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SERIES V: DATA COMMUNICATION OVER THE
TELEPHONE NETWORK

General

Procedures for the identification and selection of common modes of operation between data circuit-terminating equipments (DCEs) and between data terminal equipments (DTEs) over the public switched telephone network and on leased point-to-point telephone-type circuits

ITU-T Recommendation V.8 *bis*

(Formerly CCITT Recommendation)

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DATA COMMUNICATION OVER THE TELEPHONE NETWORK

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ITU-T Recommendation V.8 *bis*

Procedures for the identification and selection of common modes of operation between data circuit-terminating equipments (DCEs) and between data terminal equipments (DTEs) over the public switched telephone network and on leased point-to-point telephone-type circuits

Summary

This Recommendation defines signals, messages and the procedures for exchanging these over the PSTN and on leased point-to-point telephone-type circuits, for the identification and selection of common modes of operation between Data Circuit-terminating Equipments (DCEs) and Data Terminal Equipments (DTEs). These are used when the modes of operation of DCEs and DTEs communicating over the connection need to be automatically established and selected, but before signals are exchanged which are specific to a particular Recommendation. Considerations are included for the standard analogue telephony mode of operation.

Revision 2 of this Recommendation adds support for PCM Modems, as described in ITU-T V.90, V.91 and V.92.

Source

ITU-T Recommendation V.8 *bis* was revised by ITU-T Study Group 16 (2001-2004) and approved under the WTSA Resolution 1 procedure on 17 November 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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

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ITU-T Recommendation V.8 *bis*

Procedures for the identification and selection of common modes of operation between data circuit-terminating equipments (DCEs) and between data terminal equipments (DTEs) over the public switched telephone network and on leased point-to-point telephone-type circuits

1 Scope

This Recommendation defines signals, messages and procedures for exchanging these over the PSTN and on leased point-to-point telephone-type circuits, when the modes of operation of DCEs and DTEs communicating over the connection need to be automatically established and selected, but before signals are exchanged which are specific to a particular Recommendation. Considerations are included for the standard analogue telephony mode of operation.

The current revision number of this Recommendation is 2.

The principal characteristics of this Recommendation are as follows:

- a) use over the PSTN or on leased telephone-type circuits;
- b) use at call establishment on the PSTN upon automatic answering;
- c) use after PSTN call establishment when the circuit is in telephony mode;
- d) provisions to exchange capabilities information for identifying common modes of operation between DCEs and between DTEs;
- e) provisions for a DCE to request the remote DCE to initiate a common mode of operation:
 - mode determination by the calling station upon automatic answering at PSTN call establishment;
 - mode determination by the answering station upon automatic answering at PSTN call establishment; and
 - mode determination after circuit establishment by either station;
- f) provisions to prevent inadvertent disconnection of calls or annoying disturbance to users who may not have V.8 *bis* capability or be aware of V.8 *bis* procedures.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-T H.324 (1998), *Terminal for low bit-rate multimedia communication*.
- ITU-T T.30 (1999), *Procedures for document facsimile transmission in the general switched telephone network*.
- ITU-T T.35 (2000), *Procedure for the allocation of ITU-T defined codes for non-standard facilities*.
- ITU-T T.84 (1996) | ISO/IEC 10918-3:1997, *Information technology – Digital compression and coding of continuous-tone still images: Extensions*.

- ITU-T T.120 (1996), *Data protocols for multimedia conferencing.*
- ITU-T T.434 (1999), *Binary file transfer format for the telematic services.*
- ITU-T V.8 (2000), *Procedures for starting sessions of data transmission over the public switched telephone network.*
- ITU-T V.14 (1993), *Transmission of start-stop characters over synchronous bearer channels.*
- ITU-T V.18 (2000), *Operational and interworking requirements for DCEs operating in the text telephone mode.*
- ITU-T V.21 (1988), *300 bits per second duplex modem standardized for use in the general switched telephone network.*
- ITU-T V.22 (1988), *1200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits.*
- ITU-T V.22 bis (1988), *2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits.*
- ITU-T V.23 (1988), *600/1200-baud modem standardized for use in the general switched telephone network.*
- ITU-T V.32 (1993), *A family of 2-wire, duplex modems operating at data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits.*
- ITU-T V.32 bis (1991), *A duplex modem operating at data signalling rates of up to 14 400 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits.*
- ITU-T V.34 (1998), *A modem operating at data signalling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits.*
- ITU-T V.42 (1996), *Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion.*
- ITU-T V.42 bis (1990), *Data compression procedures for data circuit-terminating equipment (DCE) using error correction procedures.*
- ITU-T V.61 (1996), *A simultaneous voice plus data modem, operating at a voice plus data signalling rate of 4800 bit/s, with optional automatic switching to data-only signalling rates of up to 14 400 bit/s, for use on the General Switched Telephone Network and on leased point-to-point 2-wire telephone type circuits.*
- ITU-T V.70 (1996), *Procedures for the simultaneous transmission of data and digitally encoded voice signals over the GSTN, or over 2-wire leased point-to-point telephone-type circuits.*
- ITU-T V.76 (1996), *Generic multiplexer using V.42 LAPM-based procedures.*
- ITU-T V.80 (1996), *In-band DCE control and synchronous data modes for asynchronous DTE.*
- ITU-T V.90 (1998), *A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream.*

