [16-23] are defined as Single-Byte Extension (SBE); codes of SBE type may be transmitted at any time and to any terminal. All terminals shall recognise the (111) attribute, at least to the extent of ignoring the subsequent BAS code (the escaped value).

Values [25-31] are Multiple Byte Extension (MBE); codes of MBE may only be transmitted to a terminal which has previously indicated its capability to receive MBE. It follows that a non-CCITT capability

message may not be transmitted in the initial capability exchange, until the MBE-capability has been received.

8 Fault recovery

Some recovery procedures involve the release and establishment of new connections: this implies using D-channel signalling (see ETS 300 145 [2]). Terminals shall always release a connection when a request to do so is received from the network.

8.1 General recovery procedures

- Recovery procedure R0: the capability exchange (sequence A) is initiated; if successful the fault has been removed; if unsuccessful the fault may remain, and procedure R1 or R2 shall follow.

- Recovery procedure R1: start the mode-0 forcing procedure; if successful, re-initialise; if unsuccessful, proceed with procedure R2.

- Recovery procedure R2:

    1) calling terminal: it shall drop each faulty connection, and shall begin re-establishment unless the channel is no longer needed;

    2) called terminal: when the calling end has disconnected, it shall await a new call request.

- Recovery procedure R3: disable any decoder or data equipment being fed from multiple synchronised incoming channels until multiframe alignment and synchronisation is recovered.

- Recovery procedure R4:

    1) the remaining channels shall be renumbered, including expansion of the communication onto the additional channels when incoming A=0;

    2) the terminal initiating the renumbering shall reinstate FAS and BAS to make the new channel number known to the distant terminal;

    3) switch on ECS if desired; the code (001) [17] shall be repeated whenever the other BAS commands are repeated;

    4) the calling terminal shall clear and try to re-establish the lost channel.

- Recovery procedure R5:

    1) the terminal shall send the following:

        - audio in current mode (provided that this is <64 kbit/s) or in Mode 0F;
        - in BAS position, first (001) [0] (1B command);
        - then any other relevant commands (audio mode if changed, video-OFF, data-OFF if desired, etc.);

    2) then procedure A shall be carried out, including the same transfer-rate capabilities as before the channel loss.

- Recovery procedure R5a: R5 extended to redial all additional connections.

- Recovery procedure R6: the terminal shall act as follows:

    1) incoming information is discarded if unintelligible; if the loss of this information also causes information on other channels to become meaningless, then that is also discarded;

    2) reinstate framing on any unframed outgoing channels, and switch to a mode which uses only channels of lower number than that lost;

    3) set outgoing A-bits on all remaining channels;

4) renumber the channels whose number was above that lost (NOT necessary if only the highest numbered channel(s) have been lost);

5) switch to a mode contained within the capacity now available;

6) calling terminal - redial lost connection; called terminal - await new call to replace lost connection;

7) when the connection is restored, synchronise the additional channel to the others, and send A=0 on the outgoing direction of this channel when synchronisation is completed;

8) when incoming A=0 on this channel, switch to restore the mode which was in force before the fault.

Specific recovery procedures are detailed for the separate cases in the remaining subclauses.

8.2 Incoming A=1

Symptoms: incoming signal without errors, frame alignment (and multiframe alignment if desired) achieved; outgoing direction framed with A=0, but three consecutive incoming A bits equal to 1.

8.2.1 Incoming A=1 on I-channel

Situation: the frame alignment is achieved and speech is possible end to end.

Recovery procedure: R0.

8.2.2 Incoming A=1 on additional channels

Recovery procedure:

1) set timer T2 (10 seconds); if incoming A does not go to zero before expiry of timer, then clear this channel;

2) Recovery procedure R2.

8.3 Mode mismatch

The receiving terminal decodes and validates the BAS code, and switches its receive mode of operation accordingly. If, for any reason, a terminal receives a BAS command it cannot obey, a mode mismatch results.

The following section describes what to do if a specific case of mode mismatch has occurred.

a) incoming BAS command does not correspond to the declared capabilities of this terminal.

Procedure:
- if the incoming BAS is a capability code (100), (101), ignore it;
- if the incoming BAS is a SBE code (111), ignore the next code, if it is not known;
- if the incoming BAS is a command code (000) - (011), and it is not known what it means, ignore it and do the following:
  - set a timer T3 (value 1 second). During this time incoming information is discarded if unintelligible;
  - if the mismatch is removed (acceptable command(s) received before the timer expires), the normal operation is resumed;
  - if the mismatch is not removed before the timer expires: R0.

b) the content of one or more of the information signals does not agree with the BAS command (for example, BAS (000) [19] is received but the A/μ-law detector indicates A-law).

