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SERIES V: DATA COMMUNICATION OVER THE TELEPHONE NETWORK

Control procedures

Control of voice-related functions in a DCE by an asynchronous DTE

ITU-T Recommendation V.253

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION V.253

CONTROL OF VOICE-RELATED FUNCTIONS IN A DCE BY AN ASYNCHRONOUS DTE

Summary

This Recommendation builds upon and extends the Asynchronous DCE "AT" command set defined in Recommendation V.250. It describes a DCE command and response syntax for voice playback and record, for generation and detection of DTMF and other tones, as well as a syntax for switching between data mode, facsimile mode, and other future modes of operation. The additional mechanisms defined in this Recommendation allow a DTE in combination with a V.253-equipped DCE to implement Telephone Answering Device functions, optional speakerphone functions, and to switch to appropriate data, facsimile, or other modes of operation depending on the type of the incoming call.

Source

ITU-T Recommendation V.253 was prepared by ITU-T Study Group 16 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 6th of February 1998.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the 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.

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

NOTE

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

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation V.253

CONTROL OF VOICE-RELATED FUNCTIONS IN A DCE BY AN ASYNCHRONOUS DTE

(Geneva, 1998)

1 Scope

This Recommendation builds upon and extends the current Asynchronous DCE control Recommendation V.250 (ex-V.25 *ter*), to include a voice control and response interface definition, a collection of basic primitive functions that allows the DTE to implement a call discrimination algorithm, and a simplified general control structure, which would include data, facsimile, voice, and other future modes as personalities.

In particular, this Recommendation:

- describes a DCE command and response syntax for voice playback and record, generation and detection of DTMF and other tones, and a syntax to switch to facsimile, data modes, and other future modes. Optional Speakerphone operations are also included;
- addresses the playing and recording of voice data;
- describes compression method identifications;
- does not describe the call discrimination algorithm;
- mandates that at least one of the voice compression algorithms listed in Table 17 be supported.

NOTE – The transmission of duplex voice on the DTE interface is for further study.

At the time of the adoption of this Recommendation, no agreement exists regarding the optimal call discrimination algorithm, or even whether a single algorithm is possible. In particular, there is question of the proper processing load distribution of the call discrimination operation – whether the DCE should contain the entire algorithm, or whether the DTE and DCE must share the effort. This Recommendation requires the DTE and DCE to share the call discrimination effort, since the actual algorithm is unknown and a DCE only solution may entail unacceptable DCE storage requirements.

This Recommendation assumes that the DTE and DCE are connected via a serial asynchronous connection using V.24 circuits, and facilitates the use of serial ports by including and extending the T.32 Packet Protocol as an optional enhancement. The actual DTE/DCE command and data interchange may be implemented in any environment that provides a octet serial bi-directional data stream, including, but not limited to – processor bus attached "Fax Boards", local area networks, etc. The adaptation of the DTE/DCE command and data interchange contained in this Recommendation to these alternative communication schemes is beyond the scope of this Recommendation.

2 References

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

– CCITT Recommendation G.711 (1988), *Pulse Code Modulation (PCM) of voice frequencies*.

– ITU-T Recommendation G.723.1 (1996), *Speech coders: Dual rate speech coder for multimedia communications transmitting at 5.3 and 6.3 kbit/s*.

– CCITT Recommendation G.726 (1990), *40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM).*

– CCITT Recommendation G.728 (1992), *Coding of speech at 16 kbit/s using low-delay code excited linear prediction.*

– ITU-T Recommendation G.729 Annex A (1996), *Reduced complexity 8 kbit/s CS-ACELP speech codec.*

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

– 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.8 *bis* (1996), *Procedures for identification and selection of common modes of operation between Data Circuit-terminating Equipments (DCEs) and between Data Terminal Equipments (DTEs) over the general switched telephone network and on leased point-to-point telephone-type circuits.*

– ITU-T Recommendation V.18 (1996), *Operational and interworking requirements for DCEs operating in the text telephone mode.*

– ITU-T Recommendation V.24 (1996), *List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE).*

– ITU-T Recommendation V.25 *bis* (1996), *Synchronous and asynchronous automatic dialling procedures on switched networks.*

– ITU-T Recommendation V.250 (ex-V.25 *ter*) (1997), *Serial asynchronous automatic dialling and control*.

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

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

3 Definitions

This Recommendation defines the following terms.

3.1 Data Terminal Equipment (DTE): A DTE is any terminal or computer capable of providing commands and data to operate a DCE, facsimile DCE, or a voice DCE. In practice, a DTE is a computer of any size.

3.2 Data Circuit-terminating Equipment (DCE): A DCE is any device that connects a DTE to a communications network. This Recommendation focuses on DCEs that connect to the General Switched Telephone Network (GSTN). This class of DCEs includes DCEs compatible with V-Series modem Recommendations, facsimile DCEs, and voice DCEs.

3.3 facsimile DCE: A facsimile DCE is a device that provides facsimile communication facilities between a DTE and a remote Group 3 facsimile station across the GSTN, using the procedures specified in Recommendation T.31 or T.32.

3.4 voice DCE: A voice DCE is a device that provides voice communication facilities between a DTE and a remote station (source or destination of analog signals) across the GSTN. The DCE may provide services for selecting one or more local devices (to the DCE), in conjunction or in isolation from the GSTN, as the analog signal source/destination.

3.5 voice mode (data and facsimile): The overall DCE mode of operation that performs voice functions by accepting **+V** prefixed commands (voice commands), and providing voice and call discrimination event reports to the DTE. See 6.4.1.1 for details about the scope and rules of use for the **+V** prefixed commands.

3.6 command state: The DCE is not operating in the Voice Mode, and is not communicating with a remote station making the DCE ready to accept commands. The DCE considers data transfers from the DTE as command lines, processes these lines, and returns responses back to the DTE after completing the processing of the command lines. See 4.1.1.1 for the definition of the Voice Command State.

3.7 data state: The DCE is not operating in the Voice Mode, and is communicating with a remote station. The DTE transfers data to the DCE for transmission to the remote station, and the DCE transfers data to the DTE after reception from the remote station. The DCE monitors data and the control signals to detect events, which the DCE later reports to the DTE, pertaining to the line connecting the DCE and the remote station, and pertaining to requests from the DTE. See subclause 4.1.1.2 for the definition of Voice Transmit State, subclause 4.1.1.3 for the definition of Voice Receive State, subclause 4.1.1.4 for the definition of the Voice Duplex State, and subclause 4.2.1.2 for the definition of the Voice Speakerphone State.

3.8 distinctive ringing: A service in which the central office or PBX equipment generates different ring patterns to permit the called user or equipment to deduce information about an incoming call before the call is answered. For example, a PBX may generate different ring patterns based on whether the call is from an inside extension or an outside trunk; a central office may generate different patterns to indicate which directory number was dialled, when multiple numbers are assigned to a single line.

3.9 ringing tone: The audible signal generated by the remote central telephone office to indicate that it is generating rings on the called subscriber line.

3.10 voice-aware software: DTE program that is capable of utilizing and being compatible with the Voice Mode; otherwise the program is Voice-unaware Software.

3.11 automatic rate detection: The term automatic rate detection, sometimes referred to as "autobauding", refers to the action of the DCE, while in Command State, of automatically detecting the data rate and parity of the DTE is using for each issued command line. As an example of a possible DCE automatic rate detection algorithm, the DCE measures the duration of the start bit of the "A" or "a" of the AT command line prefix. Once the DCE establishes the data rate and parity, the DCE will use this rate for all subsequent DCE-to-DTE data transmissions, including unsolicited result codes such as RING, until the DTE changes the rate or parity again.

3.12 silence compression: Silence compression is the DCE replacement of a period of sustained inactivity, determination of which is unspecified, by placing a manufacturer specific code word(s) in the place where the DCE removed the silence. Silence compression code words are part of the compression method, and are not separately defined in this Recommendation.

4 Voice states and operation of a voice-capable DCE

A DCE is put into the Voice Mode by the command **+FCLASS=8.0**. While in the Voice Mode, a DCE is responsive to voice record, playback, and duplex commands, which begin with the prefix **+V**. Some **+V** commands may also be valid in other DCE modes, such as data mode **(+FCLASS=0)**.

At the top level (and for the purposes of this Recommendation), a DCE may comprise a non-speakerphone section and a speakerphone section. Figure 1 – Relationship between Sections and Voice States illustrates the relationship between the sections and the individual Voice States. The definition of Voice States follows in 4.1.1. Note that the Voice Command State is common.

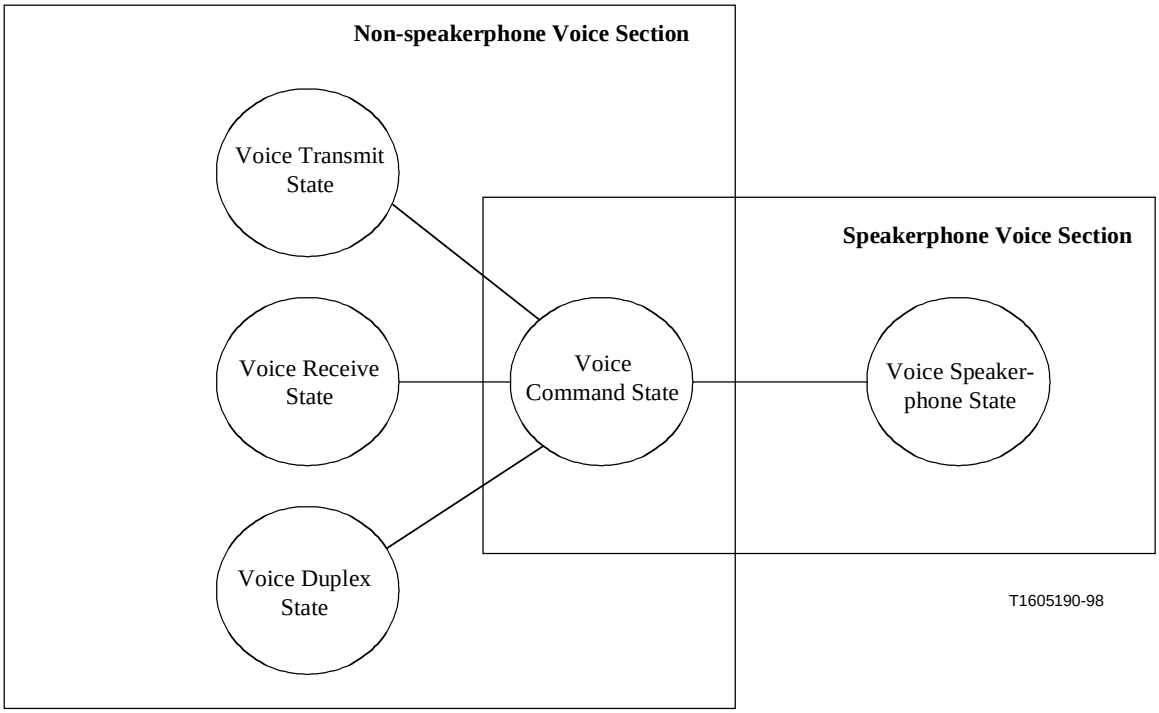


Figure 1/V.253 – Relationship between sections and voice states

4.1 Non-speakerphone section of a voice DCE

The DCE has four states – the Voice Command State (no data transfers other than event reports), the Voice Transmit State (digitized voice data transfer from the DTE to the DCE), the Voice Receive State (digitized voice data transfer from the DCE to the DTE), and the Voice Duplex State (digitized voice data transfer to and from the DTE and DCE). Note that the Voice Transmit State and the Voice Receive State are half-duplex (digitized voice data transfer from the DCE-to-DTE or from the DTE to the DCE as separate functions).

The DCE may issue event detection reports at any time, regardless of the DCE state. These reports may describe tone and cadence, such as calling tone detection, that may be a result of external switching functions or PSTN line activities (Ring), or may be a combination (Caller ID). This Recommendation does not require the DCE to monitor all of the listed events all of the time.

This Recommendation makes several assumptions, listed below, about the voice data stream.

1) The DTE is not required to interpret the incoming voice data stream, other than for <DLE> shielded codes.

2) As a result of assumption 1, the DTE cannot examine the contents of the data stream to do energy measurements, and other estimations of voice content.

3) The DCE supports one PSTN line for voice mode.

4.1.1 Voice states

4.1.1.1 voice command state: The DCE is in the Voice Command State when the DCE is operating in the Voice Mode, and is not communicating with a remote station nor with any local devices, which are capable of translating analog signals to voice (e.g. speaker) or translating voice to analog signals (e.g. microphone), making the DCE ready to accept commands. The DCE considers data transfers from the DTE as command lines, processes these lines, and returns responses back to the DTE after completing the processing of the command lines. When not processing commands, the DCE monitors the line, which connects the DCE to the remote station or to the local device, to detect events, which the DCE later reports to the DTE, pertaining to signals carried over the line such as tones, and pertaining to GSTN generated control and notification signals such as ringing.

The Voice Command State permits the DTE several options, such as waiting for an unspecified time after playing a welcome message, or switching to other modes as part of a DTE call discrimination algorithm.

The DCE will issue the OK result code when the DCE is in the Voice Command State and connects to one or more active analog source(s)/destination(s). Activating the microphone or going off-hook on a Telco connection are examples of activating an analog source and a source/destination, respectively.

4.1.1.2 voice transmit state: The DCE enters the Voice Transmit State upon executing the +**VTX** command. In this state, the DCE receives the digitized data from the DTE, converts the binary data into an analog signal, and transmits the analog signal to the remote station or to one or more other local device destinations such as a speaker. While transmitting the data:

1) the DCE monitors the line, which connects the DCE to the remote station or to one or more local devices, to detect events, which the DCE reports to the DTE. These events pertain to signals carried over the line such as tones, and to GSTN generated control and notification signals such as ringing; and

2) the DCE does not expect to receive, digitize, or process any incoming analog signals for transfer to the DTE.

This Recommendation provides for two ways to leave the Voice Transmit State:

1) a <DLE><ETX> shielded code; and

2) a DTE/DCE Inactivity Timer time-out.

Item 1) is the DTE initiated means of terminating the Voice Transmit State, and item 2) is a DCE-initiated means of terminating the Voice Transmit State. After termination of the Voice Transmit State, the DCE shall enter the Voice Command State.

4.1.1.3 voice receive state: The DCE enters the Voice Receive State upon executing the +**VRX** command. In this state, the DCE digitizes the analog signal from the remote station or from some other local device source such as a microphone, converts the analog signal into binary data, compresses or otherwise processes the data, and transfers the resulting data to the DTE. While receiving the data:

1) the DCE monitors the line, which connects the DCE to the remote station or to one or more local devices, to detect events, which the DCE reports to the DTE. These events pertain to signals carried over the line such as tones, and to GSTN generated control and notification signals such as ringing; and

2) the DCE does not expect to receive digitized data from the DTE, perform conversion, and transmit the analog signal to the remote station or to one or more local devices.

This Recommendation provides for two ways to leave the Voice Receive State:

1) a <DLE><!>; and

2) a DTE/DCE Inactivity Timer time-out.

The DCE shall inform the DTE, via <DLE> codes, about pertinent events during the voice receive, such as "Presumed End of Message" (QUIET) and "Presumed Hangup" (SILENCE) detected, BUSY detected, and DIALTONE detected, so that, at the discretion of the DTE, the DTE may terminate the Voice Receive State.

4.1.1.4 voice duplex state: The DCE enters the Voice Duplex State upon executing the **+VTR** command. This command is a direct combination of the Voice Transmit State (**+VTX** command) and the Voice Receive State (**+VRX** command) with the following exception:

The DCE shall not leave the Voice Duplex State upon receiving a <DLE><ETX> command or a <DLE><!> command, and shall ignore these commands. The use of these commands to transition to half-duplex states is for further study. The DCE shall leave the Voice Duplex State upon receiving the <DLE><^> command.

Note that this mode does not require the DCE to provide any Acoustic Echo Cancellation (AEC) nor any Line Echo Cancellation (LEC).

4.2 Speakerphone section of a voice DCE: The DCE has two states – the Voice Command State (no data transfers other than event reports), and the Voice Speakerphone State (digitized voice data transfer between the DTE and DCE).

The DCE may issue event detection reports in the Voice Command State as described above (see 4.1).

The DCE may issue event reports in the Voice Speakerphone mode only if the DCE provides that capability and the DTE enables the DCE to proceed with event reporting in the Voice Speakerphone State (**+VEM** command, see 10.5.7).

4.2.1 Voice states

4.2.1.1 Voice Command State

The Voice Command State is the same for the Speakerphone section and the Non-speakerphone section (see 4.1.1.1).

4.2.1.2 Voice Speakerphone State

Depending on the **+VSP** command (see 10.5.1) setting, the DCE may transfer analogue or digitized data (as appropriate):

- between the DCE microphone/speaker and the PSTN line;

- between the PSTN line and the DTE;
- between the microphone/speaker and the DTE.

If the DTE and DCE exchange digitized voice data, the Voice Speakerphone Mode follows the Voice Duplex Mode (see 4.1.1.4) operation description.

If event report are enabled (**+VEM** command, see 10.5.7), the DCE shall perform event reports while in the Voice Speakerphone State (which comprises all non-zero **+VSP** settings).

5 Voice and network signalling support

5.1 Events (reports sent to the DTE)

The Voice Mode may return many new event detection reports other than the familiar RING result code used in data and facsimile modems. While in the Voice Mode, the DCE can detect DTMF, detect tone and cadence events associated with call progress activities, evaluate voice quality, and monitor Telco related activities. The DCE shall report the event to the DTE at the time of detection.

Table 1 lists the events without any regard as to whether the DCE reporting of the event is optional or mandatory, and without assigning a DCE reporting mechanism. See 7.4 for information on minimum reporting requirements, and optional and mandatory DCE event reporting.

The first column of Table 1 lists the event number assignment for each event. The event number also serves another purpose; each number is a bit position in a bit field. Event number 0 is the most significant bit of the left most hex number in a hex representation (this Recommendation defines a total of eight hex digits). The final bit in the bit field occupies the least significant bit position of the right-most hex number. The bit representations of the event numbers are used in the +**VLS=** command.

The third column of Table 1 lists whether a single character is enough to report the event, or if the DCE must supply a more complicated report. The description Simple indicates a single character response (<DLE> shielded), Message indicates a full text message (<DLE><X> packet), and Pattern indicates a repeating Message.

See Table 10 for a list of the event code assignments (method of reporting).