- ITU-T V.91 (1999), *A digital modem operating at data signalling rates of up to 64 000 bit/s for use in a 4-wire circuit switched connection and on leased point-to-point 4-wire digital circuits.*
- ITU-T V.92 (2000), *Enhancements to Recommendation V.90.*
- ITU-T V.250 (1999), *Serial asynchronous automatic dialling and control.*
- ITU-T V.251 (1998), *Procedure for DTE-controlled call negotiation.*
- ISO/IEC 3309:1993, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures – Frame structure.*

3 Definitions

This Recommendation defines the following terms:

- 3.1 answering station:** The DTE, DCE and other associated terminal equipment which answers a call placed on the PSTN.
- 3.2 calling station:** The DTE, DCE and other associated terminal equipment which originates a call over the PSTN.
- 3.3 initiating station:** The DTE, DCE and other associated terminal equipment which initiates a V.8 *bis* transaction. This may be either the answering or calling station on the PSTN or either station on a leased circuit, and may change from one V.8 *bis* transaction to the next. When a transaction is initiated upon automatic answering of a call placed on the PSTN, the answering station is the initiating station.
- 3.4 responding station:** The station which responds to initiation of a V.8 *bis* transaction from the remote station. This may be either the answering or calling station on the PSTN or either station on a leased circuit, and may change from one V.8 *bis* transaction to the next. When a transaction is initiated upon automatic answering of a call placed on the PSTN, the calling station is the responding station.
- 3.5 initiating signal:** A signal which initiates a V.8 *bis* transaction.
- 3.6 message:** Framed information conveyed via modulated transmission at 300 bit/s using V.21 channels No. 1 and 2 (defined in clause 3/V.21), and referred to herein as V.21 (L) and V.21 (H), respectively.
- 3.7 responding signal:** A signal that is sent in response to an initiating signal.
- 3.8 signal:** Information conveyed via tone based transmission.
- 3.9 telephony mode:** The operational mode in which voice or other audio (rather than modulated information-bearing messages) is the method of communication.
- 3.10 transaction:** A sequence of V.8 *bis* signals and messages, beginning with an initiating signal and terminating with either a positive acknowledgment [ACK(1) (except as noted in 9.7)], a negative acknowledgment (NAK), or a time-out (see 9.8).

4 Abbreviations

This Recommendation uses the following abbreviations:

ACK	Acknowledge Message
ANS	V.25 Answer tone
ANSam	V.8 Modulated answer tone

CCITT	International Telegraph and Telephone Consultative Committee
CL	Capabilities List
CLR	Capabilities List Request
CR	Capabilities Request
DCME	Digital Circuit Multiplexing Equipment
DIS	Digital Identification Signal
ES	Escape Signal
FCS	Frame Check Sequence
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LSB	Least Significant Bit
MR	Mode Request
MS	Mode Select
MSB	Most Significant Bit
NAK	Negative Acknowledge Message
OGM	Outgoing Message (recorded voice or other audio)
PSTN	Public Switched Telephone Network

5 Overview of this Recommendation

This Recommendation provides means for DCEs and DTEs, having multiple modes of operation over the PSTN and on leased telephone-type circuits, to perform the following functions:

- selection of the desired mode of operation at automatic call establishment on the PSTN, controlled by either the calling or answering station;
- selection of the desired mode of operation while in telephony mode on an already established connection, controlled by either station;
- determination by either station of whether the remote station supports V.8 *bis*, with minimum disturbance to a voice caller;
- exchange of available capabilities between stations on a connection at call establishment or while in telephony mode; and
- graceful recovery in the event of transmission errors or selection of an unavailable mode of operation.

