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SERIES V: DATA COMMUNICATION OVER THE TELEPHONE NETWORK

Interfaces and voiceband modems

In-band DCE control and synchronous data modes for asynchronous DTE

ITU-T Recommendation V.80

(Previously "CCITT Recommendation")

ITU-T V-SERIES RECOMMENDATIONS

DATA COMMUNICATION OVER THE TELEPHONE NETWORK

For further details, please refer to ITU-T List of Recommendations.

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The 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 Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation V.80 was prepared by ITU-T Study Group 14 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 16th of August 1996.

NOTE

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

2. The status of annexes and appendices attached to the Series V Recommendations should be interpreted as follows:

- an *annex* to a Recommendation forms an integral part of the Recommendation;
- an *appendix* to a Recommendation does not form part of the Recommendation and only provides some complementary explanation or information specific to that Recommendation.

CONTENTS

IN-BAND DCE CONTROL AND SYNCHRONOUS DATA MODES FOR ASYNCHRONOUS DTE

(Geneva, 1996)

1 Scope

Recommendations exist for DTE Control of DCE using serial data interchange and start-stop framing (Recomendations V.25 *bis,* V.25 *ter*). When user data is not being transferred, DTE commands and DCE responses are delivered on the same data paths used for user data, such as V.24 circuits 103 and 104.

The above mentioned Recommendations use out-of-band mechanisms for control while user data is being transferred, such as V.24 circuits 108/2 and 109 for call control and status, and circuits 133 and 106 for flow control. All commands or status messages delivered on circuits 103 and 104 must be applied while user data transfer is suspended or terminated.

In addition, Recommendation V.25 *ter* defines two modes of DCE operation while in Online Data State for use with DTE employing asynchronous, start-stop framing; namely, Direct Mode and Buffered Mode. In addition, Recommendations V.42 and V.42 *bis* define additions to Buffered Mode for error controlled and data compressed operation, respectively.

This Recommendation is comprised of 6 elements:

- It describes procedures for an asynchronous DTE and a DCE to exchange the state of V.24 circuits, whether or not leads for those circuits exist on the V.24 interface, by the use of in-band messages on circuits 103 and 104. A complete set of V.24 circuit leads are not available on all DTE, due to interface restrictions or DTE system software.

- It describes time-invariant procedures for an asynchronous DTE and a DCE to exchange sequences of continuous mark or space of extended length, by the use of in-band messages on circuits 103 and 104. Not all DTE are capable of generating and/or interpreting such sequences directly.

- It describes procedures for an asynchronous DTE and a DCE to exchange ordinary V.25 *ter* commands and indications while in Online Data State, by encapsulating such commands and indications within in-band messages on circuits 103 and 104.

- It describes procedures for an asynchronous DTE and a DCE to exchange commands and indications for signal converter control and hookswitch status while in Online Data State, by encapsulating such commands and indications within in-band messages on circuits 103 and 104.

- It describes procedures for a Frame Tunnelling Mode of DCE operation during Online Data State, whereby the DCE converts between asynchronous HDLC framing used by a local DTE employing start-stop framing, and synchronous HDLC framing used by the remote data station.

- It describes procedures for a Synchronous Access Mode of DCE operation during Online Data State, whereby an asynchronous DTE using start-stop framing can transmit and receive arbitrarily-formatted synchronous bitstreams on the GSTN.

These procedures depend on the integrity of the data transfer path. It is preferred that the DTE-DCE link provide some means to prevent loss-of-data errors or other corruption of In-Band control information, or that the expected integrity of the link be such that this is deemed unnecessary. The specification of means to prevent loss-of-data is beyond the scope of this Recommendation.

These procedures must be time-independent because inter-character delay time cannot be preserved in DTE containing multi-tasking software, large character buffers or intermediate data links (e.g. Local Area Networks).

2 References

The following 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; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent editions of the Recommendations and other references listed below. A list of currently valid ITU-T Recommendations is regularly published.

– ITU-T Recommendation T.31 (1995), *Asynchronous facsimile DCE control – Service class 1*.

– ITU-T Recommendation T.32 (1995), *Asynchronous facsimile DCE control – Service class 2*.

– CCITT Recommendation V.4 (1988), *General structure of signals of International Alphabet No. 5 code for character oriented data transmission over public telephone networks*.

– ITU-T Recommendation V.24 (1993), *List of definitions for interchange circuits between Data Terminal Equipment (DTE) and data circuit-terminating equipment (DCE)*.

– CCITT Recommendation V.25 *bis* (1988), *Automatic calling and/or answering equipment on the General Switched Telephone Network (GSTN) using the 100-series interchange circuits*.

– ITU-T Recommendation V.25 *ter* (1995), *Serial asynchronous automatic dialling and control*.

– ISO 2111:1985, *Data communication – Basic mode control procedures – Code independent information transfer.*

– CCITT Recommendation T.50 (1992), *International Reference Alphabet (IRA) (formerly International Alphabet No. 5 or IA5), Information technology – 7-bit coded character set for information interchange*.

– ISO/IEC 3309:1993, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures – Frame structure*.

3 Definitions

For the purposes of this Recommendation, the following definitions and abbreviations apply.

3.1 command state: In Command State, the DCE is not communicating with a remote station, and the DCE is ready to accept commands. Data signals from the DTE on circuit 103 are treated as commands and processed by the DCE, and DCE responses are sent to the DTE on circuit 104. The DCE enters this state upon power-up, and when a call is disconnected.

3.2 online command state: In Online Command State, the DCE is communicating with a remote station, but treats signals from the DTE on circuit 103 as commands and sends responses to the DTE on circuit 104. Depending on the implementation, data received from the remote station during OnLine Command State may be either discarded or retained in the DCE until Online Data State is once again entered (from a DTE command). Data previously transmitted by the local DTE and buffered by the DCE may be transmitted from the buffer to the remote DCE during Online Command State, or it may be discarded or transmission deferred until Online Data State is once again entered. Online Command State may be entered from Online Data state by a mechanism defined in Recommendation V.25 *ter*, or a mechanism defined in this Recommendation, or by other manufacturer-defined means.

3.3 online data state: In Online Data State, the DCE is communicating with a remote station. Data signals from the DTE circuit 103 are treated as data and transmitted to the remote station, and data signals received from the remote station are delivered to the DTE on circuit 104. Data and Control signals are monitored by the DCE to detect events such as loss of the remote station connection and DTE requests for disconnection or switching to Online Command State. Online Data State is entered by successful completion of a command to originate or answer a call, by automatically answering a call, or by DTE command to return to Online Data state from Online Command state.

3.4 in-band command: An In-Band Command is a two or multiple character sequence, consisting of a data link escape Character followed by a command character. If the command character is followed by additional characters as defined in the command definition, this is an extended command; otherwise, it is a short command. Except for the escape character, all short or extended command characters are limited to the range of 20h to 7Eh and A0h to FEh.

3.5 in-band control circuit: An In-Band Control Circuit is a logical V.24 circuit defined between DTE and DCE, but which is presented by one device to the other by means of In-Band Commands instead of (or in addition to) by means of physical out-of-band circuits.

3.6 hexadecimal coding: In this Recommendation, hexadecimal coding is used. Hexadecimal is base-16, with the first six letters of the Roman alphabet (A-F) used to represent the digit values 10-15, in addition to the numerals 0-9 used for their traditional digit values. A single hexadecimal digit represents a four-bit binary number; two consecutive hexadecimal digits represent an 8-bit number, with the first digit representing the 4 most significant bits, and the second digit representing the 4 least significant bits.

In this Recommendation, two hexadecimal digits are followed by the lower case "h" to indicated hexadecimal notation. For example, 5Dh represents 0101 1101 in binary, or 93 in decimal, or 5/13 in T.50 character notation.

3.7 break: In this Recommendation, Break refers to extended periods of constant logic-zero on V.24 circuit 103 or circuit 104.

3.8 mark idle: In this Recommendation, Mark Idle refers to extended periods of constant logic-one on V.24 circuit 103 or circuit 104.

3.9 synchronous mode: Mode of data transmission whereby the V.24 circuits 103 (TD) and 104 (RD) transfer data synchronously at the modem-to-line interface rate, using V.24 circuits 113 or 114 for transmitter bit timing, and circuit 115 for receiver bit timing. The modem does not buffer data in either direction, nor does it implement flow control.

3.10 frame tunnelling mode: Mode of data transmission whereby the V.24 circuits 103 (TD) and 104 (RD) transfer HDLC frame data asynchronously, using the start/stop transparency procedures specified in ISO/IEC 3309. Data transmission between DCEs uses the synchronous transmission procedures specified in ISO/IEC 3309. in each direction, the DCE converts the HDLC frames between the two formats. This mode allows existing DTEs using start/stop transparency (e.g. Recommendation T.123), to take advantage of the higher throughput afforded by synchronous transmission.

3.11 synchronous access mode: Mode of data transmission whereby start-stop framed data octets from V.24 circuit 103 are stripped of the start and stop bits and concatenated for transmission to the remote DCE. The synchronous bitstream from the remote DCE is divided into octets and transmitted to the local DTE on V.24 circuit 104 with start and stop bits inserted. Flow control is available to allow the DTE-DCE octet transfer rate to be matched to that of the line without buffer underrun or overrun. While in this mode, operation may be alternated between a Transparent sub-Mode where no additional bit processing is done by the DCE, and Framed sub-Mode where bit-oriented synchronous protocol framing is performed by the DCE.

3.12 transparent sub-mode: Generic Synchronous Access Mode for unspecified DCE-DCE protocols. The transmitted bitstream is as specified by the DTE, using the EM-shielding procedures specified here. All received bits are delivered to the DTE, including constant mark idle (ones).

3.13 framed sub-mode: Synchronous Access Mode whereby the DCE performs certain bit-processing functions in support of specific DCE-DCE protocols. Bit-oriented processing includes ISO/IEC 3309 procedures for flag transparency via zero insertion, and CRCs may be generated and checked.

4 Physical layer

Procedures defined in this Recommendation are useful on interfaces based on bit-serial data interchange, and on other digital interfaces. This Recommendation is referenced to start-stop framed bit-serial interfaces that implement V.24 logical circuits. For other interfaces, a bi-directional character-serial channel is required.

4.1 Necessary serial interface circuits

DCEs complying with this Recommendation will function properly if only these circuits are connected or implemented.

Circuit	*Description*
102	Signal Common – Connection of this circuit is required for proper recognition of signals on other circuits. NOTE – This is needed for electrical interchange; it may not be needed for certain physical interfaces.
103	Transmitted Data – While in the command state, data signals are processed by the DCE and not transmitted to the remote station. In Data State, data signals are processed to detect In-Band Commands; otherwise, data signals are passed to signal converters and optional error control functions.
104	Received Data – While in the command state, data received from the remote station is buffered or ignored, and the DCE delivers responses to the DTE on this circuit. In data state, the DCE may deliver In-Band Commands to the DTE, if enabled by the DTE.