Procedure: continue decoding incoming information if possible, and carry out procedure R0.

c) the code (100) [22] has been detected in the incoming capability set, but the terminal is not able to operate in the way required for interworking with terminals on restricted networks (see ETS 300 144 [1]); an indication to this effect shall be given to the user, and the communication shall remain in Mode 0F.

8.4 Loss of alignment

If there is an indication from the network that the connection has been lost, the requirements of subclause 8.5 shall apply.

8.4.1 Unexpected loss of frame alignment in the initial channel

Symptoms: the Frame Alignment Word (FAW) is no longer detected in the initial channel, and this was not preceded by a BAS command for a mode switch to an unframed mode.

Procedure: a timer T3 is set (value 1 second). During this time incoming information is discarded if unintelligible; search for framing in the receive direction is continued; no change is made to the outgoing mode of transmission. Outcomes:

a) if framing is recovered before the timer expires, the normal operation shall be resumed;
b) if framing is not recovered before the timer expires, the terminal shall take recovery action R0.

8.4.2 Loss of multiframe alignment in initial channel

Symptoms: multiframe alignment lost without losing frame alignment; does not apply to terminals which does not seek multiframe alignment.

Procedure:

a) if the current mode is such that no information signal (audio, video or data) is carried by more than one channel, no action is necessary, other than transmission of A=1;
b) otherwise: if the calling terminal, take recovery action R2 or R3; if the called terminal, recovery action R3.

8.4.3 Loss of frame alignment in an additional channel

Symptoms: the FAW is no longer detected in the additional channel, and this was not preceded by a BAS command for a mode switch to a mode not including FAW in this channel; the initial channel still has alignment.

Procedure: a timer T3 is set (value 1 second). During this time, incoming information is discarded if unintelligible; if the loss of this information also causes information on other channels to become meaningless that shall also be discarded. Search for framing in the receive direction is continued; no change is made to the outgoing mode of transmission. Outcomes:

a) if framing is recovered before the timer expires, the normal operation shall be resumed;
b) if framing is not recovered before the timer expires: R2.

8.4.4 Loss of multiframe alignment in additional channel

Symptoms: multiframe alignment lost without losing frame alignment.

Procedure: as for loss of frame alignment in an additional channel (subclause 8.4.3).

8.5 Loss of connection or channel

Symptoms: an indication may be available from the network (D-channel or otherwise) that the connection has been lost; end-to-end transmission on that channel has been discontinued, so that all apparently received bits are meaningless and transmitted bits are unlikely to reach the remote terminal. In the absence of a network indication, the terminal detects only loss of frame alignment, so the provisions of subclause 8.4 above shall be followed.

8.5.1 Loss of the only channel

Procedure:

a) calling terminal: redial lost connection, unless the channel is no longer needed;
b) called terminal: await new call.

8.5.2 Loss of the only additional channel

The initial channel is still received in frame alignment, with incoming A=0 if transmitting framed.

Procedure:

a) R2 or R5;
b) calling terminal: redial lost connection, unless the channel is no longer needed;
called terminal: await new call to replace lost connection.

8.5.3 Loss of an additional channel if more than one additional channel was established

The initial channel is still received in frame alignment, with incoming A=0 if transmitting framed.

Procedure: R2, or R4, or R5a, or R6.

8.5.4 Loss of channels including the initial channel if more than one channel was established

Procedure: R2 or R4.

8.6 Terminal Equipment Alarm (TEA) (optional)

The significance of the TEA is defined in Clause 3 of ETS 300 144 [1]. It may be transmitted only when a terminal fault is identified which comes within the scope of this definition.

A terminal which detects TEA=1:

- shall not perform any mode switch until TEA returns to zero; it may, however, disconnect the call;
- may indicate to the user that a fault has arisen; such an indication shall avoid stimulating action by the user (e.g. a displayed message such as "Please wait...").

NOTE: The use of TEA might be mandatory for some applications (e.g. videoconference).

Annex A (informative): Bibliography

The following documents are referenced informatively in this ETS.

ITU-T Recommendation H.242 (1993):

"System for establishing communication between audiovisual terminals using digital channels up to 2 Mbit/s".

DE/TE-04120: "Integrated Services Digital Network (ISDN); Videotelephony teleservice, Abstract Test Suite for inboard signalling procedures".

ITU-T Recommendation H.230 (1993):

"Frame-synchronous control and indication signals for audiovisual systems".

History

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