Means for the functions listed above are provided by defining a set of signals, messages and procedures. Signals are intended to be detected in the presence of an interfering voice or other audio, to turn around any echo suppressors in the network prior to the beginning of information transmission and to indicate the initiation of a V.8 *bis* transaction to the receiving station while not appearing to the user and receiver as an indication of a data or facsimile device.

Messages convey significantly more information than signals, but may be used only when they will not cause disruption to a voice caller. They are intended to be used only in the absence of an interfering voice or other audio.

This Recommendation provides for error detection and rejection of corrupted messages, and rejection of mode selections that are unavailable.

6 Description of signals and messages

6.1 Escape Signal (ES)

This signal requests the remote station transition from telephony mode to an information transfer mode. In particular:

- signal ES_i is sent by the initiating station; and
- signal ES_r is sent by the responding station.

6.2 Mode Request (MR)

This signal requests the remote station transition from telephony mode to an information transfer mode and requests the transmission of a mode select message by the remote station. In particular:

- signal MR_e is sent by an automatic answering station at call establishment; and
- signal MR_d is sent by the initiating station during the course of a call, or by the calling station at call establishment in response to an MR_e .

6.3 Capabilities Request (CR)

This signal requests the remote station transition from telephony mode to an information transfer mode and requests the transmission of a capabilities list message by the remote station. In particular:

- signal CR_e is sent by an automatic answering station at call establishment; and
- signal CR_d is sent by the initiating station during the course of a call, or by the calling station at call establishment in response to a CR_e or MR_e .

6.4 Mode Select (MS)

This message requests the initiation of a particular mode of operation in the remote station.

6.5 Capabilities List (CL)

This message conveys a list of possible modes of operation of the transmitting station.

6.6 Capabilities List Request (CLR)

This message conveys a list of possible modes of operation of the transmitting station and also requests the transmission of a capabilities list by the remote station.

6.7 Acknowledge Message (ACK)

- ACK(1): This message acknowledges receipt of an MS message and terminates a V.8 *bis* transaction. It may also be used to acknowledge receipt of part of a CL-MS message combination and to request transmission of the remainder of the message combination.
- ACK(2): This message acknowledges receipt of a CL, CLR or MS message and requests the transmission of additional information by the remote station, providing the remote station has indicated that additional information is available.

6.8 Negative Acknowledge Message (NAK)

This message indicates that the receiving station is unable to interpret a received message or to invoke the mode requested by the transmitting station. Four NAK messages are defined:

- NAK(1) indicates that the receiving station is unable to interpret the received message;
- NAK(2) indicates that the receiving station is temporarily unable to invoke the mode requested by the transmitting station;
- NAK(3) indicates that the receiving station either does not support or has disabled the mode requested by the transmitting station; and
- NAK(4) indicates that the receiving station is unable to interpret a received message and requests a retransmission of the message. The use of this message is for further study.

7 Structure of signals and messages

The structure of the signals and messages is described in this clause.

7.1 Signals

V.8 *bis* signals that initiate a transaction (initiating signals) and signals that are sent in response to initiating signals during automatic call establishment (responding signals) are tone based.

Signals sent at call establishment by an automatic answering station upon answering a call are designated with the subscript "e" and signals sent during the telephony mode are designated with the subscript "d".

Signals (MR_e, MR_d, CR_e, CR_d, ES_i, and ES_r) are made up of two segments. Segment 1 consists of a dual tone pair, which is detectable in the presence of interfering voice or other audio. Segment 2 is a single tone which identifies the signal.

Signals sent by the initiating station use one dual tone pair for segment 1. Signals sent by the responding station use a different tone pair for segment 1.

7.1.1 Frequencies

The frequencies of the dual tone pairs comprising segment 1 of initiating and responding MR, CR and ES signals and the frequencies of the tones comprising segment 2 are defined in Tables 1 and 2 respectively.