4.2 Represented circuits

The following V.24 physical circuits may be represented by In-Band character sequences described in this Recommendation. When so configured, the In-Band circuit shall be used by the receiving device in place of the corresponding physical circuit.

It is preferred that the sending device should present the same information on the physical circuit as it presents on the In-Band circuit, if these physical circuits are available.

105	Request to send
106	Ready for sending
107	Data set ready
108/2	Data terminal ready
109	Data channel received line signal detector
125	Calling indicator
132	Return to non-data mode
133	Ready for receiving
142	Test Indicator

5 Serial port considerations

5.1 Serial port rate

The procedures defined in this Recommendation may be used at any bit-serial port rate supported by DTE and DCE. However, for any in-band command or indication, the serial port rate shall be fixed during its transmission. Means to detemmine the serial port rate is beyond the scope of this Recommendation. (see +IPR, Recommendation V.25 *ter*).

5.2 Serial port rate when used in command state

Subclause 4.3/V.25 *ter* describes a DCE which can automatically detect the serial port rate for new command lines during Command State; this is called ‘autobauding’.

If operating in Command State, the DTE shall send In-Band commands at the same serial port rate used in the most recently received valid command line. In-Band command shall not be embedded between the leading “A” (41h) or “a” (61h) command line prefix character and the next subsequent character in the command line prefix, e.g. “T” (54h), “t” (74h) or “/” (2Fh). The DCE must be capable of detecting in-band commands in addition to new command lines.

If operating in Command State, the DCE shall send In-Band commands at the same serial port rate used in the most recently received valid command line. The DTE must be capable of detecting In-Band commands in addition to other DCE responses.

NOTE – It is assumed that the DTE defaults with In-Band Commands disabled, so that an AT command is needed to enable In-Band Commands; that AT command will set the default serial port rate thereafter.

5.3 Flow control interactions

There are several different mechanisms defined for flow control in asynchronous DCE. The definition of these means is beyond the scope of this Recommendation (see +IFC, Recommendation V.25 *ter*).

If the procedures defined in clause 7 for 7-bit codes are enabled to represent the standard serial interface flow control circuits (106 and 133), and if the DCE is configured for 106Dh3 flow control, then these in-band control circuits could be used for flow control.

If the Synchronous Access Mode procedures defined in 8.8 are enabled for Online Data State, DC1 and DC3 characters in the data stream are shielded, so DC1/DC3 flow control may be used, if so enabled by the +IFC command.

5.4 Data stream errors

On serial interchange data circuits (103 and 104), In-Band commands are subject to the same errors as bearer data. Corruption or loss-of-data has serious adverse consequences, since the control information is presented as a transient string rather than as a static physical circuit. Corrupted In-Band Commands will be lost; corrupted data can result in erroneous detection of In-Band commands. In either case, communications system failure is a probable result.

If the DTE-DCE interface is subject to errors, provisions should be made to ensure reliable system operation. For example, for V.24 circuit status, DTE or DCE may send repeated in-band commands to represent a static circuit condition, to increase chances of successful detection. A data link protocol may also be used, such as clause 9/T.32.

6 In-band control procedures

In common DCE with ACE (Recommendation V.25 *bis*, Recommendation V.25 *ter*) the DCE expects commands from the DTE only while in a defined command state.

DCEs conforming to this Recommendation include the ability to recognize and accept DTE commands which are embedded in user data delivered on V.24 circuit 103, and include the ability to generate DCE commands and status messages to the DTE, embedded in user data on V.24 circuit 104. These features are controlled by a DTE command, defined in clause 7.

The procedure defined in this Recommendation for representing these in-band commands is based on Basic Mode Transparency, defined in ISO Standard 2111, although a different escape character is used.

6.1 Basic mode transparency

6.1.1 Character set

The character set used to build valid in-band commands is the set:

20hh - 7Eh 7- or 8-bit characters.

A0h - FEh 8-bit characters.

Recommendation V.25 *ter* allows both 7- and 8-bit characters to be used at the DTE-DCE interface; see the +ICF command definition in that Recommendation. When 7-bit characters are used, the range of allowable command characters is necessarily restricted. Valid 7-bit command characters are defined in clause 7, for use during both Command State and Online Data State. When 8-bit characters are used, additional command characters are potentially available for use in Online Data State; these are defined in clause 8 and are used during Synchronous Access Mode.

6.1.2 In-band escape character

The escape character for in-band commands is the "EM" character, which has a hexadecimal value of 19h. In 8-bit systems, the 8th bit (bit 2^7) may be zero or one and is ignored; the character may thus have the value 19h or 99h.

NOTE – Throughout the remainder of this Recommendation, the escape character is denoted mnemonically as <EM>.

6.1.3 Basic in-band command structure

Basic in-band commands consist of <EM> followed by a single valid command character. Tables 1 and 2 list defined basic in-band commands for 7-bit codes; Table 9 lists additional defined commands for 8-bit codes that are used during Synchronous Access Mode.

6.1.4 7-bit extended in-band command structure

Extended in-band commands consist of:

- <EM>
- a valid command character defined as an extend command (see Tables 1 and 2);
- a valid length byte;
- 1 to 95 additional valid characters, specified by the length byte.

The length value ranges from 20h to 7Eh, offset by 31 decimal (1Fh).

6.1.5 <EM> in data

For transparency, in-band commands for each direction are used to represent instances of user data with the same ordinal value as <EM> (19h or 99h). For the 7-bit command characters defined in clause 7, four transparency commands are defined. One in-band command represents the instance of a single 19h character, and the second represents a pair of 19h characters. For use when 8-bit character framing is in use, the third represents a single 99h 8-bit character, and the fourth represents a pair of 99h characters.

The Synchronous Access Mode procedures defined in clause 8 mandate the use of 8-bit character framing, so additional 8-bit transparency commands are available. These commands provide for transparency of DC1 and DC3 characters in data (to allow DC1/DC3 flow control to be used), and provide transparency for all 2-character combinations of 19h, 99h, DC1 and DC3.

6.1.6 Invalid in-band command recovery

An Invalid In-Band Command contains an invalid characters, other than those defined in 6.1.1 above. If an Invalid character is detected while parsing an In-Band Command, the receiver shall take three actions:

- send an Error Signal Command Indication In-Band Command to the sender;
- send the invalid character as bearer data;
- abandon the parsing and execution of the Invalid command.

6.2 In-band command execution

Unless specified otherwise, commands are executed in sequence with data delivery. For example, in a DCE with a buffer, a string of data could be received which contained an in-band command to insert a Break; the Break signal is inserted in sequence with the data. If the same stream contained an in-band command to escape to command state (AT+IBC=,,,,1,,, and AT&D1 set), that command is executed after the preceding data had been processed and delivered but before the data following the command is delivered.

The entire in-band command sequence shall be processed as commands, or discarded if unrecognized (e.g. commands defined by manufacturers or by future revisions of this Recommendation).

In-band commands that implement local flow control shall be extracted, recognized and executed independent of the user data stream.

6.3 DTE-to-DCE data streams

If enabled by the DTE, the DCE shall: process user data received on Circuit 103; recognize in-band commands; remove those in-band commands from the user data; and execute them if possible.

6.4 DCE-to-DTE data streams

If enabled by the DTE, the DCE shall generate in-band commands and insert them into user data delivered to the DTE on circuit 104. The DTE shall: process user data received on Circuit 104; recognize in-band commands; remove those in-band commands from the user data, and execute them if possible.

7 7-bit in-band command definitions

This clause defines In-Band commands that may be used during both Command State and Online Data State. Since both 7- and 8-bit character framing may be used, and in particular the character framing in Command State may dynamically change as a result of auto detection (see +ICF, Recommendation V.25 *ter*), only 7-bit codes may be used for those commands that may be received in Command State. Four sets of 7-bit in-band commands are defined. Subclause 7.2 defines commands sent from the DTE to the DCE; subclause 7.3 defines commands sent from the DCE to the DTE. Subclause 7.4 defines extended commands sent from the DTE to the DCE. Subclause 7.5 defines extended command from the DCE to the DTE.

In-Band Commands with values of 40h to 7Eh are reserved for use in this Recommendation. Values from 20h to 3Fh are reserved for manufacturers' use. Values from 40h to 5Fh are reserved for DTE-to-DCE control; values from 60h to 7Eh are reserved for DCE-to-DTE control.

7.1 V.24 status reporting

7.1.1 DCE status reporting to the DTE

If enabled by the DTE, the DCE shall report the state of the selected V.24 circuits and other Status states to the DTE by delivering the corresponding in-band command commands, in order of the ordinal value of the <command> character.

For each State, the DCE shall generate these reports when any of the following events occur:

a) The DTE issues an <EM><poll> poll command to the DCE.

b) While reporting for this state is enabled, and the State changes; for example, if the DTE has set AT+IBC=,,,,,1 and if the DCE detects a valid data carrier and turns ON Circuit 109, it shall then send <EM><109on> (19h, 67h) to the DTE.

7.1.2 DTE status reporting to the DCE

If configured by the DTE, the DTE shall report the state of the selected V.24 circuits and other Status states to the DCE by delivering the corresponding in-band commands. These in-band commands shall be presented to the DTE in order of the <command> character.

For each State, the DTE should generate these reports when any of the following events occur:

a) The DCE sends a poll command (<EM><poll>; 19h,7Eh) to the DTE.

b) While reporting for this state is enabled, and the State changes; for example, if the DTE had set AT+IBC=,,,,1 and if the DTE turns ON Circuit 108, it should then send <EM> <108on> (19h, 45h) to the DCE.

7.2 In-band commands sent by the DTE to DCE

The DCE shall interpret the lower seven bits of an In-Band Command sent by the DTE as defined in Table 1. The least significant bit is the first delivered on circuit 103 (see Recommendation V.4).

The following commands are defined as in the sequence: <19h> <Command>.

TABLE 1/V.80

DTE-to-DCE command definitions

Command	Hex codes	DCE interpretation
	<00h> to <1Fh>	(Not used, ignored by DCE)
<mfgextend> <length> <rest of cmd>	<20h>	The DCE shall decode this as a sequence of 3 + (<length> - 1Fh) characters. The meaning of <rest of cmd> is manufacturer specific
<mfgx>	<21h> to <2Fh>	The DCE shall decode these as manufacturer specific commands
	<30h> to <3Fh>	Reserved
<extend0> <length> <rest of cmd>	<40h>...	The DCE shall decode this as a sequence of 3 + (<length> - 1Fh) characters; see 7.4
<extend1> <length> <rest of cmd>	<41h>...	The DCE shall decode this as a sequence of 3 + (<length> - 1Fh) characters; see 7.4
<105off> <105on>	<42h> <43h>	Circuit 105 is OFF Circuit 105 is ON
<108off> <108on>	<44h> <45h>	Circuit 108 is OFF Circuit 108 is ON
<133off> <133on>	<46h> <47h>	Circuit 133 is OFF Circuit 133 is ON
	<48h> to <57h>	Reserved
<singleEMp> <doubleEMp>	<58h> <59h>	The DCE shall decode this as one <99h> in user data The DCE shall decoded this as <99h><99h> in user data
<flowoff> <flowon>	<5Ah> <5Bh>	DCE shall decode this as a command to suspend sending In-Band Commands to the DTE The DCE shall decode this as permission to resume sending In-Band Commands to the DTE
<singleEM> <doubleEM>	<5Ch> <5Dh>	The DCE shall decode this as one <19h> in user data The DCE shall decoded this as <19h><19h> in user data
<poll>	<5Eh>	The DCE shall decode this as a command to deliver a complete set of status commands, one for each circuit or other function supported and enabled. The DCE shall deliver these commands in ascending ordinal order
	<5Fh>	(Not used)
	<60h> to <7Eh>	Reserved
	<7Fh>	(Not used, ignored by DCE)

7.3 In-band commands sent by the DCE to DTE

The DCE shall determine the states of the seven bits of an in-band command sent to the DTE as defined in Table 2. The least significant bit is the first delivered on circuit 104 (see Recommendation V.4).