Table 1/V.253 – Events detectable in the voice mode

Event number	Event description	Event reporting
0	Caller Id Report	Message
1	DID Report	Message
2	Distinctive Ringing	Pattern
3	RING	Simple
4	DTMF Received	Simple
5	Receive Buffer Overrun	Simple
6	Facsimile Calling (e.g. 1100 Hz)	Simple
7	Data Calling (e.g. 1300 Hz)	Simple
8	Local Phone On/Off-hook	Simple
9	Presumed Hangup (SILENCE) Time-out	Simple

Table 1/V.253 – Events detectable in the voice mode *(concluded)*

Event number	Event description	Event reporting
10	Presumed End of Message (QUIET) Time-out	Simple
11	SIT Signal	Simple, Message
12	Bong Tone	Simple
13	Loop Current Interruption	Simple
14	Loop Current Polarity Reversal	Simple
15	Call Waiting Beep/Interrupt	Simple
16	Distinctive Call Waiting	Pattern
17	5-bit (Baudot) TDD (Annex A/V.18) modulation detected	Simple
18	Ringing Tone	Simple
19	BUSY	Simple
20	DIALTONE	Simple
21	Reorder/Fast Busy	Simple
22	V.21 Channel 2 7E flags	Simple
23	Transmit Buffer Underrun	Simple
24	Extension Phone On/Off-hook	Simple
25	Facsimile or Data Answer (e.g. 2100 Hz)	Simple
26	Data Answer (e.g. 2225 Hz)	Simple
27	Voice Detect	Simple
28	Call Waiting plus Caller Id. (CIDCW)	Message
29	Stuttered Dialtone	Simple (Note)
30	Invalid Voice Data Format	Simple
31	Lost Data Detected Event	Simple
32	Facsimile Answer	Simple
33	CAS tone detection	Simple
34	EDT TDD (Annex C/V.18) modulation detected	Simple
35-63	Reserved for future standardization	Reserved
Above 63	Manufacturer specific	Manufacturer defined
NOTE – The use of complex event reporting for Stuttered Dialtone is for further study.		

5.2 Actions (commands sent to the DCE)

Table 2 summarizes the actions possible in Voice Transmit State or Voice Receive State. This table also includes additional entries for AT-style commands because these commands relate to the simple action commands. This table also lists whether the DTE selects the action by an AT-style command, or by a <DLE> shielded command during voice transmission.

The first column of Table 2 lists the action number assignment for each event. These numbers are used for reference only. Note that the DCE must support action numbers 0 and 1 if the DCE supports adjustable setting in the **+VGT** command. Note that the DCE must support action numbers 3 and 4 if

the DCE supports adjustable setting in the **+VGR** command. Note that action numbers 8 through 13 are mandatory.

The third column of Table 2 lists whether a single character is enough to invoke the action, or if the DTE must supply a more complicated command. The description Simple indicates a single character command (<DLE> shielded), and Command indicates that the DTE issues the command as an AT-style command.

See Table 12 for a list of the event code assignments (commands).

Table 2/V.253 – Simple actions in the voice mode

Action number	Action	Command accepted
0	Volume increase (Voice Transmit and Voice Duplex States); Gain increase (Voice Speakerphone State).	Simple
1	Volume decrease (Voice Transmit and Voice Duplex States); Gain decrease (Voice Speakerphone State).	Simple
2	Set Volume (Voice Transmit and Voice Duplex States); Set Gain (Voice Speakerphone State).	Command
3	Gain increase (Voice Receive, Voice Duplex, and Voice Speakerphone States).	Simple
4	Gain decrease (Voice Receive, Voice Duplex, and Voice Speakerphone States).	Simple
5	Set gain (Voice Receive, Voice Duplex, and Voice Speakerphone States).	Command
6	Start Voice Receive State	Command
7	End Voice Receive State	Simple
8	Start Voice Transmit State	Command
9	Pause Voice Transmit State	Simple
10	Resume Voice Transmit State	Simple
11	End Voice Transmit State	Simple
12	Clear transmit buffer of voice data	Simple
13	Concatenate transmit data streams	Simple
14	Buffer Size Inquiry	Simple
15	Receive abort	Simple
16	Transmit CAS tone	Simple
17	Manufacturer specific	
18	Manufacturer specific	
19	Manufacturer specific	
20	Manufacturer specific	
21	Manufacturer specific	

Table 2/V.253 – Simple actions in the voice mode *(concluded)*

Action number	Action	Command accepted
22	Start Voice Duplex State	Command
23	End Voice Duplex State	Simple
24	Start Voice Speakerphone State	Command
25	End Voice Speakerphone State	Simple
26	Enable Event Reports in the Voice Speakerphone State	Command

5.3 Call discrimination

5.3.1 Description and definitions

This Recommendation provides the means for the DCE to supply all of the necessary information and DCE control for the DTE to implement a Voice/Fax/Data call discrimination algorithm. A general description of the necessary DCE requirements to perform call discrimination, as provided for in this Recommendation, is given below.

1) The DCE provides a method for switching modes, that does not change the parameters of the mode being left.
2) The DCE provides the means for the smooth transition between data, facsimile, and voice during the same call.
3) The DCE provides the means to disable or enable the automatic hangup as the normal default behaviour when switching to a Data or Facsimile Mode from the Voice Mode. This allows for DTE directed call discrimination and the transfer to Voice-unaware software.
4) The DCE provides a method, for automatic fallback to Class 0 operation, from Voice Command State at the expiration of a DTE/DCE Inactivity Timer.
5) The DCE provides a method to start a particular protocol (or handshake), once the DCE enters a data or facsimile mode.

5.3.2 Hook control under voice

As part of the call discrimination algorithm, the DCE may be switched to other Modes, such as facsimile or data, in order to try handshakes in those Modes. The DTE performs the Mode switching through a combination of the **+FCLASS** and **+VNH** commands. The DTE may issue these commands anytime the DCE is in command mode, even while off-hook. While the **+FCLASS** command does the Mode switching, the **+VNH** controls whether the DCE remembers that it answered the phone while in the Voice Mode and that the DCE shall not hang up the Telco line if the handshake fails or if the DCE performs some other operation that would have normally resulted in a hangup of the phone line.

The purpose of leaving **+VNH=0** after the **+FCLASS** switch is to allow the DTE, running Voice-aware software and determining that the remote station is not voice, to switch to software that has no knowledge of any voice determination efforts, and that is only aware of facsimile or data operations. This switching-in operation implies that the newly switched-in software will not go back to the Voice-aware software, nor switch from the data to facsimile operation (or visa versa) to try another handshake.

The purpose of leaving **+VNH=1** after the **+FCLASS** switch is to allow the DTE, running Voice-aware software and determining that the remote station is not voice, to command the DCE to attempt handshaking in other Modes (different **+FCLASS** settings). In this case, the DTE does not expect to switch to software that has no knowledge of any voice determination efforts, and that is only aware of facsimile or data operations.

The DCE response to reset events, listed below, for **+VNH=0** and **+VNH=1**, are the same; the difference between the commands is that **+VNH=1** inhibits DCE-initiated hangups. For example, a **+VNH=1** command would inhibit the go on-hook behaviour from an EIA-592 compliant DCE while still producing the +FHS:00<CR><LF>OK<CR><LF> response. The DCE responses to events not listed are dependent on the DCE. A Yes in the second column means that the DCE goes on-hook (**+VLS=0**). A Yes in the third column means that the DCE shall enable automatic rate detection and switch to Data Mode (**+FCLASS=0)**.

Reset event	On-hook	Data mode
DTE/DCE Inactivity Timer expires (Voice Mode only)	Yes	Yes
DTR drop when **&D2** is set (all applicable Modes)	Yes	Yes
DCE receives a **ATH** command (all applicable Modes)	Yes	Yes
DCE receives a **ATZ** command (all applicable Modes)	Yes	Yes
DCE power cycle	Yes	Yes

The purpose of leaving **+VNH=2** after the **+FCLASS** switch is to allow the DTE, running Voice-aware software and determining that the remote station is not voice, to switch to software that has no knowledge of any voice determination efforts, and that is only aware of facsimile or data operations. This implies that the Voice-aware software has a high degree of knowledge about the Voice-unaware software now in control, and has knowledge that the Voice-unaware software will eventually return control back to the Voice-aware software. When **+VNH=2**, the DCE shall perform the prescribed actions for the reset events listed below; the DCE responses to events not listed are dependent on the DCE. A Yes in the second column means that the DCE goes on-hook (**+VLS=0**), while a No means that the **+VLS** setting remains as is. A Yes in the third column means that the DCE shall enable automatic rate detection and switch to Data Mode (**+FCLASS=0)**.

Reset event	On-hook	Data mode
DTE/DCE Inactivity Timer expires (Voice Mode only)	Yes	Yes
DTR drop when **&D2** is set (all applicable Modes)	No	Yes
DCE receives a **ATH** command (all applicable Modes)	No	Yes
DCE receives a **ATZ** command (all applicable Modes)	No	Yes
DCE power cycle	Yes	Yes

For example, if the DTE switches the DCE from the **+FCLASS=8** voice mode to the **+FCLASS=0** data mode, the DTE would start the data handshake by issuing an **ATA** command. When **+VNH=0**, the DCE behaves as a Data Mode only DCE; the DCE would return a NO CARRIER result code and hang up the Telco line if the DCE did not detect a carrier. When **+VNH=1**, the DCE does not hang up the phone line when the DCE detects a no carrier condition, allowing the DTE to switch the DCE to another mode; the DCE would go on-hook upon receiving a reset event (i.e. an **ATH** command) listed above.

While this subclause has concentrated on reception, note that the **+FCLASS** command and mode switching operation behave similarly for transmission. For example, the DTE can switch from the **+FCLASS=8** Voice Mode, when the DCE is off-hook, to the **+FCLASS=0** Data Mode; the DTE could then issue an **ATD** command to start a data connection.

5.4 Timing marks in the voice data stream

Timing Marks is a <DLE><T > event code that the DCE periodically embeds in the receive voice data, and that represent a fixed time interval in the voice receive. The purpose of these marks is to allow the DTE to fast forward and reverse through a voice file.

The Timing Mark may be followed in the data stream by information specific to the DCE manufacturer that allows the DCE to be able to initialize transmission at that point in the data stream (e.g. re-initialize its voice decompressors). If the voice data stream contains Timing Mark code words on the receive, the DTE shall include the code words in the exact place in the data stream where they originally occurred. The DTE shall never add extra Timing Marks. The method the DTE uses to accomplish this is beyond the scope of this Recommendation (as well as file format issues). If Timing Marks are present in the data stream, the data stream shall begin with a Timing Mark.

If the DCE is using Silence Compression (and code words are present in the data stream) and is using Timing Marks for a receive operation, the DCE shall limit the time duration represented by each individual Silence Compression code words to ensure that the Timing Mark code word(s) occur at the time expected, thus maintaining the fixed time period associated with the Timing Mark.

The DTE does not need Timing Marks for fast forward and rewind functions if the compression method contains:

1) no Silence Compression;

2) a fixed compression ratio; and

3) no need for DCE re-initialization of the data decompressors.

The DTE can easily compute the new position in the data stream with the knowledge of the sample rate and bits per sample. The DTE can query if the selected compression method uses Timing Marks by using the **+VSM=?** command.

Timing marks are optional.

5.5 Compression method and availability of event detection

The DTMF/Tone detection capabilities, Silence Compression, and available sampling rates are dependent on the compression method selection. This allows for the DCE to allocate resources for producing or accepting very compressed data streams with the expected degradation in the number of reportable event detections. Since the DTMF/Tone detection capability of the DCE is dependent on the compression method selection, it is recommended that the DTE examine the event detection capabilities after every change of the compression method.

6 Operation

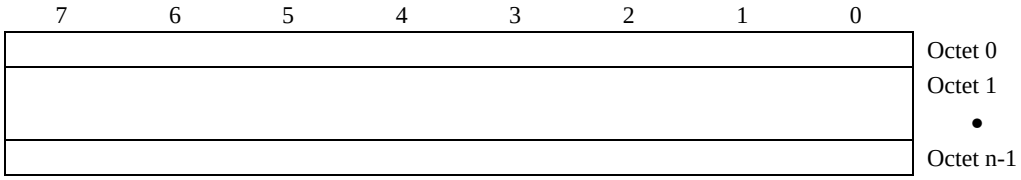
6.1 Numeric radix

This Recommendation uses decimal for all commands and result codes requiring numerical representations, unless otherwise noted.

6.2 Format conventions

6.2.1 Numbering conventions

The basic convention used in this Recommendation is illustrated below. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 0 to 7. Multiple octets are shown vertically and are numbered from 0 to n-1.



6.2.2 Order of bit transmission

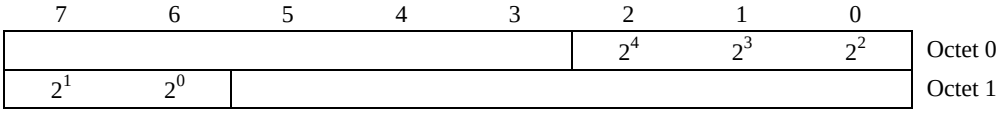
The octets are transmitted in ascending numerical order; inside an octet, bit 0 is the first bit to be transmitted.

6.2.3 Code word mapping conventions

When a code word is contained within a single octet, the lowest bit number of the code word represents the lowest-order value.

When a code word spans more than one octet, the order of the bit values within each octet progressively decreases as the octet number increases. The lowest bit number associated with the code word represents the lowest-order value.

For example, a bit number can be defined as a couple (o,b) where o is the octet number and b is the relative bit number within the octet. The figure below illustrates a field that spans from bit (0,2) to bit (1,6). The high-order bit of the field is mapped on bit (0,2) and low-order bit is mapped on bit (1,6).



6.3 Command structure

6.3.1 AT commands

The Voice Mode uses a mixture of AT-style commands for parameter setting and initiating non-simple actions. The Voice Mode uses <DLE> shielded codes (see 6.3.7) for simple actions and for event reporting in the Voice Transmit or Receive States. The operation of the AT-style commands follows the provisions in Recommendation V.250 (ex-V.25 *ter*).

6.3.1.1 Character set and format

The T.50 character set is used for commands and responses. Only the low order 7 bits of each character are used; the high order bit is ignored. Uppercase characters are equivalent to lowercase characters.

For the digitized voice data, the data are binary (not T.50 characters), transferred using 8 data bits without parity. It is therefore preferable to use character formatting with 8 data bits and no parity bit for all interactions to avoid the need to change formats when moving between the Voice Command State and the Data State.

6.3.1.2 DTE command lines

A command line is a string of characters sent from a DTE to the DCE, while the DCE is in the Voice Command State. Command lines have a prefix, a body, and a terminator. The prefix consists of the T.50 characters "AT" (4/1, 5/4) or "at" (6/1, 7/4). The body is a string of commands and associated values, restricted to printable T.50 characters (2/0-7/14). Space character (T.50 2/0) and control characters other than <CR> (T.50 0/13) and <BS> (T.50 0/8) in the command string are ignored, except for space characters embedded within <string constant>s. The terminator is the <CR> character. Characters that precede the AT prefix are ignored. The DCE shall support a command line of at least 40 characters, including embedded space characters.

See also 5.2.1/V.250 (ex-V.25 *ter*).

6.3.2 Basic command syntax

Characters within the command line are parsed as commands with associated parameter values. The basic commands consist of single characters, or single characters preceded by a prefix character (e.g. "&"), followed by a decimal parameter. Missing numeric parameters are evaluated as 0.

See also 5.3.1/V.250 (ex-V.25 *ter*).

6.3.3 Extended command syntax

The voice commands, which are preceded by the +**V** characters, described in this Recommendation uses the extended syntax described in 5.5/V.250 (ex-V.25 *ter*). These commands are terminated by the semicolon ";" character (T.50 3/11) or by the <CR> that terminated the command line. The general formats of extended commands follow.

Each Extended Command, either a Configuration or an Action command, may use a compound parameter, which refers to the additional information needed by the command to execute to completion. A complete compound parameter string consists of one or more subparameters separated by comma characters (T.50 2/12). Incomplete compound parameter strings are not allowed.

The DTE must supply the correct number and type (string or numeric) of subparameters required by the command (Action commands may take a parameter). An error occurs when:

1) attempting to use a string value where a numeric subparameter is required;
2) using a numeric value where a string subparameter is required;
3) using a parameter consisting of numeric and string values where a single value is required; or
4) using a single numeric or a single string parameter where a multiple subparameters are required.

For any of these error conditions, the DCE shall return an ERROR final result code.

The following table summarizes the parameters associated with the Action Command Syntax.

Syntax	Associated parameter values
Execute Action Command Syntax	<value> and <compound value>
Test Action Command Syntax	<value> and <compound value>

The following table summarizes the parameters associated with the Configuration Command Syntax.

Syntax	Associated parameter values
Set Configuration Command Syntax	<value> and <compound value>
Read Configuration Command Syntax	<value> and <compound value>
Test Configuration Command Syntax	<range of value> and <compound range>

6.3.3.1 Action command syntax

6.3.3.1.1 Execute action command syntax

+V<action_name>[=<value>]; or

+V<action_name>[=<compound value>]

If +V<action_name> is supported, the DCE shall execute the command as described in the command reference. Otherwise, it shall report an ERROR result code. Some action commands support use of a <value>, as an action parameter. For some of these action commands, the <value> may be omitted.

See also 5.4.3.1/V.250 (ex-V.25 *ter*).

6.3.3.1.2 Test action command syntax

+V<action_name>=?

This syntax is used by the DTE to test if an action command is implemented by the DCE, and if so to determine the range of <value>s supported for that command, if any. If +V<action_name> is supported, the DCE shall report an OK result code; otherwise, it shall report an ERROR result code. If <action_name> supports <value>s, the DCE shall report the <range of values> (see 6.3.3.4.2) or <compound range of values> (see 6.3.3.4.3) to the DTE, followed by a final result code (see 6.3.6).

See also 5.4.3.2/V.250 (ex-V.25 *ter*).

6.3.3.2 Configuration command syntax

6.3.3.2.1 Set configuration command syntax

+V<configuration_name>=<value>; or

+V<configuration_name>=<compound value>

If +V<configuration_name> is supported, and if the <value> or <compound value> is supported, the DCE shall set the parameter to the specified value. Otherwise, it shall report an ERROR result code, and the previous value or values shall be unaffected.

See also 5.4.4.2/V.250 (ex-V.25 *ter*).

6.3.3.2.2 Read configuration command syntax

+V<configuration_name>?