Table 1/V.8 *bis* – Signal tone frequencies – Segment 1

Signal	Segment 1 (dual tone) frequencies (Hz)
Initiating: MR _e , MR _d , CR _e , CR _d and ES _i	1375 + 2002
Responding: MR _d , CR _d and ES _r	1529 + 2225

Table 2/V.8 bis – Signal tone frequencies – Segment 2

Signal	Segment 2 (single tone) frequencies (Hz)
MR _e	650
MR _d	1150
CR _e	400
CR _d	1900
ES _i	980
ES _r	1650

7.1.2 Duration

The duration of segment 1 of each signal shall be 400 ms nominal and the duration of segment 2 shall be 100 ms nominal. However, for signals MR_e and CR_e, the duration of segment 1 may be shortened to 285 ms to ensure compatibility with non-V.8 bis capable modems.

NOTE – It is desirable to maintain the duration of segment 1 as 400 ms on circuits where echo suppressors may be present.

7.1.3 Tolerances

The tolerance of the frequency of all tones shall be ± 250 ppm of the nominal value.

The tolerance of the duration of the tone segments shall be $\pm 2\%$.

7.1.4 Transmitted power levels

The transmit power of all signals shall conform to applicable national regulations, for which ITU-T V.2 is a guide. However, the transmitted power of signals CR_e and MR_e shall be 12 to 15 dB below the nominal permitted transmitted power, i.e. the transmit power of continuous signals. In addition, it is desirable that the transmit power of all signals, except CR_e and MR_e, be the highest permitted level, particularly when it is known that the PSTN connection may include an echo suppressor. Note also that it is desirable to use the highest permitted level at an automatic answering station when telephony mode is available and CR_e and MR_e are retransmitted as specified in 10.2.2 after the detection of CNG, CT or CI.

7.2 Messages

Messages MS, CL, CLR, ACK and NAK shall be transmitted using V.21 modulation. V.21(L) is used for messages from an initiating station and V.21(H) is used for messages from a responding station. Frequencies F_A and F_Z shall have a tolerance of $\pm 0.01\%$.

7.2.1 Transmitted power level

The transmit power of V.21 line signals of messages shall conform to applicable national regulations, for which ITU-T V.2 is a guide.

7.2.2 Format convention

The basic format convention used for messages is illustrated in Figure 1. Bits are grouped into octets. The bits of each octet are shown horizontally and are numbered from 1 to 8. Octets are displayed vertically and are numbered from 1 to N.

The octets are transmitted in ascending numerical order. Within an octet, bit 1 is the first bit to be transmitted.

For fields which are contained within a single octet, the lowest numbered bit of the field represents the least significant bit (2^0). When a field spans multiple octets, the lowest numbered bit of the field in the highest numbered octet containing the field represents the least significant bit (2^0). The order of bit values within each octet increases as the bit number increases. The order of bit values from octet to octet increases as the octet number decreases. Figure 2 illustrates a field which spans two octets.

An exception to this convention is the Frame Check Sequence (FCS) field, which spans two octets. In this case, the order of bit values within the octets is reversed. Bit 1 of the first octet is the MSB and bit 8 of the second octet is the LSB (Figure 3).

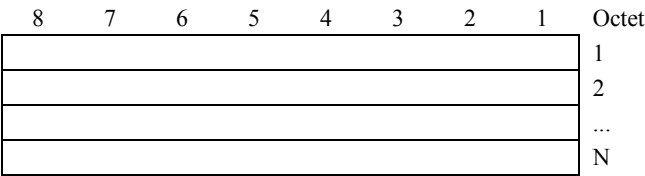


Figure 1/V.8 bis – Format convention

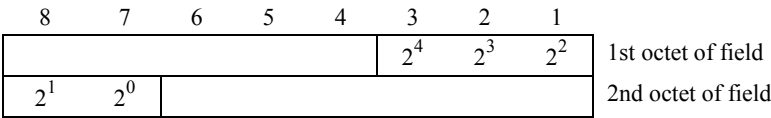


Figure 2/V.8 bis – Field mapping convention

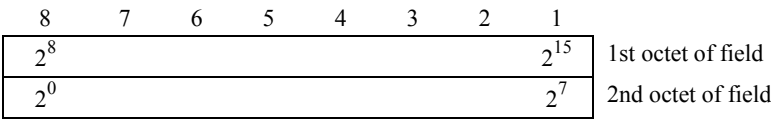


Figure 3/V.8 bis – FCS mapping convention

7.2.3 Frame structure

Messages shall use the frame structure shown in Figure 4.