The following commands are defined as in the sequence: <19h> <Command>.

TABLE 2/V.80

DCE-to-DTE command definitions

Command	Hex codes	DCE meaning/DTE interpretation
	<00h> to <1Fh>	(Not used)
	<20h> to <2Fh>	Reserved
<extendmfgx> <length> <rest of cmd>	<30h>	The DCE shall encode this as a sequence of 3 + (<length> - 1Fh) characters. The meaning of <rest of cmd> is manufacturer specific
<mfgx>	<31h> to <3Fh>	The DCE shall encode these as manufacturer specific commands
	<40h> to <5Eh>	Reserved
	<5Fh>	(Not used)
<extend0> <length> <rest of cmd>	<60h>...	The DCE shall encode this as a sequence of 3 + (<length> - 1Fh) characters; see 7.5
<extend1> <length> <rest of cmd>	<61h>...	The DCE shall encode this as a sequence of 3 + (<length> - 1Fh) characters; see 7.5
<106off> <106on>	<62h> <63h>	Circuit 106 is OFF Circuit 106 is ON
<107off> <107on>	<64h> <65h>	Circuit 107 is OFF Circuit 107 is ON
<109off> <109on>	<66h> <67h>	Circuit 109 is OFF Circuit 109 is ON
<110off> <110on>	<68h> <69h>	Circuit 110 is OFF Circuit 110 is ON
<125off> <125on>	<6Ah> <6Bh>	Circuit 125 is OFF Circuit 125 is ON
<132off> <132on>	<6Ch> <6Dh>	Circuit 132 is OFF Circuit 132 is ON
<142off> <142on>	<6Eh> <6Fh>	Circuit 142 is OFF Circuit 142 is ON
	<70h> to <75h>	Reserved
<singleEMp> <doubleEMp>	<76h> <77h>	The DCE shall encode this as one <99h> in user data The DCE shall encoded this as <99h><99h> in user data
<offline> <online>	<78h> <79h	Line status is ONLINE (off hook) Line status is OFFLINE (on hook)
<flowoff> <flowon>	<7Ah> <7Bh>	The DCE shall encode this as a command to the DTE to suspend sending In-Band Commands to the DCE The DCE shall encode this as a command to the DTE to resume sending In-Band Commands to the DCE
<singleEM> <doubleEM>	<7Ch> <7Dh>	The DCE shall encode this as one <19h> in user data The DCE shall encoded this as <19h><19h> in user data
<poll>	<7Eh>	The DCE shall encode this as a command to the DTE to deliver a complete set of commands, one for each circuit or other function supported by the DTE. Commands shall be delivered in ascending ordinal order
	<7Fh>	(Not used)

7.4 Extended in-band commands sent from DTE to DCE

The DCE shall interpret the lower seven bits of an extended in-band command sent by the DTE as defined in Table 3. Bit 0 is the first bit delivered on circuit 103 (see Recommendation V.4).

The following extended commands are defined, as in the sequences:

<19h><20h><length code><rest of cmd>
<19h><40h><length code><Extended-0 Command><rest-of-command>
<19h><41h><length code><Extended-1 Command><rest-of-command>

TABLE 3/V.80

DTE-to-DCE extended command definitions

Extended-0 command	Hexadecimal codes	DCE interpretation
	<00h> to <1Fh>	(Not used, ignored by DCE)
<mfgx>	<20h> to <2Fh>	The DCE shall decode these as manufacturer specific commands
	<30h> to <3Fh>	Reserved
<break>	<40h>	BREAK signal (space idle), see 7.4.1
<mark>	<41h>	MARK idle, see 7.4.2
<control>	<42h>	CONTROL Command line, see 7.4.3
	<43h> to <5Eh>	Reserved
	<5Fh>	(Not used)
	<60h> to <61h>	Reserved
	<62h>	Reserved
	<63h> to <7Eh>	Reserved
	<7Fh>	(Not used, ignored by DCE)

Extended-1 command	Hexadecimal codes	DCE interpretation
	<00h> to <1Fh>	(Not used, ignored by DCE)
<mfgx>	<20h> to <2Fh>	The DCE shall decode these as manufacturer specific commands
	<30h> to <3Fh>	Reserved
	<40h> to <47h>	Reserved
	<48h> to <5Eh>	Reserved for future expansion
	<5Fh>	(Not used)
	<60h> to <7Eh>	Reserved
	<7Fh>	(Not used, ignored by DCE)

7.4.1 BREAK Command

The DTE may encode a BREAK signal using an IN-Band BREAK Command. A BREAK signal is a sequence of constant logic 0, or SPACE Idle. The BREAK command specifies the length of the SPACE Idle sequence in units of 10 milliseconds. The first character of the extended command String is 40h. The remaining characters are the duration of the Space Idle, presented as a hexadecimal number, with the least significant digit first. For example, a BREAK of 4 second (4000 milliseconds) would be encoded by the DTE using a Break command with duration = 188h (400 decimal) as shown:

<19h> = <Data Link Escape>

<40h> = <extend0> command

<23h> = <length>, 23h - 1Fh = 4 = size of Extended command string

<40h> = BREAK command

<38h> = LSD of Break sequence duration, in 10 millisecond units

<38h> = Middle digit of Break sequence duration, in 160 millisecond units

<31h> = MSD of Break sequence duration, in 2560 millisecond units.

7.4.2 MARK Idle Command

The DTE may encode a MARK Idle sequence with an IN-Band MARK Command. A MARK is logic 1. Some DCE and DTE use periods of MARK idle for control (e.g. Guard Time). The MARK command specifies the length of the MARK Idle sequence in units of 10 milliseconds. The first character of the Extended Command String is 41h. The remaining characters are the duration of the MARK Idle, presented as a hexadecimal number, with the least significant digit first. For example, a MARK Idle of 1 second (64h, 100 decimal) would be encoded by the DTE as shown:

<19h> = <Data Link Escape>

<40h> = <extend0> command

<22h> = <length>, 22h - 1Fh = 3 = size of Extended command string

<41h> = MARK command

<34h> = LSD of MARK sequence duration, in 10 millisecond units

<36h> = MSD of MARK sequence duration, in 160 millisecond units

7.4.3 CONTROL extended in-band command

The DTE may deliver V.25 *ter* commands using the CONTROL command. The first character is 42h; the remaining characters are the command line string that would otherwise be delivered between the opening “AT” (or “at”) command line prefix and the terminating <CR> or <LF> characters. More than one command may be encoded in CONTROL extended command, but the Extended Command String shall not exceed the DCE’s command line buffer length; the minimum required for a V.25 *ter*-compliant DCE is 40 characters. An example, the encoding of the CONTROL command line “ATX0Y1Z3<CR>” would be encoded by the DTE as shown:

<19h> = <Data Link Escape>

<40h> = <extend0>

<26h> = <length>, 26h - 1Fh = 7 = size of Extended command string

<42h> = <CONTROL>

<58h><30h> = “X0”

<59h> <31h> = “Y1 ”

<5Ah><33h> = “Z3”

7.5 Extended in-band commands sent from DCE to DTE

The DCE shall determine the states of the seven bits of an Extended In-Band Command sent to the DCE as defined in Table 4. Bit 0 is the first bit delivered on circuit 104 (see Recommendation V.4).

The following Extended Commands are defined, as in the sequences:

<19h><30h><length code><rest-of-cmd>

<19h><60h><length code><Extended-0 Command> <rest-of-command>

<19h><61h><length code><Extended-1 Command> <rest-of-command>

TABLE 4/V.80

DCE-to-DTE extended command definitions

Extended-0 command	Hexadecimal codes	DTE interpretation
	<00h> to <1Fh>	(Not used)
	<20h> to <2Fh>	Reserved
<mfgx>	<30h> to <3Fh>	The DCE shall encode these as manufacturer specific commands
	<40h> to <41h>	Reserved
	<42h>	Reserved
	<43h> to <5Eh>	Reserved
	<5Fh>	(Not used)
<break>	<60h>	BREAK signal (space idle), see 7.5.1
<mark>	<61h>	MARK idle, see 7.5.2
<status>	<62h>	Status Report, see 7.5.3
	<63h> to <7Eh>	Reserved
	<7Fh>	(Not used)
Extended-1 command	Hexadecimal codes	DTE interpretation
	<00h> to <1Fh>	(Not used)
	<20h> to <2Fh>	Reserved
<mfgx>	<30h> to <3Fh>	The DCE shall encode these as manufacturer specific commands
	<40h> to <41h>	Reserved
	<42h> to <43h>	Reserved
	<44h> to <5Eh>	Reserved
	<5Fh>	(Not used)
	<60h> to <67h>	Reserved
	<68h> to <7Eh>	Reserved
	<7Fh>	(Not used)

7.5.1 BREAK Command

The DCE may encode a BREAK signal using an IN-Band BREAK Command. A BREAK signal is a sequence of constant logic 0, or SPACE Idle. The BREAK command specifies the length of the SPACE Idle sequence in units of 10 milliseconds. The first character of the Extended Command String is 60h. The remaining characters are the duration of the Space Idle, presented as a hexadecimal number, with the least significant digit first. For example, a received BREAK of 100 milliseconds (0Ah, 10 decimal) would be represented by the string: <19h><60h><21h><60h><41h>, encoded by the DCE as shown:

<19h> = <Data Link Escape>

<60h> = <extend0> command

<21h> = <length>, 21h - 1 Fh = 2 = size of Extended command string

<60h> = BREAK command

<41h> = LSD of Break sequence duration, in 10 millisecond units

7.5.2 MARK Idle Command

The DCE may encode a Mark Idle sequence with an In-Band MARK Command. A MARK is logic 1. Some DCE and DTE use periods of MARK idle for control. The MARK command specifies the length of the MARK Idle sequence in units of 10 milliseconds. The first character of the Extended Command String is 61h. The remaining characters are the duration of the MARK Idle, presented as a hexadecimal number, with the least significant digit first. For example, a MARK Idle of 1 second (64h, 100 decimal) would be represented by the string: <19h><60h><22h><61h><34h><36h>, encoded by the DCE as shown:

<19h> = <Data Link Escape>

<60h> = <extend0> command

<22h> = <length>, 22h - 1Fh = 3 = size of Extended command string

<61h> = MARK command

<34h> = LSD of MARK sequence duration, in 10 millisecond units

<36h> = MSD of MARK sequence duration, in 160 millisecond units

7.5.3 STATUS report extended in-band command

The DCE, if conditioned by the DTE, may report intermediate status reports, including any information text or result codes, using the STATUS command. The first character is 62h; the remaining characters are the status report, without the trailing <CR> or <LF> characters. If the report would need more than one printed line, each line shall be encoded with a separate STATUS report in-band command. An example, the encoding of the STATUS "+GCAP: +MS,+ES,+DS,+MV18S<CR><LF>OK<CR><LF>", sent in response to an in-band +GCAP command, would be encoded by the DCE as shown:

<19h><60h>	<EM><extend0>
<3Eh>	<length of 31>
<62h>	<STATUS>
<2Bh><47h><43h><41h><50h><3Ah>	"+GCAP:
<20h><2Bh><4Dh><53h><2Ch>	+MS,
<2Bh><45h><53h><2Ch>	+ES,
<2Bh><44h><53h><2Ch>	+DS,
<2Bh><4Dh><56h><31h><38h><53h>	+MV18S

<19h><60h>	<EM><extend0>
<24h>	<length of 5>
<62h>	<STATUS>
<4Fh><4Bh>	OK"

7.6 In-band service control

The DCE shall support two compound parameters to control 7-bit code in-band services. +IBC controls overall service and In-Band lead reporting. +IBM controls Mark Idle reporting.