If +V<configuration_name> is supported, the DCE shall report the current <value>, <compound value>, or a list of <compound value> separated by <CR><LF> to the DTE. Otherwise, it shall report an ERROR result code.

See also 5.4.4.3/V.250 (ex-V.25 *ter*).

6.3.3.2.3 Test configuration command syntax

+V<configuration_name>=?

This syntax is used by the DTE to test if a parameter is implemented, and if so list all valid values for the parameter, in a format specific to the individual parameter. If +V<configuration_name> is supported, the DCE shall report the <range of values> (see 6.3.3.4.2) or <compound range of values> (see 6.3.3.4.3) to the DTE. Otherwise, it shall report an ERROR result code.

See also 5.4.4.4/V.250 (ex-V.25 *ter*).

6.3.3.3 Single value parameter strings

6.3.3.3.1 Numeric constants

Decimal <numeric constant>s shall be made up of the T.50 characters "0" through "9" (3/0-3/9). Leading "0" characters shall be ignored by the DCE.

Hexadecimal <numeric constant>s shall be made up of the T.50 characters "0" through "9" (3/0-3/9) and "A" through "F" (4/1-4/6) inclusive. Leading "0" characters shall be ignored by the DCE, unless acting as a place holder to accurately represent bit positions within a binary number (e.g. a mask where each bit position represents an action that may be enabled or disabled).

See also 5.4.2.1/V.250 (ex-V.25 *ter*).

The **+FCLASS** parameter defines <value> that also includes embedded "." (T.50 2/14) period characters, for delimiting revisions.

6.3.3.3.2 String constants

<string constant>s shall consist of a string of characters bounded at the beginning and end by the double-quote character (T.50 2/2). A null string (a string of zero length) is represented by two adjacent double-quote characters (""). String parameters defined in this Recommendation shall contain neither double-quote characters nor non-displayable characters, so no provisions are made for including them in <string constant>s.

See also 5.4.2.2/V.250 (ex-V.25 *ter*).

6.3.3.3.3 Parameter values

A <value> shall consist of either a <numeric constant> or a <string constant>.

6.3.3.4 Compound parameter strings

6.3.3.4.1 Compound values

A <compound value> shall consist of a series or two or more <value>s separated by commas.

See also 5.4.2.3/V.250 (ex-V.25 *ter*).

6.3.3.4.2 Range of values

In response to command testing, the DCE shall present a <range of values> to the DTE as an ordered list, preceded by a left parenthesis character ["(" T.50 2/8], and followed by a right parenthesis character [")" T.50 2/9]. The ordered list shall consist of a single <value>, a set of <value>s separated by commas (","T.50 2/12) (e.g. "0,2"), or as two <value>s separated by a hyphen ("-" T.50 2/13) (e.g. 0-FF) to represent a continuous range of values.

See also 5.7.3.1/V.250 (ex-V.25 *ter*).

NOTE – The +**FCLASS=?** is an exception. Parentheses and hyphens are not permitted, for compatibility with Recommendations T.31 and T.32.

6.3.3.4.3 Compound range of values

In response to the testing of compound commands, the DCE shall report a <compound range of values>. This string is an ordered list of individual subparameter <range of value>s, separated by commas. Individual subparameter <ranges of value>s are presented as specified in 6.3.3.4.2 above, including parenthesis (T.50 2/8 and 2/9). This format is illustrated below.

(1st range of values), ... (last range of values)

See also 5.7.3.2/V.250 (ex-V.25 *ter*).

6.3.4 Issuing commands

See 5.5/V.250 (ex-V.25 *ter*).

All characters in a command line shall be issued at the same data rate, and with the same number of bits per character.

If the DCE detects a command line which is not properly terminated (see 6.3.1.2), it shall ignore the commands, and generate an ERROR result code. In command mode, the DCE shall ignore any characters received from the DTE that are not part of a properly-formatted command line.

The DCE shall issue no unsolicited result codes to the DTE during reception of a command line (i.e. between receipt of the first character of the prefix and the last character of the command line). See 7.2 regarding event report restrictions.

If the DCE provides a facility for echo of command lines, it is recommended that this facility be disabled by the DTE during Voice Mode operation. If the Packet Protocol (Recommendation T.32) is in use, the DCE shall not echo command lines.

The DTE shall not issue a new command line until the DCE has finished delivering the complete final result code to the previous command line, including any following <CR> and <LF> characters.

6.3.5 Command execution

See 5.6/V.250 (ex-V.25 *ter*).

Upon receipt of the termination character, the DCE shall commence execution of the commands in the command line, if any. The DCE shall execute the commands in the body of the command line left-to-right. Each command is individually executed regardless of what follows on the line. If all commands execute properly, a final result code, for the final command, is issued after execution of the final command. If an invalid command is encountered, or if execution of any command results in an error, execution of the command line is terminated at that point and all subsequent commands on the line are ignored. Commands in the line prior to the error will have already been executed.

6.3.5.1 Command execution time

Configuration commands are assumed to execute instantaneously; these cannot be aborted. Action commands which require time to execute (see 10.1.5) may be aborted while in progress, until the final result code is issued (see 6.3.6).

6.3.5.2 Aborting commands

Commands which may be aborted are explicitly noted in the description of the command. When such an aborting event is recognized by the DCE, it shall terminate the command in progress and return an OK result code to the DCE.

See also 5.6.1/V.250 (ex-V.25 *ter*).

6.3.5.3 Use of the semicolon

The DCE shall permit and parse multiple non-Action commands, separated by semicolons, on a command line. The DCE shall parse the command line left-to-right until the DCE has processed the entire command line, or until the DCE detects an error condition, at which time, the DCE shall terminate processing, and discard the remainder of the unprocessed command line.

6.3.6 DCE responses from AT commands

This Recommendation uses similar final and intermediate result codes as defined in Recommendation V.250 (ex-V.25 *ter*). The Voice Mode form of the V.250 (ex-V.25 *ter*) unsolicited result codes are very different. This Recommendation refers to the following V.250 (ex-V.25 *ter*) defined result codes. See Table 3.

Table 3/V.253 – Voice result codes from V.250 (ex-V.25 *ter*)

Result code	Numeric equivalent	Description of voice mode version
OK	0	The DCE completed the previous command or operation normally, and is now ready for another command.
CONNECT	1	The DCE successfully enters the Data State
RING	2	<DLE><R>
NO CARRIER	3	Disallowed in Voice Mode
ERROR	4	The DCE did not recognize the command, detected a parameter error, or the operation completed abnormally. The DCE is ready for another command.
NO DIALTONE	6	Disallowed in Voice Mode
BUSY	7	<DLE><b>
NO ANSWER	8	The DCE issues this result code when the DCE has continuously detected Ringing Tone for the S7 specified amount of time
CONNECT <Text>	Manufacturer specific	Disallowed in Voice Mode

6.3.7 Data stream transparent commands (<DLE> Shielded)

This Recommendation provides a means to issue commands from the DTE to the DCE (action commands), and reports from the DCE to the DTE (event reports) in the data stream. These commands and reports are denoted in the data stream by the use of the T.50 <DLE> (1/0) character followed by a character that represents the actual command or a report (additional data may occur after the event). The <DLE> character, when found as part of the data stream, is denoted by the <DLE> followed by the character that indicates a single <DLE> in the data stream. These characters are octet-aligned. This method is based on ISO 2111.

NOTE – The characters in <DLE><code character> are defined in Recommendation T.50.

6.3.7.1 DCE-to-DTE streams

The DCE shall apply the following rules:

1) Insert event reports into the data stream using the <DLE><code character> format.

2) Examine processed received data characters and insert a <DLE> character ahead of each <1/0> data character.

3) Examine processed received data characters and if the DCE detects two consecutive <1/0> data characters, the DCE may substitute <DLE><SUB> for the aforementioned data characters.

The DTE monitors the data stream and removes all character pairs beginning with <DLE> (treating the code character after the <DLE> as a message to act upon), and applies the following rules:

1) If the message character is <1/0>, the DTE re-inserts <DLE><1/0> into the data stream.

2) If the message character is <SUB>, the DTE re-inserts <DLE><SUB> into the data stream.

3) If the message character is a special character intended to mark special portions of the data (<T>, </>, and <~>; see Table 10), the DTE re-inserts the <DLE><message character> into the data stream.

Example data stream	DCE Operation	DTE operation
abcde	abc<DLE><code character>def (DCE inserts an event report)	abcdef (DTE removes event report)
abc<1/0>def	abc<DLE><1/0>def (DCE adds <DLE> code)	abc<DLE><1/0>def (DCE stores)
ab<1/0><1/0>def	ab<DLE><SUB>def (DCE replaces with <DLE><SUB>)	ab<DLE><SUB>def (DCE stores)
abcde	abc<DLE>Tdef (DCE inserts special code)	abc<DLE>Tdef (DCE stores)

6.3.7.2 DTE-to-DCE streams

The DTE shall apply the following rule:

– Insert transparent commands into the data stream by using the <DLE><code character> format.

The DCE monitors the data stream and removes all character pairs beginning with <DLE> (treating the code character after the <DLE> as a message to act upon), and applies the following rules:

1) If the message character is <1/0>, the DCE re-inserts <1/0> into the data stream.

2) If the message character is <SUB>, the DCE re-inserts two consecutive <1/0> characters.

3) If the message character is a special character intended to mark special portions of the data (<T>, </>, and <~>; see Table 10), the DCE inserts nothing and takes the appropriate action.

Example data stream	DTE Operation	DCE operation
abcdef	abc<DLE><code character>def (DTE inserts an action command)	abcdef (DCE removes event report)
abc<DLE><1/0>def	abc<DLE><1/0>def (DTE forwards)	abc<1/0>def (DCE plays)
ab<DLE><SUB>def	ab<DLE><SUB>def (DTE forwards)	ab<1/0><1/0>def (DCE plays)
abc<DLE>Tdef	abc<DLE>Tdef (DTE forwards)	abcdef (DCE removes special code)

6.4 Session management

6.4.1 Scope

6.4.1.1 +V commands

As a general rule:

1) the **+V** commands operate only while the DCE is in the Voice Mode (**+FCLASS=8**); and

2) the DCE does not accept Data Mode commands (**+FCLASS=0**) or Facsimile Mode commands (**+FCLASS=1.0**, **2.0**, etc.).

There are exceptions to these rules. In reference to item 1), there are several **+V** prefixed commands that will be accessible outside of the Voice Mode, most notably the Caller Id function. The exceptions are the **+VCID**, **+VRID**, **+VDID**, **+VDR**, **+VDT**, and the **+VNH** commands, which are valid in all Modes. In reference to item 2), the Voice Mode uses a number of commands with the **+F** prefix normally associated with the Facsimile Mode; the DCE enters the Voice Mode by receiving the **+FCLASS=8.0** command. This Recommendation permits the use of **ATD**, **ATH**, **+FCLASS**, **ATZ, +IFC**, certain **S-parameters**, and the DCE Identification commands (**+GMI?**, **+GMM?**, and **+GMR?**) while the DCE is in the Voice Command State.

6.4.1.2 Voice state information

The DCE shall maintain the Voice Mode information between mode changes. For example, if the DTE commands the DCE to leave the Voice Mode, enter the Data Mode (i.e. **+FCLASS=0**), perform some operations there, and later switch to the Voice Mode, the DTE shall find none of the voice parameters, such as the Sample Rate setting, different from before, unless a DCE reset event occurs. See 5.3.2 for the list of defined reset events.

6.4.1.3 S-parameters

This Recommendation permits sharing of compatible S-parameter definitions among the different modes. The S-parameter definitions intended for exclusive use in a given mode should have a distinct manufacturer specific S-parameter definition. The above mentioned conditions apply for all Voice, Facsimile, or Data Modes for all Recommendations, unless the Recommendation in question explicitly states otherwise, e.g. Service Class 2.

NOTE – Is this true for T.32?

The DCE shall return the ERROR result code to all DTE references to S-parameters that:

1) are explicitly disallowed while in Voice Mode; or

2) have no effect on the DCE's operation while in the Voice Mode. For example, a DTE Data Mode only S-parameter reference shall cause the DCE to report the ERROR result code.

See Table 4.

Table 4/V.253 – S-parameter usage definitions

S-parameter	Description
S0	Automatic answer disallowed in the Voice Mode
S3	Same as Rec. V.250 (ex-V.25 *ter*)
S4	Same as Rec. V.250 (ex-V.25 *ter*)
S5	Same as Rec. V.250 (ex-V.25 *ter*)
S6	Same as Rec. V.250 (ex-V.25 *ter*)
S7	Wait for Carrier After Dial. Default: 60 seconds. In the Voice Mode, this register contains the maximum amount of time that the DCE shall wait during call origination, all the time detecting for Ringing Tone, before assuming that the remote station will not go off-hook. See 10.2.5 and 10.2.6 for related information.
S8	As defined in Rec. V.250 (ex-V.25 *ter*)
S10	Automatic disconnect delay disallowed in the Voice Mode

6.4.1.4 Other V.250 (ex-V.25 *ter*) commands

The DCE shall return the ERROR result code to all disallowed V.250 (ex-V.25 *ter*) AT commands while in the Voice Mode. Table 5 lists V.250 (ex-V.25 *ter*) commands that:

1) are disallowed while in Voice Mode;

2) have additional functionality while in Voice Mode; or

3) same functionality as Recommendation V.250 (ex-V.25 *ter*).

Table 5/V.253 – V.250 (ex-V.25 *ter*) AT command operations while in voice mode

AT command	Description
A	Disallowed in the Voice Mode; use the **+VLS** command (see 10.2.4).
D	See 9.1.1
E<value>	Same as Rec. V.250 (ex-V.25 *ter*)
&F	Manufacturer specific
H0 or H	See 9.1.2
H<value>	Where <value> is any integer greater than 0; disallowed in the Voice Mode.
I<value>	Where <value> is any integer or omitted; disallowed in the Voice Mode.
L<value>	Where <value> is any integer or omitted; disallowed in the Voice Mode.
M<value>	Where <value> is any integer or omitted; disallowed in the Voice Mode.

Table 5/V.253 – V.250 (ex-V.25 *ter*) AT command operations while in voice mode *(concluded)*

AT command	Description
O<value>	Where <value> is any integer or omitted; disallowed in the Voice Mode.
P	Same as Rec. V.250 (ex-V.25 *ter*)
Q<value>	Where <value> is any integer or omitted; disallowed in the Voice Mode.
T	Same as Rec. V.250 (ex-V.25 *ter*)
X<value>	Where <value> is any integer or omitted; disallowed in the Voice Mode.
Z<value>	Where <value> is any integer or omitted (see 5.3.2)
&C<value>	Same as Rec. V.250 (ex-V.25 *ter*)
&D<value>	Where <value> is any integer or omitted. Zero and two behave as described in Rec. V.250 (ex-V.25 *ter*). One is disallowed in the Voice Mode.

6.4.1.5 Dial action

The Dial Action under the Voice Mode is the same as Recommendation V.250 (ex-V.25 *ter*).

6.4.2 Flow control

6.4.2.1 Methods

Flow control is necessary to match the DTE-DCE data rate to the line signalling rate and to the requirements of analog conversion of the voice signals and data. In-band unidirectional DC1/DC3 (XON/XOFF) flow control is mandatory; flow control using V.24 circuits 106 and 133 is optional. Voice data with cardinal values of DC1 (1/1) or DC3 (1/3) shall not be interpreted as flow control commands.

The DTE may turn off the above specified flow control methods, but some other method shall be used to avoid overrun of the DCE buffer. The credit method can be implemented using the <DLE><"?"> transparent data command character pair (see the <?> simple action command in Table 12). In the receive direction, the DTE can use delayed Packet Protocol (clause 9/T.32) acknowledge characters for flow control.

The response time of the DCE to indication of a DTE-not-ready condition shall not exceed 64 character times, as measured from the instant the DTE asserted the not-ready condition. The DCE shall further be prepared to accept at least 64 additional characters on circuit 103 at the instant it asserts a not-ready condition to the DTE.

NOTE – A Voice DCE may provide additional data buffering beyond the needs of flow control.

6.4.2.2 Implicit selection

The DTE can select the flow control method in the Voice Mode by using the **+IFC** command [defined in 6.2.12/V.250 (ex-V.25 *ter*)]. This Recommendation extends the **+IFC** command to allow some flow control inheritance. The selection of the flow control method is not global to all modes that the DCE may support, but the method is global, in a more limited sense, to those modes that are aware of the **+IFC** command. The DCE is not required to maintain the flow control method between power cycles. See 5.3.2 for the list of defined reset events.

The scope of the **+IFC** command is given below.

1) A state transition from a **+IFC** unaware mode to **+IFC** aware mode. The **+IFC** aware mode disregards the flow control method active in the other modes, and switches to the method selected by the **+IFC** command. The selected method is either the default, or the last selected setting. For example, if the DTE has not issued an **+IFC** command in any **+IFC** aware mode, the DCE shall use the normal default.

2) A state transition from a **+IFC** aware mode to another **+IFC** aware mode. The newly-selected **+IFC** aware mode shall inherit the flow control method active in the other mode.

3) A state transition from the **+IFC** aware mode to **+IFC** unaware mode. The DCE deselects the **+IFC** flow control method, and resumes the method active in the other mode before the switch to the **+IFC** aware mode.

For interoperability with existing DTE, the DCE may also support the **+FLO** syntax, as defined in Annex A.

6.4.3 Serial data interchange circuits

6.4.3.1 Mandatory circuits

The following circuits are required:

V.24 circuit	Description	V.24 circuit	Description
102	Signal Ground	103	Transmitted Data
104	Received Data		

6.4.3.2 Optional circuits

V.24 circuit	Description	V.24 circuit	Description
133	Ready for Receiving	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		

Provision of additional circuits is optional.

6.4.3.3 Optional circuits behaviour

The behaviour of Circuits 105, 106, and 133 is described in 6.2.12/V.250 (ex-V.25 *ter*).

The behaviour of Circuit 108/2 is described as follows. An ON to OFF transition on 108/2 shall cause the DCE to disconnect the call and go on-hook, unless configured otherwise by the user. If the DCE provides the **&D** parameter [defined in Recommendation V.250 (ex-V.25 *ter*)], this parameter shall also condition DCE behaviour while **+FCLASS=8.0**. The **&D0** setting shall cause the DCE to ignore transitions on circuit 108/2. The **&D1** is not permitted. The **&D2** setting shall cause the DCE to disconnect the call, and go on-hook, enter automatic rate detection operation, and switch to Data Mode, on an ON to OFF transition of circuit 108/2; the DCE shall do the above except to go on-hook when +**VNH=2**. Other values of the **&D** command are not defined in Recommendation V.250 (ex-V.25 *ter*) or in this Recommendation.