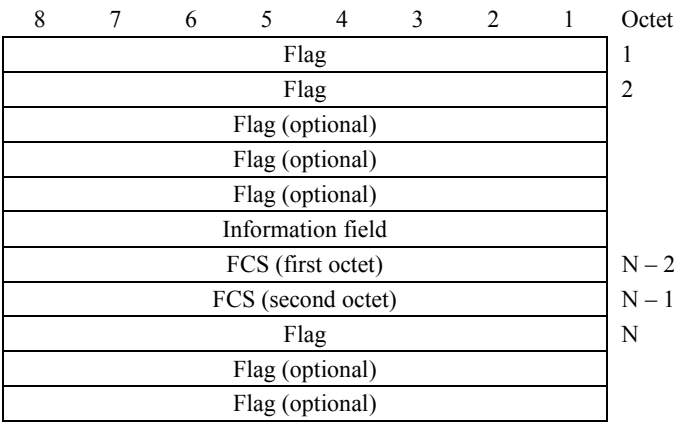


Figure 4/V.8 bis – Message structure

7.2.4 Preamble

Each message shall begin with 100 ms $\pm$ 2% of continuous V.21 marking frequency.

Where the message is preceded by an ES signal, the 100 ms of continuous marking frequency shall be treated as segment 2 of the ES signal.

7.2.5 Flag sequence

Messages shall start and end with the standard HDLC flag octet (01111110) as defined in ISO/IEC 3309. At least two but no more than five flags shall be sent to begin each message. At least one but no more than three flags shall follow the FCS of each message.

7.2.6 Information field

The contents of the information field shall consist of an integer number of octets coded in accordance with clause 8.

7.2.7 Frame check sequence field

The FCS field is 16 bits (2 octets) in length. As defined in ISO/IEC 3309, it shall be the one's complement of the sum (modulo 2) of:

- a) the remainder of $x^k (x^{15} + x^{14} + x^{13} + x^{12} x^{11} + x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the last bit of the final opening flag and the first bit of the FCS, excluding bits (binary ZEROs) inserted for transparency; and
- b) the remainder of the division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, of the product of x^{16} by the content of the frame existing between, but not including, the last bit of the final opening flag and the first bit of the FCS, excluding bits inserted for transparency.

As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all binary ONES and is then modified by division by the generator polynomial (as described above) on the information field. The one's complement of the resulting remainder is transmitted as the 16-bit FCS.

As a typical implementation at the receiver, the initial content of the register of the device computing the remainder of the division is preset to all binary ONES. The final remainder, after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the serial incoming protected bits and the FCS, will be 0001110100001111 (x^{15} through x^0 , respectively) in the absence of transmission errors.

7.2.8 Transparency

The transmitting DCE shall examine the contents of the information and FCS fields (everything between the opening and closing flags) and insert a binary ZERO after every sequence of five contiguous binary ONES to ensure that the flag octet is not simulated within the frame. The receiving DCE shall examine the contents of the frame between the opening and closing flags and discard any binary ZERO which directly follows five contiguous binary ONES.

7.2.9 Invalid frames

An invalid frame is one which:

- a) is not properly bounded by flags in accordance with 7.2.5; or
- b) has fewer than three octets between flags; or
- c) does not consist of an integral number of octets before zero-bit insertion or after zero-bit extraction; or
- d) contains a frame check sequence error.

The procedure to be adopted when an invalid frame is received is described in 9.8.

8 Information field coding format

8.1 General

The message information field consists of three components:

- a) an identification field (I), followed by;
- b) a standard information field (S); and
- c) an optional non-standard information field (NS).

This general structure is shown in Figure 5.

Identification (I) field	Standard information (S) field	Non-standard information (NS) field
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Figure 5/V.8 bis – Information field structure

8.2 Coding format for parameters in the I and S fields

In both the I and S fields most of the information to be conveyed consists of parameters relating to particular modes, features or capabilities associated with the two stations.

In order to:

- a) encode these parameters in accordance with a consistent set of rules; and
- b) allow future extension to the parameter list in a way that permits present and future V.8 bis implementations to correctly parse the information field,

the parameters are linked together in an extensible tree structure. The order in which the parameters in the tree are transmitted and the use of delimiting bits which enable the tree to be reconstructed at the receiver are described in the rules set out below.

8.2.1 Parameter classification

Parameters (Pars) are classified as:

- NPar – Parameter which has no subparameters associated with it; and
- SPar – Parameter which has subparameters associated with it.

The general structure of this tree is as shown in Figure 6.