7.7 Overall service control

This subclause defines three control states the DCE may take with respect to the In-Band Control service for both circuits 103 and 104:

1) disabled;

2) 7-bit command characters enabled, 8th bit ignored; and

3) 7-bit command characters enabled, 8th bit significant.

This is controlled by the first subparameter, <IB>.

If 7-bit only command characters are enabled by <IB>=1, then if 8-bit character framing is being used on the DTE-DCE interface, the high order bit of the command characters (2^7) shall be ignored, i.e. command characters received with the high order bit set are considered equivalent to those received with the high order bit reset.

If 7-bit command characters are enabled by <IB>=2, then if 8-bit character framing is being used on the DTE-DCE interface, additional command character definitions are possible that do not conflict with the commands defined in this clause, by setting the high order bit. Such commands are defined in clause 8 and are enabled independently by procedures described therein. Command characters received with the high order bit set in Command State, or in Online Data State outside of the Synchronous Access Mode procedures, shall be ignored.

7.8 Individual status control

The DCE and the DTE define Status States, for each V.24 circuit supported and for any other Status condition supported (e.g. line connection status). For each of these Status States, the device (DTE or DCE) shall maintain a Reporting State, which controls whether that Status is reported.

Subparameters from the +IBC compound parameter control the reporting of each In-Band circuit. These are described in Table 5.

The default state for each Reporting State should be OFF (0); each State should require an explicit command to enable reports. For example, after an AT+IBC=,,,,,1 command, the DCE will report Circuit 109 status by an In-Band command only once; additional reports require a DTE <EM><poll> command or a change in the status of circuit 109 (e.g. the DCE detects Data Carrier).

7.9 V.25 *ter* formatted syntax for control of in-band Control, +IBC

The DCE shall maintain a compound parameter which implements the service control switch (see 7.6) and the individual reporting control switches.

In the following format definitions, the symbol <circuit_number> (e.g. <109>) signifies the subparameter that controls the in-band reporting of the corresponding V.24 circuit.

7.9.1 Set the in-band service controls, +IBC=<compound string>

Format:

+IBC=<IB>,<105>,<106>,<107>,<108>,<109>,<110>,<125>,<132>,<133>,<135>,<142>,<hook>

Valid values: see Table 5.

Mandatory values: If implemented in the DCE, 0,1,2 for <IB>; 0 other subparameters.

Default settings: 0 for all parameters.

7.9.2 Read the current in-band service settings, +IBC?

Format: +IBC?

DCE response:

+IBC: <IB>,<105>,<106>,<107>,<108>,<109>,<110>,<125>,<132>,<133>,<135>,<142>,<hook><CR>

7.9.3 Test supported in-band service settings, +IBC=?

Format: +IBC=?

DCE response:

+IBC: (0-2),(supported ckt. 105 report enable/disable values),(supported ckt. 106 report enable/disable values), ...

Example response, for a DCE that supports reporting all values:

+IBC: (0-2),(0,1),(0,1),(0,1),(0,1),(0,1),(0,1),(0,1),(0,1),(0,1),(0,1),(0.1),(0,1)

NOTE – The DCE shall return "ERROR" if none of the in-band commands defined in clause 7 are supported.

7.9.4 Subparameter definitions

TABLE 5/V.80

+IBC subparameter definitions

+IBC setting	Description
+IBC=0,,,,,,,,,,,, +IBC=1,,,,,,,,,,,, +IBC=2,,,,,,,,,,,,	In-Band Control Service Disabled In-Band Control Service Enabled, 7-bit codes only allowed (Tables 1.2), i.e. high-order bit not significant In-Band Control Service Enabled, 7-bit codes (Tables 1.2) allowed, and 8-bit codes available, i.e. high-order bit significant (see clause 8)
+IBC=,0,,,,,,,,,,, +IBC=,1,,,,,,,,,,,	DTE circuit 105 reports Disabled DTE circuit 105 reports Enabled
+IBC=,,0,,,,,,,,,, +IBC=,,1,,,,,,,,,,	DCE circuit 106 reports Disabled DCE circuit 106 reports Enabled
+IBC=,,,0,,,,,,,,, +IBC=,,,1,,,,,,,,,	DCE circuit 107 reports Disabled DCE circuit 107 reports Enabled
+IBC=,,,,0,,,,,,,, +IBC=,,,,1,,,,,,,,	DTE circuit 108 reports Disabled DTE circuit 108 reports Enabled
+IBC=,,,,,0,,,,,,, +IBC=,,,,,1,,,,,,,	DCE circuit 109 reports Disabled DCE circuit 109 reports Enabled
+IBC=,,,,,,0,,,,,, +IBC=,,,,,,1,,,,,,	DTE circuit 110 reports Disabled DTE circuit 110 reports Enabled
+IBC=,,,,,,,0,,,,, +IBC=,,,,,,,1,,,,,	DCE circuit 125 reports Disabled DCE circuit 125 reports Enabled
+IBC=,,,,,,,,1,,,, +IBC=,,,,,,,,0,,,,	DTE circuit 132 reports Disabled DTE circuit 132 reports Enabled
+IBC=,,,,,,,,,1,,, +IBC=,,,,,,,,,0,,,	DTE circuit 133 reports Disabled DTE circuit 133 reports Enabled
+IBC=,,,,,,,,,,1,, +IBC=,,,,,,,,,,0,,	DTE circuit 135 reports Disabled DTE circuit 135 reports Enabled
+IBC=,,,,,,,,,,,1, +IBC=,,,,,,,,,,,0,	DTE circuit 142 reports Disabled DTE circuit 142 reports Enabled
+IBC=,,,,,,,,,,,,0 +IBC=,,,,,,,,,,,,1	DCE line connect status reports Disabled DCE line connect status reports Enabled

NOTE – Eight-bit command codes are defined in clause 8, and are enabled independently by the Synchronous Access Mode configuration commands defined therein. These 8-bit codes cannot be used simultaneously with <IB>=1, as the DCE would interpret received command codes with the high order bit set as 7-bit codes.

7.10 In-band MARK Idle Reporting Control, +IBM

If enabled, a DCE shall report a sufficiently long Mark-ldle interval with one or more In-Band Mark Idle reports (see 7.5.2). The DCE shall maintain timers used to control the reporting of Mark Idle periods, and a control setting to determine the use of these timers.

7.10.1 Mark Idle period intervals

A Mark Idle period may be modelled by three intervals, Minimum, Repeat and Final. These are illustrated in Figure 1:

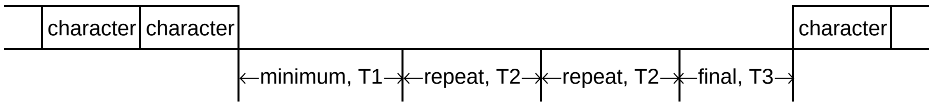

FIGURE 1/V.80

Mark Idle intervals

Minimum Interval: the minimum interval begins with the receipt of the last complete character, and ends with the expiration of the minimum duration timer, T1.

Repeat Interval: the second interval begins with the expiration of the T1 timer, and ends with the expiration of the second interval timer, T2.

Final Interval: the final interval begins with the expiration of either T1 or T2, and ends with the receipt of a new character; define this as T3.

Total Interval: the sum of the minimum interval, zero or more repeat intervals, and a final interval.

7.10.2 Set Mark-ldle Report Controls

Syntax:

+IBM=[<mic>][,[<T1 >][,[<T2>]]]

Description:

Subparameter <mic> specifies how Mark Idle reports shall be generated. Valid values of <mic> are defined in Table 6.

Decimal coded subparameters <T1> and <T2> specify the Minimum and Repeat intervals, in units of 10 milliseconds.

7.10.3 Read the Current In-Band Mark Idle Settings, +IBM?

Format: +IBM?

DCE response:

+IBM:<mic>,<T1 >,<T2><CR>

Example response, for a DCE set-up to report the Mark Idle periods exceeding a second, and then on subsequent repetitions of 10 seconds, would report:

+IBM:3,100,1000<CR>

TABLE 6/V.80

Mark Idle control selections

<mic>	Description
0	no reports
1	report only once when <T1 > expires
2	report each time <T2> expires
3	report once when <T1> expires, and then each time <T2> expires
4	report only when the Mark-ldle Period ends; T3 = the entire interval
5	report the first time when <T1> is exceeded, and then once more when the mark idle period ends
6	report each time when <T2> is exceeded, and then once more when the mark idle period ends; T3 = entire interval – N*T2
7	report the first time when <T1> is exceeded, and then each time <T2> is exceeded, and then once more when the mark idle period ends; T3 = entire mark idle period – N*T2 - T1

7.10.4 Test Supported In-Band Mark Idle Settings, +IBM=?

Format: +IBM=?

DCE response:

+ IBM:(range of mic values),(range of T1 values),(range of T2 values)<CR>

Example response, for a DCE that supports 8-bit timers:

+IBM:(0-7),(0-255),(0-255)

NOTE – The DCE shall return “ERROR” if Mark Idle Reporting is not supported.

8 8-bit commands: Synchronous data modes

This clause defines 8-bit command characters, which are used to implement optional synchronous data modes for V-Series DCE controlled by asynchronous V.25 *ter* commands. It includes an optional Synchronous Access Mode, which encompasses mechanisms to support multimedia services (e.g. Recommendation H.324) on a DTE equipped with an asynchronous-only serial port. It specifies:

a) means to select synchronous modes;

b) means to indicate synchronous modes;

c) means to control flow control thresholds;

d) in-band means to control bit-processing in the DCE;

e) in-hand means to control signal converter operation after connection.