The DCE may indicate incoming call on V.24 Circuit 125.

When the DCE switches to **+FCLASS=0** operation, the behaviour of all control circuits shall be as specified by Recommendation V.250 (ex-V.25 *ter*) and manufacturer-specific extensions and modifications.

Circuit 107, if provided, shall normally be held in the ON condition at all times when the DCE is powered on and **+FCLASS=8**. Manufacturers may provide an option to cause Circuit 107 to obey the V.24 definition, which is for Circuit 107 to be ON only when the DCE is off-hook, and OFF when the DCE is on-hook.

Circuit 109, if provided, shall normally be held in the ON condition at all times when the DCE is powered on and **+FCLASS=8**. Manufacturers may provide an option to cause Circuit 109 to be ON when the DCE is off-hook and OFF when the DCE is on-hook. The **&C<n>** command, defined in Recommendation V.250 (ex-V.25 *ter*), may be used for this purpose; the **&C0** setting holds circuit 109 always in the ON condition, and the **&C1** setting may be used to indicate the optional behaviour (indicating the on-hook/off-hook condition).

6.4.4 DTE/DCE interface rate changes

While the DCE is detecting the rate and parity and is in Voice Command State, the DCE shall issue responses using the same rate, word length, and parity as the most recent DTE command line. In the event that the DCE has received no DTE command, the rate, word length, and parity used will depend on the DCE's capabilities. When the DCE receives a fixed rate command that changes the operation from automatic rate detection to fixed-rate (word length and parity remain the same as determined from automatic rate detection or from other DCE capabilities), the change shall only occur after the complete DCE response. While the DCE is using fixed-rate operation and in Voice Command State, the DCE shall issue responses using the selected rate and utilize the same word length and parity determined before entering fixed-rate operation. In the event that the DCE has not determined the word length and parity, the word length and parity used will depend on the DCE's capabilities. When the DCE receives a fixed rate command that changes the operation from fixed-rate to automatic rate detection, the DCE shall resume the last rate, word length, and parity determined before entering fixed-rate operation. In the event that the DCE has not determined the rate, word length, and parity, the results depend on the DCE's capabilities.

The DTE can enable or disable automatic rate detection and fixed-rate operation, while in the Voice Mode, by issuing the **+IPR** command.

On entering the Voice Mode, the DCE shall execute an implied rate adjustment **+IPR** command using the rate from the Mode just exited. If the last Mode used automatic rate detection, the DCE would execute a **+IPR=0** command transparent to the DTE. If the last Mode used a fixed-rate, the DCE would execute the appropriate **+IPR** command to establish the same fixed-rate. In no event shall the DCE see separate result codes from the mode switch and the rate adjustment command. Assuming the Mode switch is successful, a rate adjustment failure for any reason shall cause the DCE to enter automatic rate detection operation.

Once the DCE is using the fixed-rate operation, the DCE shall maintain this fixed rate for the duration of the Voice Mode or until:

1) the DCE receives another **+IPR** command; or

2) the DCE rate changes as a side effect of another command, such as the **ATZ** command.

See 5.3.2 for the list of defined reset events.

On exiting the Voice Mode, the DCE shall execute an implied rate adjustment appropriate to the new Mode if such a command exists. If the Voice Mode used automatic rate detection, the DCE would execute an appropriate Enable Automatic Rate Detection command for the new mode transparently to the DTE. If the Voice Mode used a fixed-rate, the DCE would execute the appropriate fixed-rate command to establish the same fixed-rate. The DCE shall not do rate adjustments described above for those Modes that explicitly mandate:

1) a certain rate; or

2) the DCE maintain and resume the rate across Mode transitions.

Note that T.32 maintains that it is the DTE's responsibility to set the correct fixed-rate upon entering Facsimile Mode from the Voice Mode; the transition from voice to T.32 facsimile mode satisfies this requirement (i.e. not requiring a **+IPR** command).

6.4.5 DTE/DCE inactivity timer

The purpose of this timer is to ensure that the DTE does not leave the DCE in a state that is inaccessible by Voice-unaware software. The DTE/DCE Inactivity Timer is activated when the DTE selects the voice fixed-rate. This timer expires if there is a cessation of the data stream from the DTE to the DCE, in the Voice Command State and in the Data State, for a DTE selectable time. On the expiration of this timer, the DCE shall switch to the Data Mode with automatic rate detection. The switch to automatic rate detection (and Data Mode) allows DTE Voice-unaware software to recover control of the DCE in the event of a catastrophic failure that does not result in a DCE power down.

It is recommended that the DTE software leave the DCE in automatic rate detection (and Data Mode) operation, and use the DTE/DCE Inactivity Timer only as needed. Leaving the DCE in the automatic rate detection operation is an extra measure to prevent confusion resulting from Voice-unaware software accessing a DCE in the Voice Mode at a fixed DTE/DCE Interface Rate. The **ATH** command (see 9.1.2) does the switch to automatic rate detection and Data Mode automatically for these reasons.

This Recommendation does not allow the DCE automatic answer feature, since this feature does not allow the DTE to set the DCE in the Voice Mode before answering the phone.

If the particular DCE implementation does not have a Data Mode, the DCE shall not perform any Mode change upon the expiration of the DTE/DCE Inactivity Timer. If the particular DCE implementation does not support automatic rate detection, the DCE shall not change the fixed DTE/DCE Interface Rate.

6.4.6 DCE implementations without data modes

If the given DCE does not have a Data Mode (i.e. **+FCLASS=0**) and the DCE is processing a command that usually switches the DCE to the Data Mode, either directly or as a side effect, the DCE shall perform the non-switching portions of the command, but stop any further processing of the command at the mode switch. The **ATH** (see 9.1.2) command is an example – the DCE would hang up the phone, enable automatic rate detection, but would not go to the Data Mode.

If the given DCE does not have a Data Mode (i.e. **+FCLASS=0**) and the DCE detects an event that usually switches the DCE to the Data Mode, either directly or as a side effect, the DCE shall process the non-switching portions of the event, but stop any further processing of the command at the mode switch. The DTE/DCE Inactivity Timer time-out event is an example – the DCE would hang up the phone, enable automatic rate detection, but would not go to the Data Mode.

7 Events (unsolicited result codes)

The form of the unsolicited result codes for the Voice Mode is very different from that defined in Recommendation V.250 (ex-V.25 *ter*). This Recommendation refers to these events as event detection reports.

Table 1 lists the events without any regard as to whether the DCE reporting of the event is optional or mandatory, and without assigning a DCE reporting mechanism. The next subclauses define simple <DLE><code character> shielded codes and a general message packet for reporting most of these events listed in Table 1.

7.1 Forms of the event detection report

7.1.1 Simple event detection report

The DCE shall use the simple report format when one character is enough to report an event (e.g. RING). The form of the report is <DLE><code>, where <code> can be one of the possible character values listed in Table 10. The <code> parameter "X " has a special significance, and is defined in 7.1.2.

7.1.2 Complex event detection report

The DCE shall use the complex report format when one character is not enough to report an event (e.g. RING), or a response to an action (e.g. Buffer Space Inquiry <DLE>?). **As a general rule, all multi-character data responses will follow this report format.** The form of the report is <DLE>X<response><DLE><.>, where <response> is a data or text string, and <DLE><.> is the data packet terminator. If a single character is sufficient to report an event, the DCE shall use the simple report format defined above.

See the Caller Id example, Example 2 in 9.2.3.1.3, for an example of this format.

The <response> shall present data in one of the three possible formats. Multiple forms may appear in the same <response> parameter. The DCE may place <LF> (0/10) characters in the <response>.

For those complex events that can be reported in Service Classes other than Class 8, such as Caller ID and Distinctive Ring, the reports are displayed without the <DLE><X> prefix or the <DLE><.> suffix in Classes other than Class 8. See Example 2 in 9.2.3.1.3. See Table 6.

Table 6/V.253 – Valid response forms for the complex event report

<tag>=<data><CR>	Where <tag> identifies the data type, "=" is T.50 3/13, <data> is a specific data instance, and <CR> is T.50 0/13. Table 7 lists the permitted tags.
<result codes><CR>	Where <result codes> are V.250 (ex-V.25 *ter)* formatted result codes, and T.50 0/13.
<CR>	Where <CR> is T.50 0/13. This form is a null message.

Manufacturer-specific data shall always use the <tag>=<data><CR> format with the manufacturer-specific <tag> identifier.

Table 7/V.253 – Valid tags for the complex event report

Tag	Description
TIME	Table 13
DATE	Table 13
NMBR	Table 13
NAME	Table 13
MESG	Table 13
ERRM	Table 8. Note that this tag is not limited to exclusive use for Caller Id.
DRON	Distinctive Ring Cadence On-time. See 10.3.1.
DROF	Distinctive Ring Cadence Off-time. See 10.3.1.
CPON	Control Tone Cadence On-time. See 10.3.2.
CPOF	Control Tone Cadence Off-time. See 10.3.2.
CWON	Call Waiting Cadence On-time. See 10.3.1.
CWOF	Call Waiting Cadence On-time. See 10.3.1.
ASTB	Table 12
NDID	DID Services. See 9.2.4.
SITT	Table 9
Z???	(??? Manufacturer's choice) Manufacturer specific

Table 8 describes the currently defined <data> values for the ERRM tag (i.e. <ERRM>< = ><data><CR>).

Table 8/V.253 – Defined values for the ERRM tag

<data>	Description
ICLID_202	See 9.2.3
CIDCW_202	See 9.2.3; see also Table 10 g (6/7).
Z<text>	(<text> manufacturer's choice) Manufacturer specific
Other text strings	Reserved for future standardization

DCE shall report SITT with the simple event report <DLE><"J"> (Table 10). DCE which can distinguish different types of SIT Signals shall also transmit a complex event report, using the <SITT>=<data><CR> format, using <data> values defined in Table 9 below:

Table 9/V.253 – Defined values for the SITT tag

<data>	Description
ICNT	Intercept Tone
VCCT	Vacant Code Tone
REOT	Reorder Tone
NCDT	No Circuit Detected Tone
TON4	Fourth SIT Signal Number
TON5	Fifth SIT Signal Number
TON6	Sixth SIT Signal Number
TON7	Seventh SIT Signal Number
Other text strings	Reserved for future standardization

7.2 Event reports restrictions

The DTE must expect these codes at any time and in any state – Command or Data State – while in the Voice Mode. The DCE may return the event detection reports right after the OK result code from the **+FCLASS** command.

The DCE shall not embed event detection reports within result codes [V.250 (ex-V.25 *ter*) definitions] – either final (e.g. between the "O" and the "K" in the result code OK), intermediate (e.g. between the "T" and the <CR> in the result code CONNECT), or unsolicited (e.g. between <DLE> and <code character>). The DCE may embed the event detection reports within the information responses [V.250 (ex-V.25 *ter*) definitions] from the DCE, such as the responses from the **+VSM=?** command or the DCE Identification commands. See 6.3.4 for considerations about issuing commands.

The DCE may also embed one or more Simple Event Detection Report (see 7.1.1) within the data portion of a Complex Event Detection Report as long as the DCE does not place the Simple Event Detection Report between the <DLE> and <code character> of a <DLE> shielded character pair.

7.3 <DLE> shielded event codes sent to the DTE

Table 10 is the list of the <DLE> shielded code assignments for simple event detection reports, complex event report header, and other codes.

This Recommendation defines the following <DLE> shielded codes for the Voice Mode. Table 10 lists the valid values of <code character> in the expression <DLE><code character>. The number in parenthesis in the first column corresponds to the T.50 equivalent. The expression [Event Number <number>] refers to the numbering scheme used in Table 1.

Table 10/V.253 – Descriptions of <DLE> shielded codes sent to the DTE

Code	Event Report Description
<DLE> (1/0)	Two contiguous <DLE><DLE> codes indicate a single <DLE> in the data stream
<SUB> (1/10)	<DLE><DLE> in the data stream
<ETX> (0/3)	End Data State. The DCE sends this code to signify the end of the voice data. See Table 11 for a more complete discussion of this response code.
Q (5/1)	Data stream shielded XON character. Used in the Packet Protocol.
S (5/3)	Data stream shielded XOFF character. Used in the Packet Protocol.
M (4/13)	Data stream shielded SOH code used for the Packet Protocol
W (5/7)	Data stream shielded ETB code used for the Packet Protocol
F (4/6)	Data stream shielded ACK code used for the Packet Protocol
U (5/5)	Data stream shielded NAK code used for the Packet Protocol
G (4/7)	Data stream shielded ENQ code used for the Packet Protocol
T (5/4)	Timing Mark. See 5.4 for details.
X (5/8)	Packet Header for the "Complex Event Detection Report" (additional event data transfers to the DTE)
. (2/14)	Packet Terminator for the "Complex Event Detection Report" (additional event data transfers to the DTE)
/ (2/15)	Start of DTMF tone shielding (see 7.6)
~ (7/15)	DTMF transitions to off (see 7.5 and 7.6)
R (5/2)	[Event Number 3] Ring. The <DLE> shielded version of the RING result code.
1 (3/1)	[Event Number 4] DTMF 1 (see 7.5)
2 (3/2)	[Event Number 4] DTMF 2 (see 7.5)
3 (3/3)	[Event Number 4] DTMF 3 (see 7.5)
4 (3/4)	[Event Number 4] DTMF 4 (see 7.5)
5 (3/5)	[Event Number 4] DTMF 5 (see 7.5)
6 (3/6)	[Event Number 4] DTMF 6 (see 7.5)
7 (3/7)	[Event Number 4] DTMF 7 (see 7.5)
8 (3/8)	[Event Number 4] DTMF 8 (see 7.5)
9 (3/9)	[Event Number 4] DTMF 9 (see 7.5)
0 (3/0)	[Event Number 4] DTMF 0 (see 7.5)
A (4/1)	[Event Number 4] Extended Keypad DTMF A (see 7.5)
B (4/2)	[Event Number 4] Extended Keypad DTMF B (see 7.5)
C (4/3)	[Event Number 4] Extended Keypad DTMF C (see 7.5)
D (4/4)	[Event Number 4] Extended Keypad DTMF D (see 7.5)
* (2/10)	[Event Number 4] Extended Keypad DTMF E (see 7.5)
# (2/3)	[Event Number 4] Extended Keypad DTMF F (see 7.5)

Table 10/V.253 – Descriptions of <DLE> shielded codes sent to the DTE *(continuation)*

Code	Event Report Description
o (6/15)	[Event Number 5] Receive Buffer Overrun. The DCE shall disregard the latest voice data in favour of the oldest voice data in the DCE's buffer. The DCE shall place the code at the end of the buffer, thus marking the place where the data lost. The DCE shall not continuously send this code. After the end of an overrun condition (data flow to the DCE to the DTE begins again), the DCE shall allow an implementation specific amount of empty space in the voice data buffer, before the DCE can send the code again. This code does not indicate how much contiguous data the DCE lost, but does report multiple gaps of data.
c (6/3)	[Event Number 6] Facsimile Calling. The DCE uses an implementation specific means to detect a calling facsimile device. The DCE may use the T.30 1100 Hz tone and cadence information to make the determination (the actual detection criterion is implementation specific), or other methods as they become available. If the DCE continues to detect a facsimile calling device, the DCE may repeatedly report this event. The time interval between reports shall be no less than 4.0 seconds.
e (6/5)	[Event Number 7] Data Calling. The DCE uses an implementation specific means to detect a calling data device. The DCE may use the V.25 1300 Hz tone and cadence information to make the determination (the actual detection criterion is implementation specific), or other methods as they become available. If the DCE continues to detect a data calling device, the DCE may repeatedly report this event. The time interval between reports shall be no less than 4.0 seconds.
h (6/8)	[Event Number 8] Line current break (local phone goes on-hook)
H (4/8)	[Event Number 8] Line current detected (local phone goes off-hook)
s (7/3)	[Event Number 9] "Presumed Hangup" (SILENCE) Time-out. If the DCE continues to detect SILENCE, the DCE may repeatedly report this event. The time interval between reports shall be no less than the time period specified by the **+VSD** command. The detection criterion is implementation specific. See Table 11 for a more complete discussion of this response code.
q (7/1)	[Event Number 10] "Presumed End of Message" (QUIET) Time-out. If the DCE continues to detect QUIET, the DCE may repeatedly report this event. The time interval between reports shall be no less than a time period specified by the **+VSD** command. The detection criterion is implementation specific. See Table 11 for a more complete discussion of this response code.
J (4/10)	[Event Number 11] SIT Signal; see also 7.1.2 for complex reporting.
$ (2/4)	[Event Number 12] Calling Card (Bong) Tone
l (6/12)	[Event Number 13] Loop Current Interruption. This usually indicates a remote hangup. See Table 11 for a more complete discussion of this response code.
L (4/12)	[Event Number 14] Loop Current Polarity Reversal. This may indicate a hang-up depending on the implementation of the central office. See Table 11 for a more complete discussion of this response code.
w (7/7)	[Event Number 15] Call Waiting/Beep Interrupt
t (7/4)	[Event Number 17] 5-bit (Baudot) TDD (Annex A/V.18) modulation detected
r (7/2)	[Event Number 18] Ringing Tone. See 3.9.