These means allow a DTE to implement standard or proprietary data link protocols, such as:

- Recommendation H.223 (multimedia terminal multiplex layer).
- Recommendation V.76 (digital simultaneous voice and data multiplex layer).
- Recommendation V.42 (with detection phase).
- Annex C/T.30.
- Annex F/T.30.
- Recommendation Q.922.

8.1 Synchronous modes enable

The synchronous modes are enabled by additional parameter values in the +ES V.25 *ter* command. Enabling Synchronous Access Mode enables the use of the 8-bit command characters defined in Table 9, independent of the enabling of the 7-bit commands with the +IBC command (see 7.9). However, Synchronous Access Mode cannot be used if the 7-bit commands are enabled with <IB>=1.

The operation of the Synchronous Access sub-Mode is configured by the +ESA parameter. The +ES command definition is amended as follows (additions shown in italics):

Parameter

+ES=[<orig_rqst>[,<orig_fbk>[,<ans_fbk>]]]

Description

This extended-format compound parameter is used to control the manner of operation of the V.42 protocol in the DCE (if present). It accepts three numeric subparameters:

- **<orig_rqst>,** which specifies the initial requested mode of operation when the DCE is operating as the originator.
- **<orig_fbk>,** which specifies the acceptable fallback mode of operation when the DCE is operating as the originator.
- **<ans_fbk>**, which specifies the acceptable fallback mode of operation when the DCE is operating as the answerer.

Defined Values

TABLE 7/V.80

Error Control Operation subparameters

<orig_rqst>	Description
0	Direct mode
1	Initiate call with Buffered mode only
2	Initiate V.42 without Detection Phase. If Rec. V.8 is in use, this is a request to disable V.42 Detection Phase
3	Initiate V.42 with Detection Phase
4	Initiate Altemative Protocol
5	*Initiate Synchronous Mode when connection is completed, immediately after the entire CONNECT result code is delivered. V.24 circuits 113 and 115 are activated when Data State is entered*
6	*Initiate Synchronous Access Mode when connection is completed, and Data State is entered*
7	*Initiate Frame Tunnelling Mode when connection is completed, and Data State is entered*
<orig_fbk>	Description
0	Error control optional (either LAPM or Alternative acceptable); if error control not established, maintain DTE-DCE data rate and use V.14 buffered mode with flow control during non-error-control operation
1	Error control optional (either LAPM or Alternative acceptable); if error control not established, change DTE-DCE data rate to match line rate and use Direct mode
2	Error control required (either LAPM or Alternative acceptable); if error control not established, disconnect
3	Error control required (only LAPM acceptable); if error control not established, disconnect
4	Error control required (only Altemative protocol acceptable); if error control not established, disconnect

TABLE 7/V.80 *(concluded)*

Error Control Operation subparameters

<ans_fbk>	Description
0	Direct mode
1	Error control disabled, use Buffered mode
2	Error control optional (either LAPM or Alternative acceptable); if error control not established, maintain DTE-DCE data rate and use local buffering and flow control during non-error-control operation
3	Error control optional (either LAPM or Alternative acceptable); if error control not established, change DTE-DCE data rate to match line rate and use Direct mode
4	Error control required (either LAPM or Alternative acceptable); if error control not established, disconnect
5	Error control required (only LAPM acceptable); if error control not established, disconnect
6	Error control required (only Alternative protocol acceptable); if error control not established, disconnect
7	*Initiate Synchronous Mode when connection is completed, immediately after the entire CONNECT result code is delivered. V.24 cicuits 113 and 115 are activated when Data State is entered*
8	*Initiate Synchronous Access Mode when connection is completed, and Data State is entered*
9	*Initiate Frame Tunnelling Mode when connection is completed, and Data State is entered*

Note that when the <orig_rqst> parameter is set to 5, 6 or 7, the setting of the <orig_fbk> parameter is ignored.

Recommended Default Settings

For <orig_rqst>: 3

For <orig_fbk>: 0

For <ans_fbk>: 2

Read Syntax

+ES?

The DCE shall transmit a string of information text to the DTE, consisting of:

+ES: <orig_rqst>,<orig_fbk>,<ans_fbk>

For example, +ES: 3,0,2 for the recommended defaults.

Test Syntax

+ES=?

The DCE shall transmit a string of information text to the DTE, consisting of:

+ES: (list of supported <orig_rqst> values),(list of supported <orig_fbk> values),(list of supported <ans_fbk> values)

For example, +ES: (0-7),(0-4),(0-9) for all defined values.

Implementation

Implementation of this parameter is mandatory if V.42 error control, Buffered mode, *Synchronous Mode, Frame Tunnelling Mode or Synchronous Access Mode is* implemented in the DCE.

8.2 Synchronous access mode configuration

Parameter

+ESA=[<trans_idle>[,<framed_idle>[,<framed_un_ov>[,<hd_auto>[,<crc_type>[,<nrzi_en>[,<syn1> [,<syn2>]]]]]]]]

Description

This extended-format compound parameter is used to control the manner of operation of the Synchronous Access Mode in the DCE (if present). It accepts six numeric subparameters:

- **<trans_idle>**, which specifies the bit sequence transmitted by the DCE when a transmit data buffer underrun condition occurs, while operating in Transparent sub-Mode.
- **<framed_idle>**, which specifies the bit sequence transmitted by the DCE when a transmit data buffer underrun condition occurs immediately after a flag, while operating in Framed sub-Mode.
- **<framed_un_ov>**, which specifies the actions undertaken by the DCE when a transmit data buffer underrun or overrun condition occurs immediately after a non-flag octet, while operating in Framed sub-Mode.
- **<hd_auto>**, which specifies whether or not, in V.34 half duplex operation, additional procedures besides those specified in clause 12/V.34 shall be performed by the DCE when switching from primary channel to secondary channel operation, and vice versa.
- **<crc_type>**, which specifies the CRC polynomial used while operating in Framed sub-Mode.
- **<nrzi_en>**, which specifies if Non Return to Zero Inverted (NRZI) encoding is to be used by the DCE for transmit and receive data.
- **<syn1>**, **<syn2>**, which specifies the octet value(s) to be used while performing character-oriented framing.

Defined Values

TABLE 8/V.80

Synchronous Access Mode Operation subparameters

<trans_idle>	Description
0	In Transparent sub-Mode, DCE transmits 8-bit SYN sequence on idle. DCE receiver does not hunt for synchronization sequence
1	In Transparent sub-Mode, DCE transmits 8-bit SYN sequence on idle. DCE receiver hunts for 8-bit SYN sequence
2	In Transparent sub-Mode, DCE transmits 16-bit SYN sequence on idle. DCE receiver hunts for 16-bit SYN sequence
<framed_idle>	Description
0	In Framed sub-Mode, DCE transmits HDLC flags on idle
1	In Framed sub-Mode, DCE transmits marks (ones) on idle
<framed_un_ov>	Description
0	In Framed sub-Mode, DCE transmits abort on underrun in middle of frame
1	In Framed sub-Mode, DCE transmits a flag on underrun in middle of frame, and notifies DTE of underrun or overrun

TABLE 8/V.80 *(concluded)*

Synchronous Access Mode Operation subparameters

<hd_auto>	Description
0	When switching between primary and secondary channel operation in V.34 half duplex, the DCE only executes those procedures defined in clause 12/V.34
1	When switching between primary and secondary channel operation in V.34 half duplex, the DCE executes additional procedures as described in 8.8.5 besides those defined in clause 12/V.34
<crc_type>	Description
0	CRC generation and checking disabled
1	In Framed sub-Mode, the 16-bit CRC specified in 8.1.1.6/V.42 is generated by the DCE in the transmit direction, and checked by the DCE in the receive direction
2	In Framed sub-Mode, the 32-bit CRC specified in 8.1.1.6/V.42 is generated by the DCE in the transmit direction, and checked by the DCE in the receive direction
<nrzi_en>	Description
0	NRZI encoding and decoding disabled
1	NRZI encoding enabled in the DCE in the transmit direction, and NRZI decoding enabled in the DCE in the receive direction
<syn1>	Description
0-255	When <trans_idle>=0, specifies the 8-bit transmit idle sequence to be used by the DCE. When <trans_idle>=1, specifies the 8-bit synchronization sequence to be used by the DCE. When <trans_idle>=2, specifies first 8 bits of 16-bit synchronization sequence to be used by the DCE
<syn2>	Description
0-255	When <trans_idle>=2, specifies last 8 bits of 16-bit synchronization sequence to be used by the DCE

Recommended Default Settings

Recommended default setting for all subparameters is zero, except for <syn1> and <syn2>, which have recommended defaults of 255 (FFh hexadecimal).

Read Syntax

+ESA?

The DCE shall transmit a string of information text to the DTE, consisting of:

For example, +ES: 0,0,0,0,0,0,255,255 for the recommended defaults.

Test Syntax

+ESA=?

The DCE shall transmit a string of information text to the DTE, consisting of:

+ESA: (list of supported <trans_idle> values), (list of supported <framed_idle> values), (list of supported <framed_un_ov> values), (list of supported <hd_auto> values), (list of supported <crc_type> values), (list of supported <nrzi_en> values), (list of supported <syn1> values), (list of supported <syn2> values)

For example, +ES: (0-2),(0-1),(0-1),(0-1),(0-2),(0-1),(0-255),(0-255) for all defined values.

Implementation

If Synchronous Access Mode is implemented in the DCE, implementation of the following subparameter values are mandatory:

<trans_idle>: 0

<nrzi_en>: 0

8.3 Synchronous Mode Indication

If the +ER parameter is set to 1 (enabled), and if a connection is initiated in Synchronous Mode or Synchronous Access Mode, the DCE shall report: +ER: NONE, after the carrier negotiation results are reported.

8.4 Transmit Flow Control Thresholds

Parameter

+ITF=[<off>[,<on>[,<report_period>]]]

Description

This optional compound parameter allows the DTE to determine the input buffer size in the DCE for data on circuit 103 from the DTE, to control the thresholds used for flow control of such data, and to control how often the DCE reports to the DTE the number of octets in this buffer. (The DTE can adjust its own thresholds for flow control of data on circuit 104 from the DCE.) The +IFC command determines the means used to signal <DTE-by-DCE> flow control.

The setting of this parameter is ignored in Direct and Synchronous Modes, where flow control is not used. Subparameters <off> and <on> are applicable in Synchronous Access, Frame Tunnelling, Buffered V.14, and error control modes. Subparameter <report_period> is applicable only in Synchronous Access mode.

Subparameter <off> determines the threshold, in octets, above which the DCE shall generate a flow off signal.

Subparameter <on> determines the threshold, in octets, below which the DCE shall generate a flow on signal.

Subparameter <report_period> determines the interval, in units of 10 milliseconds, between transmissions of indications by the DCE on circuit 104; such indications convey to the DTE the number of octets in the DCE's input transmit data buffer at any point in time.