Table 10/V.253 – Descriptions of <DLE> shielded codes sent to the DTE *(continuation)*

Code	Event Report Description
b (6/2)	[Event Number 19] BUSY. If the DCE continues to detect BUSY, the DCE may repeatedly report this event. The time interval between reports shall be no less than 4.0 seconds. The detection criterion is implementation specific. See Table 11 for a more complete discussion of this response code.
d (6/4)	[Event Number 20] DIALTONE. If the DCE continues to detect DIALTONE, the DCE may repeatedly report this event. The time interval between reports shall be no less than 3.0 seconds. The detection criterion is implementation specific. See Table 11 for a more complete discussion of this response code.
K (4/11)	[Event Number 21] Reorder/Fast Busy
N (4/14)	[Event Number 22] V.21 Channel 2 7E flags
u (7/5)	[Event Number 23] Transmit Buffer Underrun. The DCE shall report this code if the DCE's buffer becomes empty without first receiving a <DLE><ETX> or a <DLE><CAN > command. See Table 12 for a more complete discussion of these commands. The DCE shall generate analog silence while the buffer is in the Underrun condition. The DCE shall continue in the voice transmit mode. The DCE shall buffer an implementation specific amount of voice data, before the DCE can resume sending the voice data over to the analog destination. This buffering is to insure a clean restart of the voice transmission.
p (7/0)	[Event Number 24] Line voltage increase (extension phone goes on-hook)
P (5/0)	[Event Number 24] Line voltage decrease (extension phone goes off-hook)
a (6/1)	[Event Number 25] Facsimile or Data Answer. The DCE uses an implementation specific means to detect a answering facsimile or data device (the DCE receives information that the answering device is one or the other). The DCE may use the V.25/T.30 2100 Hz answer tone and cadence information to make the determination (the actual detection criterion is implementation specific), or other methods as they become available. If the DCE continues to detect a facsimile or data answering device, the DCE may repeatedly report this event. The time interval between reports shall be no less than 0.5 seconds.
f (6/6)	[Event Number 26] Data Answer. The DCE uses an implementation specific means to detect a answering data device (the DCE receives information that the answering device is one or the other). The DCE may use the Bell 2225 Hz answer tone and cadence information to make the determination (the actual detection criterion is implementation specific), or other methods as they become available. If the DCE continues to detect a data answering device, the DCE may repeatedly report this event. The time interval between reports shall be no less than 4.0 seconds.
V (5/6)	[Event Number 27] Voice Detection – high confidence of voice. The DCE, by some implementation specific process, has determined, with a high probability, that the activity on the line is voice.
v (7/6)	[Event Number 27] Voice Detection – low confidence of voice. The DCE, by some implementation specific process, has determined, with a low probability, that the activity on the line is voice.
g (6/7)	[Event Number 28] CIDCW (Caller ID Call Waiting); see also Table 11 for complex reporting.
i (6/9)	[Event Number 29] Stuttered Dialtone

Table 10/V.253 – Descriptions of <DLE> shielded codes sent to the DTE *(concluded)*

Code	Event Report Description
E (4/5)	[Event Number 30] Invalid Voice Data Format. The DCE has determined that the voice data from the DTE is incompatible with the selected Voice Compression Method (see 10.2.8). The DCE shall issue this report only once voice data stream.
Y (5/9)	[Event Number 31] Lost Data Detected Event. The DCE has detected a loss of a data octet in the voice data stream from the DTE arising from some other source than a underrun or overrun. The DCE shall not continuously send this code.
m (6/13)	[Event Number 32] Facsimile Answer. The DCE uses an implementation specific means to detect a answering facsimile device. If the DCE continues to detect a facsimile answering device, the DCE may repeatedly report this event. The time interval between reports shall be no less than 0.5 seconds.
@ (4/0)	[Event Number 33] Reserved (CAS Tone detected)
n (6/14)	[Event Number 34] EDT TDD (Annex C/V.18) modulation detected
% (2/5)	[Event Number 63] Manufacturer specific
& (2/6)	[Event Number 48] Manufacturer specific
’ (2/7)	[Event Number 49] Manufacturer specific
((2/8)	[Event Number 50] Manufacturer specific
) (2/9)	[Event Number 51] Manufacturer specific
All other 7-bit T.50 characters	Reserved for future standardization

7.4 Minimum event reporting requirements

The DCE shall support, at a minimum, Event Numbers 3, 4, 6, 18, 19, and 25 in Command Mode; Event Numbers 5, 9, and 10 in Voice Receive State; and Event Number 23 in Voice Transmit State.

If the DCE supports the reporting of calling tone events, the DCE shall monitor the calling tones for the proper frequency, and cadences at the onset of the connection to the analog source/destination (e.g. telephone over the GSTN or connection to a handset locally connected to the DCE) for a period consistent with the expected duration, either as defined by other Recommendations or common industry practice, of the those supported calling tones. The onset of the connection can occur immediately on the switch, or after some delay, which is permitted or required by other Recommendations or common industry practice, by the protocol associated with the particular connection. After a time interval longer than the calling tone duration, the DCE is permitted to cease monitoring for calling tones. If a given implementation requires that one or more calling tones be monitored for the duration of the entire connection to the analog source/destination, it is recommended that the DCE implement a manufacturer-specific device in the **+VLS** command (see 10.2.4).

If the DCE supports the reporting of answer tone events, the DCE shall monitor the answer tones for the proper frequency, and cadences at the onset of the connection to the analog source/destination (e.g. telephone over the GSTN or connection to a handset locally connected to the DCE) for a period consistent with the expected duration, either as defined by other Recommendations or common industry practice, of the those supported answer tones. The onset of the connection can occur immediately on the switch, or after some delay, which is permitted or required by other Recommendations or common industry practice, by the protocol associated with the particular

connection. After a time interval longer than the answer tone duration, the DCE is permitted to cease monitoring for answer tones. If a given implementation requires that one or more answer tones be monitored for the duration of the entire connection to the analog source/destination, it is recommended that the DCE implement a manufacturer-specific device in the +**VLS** command (see 10.2.4).

This Recommendation mandates that the DCE shall not detect a DTMF tone sooner than 25 milliseconds (see 7.6). The minimum tone length time for positive detection of other tones, not governed by other Recommendations, is unspecified.

7.5 DTMF event report sequence

Once the DCE has made a positive DTMF determination as described in 7.6, the DCE shall produce the corresponding DTMF event code every 70 milliseconds (including the 25-millisecond detection interval described in 7.6) until the DCE no longer detects the DTMF tone. The DCE shall produce the <DLE><~> event code on the transition from DTMF on-to-off. For example, if the DCE detects a DTMF 1, the DCE could produce the following sequence: <DLE><1><DLE><1><DLE><1><DLE><~>. The DCE shall produce the <DLE><~> event code before reporting another DTMF tone.

7.6 Recorded DTMF tone on playback

On a voice receive, a DCE shall alter, remove, or shield DTMF tones from the received data stream by one of the methods described below. The term eliminate means that the DCE may physically remove the data in question, or may change the data in question by removing the DTMF frequency components in said data. This Recommendation presumes that the DTMF determination period is greater than 25 milliseconds.

1) Eliminate the entire DTMF tone burst from the voice data stream.
2) Eliminate a sufficient amount of the DTMF tone burst to leave no less than 25 milliseconds of digitized tone data.
3) Use the <DLE></> shielding procedure described below.
4) Use the <DLE></> shielding procedure and eliminate a sufficient amount of the DTMF tone burst to leave no less than 25 milliseconds of digitized tone data.

The following describes the shielding procedure a DCE may employ. The DCE shall embed a <DLE></> code into the voice data stream to the DTE when the DCE has made a preliminary determination that the receive tone is a DTMF tone. One possible method of making this preliminary determination is when the DCE has detected the high frequency tone component; the actual method is manufacturer-specific. The DCE shall present this code no later than 25 milliseconds from the onset of the tone. If the DCE later determines, for the same tone burst, that the tone is not a DTMF tone, the DCE shall insert the <DLE><~> code to indicate the end of the determination interval (without any intervening DTMF codes). If the DCE later determines, for the same tone burst, that the tone is a DTMF tone, the DCE shall report the DTMF report sequence as described in 7.5. For example, if the DCE detects a DTMF 1, the DCE could produce the following sequence: <DLE></><DLE><1><DLE><1><DLE><1><DLE><~>. The DCE shall produce the <DLE><~> event code before reporting another DTMF tone sequence.

On a voice transmit, the DCE shall not report any DTMF detections upon receiving the <DLE></> code from the DTE until the DCE receives the <DLE><~> code from the DTE. This inhibiting of DTMF reporting shall cease upon a reset event, or until the DTE switches the DCE to the Voice Mode. DTE is permitted to use this method to disable DTMF tone event reports.

The DCE is required to support the <DLE></> and the <DLE><~> codes on a voice transmit even if the DCE does not use the shielding procedure described above.

7.7 Silence detection during voice receives

The DCE may report the end of a voice receive operation in one of seven possible ways, and remains in the Data State for six of the event reports. The DCE switches to the Command State after the <DLE><ETX> report. See Table 11 for the list of all of these possible event detection reports. This Recommendation mandates three of these reports:

1) "Presumed Hangup" (SILENCE);

2) "Presumed End of Message" (QUIET); and

3) the <DLE><ETX> report caused by the DTE issuance of a <DLE><!> action command.

This Recommendation mandates that the DCE shall monitor the analog source (or the digitized representation thereof) with the aim of detecting long periods of inactivity (i.e. silence). This inactivity indicates a possible end of the voice message during the voice receive operation. The actual means of characterizing the amount of activity from the analog source (i.e. long-term energy detection or other means) for periods of time indicated by the **+VSD** command (10.2.7), as well as the means for the exclusion of noise (i.e. clicks and pops) from the analysis are manufacturer specific. The reason for the DCE performing this function is because the DTE cannot, in the case of data compression, analyse the voice data stream. The DCE shall report the periods of sustained inactivity by issuing two possible event reports:

1) "Presumed Hangup" (SILENCE); and

2) "Presumed End of Message" (QUIET) event reports.

Table 11 describes these two reports and their differences.

The DTE must know if there was any activity from the analog source for any appreciable time preceding the long period of inactivity (i.e. silence interval specified by the **+VSD** command) in the data stream, in order to properly perform call discrimination. For example, the DCE transmits the welcome message, goes to the Voice Receive State, and the DTE starts storing data. The DTE does not know if this recorded data has any voice content. If the DCE merely reported a long period of inactivity at some point in the operation, the DTE does know if there was any voice activity on the line before the reported long period of silence. It is possible for the DTE to time the operation, but this Recommendation does not require timing on the DTE (but does not claim that DTE timing is not required). A long period of silence with no preceding activity may indicate a facsimile machine connected at the remote location (some facsimile machines do not send out calling tones), at which point the DTE may consider trying a facsimile handshake.

See Table 10 for additional information on these event reports. The number in parenthesis in the first column corresponds to the T.50 equivalent.

Table 11/V.253 – Possible voice mode receive end of message determinations

Code	Event report description
ETX (0/3)	The DCE receives a <DLE><!> from the DTE
s (7/3)	[Event Number 9] "Presumed Hangup (SILENCE) Time-out. The DCE has determined that, by means unspecified, there was never any appreciable activity from the analog source for a sufficient time before the start of sustained inactivity time interval from the analog source. The DTE may adjust the sensitivity and length of the inactivity time interval using **+VSD** command (see 10.2.7).
q (7/1)	[Event Number 10] "Presumed End of Message" (QUIET) Time-out. The DCE has determined that, by means unspecified, there was appreciable activity from the analog for a sufficient time before the start of sustained inactivity period from the analog source. The DTE may adjust the sensitivity and the length of the inactivity time interval using **+VSD** command (see 10.2.7).
l (4/9)	(ASCII 6C hex) [Event Number 13] Loop Current Interruption. The calling party controls this event, and the DCE shall consider the event as a remote hangup.
L (4/12)	[Event Number 14] Loop Current Polarity Reversal. The calling party controls this event, and the DCE shall consider the event as a remote hangup.
b (6/2)	[Event Number 19] BUSY. The DCE detects busy tone.
d (6/4)	[Event Number 20] DIALTONE. The DCE detects dial tone.

8 Actions

The Voice Mode uses a mixture of AT-style commands for parameter setting and initiating actions, and <DLE> shielded codes for simple actions in the Voice Transmit and Receive States.

8.1 Simple action commands

The DCE shall use the simple command format when one character is enough to initiate an action (e.g. Bump the transmit volume up by one). The form of this command is <DLE><code>, where <code> can be one of the possible character values listed in Table 12.

8.2 Configuration setting and initiating action commands

The DCE shall use these AT-style commands, while in Voice Command State, for configuration setting and initiating actions. These commands are covered in the next subclauses.

8.3 <DLE> codes sent to the DCE

This Recommendation defines the following <DLE> shielded codes for simple actions in the Voice Mode. Table 12 lists the valid values of <code> in the expression <DLE><code>. The expression [Action Number <number>] refers to the numbering scheme used in Table 2. The term "Immediate Command" in Table 12 means that the DCE shall take action upon receiving the command from the DTE. The term "Stream Command" in Table 12 means that the code keeps its position in the data stream; the DCE shall delay in taking the prescribed action until the DCE comes to that location in the DCE's normal processing of the data stream.

The DCE shall consume unrecognized <DLE> shielded codes, and give no indication of such action. The number in parenthesis in the first column corresponds to the T.50 equivalent.

Table 12/V.253 – Descriptions of <DLE> shielded codes sent to the DCE

Code	Simple action command description
<NUL> (0/0)	Do nothing. The DTE can use the code to refresh the DTE/DCE Inactivity Timer, instead of XON.
<DLE> (1/0)	Two contiguous <DLE><DLE> codes indicate a single <DLE> in the data stream ("Immediate Command" or "Stream Command")
<SUB> (1/10)	<DLE><DLE> in the data stream ("Immediate Command" or "Stream Command")
Q (5/1)	Data stream shielded XON code used for the Packet Protocol
S (5/3)	Data stream shielded XOFF code used for the Packet Protocol
M (4/13)	Date stream shielded SOH code used for the Packet Protocol
W (5/7)	Date stream shielded ETB code used for the Packet Protocol
F (4/6)	Data stream shielded ACK code used for the Packet Protocol
U (5/5)	Data stream shielded NAK code used for the Packet Protocol
G (4/7)	Data stream shielded ENQ code used for the Packet Protocol
T (5/4)	Timing Marks (not generated by DTE). See 5.4.
/ (3/12)	Start of DTMF tone shielding ("Immediate Command"). See 7.6.
~ (2/15)	DTMF transitions to off ("Immediate Command"). See 7.5 and 7.6.
u (7/5)	[Action Numbers 0 and 3] Increase the volume or gain by one unit ("Immediate Command"). For the Voice Transmit and Receive States, this simple command increases the volume or gain by one unit. If the DCE receives this code during a playback, the DCE shall increase its output volume by one unit as applicable for the hardware configuration device currently used to send the analog data. If the DCE receives this code during a record, the DCE shall increase its input gain by one unit as applicable to the hardware configuration. For the Voice Duplex State, this command increases the analog sink volume by one unit. The DCE shall increase its output volume by one unit as applicable for the hardware configuration device currently used to send the analog data. For the Voice Speakerphone State, this command increases the speaker gain by one unit. The DCE shall ignore this command in the Voice Command State. See 8.3.1 and 8.3.2 for additional requirements.
d (6/4)	[Action Numbers 1 and 4] Decrease the volume or gain by one unit ("Immediate Command"). For the Voice Transmit and Receive States, this simple command decreases the volume or gain by one unit. If the DCE receives this code during a playback, the DCE shall reduce its output volume by one unit as applicable for the hardware configuration device currently used to send the analog data. If the DCE receives this code during a record, the DCE shall reduce its input gain by one unit as applicable to the hardware configuration. For the Voice Duplex State, this command decreases the analog sink volume by one unit. The DCE shall decrease its output volume by one unit as applicable for the hardware configuration device currently used to send the analog data. For the Voice Speakerphone State, this command decreases the speaker gain by one unit. The DCE shall ignore this command in the Voice Command State. See 8.3.1 and 8.3.2. for additional requirements.

Table 12/V.253 – Descriptions of <DLE> shielded codes sent to the DCE *(continuation)*

Code	Simple action command description
<ESC> (1/11)	[Action Number 7] End Voice Receive State ("Stream Command"). The DTE sends this code to stop sampling the voice signal and return to Command State. The DCE shall complete the transfer of the contents of its buffer followed by <DLE><ESC>, switch to the Voice Command State, and return the OK result code.
p (7/0)	[Action Number 9] Pause Voice Transmit State ("Immediate Command"). This code commands the DCE to suspend sending analog data to the currently selected analog destination. While paused, the DCE shall maintain the contents of its internal transmit buffer, the state of its compressors, continue in the Data State, and send silence over to the analog destination (to mark time). See 8.3.2 for additional requirements.
r (7/2)	[Action Number 10] Resume Voice Transmit State ("Immediate Command"). This code commands the DCE to resume playing the contents of the DCE buffer to the currently selected output device. Before resuming the sending of analog data over to the analog destination, the DCE shall not reset the contents of its internal transmit buffer, nor reset its compressors. See 8.3.2 for additional requirements.
<ETX> (0/3)	[Action Number 11] End Voice Transmit State ("Stream Command"). The DTE sends this code to signify the end of the voice data from the DTE, and return to Command State. The DCE shall complete the transmission of the contents of its buffer, before switching to the Voice Command State and returning the OK result code.
<CAN> (1/8)	[Action Number 12] Clear transmit buffer of voice data ("Immediate Command"). This code commands the DCE to: 1) clear its internal transmit buffer; 2) make ready for a new voice data stream with the same parameters as the last stream; and 3) reset its compressors, and send silence over to the analog destination while paused (to mark time). See 8.3.2 for additional requirements.
<FS> (1/12)	[Action Number 13] Concatenate transmit data streams ("Stream Command"). The DTE sends this code to signify the start of a new voice data stream with the same parameters (i.e. sample rate) as the last stream without first returning to the Voice Command State. The DCE shall transmit the remainder of its internal transmit buffer, and reset its compressors before transmitting the data after the <DLE><FS > code. If Timing Marks are enabled, the new data stream shall begin with a Timing Mark immediately after the <DLE><FS > command. See 8.3.2 for additional requirements.
<n> (6/14)	[Action Number 3] Increase the volume or gain by one unit ("Immediate Command"). The DCE shall ignore this command while in the Voice Transmit, Receive, and Command States. For the Voice Duplex State, this command increases the analog source gain by one unit; the DCE shall increase its output gain by one unit as applicable for the hardware configuration device currently used to send the analog data. For the Voice Speakerphone State, this command increases the microphone gain by one unit. See 8.3.1 and 8.3.2 for additional requirements.