A <report_period> value of zero commands the DCE not to transmit such indications to the DTE. The indications take the form of the three-octet sequence <EM><bnum><octnum0><octnum1>. The <bnum> code is defined in Table 9. The two octets <octnum0><octnum1> indicate the number of octets in the DCE's transmit data input buffer at the time at which the indication is transmitted by the DCE. The range of reportable values is 00_{10} - 16383_{10}. The low-order bit of both <octnum0> and <octnum1> is set to zero, to ensure that neither of the two octets mimic EM, DC1, or DC3. The remaining bits form a 14-bit number with the second transmitted bit in <octnum0> (i.e. the next-to-lowest order bit) being the least significant bit of the reported value, and the high-order bit of <octnum1> being the most significant bit of that value.

The DCE shall return the ERROR result code if the DTE specifies that the <off> subparameter be set to a value less than or equal to the <on> subparameter; the current parameter value settings shall not be modified.

For the <on> and <off> subparameters, the input buffer is assumed to reside between the DCE's V.24 interface and the Synchronous Access protocol layer, i.e. the buffer count includes all octets, including EM codes, received from the DTE, with the exception of DC1 and DC3 if these are used to signal <DCE-by-DTE> flow control.

For the <report_period> subparameter, the reported value includes only those octets to be transmitted as bearer data by the DCE, exclusive of escape octets, i.e. it does not include EM commands from the DTE, and counts sequences such as <EM><tcq> and <EM><tcs> as one octet.

Defaults

Set by manufacturer.

Test Syntax

+ITF=?

The DCE shall transmit a string of information text to the DTE, consisting of:

+ITF: (list of supported <off> values),(list of supported <on> values),(list of supported <report_period> values)

The maximum reported <off> value is the input transmit data buffer level at which the DCE signals a transmit data overrun indication to the DTE.

Implementation

This parameter is optional. However, it is necessary for high quality of service in multimedia services, particularly in maintaining low transmit data delay.

8.5 Synchronous Access Mode In-Band Commands and Indications

In Synchronous Access Mode, in-band commands and indications are defined in Table 9 for various functions. Each command or indication consists of an <EM> octet followed by a second octet which specifies the desired command or indication. Some commands and indications are followed immediately by one or two additional octets which specify associated parameters. For example, the <EM><bnum> indication is followed by <octnum0><octnum1> octets, which specify the number of octets in the transmit data buffer.

Some of these additional parameters refer to DCE data signalling rate. For example, the <EM><rate> indication is followed by the parameters <tx><rx>, which specify the transmit and receive data signalling rate at the completion or a retrain or rate renegotiation. The values for these parameters are defined in Table 10.

TABLE 9/V.80

Synchronous Access Mode In-Band Commands

Command/ indication pair symbol	Hex codes	Description, circuit 103	Description, circuit 104	Transparent sub-mode	Framed sub-mode
		Character Transparency	**Character Transparency**		
<EM><t1>	5Ch	transmit one 19h pattern	received one 19h pattern	✓	✓
<EM><t2>	76h	transmit one 99h pattern	received one 99h pattern	✓	✓
<EM><t3>	A0h	transmit DC1	received DC1	✓	✓
<EM><t4>	A1h	transmit DC3	received DC3	✓	✓
<EM><t5>	5Dh	transmit two 19h patterns	received two 19h patterns	✓	✓
<EM><t6>	77h	transmit two 99h patterns	received two 99h patterns	✓	✓
<EM><t7>	A2h	transmit two DC1 patterns	received two DC1 patterns	✓	✓
<EM><t8>	A3h	transmit two DC3 patterns	received two DC3 patterns	✓	✓
<EM><t9>	A4h	transmit 19h, 99h	received 19h, 99h	✓	✓
<EM><t10>	A5h	transmit 19h, DC1	received 19h, DC1	✓	✓
<EM><t11>	A6h	transmit 19h, DC3	received 19h, DC3	✓	✓
<EM><t12>	A7h	transmit 99h, 19h	received 99h, 19h	✓	✓
<EM><t13>	A8h	transmit 99h, DC1	received 99h, DC1	✓	✓
<EM><t14>	A9h	transmit 99h, DC3	received 99h, DC3	✓	✓
<EM><t15>	AAh	transmit DC1, 19h	received DC1, 19h	✓	✓
<EM><t16>	ABh	transmit DC1, 99h	received DC1, 99h	✓	✓
<EM><t17>	ACh	transmit DC1, DC3	received DC1, DC3	✓	✓
<EM><t18>	ADh	transmit DC3,19h	received DC3, 19h	✓	✓
<EM><t19>	AEh	transmit DC3, 99h	received DC3, 99h	✓	✓
<EM><t20>	AFh	transmit DC3, DC1	received DC3, DC1	✓	✓
<EM><mark>	B0h	begin transparent sub-mode	HDLC Abort detected in Framed sub-Mode	✓	✓ (receive only)

TABLE 9/V.80 *(concluded)*

Synchronous Access Mode In-Band Commands

Command/ indication pair symbol	Hex codes	Description, circuit 103	Description, circuit 104	Transparent sub-mode	Framed sub-mode
<EM><flag>	B1h	transmit a flag; enter Framed sub-Mode if currently in Transparent sub-Mode. If enabled, precede with FCS if this follows a non-flag octet sequence	Non-flag to flag transition detected. Preceding data was valid frame; FCS valid if CRC checking was enabled		✓
<EM><err>	B2h	– transmit Abort –	Non-flag to flag transition detected. Preceding data was not a valid frame		✓
<EM><hunt>	B3h	put receiver in hunt condition	– not applicable –	✓	✓
<EM><under>	B4h	– not applicable –	transmit data underrun	✓	✓
<EM><tover>	B5h	– not applicable –	transmit data overrun	✓	✓
<EM><rover>	B6h	– not applicable –	receive data overrun	✓	✓
<EM><resume>	B7h	resume after transmit underrun or overrun	– not applicable –		✓
<EM><bnum>	B8h	– not applicable –	the following octets, <octnum0><octnum1 >, specify the number of octets in the transmit data buffer.	✓	✓
<EM><unum>	B9h	– not applicable –	the following octets, <octnum0><octnum1 >, specify the number of discarded octets		✓
		duplex carrier control	**duplex carrier status**		
<EM><eot>	BAh	terminate carrier, return to command state	loss of carrier detected, return to command state	✓	✓
<EM><ecs>	BBh	go to on-line command state	confirmation of <EM><esc> command	✓	✓
<EM><rrn>	BCh	Request rate reneg. (duplex)	indicate rate reneg. (duplex)	✓	✓
<EM><rtn>	BDh	Request rate retrain (duplex)	indicate rate retrain (duplex)	✓	✓
<EM><rate>	BEh	following octets, <tx><rx>, set max. tx and rx rates	retrain/reneg. completed; following octets, <tx><rx>, indicate tx and rx rates	✓	✓
		V.34 HD carrier control	**V.34 HD duplex carrier status**		
<EM><pri>	BCh	go to primary ch. operation	pri. ch. operation commenced; following octet, <prate>, indicates bit rate	✓	✓
<EM><ctl>	BFh	go to control ch. operation	ctl. ch. operation commenced; following octets, <prate><crate>, indicates bit rates	✓	✓
<EM><rtnh>	BDh	initiate pri. channel retrain	indicate pri. channel retrain	✓	✓
<EM><rtnc>	C0h	initiate ctl. channel retrain	indicate ctl. channel retrain	✓	✓
<EM><rateh>	BEh	following octets, <maxp> <prefc>, set max. pri, rate and preferred ctl. ch. rate	– not applicable –	✓	✓
<EM><eoth>	BAh	terminate carrier	carrier termination detected	✓	✓
<EM><ecs>	BBh	go to command state	– not applicable –	✓	✓

TABLE 10/V.80

Synchronous Access Mode Command/lndication Bit Rate Values
(values for parameters <tx>, <rx>, <maxp>, <prate>)

Symbol	Hex code	Duplex or primary channel data signalling rate
<p12>	20h	1200 bit/s
<p24>	21h	2400 bit/s
<p48>	22h	4800 bit/s
<p72>	23h	7200 bit/s
<p96>	24h	9600 bit/s
<p120>	25h	12 000 bit/s
<p144>	26h	14 400 bit/s
<p168>	27h	16 800 bit/s
<p192>	28h	19 200 bit/s
<p216>	29h	21 600 bit/s
<p240>	2Ah	24 000 bit/s
<p264>	2Bh	26 400 bit/s
<p288>	2Ch	28 800 bit/s
<p312>	2Dh	31 200 bit/s
<p336>	2Eh	33 600 bit/s

8.6 Synchronous Mode Operation

In Synchronous Mode operation, the V.24 interface switches from start-stop framing to transparent synchronous operation when the Online Data State is entered. In Online Data State, transmit and receive data are transferred directly between the synchronous signal converter and the V.24 interface. Circuits 114 and 115 are held OFF by the DCE in Command State and are activated when in Online Data State. Circuit 113 is ignored in Command State and, depending on DCE configuration, may be used as the transmitter timing source in Online Data State.

8.7 Frame Tunnelling Mode Operation

In Frame Tunnelling Mode operation, at the V.24 interface the procedures specified in 4.5.2.2 and 4.5.3.1 of ISO/IEC 3309 shall be used. From DCE to DCE, the synchronous transmission procedures specified in 4.5.1 of ISO/IEC 3309 shall be used. In both the transmit and receive directions, the DCE shall convert between the two formats as required.

Flow control as selected by the +IFC parameter shall be used.

Data format is 1 start bit, 8 data bits, no Parity, 1 stop bit. The +ICF parameter is ignored.

8.8 Synchronous Access Mode Operation

As it may be useful to use both Transparent sub-Mode and Framed sub-Mode during the same session, it is possible to dynamically switch between the two sub-modes using EM codes. The <EM><mark> code initiates Transparent sub-mode in the DCE; no data is implicitly transmitted by the DCE as a result of this code. The <EM><flag> code commands the DCE to transmit an HDLC flag and enter Famed sub-Mode. The DCE shall flush its receive data buffer on every sub-Mode transistion.

When Synchronous Access Mode is entered after the CONNECT result code is sent to the DTE, the DCE shall initially operate in Transparent sub-Mode in both the transmit and receive directions.

Data format is 1 start bit, 8 data bits, no Parity, 1 stop bit. The +ICF parameter is ignored.

8.8.1 Transparent sub-Mode

8.8.1.1 Transmit

In the transmit direction, the DCE shall strip the start and stop framing bits from the DTE-originated bitstream, translate the EM-shielded code defined in Table 9, and transmit the resulting synchronous bit sequence on the line. The DCE shall do no other bit processing on the transmit data.

When a transmit underrun condition occurs, the DCE shall transmit the <EM><under> code to the DTE on circuit 104. In addition, the DCE shall transmit one or more SYN sequences on the line until additional data is received from the DTE. While the DTE may intentionally underrun the transmit data in order to avoid sending what is, in some protocols, "idle" data to the DCE, it should be noted that the number of octets thus transmitted on the line during this period (i.e. from the commencement of the underrun condition to the time that the next octet is received from the DTE), is indeterminate.

When a transmit overrun condition occurs, the DCE shall transmit the <EM><tover> code to the DTE on circuit 104. Depending on DCE implementation, the octets causing the overrun may either overwrite previous data, or be discarded.

8.8.1.2 Receive

If the <trans_idle> subparameter of the +ESA parameter is set to either 1 or 2, the DCE receiver shall enter the Transparent sub-Mode in a "hunt" condition, and discard all receive data until the specified SYN sequence is received. When the SYN sequence is received, the DCE shall partition the received data, including the SYN sequence, into octets, append start and stop framing bits, EM-shield certain octets as necessary as defined in Table 9, and send the resulting asynchronous framed data to the DTE. The DTE may command the DCE to flush its receive data buffer and put its receiver in the "hunt" condition at any time with the <EM><hunt> code. The DCE shall do no other bit processing on the receive data.

If the <trans_idle> subparameter of the +ESA parameter is set to zero, the DCE received shall immediately begin forwarding receive data to the DTE upon entering Transparent sub-Mode. The <EM><hunt> code has no effect in this case.

When a receive overrun condition occurs, due to either excessive flow-off indications from the DTE or inadequate DTE-DCE data signalling rate, the DCE shall insert the <EM><rover> code at the point in the receive octet stream at which data was lost.

Note that, since in some protocols the number of consecutive marks is significant (V.42 detection phase is one such example), and the DCE has no knowledge of the specifics of such a protocol, when the DCE is receiving continuous marks it shall continue to send 11111111 octets to the DTE at the rate at which they are received on the line, unless the hunt condition is configured and active.

8.8.2 Framed sub-Mode

8.8.2.1 Transmit

In bit-oriented Framed sub-Mode operation, the zero-insertion bit transparency procedures defined in 4.5.1 of ISO/IEC 3309 are used for DCE-DCE data. Thus, additional EM codes are needed to identify, at the DTE-DCE interface, bit sequences such as HDLC flags to which zero insertion is not applied. These additional EM codes are defined in Table 9.

The DTE signals the DCE to initiate Framed sub-Mode with the <EM><flag> code, which signals the DCE to transmit a flag. Additional flags may be explicitly specified by the DCE with additional <EM><flag> codes, or by an intentional transmit underrun if the DCE is configured for flag idle operation.

If enabled, the DCE shall compute the selected CRC polynomial on all message data received on circuit 103, beginning with the first non-flag octet following the transmission of one or more flags. All in-band commands are excluded from this calculation. When the DTE terminates a non-flag octet sequence with an <EM><flag> code, the DCE shall transmit this CRC on the line as the Frame Check Sequence before the flag octet. These polynomials are specified in 8.1.1.6/V.42.

When a transmit underrun condition occurs during a non-flag octet sequence, the action taken by the DCE depends on the setting of the <framed_un_ov> subparameter of the +ESA parameter. If <framed_un_ov>=0, the DCE shall substitute an Abort by transmitting at least eight ones. If <framed_un_ov>=1, the DCE shall substitute a flag. In either case, this will then be followed by flags or marks, depending on the setting of the <framed_idle> subparameter of the +ESA parameter. If the DCE is computing a CRC when this occurs, an FCS is not transmitted on the line. The DCE shall then send the <EM><under> code to the DTE on circuit 104.

If <framed_un_ov>=1, the DCE shall ignore further transmit data on circuit 103 until an <EM><resume> code is received from the DTE on circuit 103. Upon receiving the <EM><resume> code from the DTE, the DCE shall transmit the <EM><unum><octnum0><octnum1> indication to the DTE. The <octnum0><octnum1> octets indicate the number of bearer data octets that were discarded by the DCE from the occurrence of the underrun condition, up to the point at which the <EM><resume> code was received. The coding of <octnum0><octnum1> is the same as that in 8.4.

When a transmit underrun condition occurs during a flag octet sequence, the DCE shall not send an <EM><under> code to the DTE. Depending on the setting of the +ESA parameter, the DCE shall substitute one or more flags, or eight or more ones, until subsequent data is received from the DTE.

When a transmit overrun condition occurs, the action taken by the DCE depends on the setting of the <framed_un_ov> subparameter of the +ESA parameter. If <framed_un_ov>=0, the DCE shall transmit the <EM><tover> code to the DTE on circuit 104. Depending on DCE implementation, the octets causing the overrun may either overwrite previous data, or be discarded. If the overrun occurs in the middle of a non-flag octet sequence, the DCE shall insert an Abort at the point at which the overrun occurred. In the case where previous data is overwritten, if the overwriting data causes a non-flag octet sequence to be terminated by a flag, an FCS is not transmitted.

If <framed_un_ov>=1, the DCE shall substitute a flag at the point in the octet immediately before the occurrence of the overrun. This will then be followed by flags or marks, depending on the setting of the <framed_idle> subparameter of the +ESA parameter. If the DCE is computing a CRC when this occurs, an FCS is not transmitted on the line. The DCE shall then send the <EM><over> code to the DTE on circuit 104. The DCE shall ignore further transmit data on circuit 103 until an <EM><resume> code is received from the DTE on circuit 103. Upon receiving the <EM><resume> code from the DTE, the DCE shall transmit the <EM><unum><octnum0><octnum1> indication to the DTE. The <octnum0><octnum1> octets indicate the number of bearer data octets that were discarded by the DCE from the occurrence of the overrun condition, up to the point at which the <EM><resume> code was received. The coding of <octnum0><octnum1> is the same as that in 8.7.

NOTE – After the DTE transmits the <EM><resume> code, it should not transmit any more data to the DCE until the <EM><octnum0><octnum1> is received from the DCE.

The DTE may signal the DCE to transmit an Abort with the <EM><err> code.

8.8.2.2 Receive

When bit-oriented Framed sub-Mode is initiated, the DCE receiver shall enter a "hunt" condition and search the received bitstream for HDLC flags. Until a valid flag octet is detected, the DCE shall discard the received data and shall not forward it to the DTE. Upon detecting a flag, the DCE shall send an <EM><err> code to the DTE. Subsequent consecutive received flags are not forwarded to the DTE.

After a flag is detected and the <EM><err> code has been forwarded to the DTE, the DCE shall forward the first and subsequent non-flag octets to the DTE by removing the zero-inserted bits, appending start and stop framing bits, and EM-shielding certain octet values as defined in Table 9. Starting with the first non-flag octet, the selected CRC polynomial shall be computed by the DCE, if enabled. If the non-flag octet sequence is terminated with a valid flag the DCE shall forward the <EM><err> code to the DTE if the enabled FCS was in error; otherwise, the DCE shall send the <EM><flag> code to the DTE. If the closing flag octet is followed immediately by non-flag data, the flag will be considered the opening flag of the next frame.

If seven or more consecutive ones are received, the DCE shall indicate this to the DCE by forwarding the <EM><mark> code. Note that this code does not indicate that the DCE has entered the transparent sub-mode. The DCE shall subsequently enter the “hunt” condition as described in the proceding paragraphs.

The DTE may command the DCE receiver to flush its receive data buffer and re-enter the “hunt” condition at any time with the <EM><hunt> code.

When a receive overrun condition occurs, due to either excessive flow-off indications from the DTE or inadequate DTE-DCE data signalling rate, the DCE shall insert the <EM><rover> code at the point in the receive octet stream at which data was lost.

The handling of received residue bits is for further study.

8.8.3 Escape to On-Line Command State

If the DTE sends an <EM><ecs> command, the DCE shall issue a confirming <EM><ecs> indication followed by an OK result code, and enter On-Line Command State. While in On-Line Command State, the DCE shall transmit the configured idle sequence if carrier is being transmitted, and discard received data.

8.8.4 Duplex Carrier Control

The DTE may command the DCE to initiate a carrier retrain or rate renegotiation request. Similarly, the DCE shall indicate to the DTE when a retrain or rate renegotiate request is received from the remote DCE.

The DTE may issue the <EM><rate><tx><rx> command at any time during a connection. This command has the effect of altering the settings of the <max_rate> and <max_rx_rate> subparameters, respectively, in the +MS parameter. These settings are then active for subsequent retrains and rate renegotiations. The values for the <tx> and <rx> parameters are defined in Table 10.

8.8.4.1 Retrain

If the DTE issues an <EM><rtn> command to the DCE, optionally preceded by a rate command, the DCE shall use the relevant V-Series modem procedures to request a retrain. If the DCE receives a retrain request from the remote DCE, the DCE shall indicate this to the DTE with the <EM><rtn> indication.

At the conclusion of the retrain, the DCE shall indicate the signalling rates to the DTE with the <EM><rate><tx><rx> indication.

If the retrain attempt results in carrier disconnection, the DCE shall remain connected to the network, issue an <EM><eot> indication, enter Command State, and issue a NO CARRIER result code.

8.8.4.2 Rate renegotiation

If the DTE issues an <EM><rrn> command to the DCE, optionally preceded by a rate command, the DCE shall use the relevant V-Series modem procedures to request a rate renegotiation. If the DCE receives a rate renegotiation request from the remote DCE, the DCE shall indicate this to the DTE with the <EM><rrn> indication.

At the conclusion of the renegotiation, the DCE shall indicate the signalling rates to the DTE with the <EM><rate><tx><rx> indication.

If the renegotiation attempt results in carrier disconnection, the DCE shall remain connected to the network, issue an <EM><eot> indication, enter Command State, and issue a NO CARRIER result code.

8.8.4.3 Carrier termination

If the DTE sends an <EM><eot> command, the DCE shall issue a confirming <EM><eot> indication. The DCE shall then follow the relevant V-Series modem procedures to terminate the data carrier, but remain connected to the network. When the modem carrier is disconnected, the DCE shall issue a NO CARRIER result code, and enter Command State.

If the remote terminal initiates procedures to terminate the data carrier, the DCE shall complete the carrier disconnection but remain connected to the network, issue an <EM><eot> indication, enter Command State, and issue a NO CARRIER result code.

8.8.5 Half duplex V.34 carrier control

While the DCE is using V.34 half duplex modulation, the DTE may command the DCE to initiate the various procedures defined in clause 12/V.34 for transitioning between half duplex primary channel operation and duplex control channel operation, and for initiating primary and control channel retrains.

The DTE may issue the <EM><rateh><maxp><prefc> command at any time during a connection. The <maxp> parameter sets the maximum primary channel bit rate that the DCE may negotiate during subsequent control channel retrains and restarts (the V.34 primary channel bit rate is determined at the commencement of the proceeding control channel operation, unless modified during control channel operation by a control channel retrain). The values for this parameter are defined in Table 10. The <prefc> parameter sets the control channel bit rate that the DCE shall select for the remote transmitter (i.e. bits 27 and 50 in the transmitted MPh sequence). The defined values for this parameter are: 0 - 1200 bit/s, asymmetric rates not permitted; 1 - 2400 bit/s, asymmetric rates not permitted; 2 - 1200 bit/s, asymmetric rates permitted; 3 - 2400 bit/s, asymmetric rates permitted; 4 determined by DCE. Note that if one or both DCEs does not permit asymmetric control channel signalling rates, the remote transmitter may in fact operate at 1200 bit/s when control channel operation is commenced, even if operation at 2400 bit/s was specified by the local DCE.