Table 12/V.253 – Descriptions of <DLE> shielded codes sent to the DCE *(concluded)*

Code	Simple action command description
<s> (7/3)	[Action Number 4] Decrease the volume or gain by one unit ("Immediate Command"). The DCE shall ignore this command while in the Voice Transmit, Receive, and Command States. For the Voice Duplex State, this command decreases the analog source gain by one unit; the DCE shall decrease its output gain by one unit as applicable for the hardware configuration device currently used to send the analog data. For the Voice Speakerphone State, this command decreases the microphone gain. See 8.3.1 and 8.3.2 for additional requirements.
<^> (5/14)	[Action Numbers 23 and 25] End Voice Duplex State ("Stream Command"), and End Voice Speakerphone State when **+VSP** is greater than one ("Stream Command"). The DTE sends this code to signify the end of the duplex voice data transfer, and to return to the Voice Command State. The DCE shall complete the transmission of the contents of its buffer, and shall discard the contents of its receive buffer, before switching to the Voice Command State and returning the OK result code. See 8.3.2 for additional requirements.
? (3/15)	[Action Number 14] Transmit Buffer Space Available ("Immediate Command"). The DTE sends this code to inquire about the amount of free space present in the transmit buffer. The DTE shall not send any more voice data until the response is received. The form of the response is: <DLE><X><ASTB=octets available><DLE><.> where <octets available> is the number of octets of free space in the DCE's transmit buffer, and is in decimal. The DCE shall recognize this command while in the Voice Transmit and Command States.
! (2/1)	[Action Number 15] Receive abort ("Immediate Command"). The DTE sends this code to signify the end of the voice data reception, and return to the Voice Command State. The DCE shall discard the contents of its buffer, before switching to the Command State and returning the OK result code. The DCE shall recognize this command while in the Voice Receive State.
@ (4/0)	[Action Number 16] Reserved (Transmit CAS tone)
% (2/5)	[Action Number 17] Manufacturer specific
& (2/6)	[Action Number 18] Manufacturer specific
' (2/7)	[Action Number 19] Manufacturer specific
((2/8)	[Action Number 20] Manufacturer specific
) (2/9)	[Action Number 21] Manufacturer specific
All other T.50 codes	Reserved for future standardization

8.3.1 Adjusting the volume and gain levels by <DLE> codes

8.3.1.1 Non-speakerphone section

8.3.1.1.1 Voice transmit and voice receive state

The DCE shall recognize the <DLE><u>, and <DLE><d> commands while in the Voice Transmit and Voice Receive States. The DCE shall ignore these commands if the volume or gain is already at the range limits. The DTE can query the permitted adjustment range by using the **+VGT** command (see 10.2.2) and **+VGR** command (see 10.2.1). The DCE shall ignore the command if Automatic Level Control or Automatic Gain Control (AGC) is active. One unit is manufacturer specific and has the same meaning as in the **+VGT** and the **+VGR** commands.

The DTE shall use the **+VGT** and the **+VGR** commands if the DTE wishes to set specific levels.

8.3.1.1.2 Voice duplex state

The DCE shall operate according to 8.3.1.1.1 with the following exception. The DCE shall recognize the <DLE><u> and <DLE><d> commands to adjust the analog sink (e.g. speaker) volume, and recognize the <DLE><n> and <DLE><s> commands to adjust the analog source (e.g. microphone) gain while in the Voice Duplex State.

8.3.1.2 Speakerphone section

While in Voice Speakerphone State, the DCE shall recognize the <DLE><u> and <DLE><d> commands to adjust the speaker gain, and recognize the <DLE><n> and <DLE><s> commands to adjust the microphone gain. The DCE shall ignore the respective commands if the microphone or speaker gain is already at the range limits. The DTE can query the permitted adjustment range by using the **+VGM** command (see 10.5.2) and **+VGS** command (see 10.5.3). One unit is manufacturer specific and has the same meaning as in the **+VGM** and the **+VGS** commands.

The DTE shall use the **+VGM** and the **+VGS** commands to set specific levels.

8.3.2 Pause and resume commands during voice states with DTE to DCE data transfers

The "**DTE to DCE Data Transfer State**" is defined as the Voice Transmit State, the Voice Duplex State, and the Voice Speakerphone State (while +**VSP** is greater than 1).

The "**DCE End Data State**" command is defined as follows. For the Voice Transmit State, this command is <DLE><ETX> command. For the Voice Duplex State and the Voice Speakerphone State (+**VSP** is greater than 1), this command is <DLE><^>.

The "**Volume/Gain Adjustment**" commands are defined as follows. For the Voice Transmit State, this command is <DLE><u> and <DLE><d> commands. For the Voice Duplex State and the Voice Speakerphone State (**+VSP** is greater than 1), these commands are <DLE><u>, <DLE><d>, <DLE><n>, and <DLE><s> commands.

The interaction of the "pause" command (<DLE><p>) and the "resume" commands (<DLE><r>, <DLE><CAN>, <DLE><FS>, and in a different manner, <DLE><ETX>) function differently from the implied "pause" and "resume" during conditions of a DCE voice transmit buffer underrun (see 10.1.6). When "paused" because of the command, the DCE must receive a "resume" command before:

1) resuming transmitting voice data from the DCE voice transmit buffer to the analog destination;

2) begin sending silence (because of no data in the DCE buffer) to the analog destination; or

3) do item 1) if appropriate and leave the Data State in the case of receiving the "DCE End Data State" command.

When "paused" because of a buffer underrun, the DCE resumes sending voice data to the analog destination immediately upon receiving more data from the DTE, subject to the recommendations prescribed in 10.1.6.

The DCE shall recognize the <DLE><p>, <DLE><r>, <DLE><ETX>, <DLE><CAN>, <DLE><FS> commands while in the "DTE to DCE Data Transfer State".

While the DCE is "paused" because of a <DLE><p> command the DCE shall recognize the <DLE><r>, "DCE End Data State command", <DLE><CAN>, <DLE><FS>, <DLE><u>, and <DLE><d> commands. The DCE shall ignore <DLE><p> commands when "paused".

The DTE may use the <DLE><r>, “DCE End Data State” command, <DLE><CAN>, or <DLE><FS> command to move the DCE out of the "paused" operation state. The DCE shall be ready to accept additional DTE voice data immediately (subject to flow control) after receiving a <DLE><r>, <DLE><CAN>, or <DLE><FS> command. The DCE shall not accept additional voice data after receiving a "DCE End Data State" command. The DCE shall ignore <DLE><r> commands when not "paused".

The DCE shall recognize the <DLE><p>, <DLE><r>, <DLE><CAN>, and the "Volume/Gain Adjustment" commands in the period between the DTE sending the DCE a "DCE End Data State" command and before the DCE has responded with the OK result code (e.g. the DCE is transmitting the contents of its internal voice transmit buffer). If the DTE sends the DCE a <DLE><CAN> during this period, the DCE shall discard the contents of the DCE internal buffer and leave the Data State.

The DTE/DCE Inactivity Timer is active (presuming **+VIT** is non-zero, see 10.2.3) while the DCE is "paused" because of a <DLE><p> command, or a voice transmit buffer underrun.

NOTE – The DTE is permitted to send more data to the DCE while the DCE is "paused" because of a <DLE><p> command. It is recommended that the DTE take the appropriate precautions to avoid the situation where a deadlock occurs because the DCE has flowed off the DTE, but the DCE cannot proceed until receiving a "resume" command from the DTE.

9 Support commands

9.1 Action commands

9.1.1 Dial command in voice (with +FCLASS=8.0)

9.1.1.1 ATD

This command causes the DCE to dial a phone number. The DCE shall perform an implied **+VLS=1** command if **+VLS=0** at the time of the **ATD** command. If the **+VLS** is not equal to zero at the time of the **ATD** command, the DCE shall use the current setting for the dial action.

NOTE – The DCE may issue unsolicited result codes before going off-hook and issuing the final result code.

The DCE shall attempt to determine when the remote station has gone off-hook by Ringing Tone detection and disappearance (see the **+VRA** and the **+VRN** commands, 10.2.5 and 10.2.6, respectively). Once the DCE has determined that the remote station has gone off-hook, the DCE shall return the OK result code.

9.1.1.1.1 Result code

The DCE issues the OK result code when the DCE has determined that the remote station has gone off-hook with high confidence. For example, the DCE reports this result code when the DCE has determined, because the DCE detected an answer tone, that the remote station is a data modem. The DCE may also issue this result code when the DCE has assumed that the remote station has gone off-hook by actions associated with the **+VRA** (see 10.2.5) and the **+VRN** (see 10.2.6) commands.

The DCE issues the NO ANSWER result code when the DCE has continuously detected Ringing Tone for the S7 specified amount of time.

9.1.2 Hangup command in voice (with +FCLASS=8)

9.1.2.1 ATH

This command causes the DCE to hang up the phone. In the Voice Mode, this command is equivalent to the **+VLS=0** command (see 10.2.4), and a DCE switch to the Data Mode with automatic rate detection; regardless of the state of the **+VNH** command (see 9.2.5). When the **+VNH=0** command is in effect and the DCE is not in the Voice Mode, the **ATH** command behaves as usual for the Mode. In particular:

1) The **ATH** command shall force the command **+FCLASS=0**, but will not change any of the voice parameters, such as **+VSM**, **+VSD**, etc. The DTE must re-issue an **+FCLASS=8** command to re-enter the Voice State after hanging up the phone.

2) The **ATH** command shall force the command **+IPR=0**, thus re-enabling automatic rate detection.

When the **+VNH=1** or **+VNH=2** command is in effect and the DCE is not in the Voice Mode, the DCE shall issue an OK result code as a result of the **ATH** command, but the DCE may or may not go on-hook depending on the setting of the **+VNH** command. See 5.3.2 for additional information on the effect of the **+VNH** command on reset events.

As part of the call discrimination algorithm, the DCE may switch to other modes, such as facsimile or data, in order to try handshakes in these modes. See 5.3.2 for a description of the behaviour of the **ATH** command in the non-voice mode with the **+FCLASS**, **+VLS=1**, and **+VNH** commands.

NOTE – The Voice Mode does not support the **ATH1** command.

9.1.2.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <value> of the command line **ATH<value>** is non-zero.

9.1.3 Repeat Caller ID (+VRID)

9.1.3.1 +VRID=<rmode>

	Default	Mandatory
<rmode>	0	(0,1) for all FCLASS's in those Voice DCEs that support detection of Caller ID

This command instructs the DCE to send all available call information on the last incoming call to the DTE. This command allows the DTE to request the information after a call has been answered. This command has one associated value, to choose formatted or unformatted call information text. The value may be 0 or 1. **+VRID** entered without a value is the same as entering the command with value 0.

The DCE shall return the OK result code after this command is executed; that is, after the requested information text has been sent to the DTE. If no information is available, the OK result code shall be sent to the DTE.

The <pmode> parameter of the **+VCID** command (see 9.2.3) is not affected by the **+VRID** command.

9.1.3.1.1 Subparameter description

<rmode>	**Reporting mode**
0	Display Caller ID information in formatted form to the DTE. The DCE shall present the data items in a <Tag><Value> pair format. The expected pairs are date, time, caller code (telephone number), and name. See 9.2.3.1.3 for a description of formatted form reporting.
1	Display Caller ID information in unformatted form to the DCE. The DCE shall present the entire packet of information, excluding the leading U's (line seizure information), in T.50 printable numbers. See 9.2.3.1.4 for a description of unformatted form reporting.

9.1.3.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <rmode> subparameter is out of range.

9.1.3.2 +VRID=?

The form of the response for this command follows.

+VRID=?

(0,1)

OK

9.2 Configuration commands

9.2.1 Mode selection

9.2.1.1 +FCLASS=<mode>

	Default	**Mandatory**
<mode>	0 if Data Mode present, otherwise manufacturer specific.	8

This command selects a DCE mode – data, facsimile, or voice. The DCE shall recognize the value of 8 as the Voice Mode described in this Recommendation.

As part of the call discrimination algorithm, the DCE may switch to other modes, such as facsimile or data, in order to try handshakes in these modes. See 5.3.2 for a description of the behaviour of the **+FCLASS** command with the **ATH**, **+VLS=1**, and **+VNH** commands.

NOTE – The **+FCLASS** command defines <mode> subparameter values with embedded "." period characters.

9.2.1.1.1 Subparameter description

<mode>	**DCE mode**
0	Data Mode
1.0	Service Class 1 (T.31, Facsimile Mode).
2.0	Service Class 2 (T.32, Facsimile Mode).
3-7	Reserved for other Facsimile Modes
8.0	Enter Voice Record/Playback Mode
9-16	Reserved for other Voice Modes
17	V.70 DSVD Mode
18	H.324 Videophone Mode
16-255	Reserved for future standardization

9.2.1.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <mode> subparameter is out of range.

9.2.2 +FCLASS=?

The Service Classes available from a DCE are tested by the **+FCLASS=?** command. The response is a string of values, separated by commas, followed by the OK result code; neither bracketing parentheses nor hyphens are permitted.

Example 1 – The following example illustrates inquiring about DCE's supported Modes. The DCE reports it is capable of Data Mode (i.e. Class 0) functions, Service Class 1 (T.31) and Service Class 2 (T.32) facsimile functions, and Voice Mode functions. DTE originated commands and data are in bold face.

```
AT+FCLASS=?
0,1.0,2.0,8.0
OK
```

9.2.3 Caller Id service

This subclause defines reporting of Caller ID information delivered at the beginning of the call (ICLID).

9.2.3.1 +VCID=<pmode>

	Default	Mandatory
<pmode>	0	(0,1,2) for all **FCLASS's** in those Voice DCEs that support detection of Caller ID

This command controls the reporting and presentation of data associated Caller ID services, where implemented by national Administrations, in the Incoming Call Line ID (ICLID) data format. The ICLID data comes in one of two formats – Single Data Message (SDM) format, or Multiple Data Message (MDM) format.

The DCE shall report any Caller Id information detected after the first ring. Note that one or more <CR><LF> combinations may occur after the RING result code.

The DCE shall present all data items, found in the **Single Message Format**, contained in the **Single Data Message** (SDM) and in the **Multiple Data Message** (MDM) packets. The DTE can expect, at a minimum, to receive the date, time, and caller code (telephone number).

The DCE shall present the data items in the <tag><=><value> pair format for the formatted and the unformatted presentation modes. Spaces are present on both sides of the equal sign. See Table 13 for the list of defined tags.

9.2.3.1.1 Subparameter description

<pmode>	Reporting mode
0	Disable Caller ID reporting
1	Enable Caller ID with formatted presentation to the DTE. The DCE shall present the data items in a <Tag><Value> pair format. The expected pairs are date, time, caller code (telephone number), and name.
2	Enable Caller ID with unformatted presentation to the DCE. The DCE shall present the entire packet of information, excluding the leading U's (line seizure information), in T.50 printable numbers.

9.2.3.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <pmode> subparameter is out of range.

9.2.3.1.3 Formatted form reporting

The DCE shall not present the Caller Id information if the DCE detects a checksum error in the Caller Id packet (either SDM or MDM) while in this presentation mode. If the DCE receives multiple copies of the Caller Id packets, the DCE shall present one of the correct packets to the DTE. If the DCE has never presented a correct packet, but has received the line seizure information at least once, the DCE shall return <ERRM>< = ><ICLID_202><CR>.

The DCE breaks up the presentation of the date and time into two separate <Tag><Value> pairs for those data items where the date and time appear together.

Table 13/V.253 – Caller Id tags for formatted presentation

Tag	Description
DATE	DATE = MMDD where MM is the month number, 01 through 12, and DD is the day number, 01 through 31. All numbers are in T.50 decimal, and for numbers less than 10, a leading zero character is required.
TIME	TIME = HHMM where HH is the hour number, 00 through 23, and MM is the minute number, 00 through 59. All numbers are in T.50 decimal, and for numbers less than 10, a leading zero character is required.
NMBR	NMBR = <Number> or P or O (T.50 4/15) where <Number> is the telephone number of the caller, where P indicates that the calling number information is not available since the originating caller has requested Private service, and where O indicates that the calling number information is not available because the caller is out of area code.
NAME	NAME = <Listing Name> where <Listing Name> is the subscription listing name
MESG	MESG = <Data Tag><Length of Message><Data><Checksum> in printable T.50 (to avoid possible problems with binary output) numbers. This tag indicates a data item not listed above. The message is only possible for **Multiple Message Format.**

In the event of an unrecognized data tag, the DCE shall present the given data item's information as printable hex numbers following the MESG tag. The DCE shall follow the conventions of the Unformatted Form Reporting (defined below) where applicable for the given data item only. See the examples below. The DCE shall include all **Message Type Octet(s)**, **Message Length Octet(s)**, **Data Octet(s)**, and **Checksum Octet(s)**, if found, for the presentation.

Example 2 – The following example of Formatted Form Reporting illustrates the case where the DCE does not recognize the tag of one given data item from a packet of data items.

```
RING
DATE=0321
TIME=1405
NMBR=5045551234
NAME=DOE JOE
MESG=060342424231

RING
RING
```

Example 3 – The following example illustrates Example 2 in the unsolicited response form of the Voice Mode. See 7.1.2 for a description of the form of the packets for unsolicited response data transfers to the DTE.

```
<DLE><R>
<DLE><X>
DATE=0321
TIME=1405
NMBR=5045551234
NAME=DOE JOE
MESG=060342424231
<DLE><.>
```

<DLE><R>

<DLE><R>

Example 4 – The following example of Formatted Form Reporting illustrates the case where the DCE does not recognize the tag of the packet.

RING

MESG=060342424231

RING

RING

9.2.3.1.4 Unformatted form reporting

The DCE shall present all data items and packet control information, found in the **Single Message Format**, contained in the **Single Data Message** (SDM) and in the **Multiple Data Message** (MDM) packets. The DCE shall, however, exclude the leading U's (line seizure information) from the presentation. The DCE shall include the checksum in the presentation. The DCE shall present the entire Caller Id packet in hex as printable numbers. The T.50 characters in the hex message shall be in the bit order presented to the DCE. The DCE shall not insert spaces, <CR>, or <LF> T.50 codes, for formatting, between the characters of the packet.

The DCE shall not check the checksum, and it is the responsibility of the DTE to check the validity of the message(s). Note that this means that the DCE will present the Caller Id information even if the DCE detects a checksum error in the Caller Id packet (either SDM or MDM) while in this presentation mode. If the DCE receives multiple copies of the Caller Id packets, the DCE shall present all of the packets to the DTE.

The DCE shall present all information contained in the packet in hex as T.50 printable characters. The DCE shall include all **Message Type Octet(s)**, **Message Length Octet(s)**, **Data Octet(s)**, and **Checksum Octet(s)** for the presentation.

Example 5 – The following example illustrates Unformatted Form Reporting.

RING

MESG=0412303332313134303539313435353132333435

RING

RING

9.2.4 DID service

9.2.4.1 +VDID=<digits>,<timeout>

	Default	Mandatory
<digits>	0	0
<timeout>	Manufacturer specific	Manufacturer specific

This command controls the setting and reporting of data associated with DID-type services.

The report is one line having the form:

NDID=<multiple digits><CR><LF>

The <LF> character is optional.

The <DLE> shielded version of these messages (DCE in Voice Mode) is described in 7.1.2.

9.2.4.1.1 Subparameter description

<digits>: This subparameter is the maximum number of digits (DTMF, MF, etc.) the DCE may report after notification of an incoming call by the Telco. The DTE may request that the DCE present no digits (assuming the DCE is capable of reporting DID information) by setting this subparameter to zero. The DCE shall end the DID report presenting the number of digits specified in the <digits> subparameter.

<timeout>: This subparameter is the time interval to wait after the last DCE presented DID digit to wait before assuming that there is no more DID information to follow, and ending the DID digit report. The actual range is manufacturer-specific range in units of 0.01 seconds. The value of zero for this subparameter may have unspecified results.

9.2.4.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if either the <digits> or <timeout> if any of the subparameters are out of range.

9.2.5 Automatic hangup control

9.2.5.1 +VNH=<hook>

	Default	Mandatory
<hook>	0	0,1

This command causes the DCE to enable or disable automatic hangups to a varying degree in the data and facsimile modes. This command is part of a possible DTE call discrimination operation. See 5.3.2 for the main description of the behaviour of the **+VNH** command, and its interaction with the **+FCLASS**, and **ATH** commands. See 5.3.1 for the additional features necessary for call discrimination.

The DTE uses this command by selecting a non-zero **+VNH** setting; this setting becomes effective immediately after the DCE response. The setting remains across a **+FCLASS** Mode switch. The **+VNH** setting resets to zero when:

1) the DTE uses a **+VNH** command to change the setting;
2) the DTE commands another **+FCLASS** Mode change without first issuing another **+VNH** command;
3) a reset event occurs as listed in 5.3.2; or
4) the DCE receives a **+VIP** command.

9.2.5.1.1 Subparameter description

<hook>	Hook control description
0	The DCE retains automatic hangups as is normal in the other modes (such as hanging up the phone when the DCE does not detect a data carrier within a given time interval).
1	The DCE shall disable automatic hangups usually found in the other non-Voice Modes
2	The DCE shall disable automatic hangups in the other non-Voice Modes. The DCE shall only perform a "logical" hangup (return the OK result code).
3-255	Reserved for future standardization

9.2.5.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <hook> subparameter is out of range.

9.3 Miscellaneous AT commands

9.3.1 S-parameters

9.3.1.1 ATSn=<value>

This command will set the Sn parameter to <value>. The DCE will set the nth parameter to zero if no <value> is present. These parameters are common to the data, facsimile, and voice modes, unless explicitly stated otherwise as part of another Recommendation, e.g. Service Class 2.0.

9.3.1.2 ATSn?

The DCE returns a single line of information text. For the Voice Mode, this text shall consist of exactly three characters, giving the value of the S-parameter in decimal, with leading zeros included.

9.3.2 ATZ

This command causes the DCE to reset the DCE to the Data Mode (**+FCLASS=0**), to set all of the data mode parameters to their default values as in Recommendation V.250 (ex-V.25 *ter*), and to enable automatic rate detection (**+IPR=0**). See 6.4.6 for details about implementations without a Data Mode.

10 Voice commands

10.1 Action commands

10.1.1 Initialize voice parameters

10.1.1.1 +VIP (optionally +VIP=<n>)

	Default	Mandatory
<n>	0	0

This command causes the DCE to initialize all the Voice parameters to the manufacturer-determined default settings. This command has no effect on the **+FCLASS** setting, and has the same effect as if the DTE had issued individual parameter setting commands.

Manufacturers may optionally provide a selection of default profiles, chosen by the <n> parameter.

10.1.1.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <n> subparameter is out of range.

10.1.2 Ring local phone

10.1.2.1 +VRL=<ring_duration>[,<silence_duration>[,<ring_duration>]...]

This command is optional. This command causes the DCE to produce ringing voltage to the attached local phone. The command returns the OK result code immediately if all subparameters are found to be properly formatted; the actual production of ringing occurs "asynchronously". No separate

indication is given to the DTE when the specified ring pattern has been completed. If the local phone is off-hook, then the ringing is not performed (although an OK result code is still produced); if the local phone goes off-hook during the ringing, then ring voltage is terminated and the remainder of the ringing is not performed (the DTE is informed of the local phone off-hook condition through the event report defined in Table 10).

10.1.2.1.1 Subparameter description

The **+VRL** command can accept a variable number of subparameters. All subparameters are decimal values in the range 0 to 255, each in increments of 100 milliseconds. The first subparameter indicates the duration of the first ringing segment of the ring pattern; the second subparameter, if present, indicates the duration of the silent period before the next segment of the ring pattern; the third subparameter indicates the duration of the second ringing segment; and so forth, alternatively specifying the duration of the ring and silence segment. Note that it is not necessary to indicate the amount of silence that follows the pattern separating it from the next pattern; it is the responsibility of the DTE to repeat the command (at, typically, 6 second intervals) if additional ring patterns are desired.

The DCE shall support subparameter strings specifying a minimum of three <ring_duration> subparameters; more may be supported.

10.1.2.1.2 Result code

The DCE shall issue the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the DCE encountered an error in parsing the subparameters or if a subparameter value is outside the supported range.

Examples

Example 6 – The following example illustrates the use of the **+VRL** command. The following execution of **+VRL** will produce a standard 2-second ring. Issuing such commands at 6-second intervals would generate the normal North American ring cadence.

+**VRL=20**

Example 7 – The following example illustrates the use of the **+VRL** command. The following execution of **+VRL** will produce a "double-ring" pattern (800 milliseconds of ringing, 400 milliseconds of silence, 800 milliseconds of ringing).

+VRL=8,4,8

Test Syntax

The general format of the information text is:

(<ring_duration_range>).(<silence_duration_range>),<max_ring_duration>

where <ring_duration_range> indicates the supported values for the <ring_duration> subparameters, <silence_duration_range> indicates the supported values for the <silence_duration> subparameters, and <max_ring_durations> indicates the number of <ring_duration> subparameters that can appear in a single +**VRL** command (the <ring_duration> subparameters are presumed to be separated by <silence-duration> subparameters).

If the DCE does not support generation of ringing on the local phone, the information text returned is:

(0),(0),0

The information text response:

(0-255),(0-255),3

indicates that the DCE supports the full range of values for both <ring_duration> and <silence_duration> subparameters, and the minimum three <ring_duration> subparameters per string.

10.1.3 Voice receive state

10.1.3.1 +VRX (optionally +VRX=<n>)

	Default	Mandatory
<n>	0	0

This command causes the DCE to start the voice reception process.

The DCE begins the voice receive mode by returning the CONNECT result code to the DTE. After this report, the DCE sends <DLE> shielded (described in 6.3.7) voice data to the DTE. See Table 12 for the list of possible action commands during a voice receive. The DCE shall send the voice data in the format previously selected by the **+VSM** command.

This Recommendation provides for two ways to leave the Voice Receive State:

1) a <DLE><!>; and

2) a DTE/DCE Inactivity Timer time-out.

The DCE shall inform the DTE, via <DLE> codes, about pertinent events during the voice receive, such as "Presumed End of Message" (QUIET) and "Presumed Hangup" (SILENCE) detected, BUSY detected, and DIALTONE detected, so that, at the discretion of the DTE, the DTE may terminate the Voice Receive State. See Table 11 for a list of possible event determinations and associated <DLE> shielded event reports.

On termination of the Voice Receive State, the DCE shall append a <DLE><ETX> character pair (padding out to an octet boundary may be necessary), followed by the OK result code. The DCE shall return to Voice Command State.

The DTE/DCE Inactivity Timer is in effect while the receive operation is in progress. If the DTE wishes to use this timer and stop the DCE from performing unwanted restarts, the DTE must assure that there are data sent from the DTE to the DCE often enough to refresh the timer; the DTE may use the <DLE><NUL> shielded code as a no-operation command to refresh the timer.

The permitted **+VLS** pre-assigned indices for this command are given in Table 15.

10.1.3.1.1 Subparameter description

<n>	Rx Operation
0	Voice receive operation described above. This selection does not provide for DCE periodical tone production during a voice receive operation. NOTE – This Recommendation presumes that the DTE shall issue the proper notifications of a record operation in progress by message playbacks to satisfy possible legal requirements.
1	Voice receive operation described above. This selection does provide for DCE periodical tone production during a voice receive operation. The tone frequency and cadence is manufacturer specific.
2-127	Reserved for future standardization
128-255	Manufacturer specific

10.1.3.1.2 Result code

The DCE shall return this result code if the DCE accepts the command. The DCE shall return the ERROR result code if the DCE is not connected to the off-hook Telco line, or one non-Telco input device.

10.1.3.1.3 DCE event report capabilities

For a given **+VSM** setting, the DCE shall report the events given by the <rx event> subparameter of the **+VLS=?** Command (see 10.2.4.2) corresponding to the current **+VLS** setting.

10.1.4 Voice duplex state

In general, this Data State is a concatenation of the Voice Transmit State and the Voice Receive State. Note that this Voice Duplex State uses the Non-speakerphone section of the model Voice DCE (see clause 4 for a description of the DCE model).

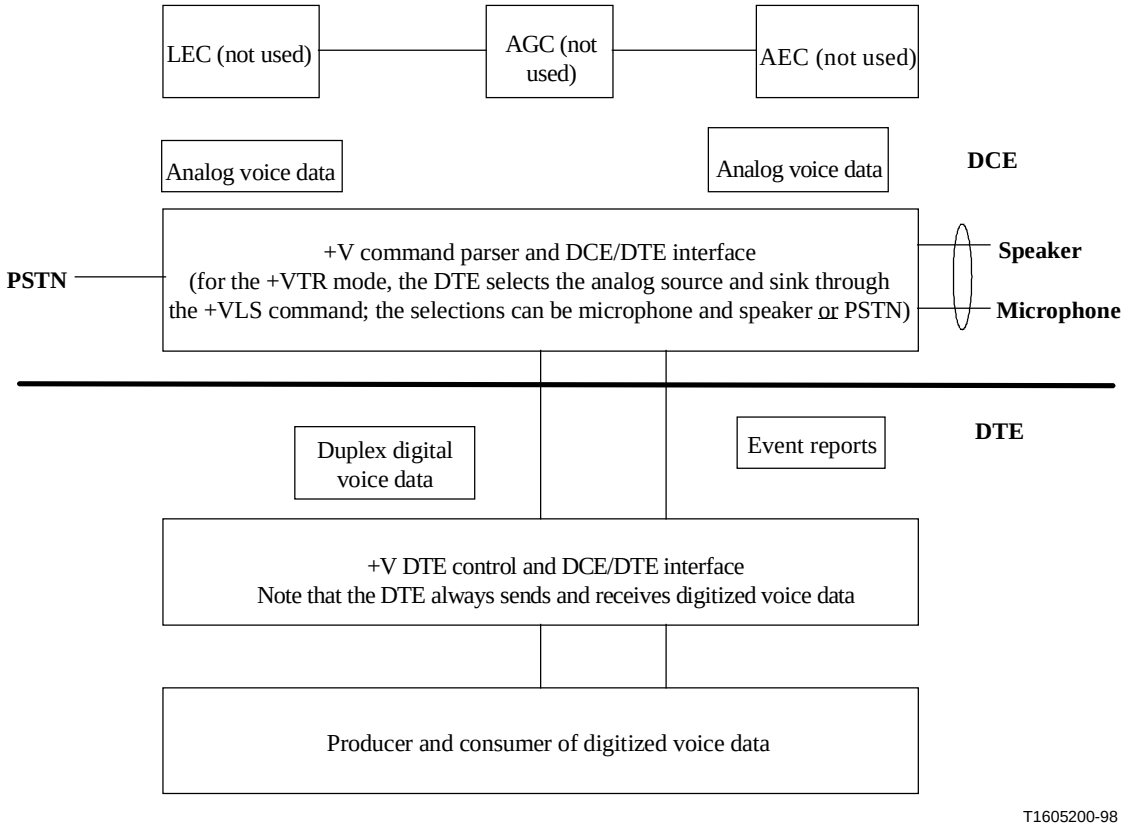


Figure 2/V.253 – +VTR command

10.1.4.1 +VTR

This command causes the DCE to start the voice transmission and reception process. The DCE is not required to perform any Acoustic Echo Cancellation nor any Line Echo Cancellation.

The DCE begins the Voice Duplex State by returning the CONNECT result code to the DTE. After this report, the DCE sends <DLE> shielded (described in 6.3.7) voice data to the DTE, and the DTE can send the <DLE> shielded (described in 6.3.7) voice data. See Table 12 for the list of possible action commands during a voice receive. The DCE shall send the voice data in the format previously selected by the **+VSM** command.

It is recommended that the DCE hold some portion of the voice data, when first starting the Voice Duplex State, before actually transmitting the data over to the analog destination. It is recommended that the DCE shall also delay voice data transfers from the DCE to the DTE by an equal amount.

The DCE shall accept data from the DTE and emit data to the DTE in the format previously selected by the **+VSM** (see 10.2.8) command, and use the flow control method selected by the **+IFC** command.

Gaps in the voice data stream from the DTE to the DCE shall not cause the DCE to terminate the Voice Duplex State. The DCE may perform any synchronization necessary with the DCE to DTE data flow.

The DTE shall signal the termination of the voice data stream by appending a <DLE><ETX> command and padding out to an octet boundary if necessary (Table 12). The DCE shall issue the <DLE><ETX> character pair (thereby ending the DCE to DTE voice data flow) followed by the OK result code, and return to the command mode after the DCE has completely transmitted the contents of its buffer. Note that in the period between the DTE has sent the DCE a <DLE><^> command and

before the DCE has responded with the OK result code, the DTE may issue a limited number of simple commands (i.e. <DLE><CAN>). See Table 12 and 8.3.2.

This Recommendation provides for two ways to leave the Voice Duplex State:

1) a <DLE><^> shielded code; and

2) a DTE/DCE Inactivity Timer time-out.

Item 1) is the DTEs initiated means of terminating the Voice Duplex State, and item 2) is a DCE-initiated means of terminating the Voice Duplex State. After termination of the Data State, the DCE shall enter the Voice Command State.

Note that the DCE shall not leave the Voice Duplex State upon receiving a <DLE><ETX> command or a <DLE><!> command, and shall ignore the aforementioned commands. The use of these commands to transition to half-duplex states is for further study.

The permitted **+VLS** pre-assigned indices for this command are given in Table 15.

10.1.4.2 DCE event report capabilities

For a given **+VSM** setting, the DCE shall report the events given by the bitwise OR'ing of <tx event> and <rx event> subparameters of the **+VLS=?** Command (see 10.2.4.2) corresponding to the current **+VLS** setting.

10.1.4.3 Result code

The DCE shall return the CONNECT result code if the DCE accepts the command. The DCE shall return the ERROR result code if the DCE is not connected to at least one off-hook Duplex PSTN line, or one Duplex non-PSTN device.

10.1.5 DTMF and tone generation in voice

10.1.5.1 +VTS=<string>

	Default	Mandatory
<string>	Null string	DTMF and single tones

This command causes the DCE to produce DTMF tones, single frequency tones, and optionally, double frequency tones. This command allows the DTE to generate dialtones, busy, etc. for those DCEs capable of generating two arbitrary tones.

The DCE may perform tone detection during the playing of tones. The DCE shall accept the <DLE><!> to abort the playing of the tones, return the OK result code, and return to the Voice Command State.

The DTE/DCE Inactivity Timer is in effect while the tone production operation is in progress. If the DTE wishes to use this timer and stop the DCE from performing unwanted restarts, the DTE must assure that there are data sent from the DTE to the DCE often enough to refresh the timer; the DTE may use the <DLE><NUL> shielded code as a no-operation command to refresh the timer.

The DCE's support for the second tone generation is optional.

The DCE shall produce compliant DTMF tones when processing DTMF tone production codes. The DCE need not produce compliant DTMF tones when producing two tones, even if the frequencies are correct for a given DTMF tone.

10.1.5.1.1 Subparameter description

The tone generation string shall consist of elements in a list where each element is separated by commas. Each element can be:

1) a single character in the set, 0-9, #, *, !, and A-D;

2) a string drawn from the set but not including ! enclosed in square brackets, "[]"; or

3) a string enclosed in curly braces. "{}".

The DCE shall interpret item 1), a single character, as a DTMF digit except for ! as a hookflash with a duration given by the **+VTD** command. The DCE shall interpret item 2), quantity in the square brackets, as a general dual tone and duration selection. The DCE shall interpret item 3), quantity in the curly braces, as a DTMF tone or hookflash with a different duration than that given by the **+VTD** command.

Missing subparameters assume the default value. Unspecified values always default to zero for frequencies, DTMF * for DTMF tones, and **+VTD** for duration. The omission of commas (and associated subparameters) is valid.

The quantity in the square brackets consists of a three-element list. The first element is the first frequency, the second element is the second frequency, and the third element is the duration in 0.01 second intervals. A list may contain null elements. For example [3000] means that the DCE generates a single tone at 3000 Hz for the default duration, [3000,3300] means that the DCE generates a dual tone at 3000 and 3300 Hz for the default duration, and [,3300] means that the DCE generates a single tone at 3300 Hz for the default duration.

The quantity in the curly braces consists of a two-element list. The first element is the DTMF tone or hookflash (!) character, and the second element is the duration in 0.01 seconds. The characters are of the same set given above. A list may contain null elements. For example, {2} means DTMF tone "2" for the default duration, and {} means silence for the default duration.

The DCE shall stop the tone generation at the point in the string where the DCE detects a parsing error, encounters an invalid frequency range, encounters a <CR>, or encounters a semi-colon.

10.1.5.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the DCE encountered an error in parsing the <string> subparameter, or if a selected frequency is out of range.

Example 8 – The following example illustrates tone generation without using any null elements. The table, following the example of the tone generation command, illustrates the DCE execution of the command.

```
AT+VTS= {!,30},1,2,[1000,1300,50],!,{*,6},[800,1300,50],9
```

1) Hookflash with a duration of 300 ms.

2) Play DTMF 1 with a duration given by the **+VTD** command.

3) Play DTMF 2 with a duration given by the **+VTD** command.

4) Play tone pair at 1000 Hz and 1300 Hz with a duration of 500 ms.

5) Hookflash with a duration given by the **+VTD** command.

6) Play DTMF * with a duration of 60 ms.

7) Play tone pair at 800 Hz and 1300 Hz with a duration of 500 ms.

8) Play DTMF 9 with a duration given by the **+VTD** command.