8.8.5.1 Transition from control channel to primary channel operation

If the DTE issues an <EM><pri> command to the DCE during control channel operation, the DCE shall execute the control channel turn-off procedures defined in 12.6.3/V.34, and proceed with the primary channel resynchronization procedures defined in 12.5/V.34.

At the conclusion of the resynchronization, the DCE shall indicate this to the DTE with the <EM><pri><prate> indication, where <prate> indicates the primary channel bit rate.

If the <hd_ auto> subparameter of the +ESA parameter is set to one, upon receipt of the <EM><pri> command, a source modem shall transmit 40 ones on the control channel, and continue transmitting ones until loss of control channel carrier from the remote transmitter is detected, before proceeding with the turn-off procedures defined in 12.6.3/V.34. For <hd_auto>=1, a recipient modem shall proceed with 12.6.3/V.34 procedures upon receipt of 40 consecutive ones from the remote transmitter, i.e. an <EM><pri> command is not required by the recipient modem in this case.

If the resynchronization attempt results in carrier disconnection, the DCE shall remain connected to the network and issue an <EM><eoth> indication.

8.8.5.2 Transition from primary channel to control channel operation

If the DTE issues an <EM><ctl> command to the DCE during primary channel operation, the DCE shall execute the primary channel turn-off procedures defined in 12.5.3/V.34, and proceed with the control channel resynchronization procedures defined in 12.6/V.34.

At the conclusion of the resynchronization, the DCE shall indicate this to the DTE with the <EM><ctl><prate><crate> indication, where <prate> indicates the bit rate to be used for subsequent primary channel operation, and <crate> indicates the transmit and receive control channel bit rate. Defined values for <crate> are: 0 - 1200 bit/s receive and transmit; 1 - 2400 bit/s receive and transmit; 2 - 1200 bit/s receive, 2400 bit/s transmit, 3 - 2400 bit/s receive, 1200 bit/s transmit.

If the <hd_auto> subparameter of the +ESA parameter is set to one, a recipient modem shall proceed with 12.5.3/V.34 procedures upon loss of primary channel carrier from the remote transmitter, i.e. an <EM><pri> command is not required by the recipient modem in this case.

If the resynchronization attempt results in carrier disconnection, the DCE shall remain connected to the network and issue an <EM><eoth> indication.

8.8.5.3 Primary channel retrain

If the DTE issues an <EM><rtnh> command to the DCE, the DCE shall execute the primary channel retrain procedures defined in 12.7/V.34. If the DCE receives a primary channel retrain request from the remote DCE, the DCE shall indicate this to the DTE with the <EM><rtnh> indication.

At the conclusion of the retrain when control channel operation is entered, the DCE shall indicate this to the DTE with the <EM><ctl><prate><crate> indication, where <prate> indicates the bit rate to be used for subsequent primary channel operation, and <crate> indicates the transmit and receive control channel bit rate. The values defined for <crate> are specified in 8.8.5.2.

If the resynchronization attempt results in carrier disconnection, the DCE shall remain connected to the network and issue an <EM><eoth> indication.

8.8.5.4 Control channel retrain

If the DTE issues an <EM><rtnc> command to the DCE while in control channel operation, the DCE shall execute the control channel retrain procedures defined in 12.8/V.34. If the DCE receives a control channel retrain request from the remote DCE, the DCE shall indicate this to the DTE with the <EM><rtnc> indication.

At the conclusion of the retrain, the DCE shall indicate this to the DTE with the <EM><ctl><prate><crate> indication, where <prate> indicates the bit rate to be used for subsequent primary channel operation, and <crate> indicates the transmit and receive control channel bit rate. The values defined for <crate> are specified in 8.8.5.2.

If the resynchronization attempt results in carrier disconnection, the DCE shall remain connected to the network and issue an <EM><eoth> indication.

8.8.5.5 Carrier termination

If the DTE sends an <EM><eoth> command to a source DCE or to a recipient DCE during control channel operation, the DCE shall follow the relevant primary channel or control channel turn-off procedures as specified in 12.5.3.1/V.34 or 12.6.3/V.34, but shall not execute the subsequent start-up procedures for the alternate mode of operation. The DCE shall also remain connected to the network. When the modem carrier is disconnected, the DCE shall issue a confirming <EM><eoth> indication to the DTE.

If the <hd_auto> subparameter of the +ESA parameter is set to one, upon receipt of the <EM><eoth> command during control channel operation, the DCE shall transmit 40 ones on the control channel, and continue transmitting ones until loss of control channel carrier from the remote transmitter is detected, before proceeding with the turn-off procedures defined in 12.6.3/V.34.

If remote transmitter carrier is lost, the DCE shall issue an <EM><eoth> indication. Also, for <hd_auto>=1, if a source DCE receives 40 consecutive ones during control channel operation, the DCE shall terminate its carrier and issue an <EM><eoth> indication.

8.9 Examples

8.9.1 Detection phase

While the V.42 detection phase may be implemented in the DTE with the DCE operating in a synchronous (Recommendation V.14) mode, it is often too difficult in such cases to transmit the required number of stop bits (between 8 and 16) for the ODP and ADP sequences, and, if desired, to verify that the specified number of stop bits for such sequences have been received. Thus, it may be advantageous to implement Detection Phase with the DCE in Synchronous Access Mode instead. The following table shows an example of this for the Originating DCE:

Circuit 103	Circuit 104	Notes
AT+ES=6 D<number>↲	…..↲ CONNECT↲ <EM><under><FF> <FF><FF><FF><FF> ... <FF>...	Dial remote terminal, complete modulation handshake. Connection starts in transparent sub-mode, TX underrun, receiving constant marks
[<11><FF><17><F9><7F>] repeated		Send ODP (other octet patterns will also generate a valid ODP)
	<FF><8A><FE><1B> <FA><7F><45><FF> <FF><86><FE><FF> <5F><DI><BF><A1> <FF><FF>…	ADP signifying V.42 (“EC”) detected. Note there are a multitude of other octet patterns that represent a valid ADP
<EM><flag>		Transition to Framed sub-Mode

Appendix I

Configuring the DTE-DCE Interface in Synchronous Access Mode for Multimedia Applications

The transmission of digitally encoded real-time multimedia data, such as voice, imposes additional and conflicting performance requirements on the operation of the DTE while using Synchronous Access Mode in the DCE. On the one hand, transmit underrun must be avoided in order to prevent gaps and breakups in the media stream at the remote terminal. On the other hand, it is desirable to keep the amount of data stored at any given time in the DCE's transmit data buffer small, in order to minimize the latency introduced by such buffering.

I.1 Minimum DTE-DCE data signalling rate

To avoid transmit underrun, the rate at which octets arrive from the DTE, after <EM>'s and command codes are removed, must be greater than one-eighth the DCE transmitter's data signalling bit rate. As it is desirable to keep the number of octets in the DCE's transmit buffer small, this must be true for the instantaneous octet rate from the DTE as well as the average rate, as the buffer contents may not be sufficient to prevent underrun for those instances in the data stream that contain large numbers of <EM> shielded octets.

As a worst case, the transmit data stream will contain octets that require <EM> shielding alternating with those that do not, e.g. <EM>,a,<EM>,b,<EM>,z,... For this octet stream, the number of octets transmitted across the DTE-DCE interface will be 50% greater than the number of octets actually transmitted by the DCE to the remote terminal.

Thus, for a DCE transmitter signalling bit rate R, the DTE's octet transmit rate $R_{OCT\text{-}DTE}$ must satisfy:

$$R_{OCT\text{-}DTE} > 1.5 \times R8h = 0.1875R$$

As an example, for a DCE transmitter rate of 28 800 bit/s, the DTE transmitter must be capable of transmitting at least 5400 octets per second Since ten bit times are required to transmit a start-stop framed octet, in this example, the DTE-DCE interface bit rate would need to be greater than 54 000 bit/s. In order to allow for occasional <EM> shielded commands and indications that are not part of the transmit data, and for possible clock drift between the DTE and DCE, the DTE-DCE interface bit rate should be greater than this figure.

In practice, it is desirable to set the DTE-DCE interface bit rate as high as possible. This allows the DTE to get receive data from the DCE as quickly as possible to minimize latency in that direction. In the transmit direction, this also allows the DTE to replenish the DCE's transmit buffer as quickly as desired, when the DCE indicates that the buffer contents are low and underrun is imminent.

I.2 Flow control thresholds and buffer contents reporting

In Synchronous Access Mode, the DTE-DCE interface operates with start-stop framing. V.24 circuit 114 is not available or not active, and thus the DTE gets no transmitter timing information from the DCE. Thus, even if the DTE could precisely account for the effects of <EM> codes, zero insertion, etc., the octet rate from the DTE would still eventually overrun or underrun the DCE input buffer due to oscillator drift between the two devices. Thus, some sort of flow control feedback from the DCE to the DTE is necessary.

The +ITF parameter allows the DTE to configure flow control operation. The DTE can set the <on> and <off> subparameters to keep the amount of data in the transmit buffer small.

When setting the <on> subparameter,the DTE must take into account its maximum expected response time to a flow on signal from the DCE. The contents of the transmit buffer when this signal is generated must be sufficient so that the transmit buffer does not empty during the maximum response period, which would cause a transmit underrun.

The <off> subparameter setting determines the maximum latency introduced by the transmit data buffer. For a constant DTE octet transmit rate, setting the value of <off closer to that of <on> will tend to increase the frequency at which flow on and flow off signals are generated by the DCE. For fixed <off> and<on> values, maintaining the DTE octet transmit rate close to the octet rate of the DCE (after accounting for <EM> codes), will tend to decrease the frequency at which flow on and flow off signals are generated by the DCE.

In addition, using the +ITF parameter, the DTE can instruct the DCE to periodically report to the DTE the number of octets in the transmit data input buffer. The DTE may use this facility to implement a finer-grained adjustment of the rate at which it transmits octets to the DCE, with a corresponding decrease in the variation in the number of octets in the buffer.

The variation in the amount of data in the DCE's transmit buffer may contribute to the jitter in the logical channels seen by the remote terminal. The minimum potential buffer level will be the <on> level, minus the number of octets transmitted by the DCE during the DTE's maximum response time to a flow on signal. The maximum potential buffer level will be the <off> level, plus the number of octets transmitted by the DTE during the DTE's maximum response time to a flow off signal. The actual jitter may be less than this if the <report_period> subparameter is used. Jitter of this type is typically indicated to the remote terminal during protocol establishment, and if applicable, the DTE should account for the additional jitter contribution induced by the DCE transmit buffer when communicating the maximum expected jitter to the remote end.

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