Example 9 – The following example illustrates tone generation using null elements. The table, following the example of the tone generation command, illustrates the DCE execution of the command.

```
AT+VTS=1,2,[1000,1300,50],[800],9
```

1) Play DTMF 1 with a duration given by the **+VTD** command.
2) Play DTMF 2 with a duration given by the **+VTD** command.
3) Play tone pair at 1000 Hz and 1300 Hz with a duration of 500 ms.
4) Play tone pair at 800 Hz with a duration given by the **+VTD** command.
5) Play DTMF 9 with a duration given by the **+VTD** command.

Example 10 – The following example illustrates tone generation using null elements and periods of silence. The table, following the example of the tone generation command, illustrates the DCE execution of the command.

```
AT+VTS=1,[,,50],2,[],9
```

1) Play DTMF 1 with a duration given by the **+VTD** command.
2) Play silence with a duration of 500 ms.
3) Play DTMF 2 with a duration given by the **+VTD** command.
4) Play silence with a duration given by the **+VTD** command.
5) Play DTMF 9 with a duration given by the **+VTD** command.

10.1.5.2 +VTS=?

The form of the response for this command follows.

+VTS=?

<freq1>,<freq2>,<dur>

where the <freq1>, <freq2>, and the <dur> subparameters comprise a <compound range of values> (see 6.3.3.4.3). The OK result code follows the string.

10.1.5.2.1 Subparameter description

Zeros are implied in the **+VTS=?** response for the frequencies, even if the DCE does report the zeros. The DCE must support a non-zero <dur> parameter.

<freq1>: First frequency range.

<freq2>: Second frequency range.

<dur>: Duration range for the square brackets and curly braces constructs. The units are in 0.01 seconds. The range of the permitted values for the **+VTD** command (see 10.2.9) shall be inclusive within the range of the <dur> subparameter.

Example 11 – The following example illustrates inquiring about the DCE support of this command. The DCE reports that the DCE supports two frequencies, both in the range 200 to 3300 Hz, and supports a duration range from 0 to 5 seconds. DTE originated commands and data are in bold face.

```
AT+VTS=?
(200-3300),(200-3300),(0-500)
OK
```

Example 12 – The following example illustrates inquiring about the DCE support of this command. The DCE reports that the DCE supports one frequency in the range 200 to 3300, and supports a duration range from 0 to 5 seconds. DTE originated commands and data are in bold face.

AT+VTS=?

(200-3300),(0),(0-500)

OK

10.1.6 Transmit data state

10.1.6.1 +VTX

This command causes the DCE to start the voice transmission process.

The DTE can send the <DLE> shielded (described in 6.3.7) voice data after the DTE receives the CONNECT result code. See Table 12 for the list of simple action commands defined during a voice transmit.

It is recommended that the DCE hold some portion of the voice data, when first starting the voice transmit mode, before actually transmitting the data over to the analog destination. The DCE accepts data from the DTE in the format previously selected by the **+VSM** (see 10.2.8) command, and uses the flow control method selected by the **+IFC** command.

Gaps in the voice data stream from the DTE to the DCE shall not cause the DCE to terminate the Voice Transmit State. It is recommended that the voice data is buffered by the DCE in such a fashion as to withstand gaps of missing data from the DTE. This Recommendation does not mandate a minimum DCE transmit buffer size. If the DCE does have any current voice data, the DCE shall send silence over to the analog destination until the DTE provides more voice data. It is recommended that the DCE hold some portion of the voice data, when re-starting the voice transmit, before actually transmitting the data over to the analog destination.

The DTE shall signal the termination of the voice data stream by appending a <DLE><ETX> command and padding out to an octet boundary if necessary (Table 12). The DCE shall issue the OK result code and return to the command mode after the DCE has completely transmitted the contents of its buffer. Note that in the period between the DTE has sent the DCE a <DLE><ETX> command and before the DCE has responded with the OK result code, the DTE may issue a limited number of simple commands (i.e. <DLE><CAN>). See Table 12 and 8.3.2.

This Recommendation provides for two ways to leave the Voice Transmit State:

1) a <DLE><ETX> shielded code; and

2) a DTE/DCE Inactivity Timer time-out.

Item 1) is the DTE-initiated means of terminating the Voice Transmit State, and item 2) is a DCE-initiated means of terminating the Voice Transmit State. After termination of the Data State, the DCE shall enter the Voice Command State.

The permitted **+VLS** pre-assigned indices for this command are given in Table 15.

10.1.6.1.1 Result code

The DCE shall return the CONNECT result code if the DCE accepts the command. The DCE shall return the ERROR result code if the DCE is not connected to at least one off-hook Telco line, or one non-Telco device.

10.1.6.1.2 DCE event report capabilities

For a given **+VSM** setting, the DCE shall report the events given by the <tx event> subparameter of the **+VLS=?** Command (see 10.2.4.2) in accordance with the current **+VLS** setting.

10.2 Action controls (configuration command)

10.2.1 Receive gain selection

10.2.1.1 +VGR=<gain>

	Default	Mandatory
<gain>	0 or 128	0 or 128

This command causes the DCE to set the gain for the received voice samples.

10.2.1.1.1 Subparameter description

The receive gain is an unsigned octet where values larger than 128 indicate a larger gain than nominal, and values smaller than 128 indicate a gain smaller than nominal. The nominal value is 128. The largest range of numbers is 0 to 255. The DCE may limit the receive gain to a more narrow range, such as 120 to 136 or 120 to 128. The value of zero is reserved for DCE Automatic Gain Control (AGC).

10.2.1.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <gain> subparameter is out of range.

10.2.2 Volume selection

10.2.2.1 +VGT=<level>

	Default	Mandatory
<level>	0 or 128	0 or 128

This command causes the DCE to set the volume level, either by amplifying or attenuating the signal, for the transmitted voice samples.

10.2.2.1.1 Subparameter description

The transmit gain (or attenuation) is an unsigned octet where values larger than 128 indicate a larger gain than nominal, and values smaller than 128 indicate a smaller gain (or larger attenuation) than nominal. The nominal value is 128. The largest range of numbers is 0 to 255. The DCE may use a more narrow range, such as 120 to 136 or 120 to 128. The value of zero is reserved for DCE Automatic Volume Control (AVC).

10.2.2.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <level> subparameter is out of range.

10.2.3 DTE/DCE inactivity timer

10.2.3.1 +VIT=<timer>

	Default	Mandatory
<timer>	0	0

This command sets the DCE's initial value for the DTE/DCE Inactivity Timer. See 6.4.5 for a description of the DTE/DCE Inactivity Timer.

10.2.3.1.1 Subparameter description

The permitted timer range is given by the **+VIT=?** command. The units are in 1.0 seconds. The DTE can disable the Inactivity Timer by using a value of zero.

10.2.3.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <timer> subparameter is out of range.

10.2.4 Analogue source/destination selection

10.2.4.1 +VLS=<label>

	Default	Mandatory
<label>	Manufacturer specific	Manufacturer specific

This command causes the DCE to select one or more source/destinations of the analog data.

10.2.4.1.1 Subparameter description

The DTE uses an integer, the <label> subparameter, as a label to identify each of the DCE supported analog source/destination hardware configurations. This Recommendation uses Primitives to describe which voice I/O device (e.g. speaker) are components in a possible hardware configuration, and has grouped these Primitives in order to define and label sixteen common configurations.

Primitives are <string constant>s with one T.50 character code optionally followed by an T.50 number code. The Primitives, "L" and "T", cannot have number codes. This Recommendation equates a Primitive with a single character code, and a Primitive with a character code followed by the "0" code (T.50 2/0). Table 14 lists the defined Primitives. A concatenation of the Primitives describes a possible analog source/destination hardware configuration. Table 15 contains sixteen commonly-used hardware configurations, and the Primitive grouping and <label> subparameter value used to select this configuration.

Values after the first sixteen values are available for manufacturer-specific hardware configurations.

Table 14/V.253 – Codes for voice I/O primitives

Primitive code	Description
L	Local Phone
T	Telco Line
M0	Internal Microphone
M1	External Microphone
S0	Internal Speaker
S1	External Speaker
H0	External Microphone and Speaker combination (handset or headset)
Zn	Manufacturer-specific device (n> = 0)
Mn	Manufacturer-specific extension (n>1)
Sn	Manufacturer-specific extension (n>1)
Hn	Manufacturer-specific extension (n>0)

Table 15/V.253 – Pre-assigned voice I/O labels

<label>	Primitives	Description	+VTX	+VRX	+VTR	+VSP=1	+VSP=2	+VSP=3	+VSP=4
0	None	DCE on-hook. Local phone connected to PSTN.							
1	T	DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.	✓	✓	✓		✓		✓
2	L	DCE on-hook. Local phone connected to DCE.	✓	✓	✓				
3	LT	DCE off-hook. Local phone connected to PSTN. DCE connected to PSTN.	✓	✓	✓				
4	S	Internal Speaker connected to DCE. DCE on-hook. Local phone connected to PSTN.	✓						
5	ST	Internal Speaker connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.	✓	✓	✓				
6	M	Internal Microphone connected to DCE. DCE on-hook. Local phone connected to PSTN.		✓					
7	MST	Internal Microphone and Internal Speaker connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.				✓			
8	S1	External Speaker connected to DCE. DCE on-hook. Local phone connected to PSTN.	✓						
9	S1T	External Speaker connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.	✓	✓	✓				

Table 15/V.253 – Pre-assigned voice I/O labels *(concluded)*

<label>	Primitives	Description	+VTX	+VRX	+VTR	+VSP=1	+VSP=2	+VSP=3	+VSP=4
10	MS1T	Internal Microphone and External Speaker connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.				✓			
11	M1	External Microphone connected to DCE. DCE on-hook. Local phone connected to PSTN.		✓					
12	M1ST	External Microphone and Internal Speaker connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.				✓			
13	M1S1T	External Microphone and External Speaker connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.				✓			
14	H	External Microphone and Speaker combination (handset or headset) connected to DCE. DCE on-hook. Local phone connected to PSTN.	✓	✓	✓				
15	HT	External Microphone and Speaker combination (handset or headset) connected to PSTN. DCE off-hook. DCE connected to PSTN. Local phone provided with power to detect hook condition.	✓	✓	✓				
16	MS	Internal Microphone and Internal Speaker connected to DCE			✓			✓	✓
17	MS1	Internal Microphone and External Speaker connected to DCE			✓			✓	✓
18	M1S	External Microphone and Internal Speaker connected to DCE			✓			✓	✓
19	M1S1	External Microphone and External Speaker connected to DCE			✓			✓	✓

10.2.4.1.2 Result codes

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <label> subparameter is out of range, or if the DCE cannot service the request in the <label> subparameter.

10.2.4.2 +VLS=?

The form of the response for this command follows.

+VLS=?

<label>,<devices>,<transmit event>,<receive event>,<idle event>

where the <label> subparameter is a label that identifies the DCE analog source/destination hardware configuration, the <devices> subparameter is a <string constant> (See 6.3.3.3.2) made up of Primitives, and the <transmit event>, the <receive event>, and the <idle event> subparameters are the DCE event reporting capabilities for the Voice Transmit State, Voice Receive State, and the Voice Command State, respectively. Each of the event reporting subparameters is a hex number that

represents an event bit field. The hex number format is given in 4.2, with each bit defined in Table 1; a one in the bit field indicates that the DCE can report the associated event.

Each of the possible hardware configurations has its own <label>, ..., <idle event> description line (the above form description shows just one). A <CR><LF> separates each description line from another. Note that the event reporting capability is closely tied to the description of the hardware configuration.

The DCE detectable events depend on the compression method selected by the **+VSM** (see 10.2.8). The DTE can learn the event reporting capabilities of the Voice Duplex State by the bitwise or'ing of the <transmit event> and <receive event> subparameters.

Example 13 – The following example illustrates inquiring about the DCE supported analog source/destination hardware configurations and event detection capabilities for the selected compression method. DTE originated commands and data are in bold face.

AT+VLS=?

0,"",0A000100,0E601800,1A803840

1,"T",0A000100,0E601800,1A803840

OK

10.2.5 Ringing tone goes away timer

10.2.5.1 +VRA=<interval>

	Default	Mandatory
<interval>	50	50

The DCE only uses this command in call origination transactions. This command sets the amount of time the DCE shall wait between Ringing Tone before the DCE can assume that the remote station has gone off-hook.

The **+VRA** command does not effect Quiet Answer (@) dial modifier. The **+VRA** command is the same as @ at the end of the dial string.

10.2.5.1.1 Subparameter description

The units are in 0.10 second increments. A value of zero forces the DCE to return the OK result code immediately after the first Ringing Tone.

The <interval> subparameter refers to the silence interval length between the end of one ring interval and the start of the next ring interval.

10.2.5.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <interval> subparameter is out of range.

10.2.6 Ringing tone never appeared timer

10.2.6.1 +VRN=<interval>

	Default	Mandatory
<interval>	10	10

The DCE only uses this command in call origination transactions. This command sets the amount of time the DCE will wait looking for Ringing Tone. If the DCE does not detect Ringing Tone in this time period, the DCE shall assume that the remote station has gone off-hook, and return a OK result code.

10.2.6.1.1 Subparameter description

A **+VRN** setting more than the S7 parameter means that only the S7 timer is in effect.

The units are in 1.0 second increments. A value of zero forces the DCE to immediately return the OK result code after dialling.

10.2.6.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <interval> subparameter is out of range.

10.2.7 Silence detection (QUIET and SILENCE)

10.2.7.1 +VSD=<sds>,<sdi>

	Default	Mandatory
<sds>	128	128
<sdi>	50	0,50

This command causes the DCE to set the silence detection sensitivity, and the required period of silence before the DCE reports silence detected at the end of a voice receive either with the "Presumed End of Message" (QUIET) or "Presumed Hangup" (SILENCE) event reports. The DTE may select for the DCE, if available, to use the same silence detection sensitivity selection for both the silence compression and silence detection (for end of voice receive).

This command sets the length of a time interval, which must contain no or little activity from the analog source, before the DCE can report the end of a voice receive operation. The voice activity determination algorithm is determined by the DCE manufacturer.

The DCE may return two different event reports, "Presumed End of Message" (QUIET) (<DLE><q>) or "Presumed Hangup" (SILENCE) (<DLE><s>), when the above-mentioned time interval expires. The difference lies in whether the DCE detected any voice activity during the given voice receive operation. See Table 11 for an explanation of the difference from the DCE point of view.

10.2.7.1.1 Subparameter description

Table 16 describes the possible coupling of the **+VSD** and **+VSM** (see 10.2.8) commands through the <sds> subparameter. A <sdi> subparameter value of zero always means that the long-term silence detection is disabled. Note that long-term silence detection refers to the probable use of this function to detect the end of a voice receive (the user stops talking).

Table 16/V.253 – Relationship between the <sds> and silence compression subparameters

+VSD <sds>	+VSM silence compression in use	+VSM silence compression not in use or the DCE does not support silence compression
0	Use **+VSM** silence compression setting and algorithm for long-term silence detection	Use manufacturer's default long-term silence detection level and algorithm
Not 0	Sets long-term silence detection setting independent of presence or use of silence compression. <sds> = 128; nominal level of sensitivity. <sds> > 128; more aggressive [less sensitive, higher noise levels considered to be silence]. <sds> < 128; less aggressive [more sensitive, lower noise levels considered to be silence].	

<sds>: The DTE uses this subparameter to select greater amounts of DCE silence detection activity; larger values of this subparameter imply that the DTE wants the DCE to treat noisier conditions as silence.

NOTE – This actual value of this subparameter has no physical meaning, such as energy, since the process of silence compression may consider other parameters that are not easy to quantify alone or as a total algorithm.

Manufacturer specific range with 128 as nominal. The largest range of numbers is 0 to 255. The DCE may limit the Silence Detection Sensitivity to a more narrow range, such as 120 to 136 or 120 to 128. Zero has special meaning as described in Table 16.

<sdi>: The required period of silence before the DCE can report silence detected either with the "Presumed End of Message" (QUIET) or "Presumed Hangup" (SILENCE) event reports. A value of zero disables the DCE silence detection; the DCE shall not report any "Presumed End of Message" (QUIET) or "Presumed Hangup" (SILENCE) event reports.

Manufacturer specific range in units of 0.1 seconds.

10.2.7.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if one or more of the following conditions apply:

1) if the <sds> or the <sdi> subparameter is out of range; or

2) if any of the two subparameters are missing from the command tail.

In the event of any error, the DCE shall maintain the previous values for the two subparameters.

10.2.8 Compression method selection

10.2.8.1 +VSM=<cml>,<vsr>,<scs>,<sel>

	Default	Mandatory
<cml>	Manufacturer specific <9	Any value 0-8
<vsr>	Manufacturer specific	Manufacturer specific
<scs>	128	128
<sel>	0	0

This Recommendation specifies that support for at least one of the compression methods listed in Table 17 is mandatory. Support for any of these compressions implies real-time compression (e.g. during voice transmit and voice receive operations).

This command causes the DCE to set the voice compression method, the silence compression sensitivity, and the voice sampling rate. The DCE can maintain different event detection capability for each compression method (see 5.5).

This Recommendation provides facilities for DCE labelling of compression methods.

This command allows the DTE to set the amount of silence compression appropriate to a given situation. For example, the DTE may wish to record the welcome message with the least amount of silence removal with the presumption that the message would also have less distortion, while the DTE may wish to record other messages with a more aggressive silence removal in order to save disk space.

10.2.8.1.1 Subparameter description

<cml>: The DTE uses this subparameter to select a compression method. This subparameter is the means to select the Compression Method, and has the form of a <numerical constant>. The DTE can obtain the label and a <string constant> identifier by using the **+VSM=?** command.

Values in the range of 0 to 127 are specified in this Recommendation or reserved for future standardization. Values greater than 127 are manufacturer specific.

<vsr>: The DTE selects the DCE voice sampling rate from among those supported; listed in the response of the **+VSM=?** command.

The units are samples per second.

<scs>: This subparameter has different interpretations depending on whether the DCE is transmitting or receiving voice.

On a voice receive, the DTE uses this subparameter to select greater amounts of DCE silence compression activity; larger values of this subparameter imply that the DTE wants the DCE to treat noisier conditions as silence. The actual value of this subparameter has no physical meaning, such as energy, since the process of silence compression may consider other parameters that are not easy to quantify alone or as a total algorithm. A value of zero disables the DCE silence compression.

For a voice transmit, the DTE signals the DCE that the data stream was recorded with silence compression by selecting an in-range non-zero value for this subparameter (same value as receive). The DTE enabling of silence compression for transmit of a voice data stream not recorded with silence compression enabled, or the disabling of silence compression for transmit of a voice data stream recorded with silence compression enabled may produce unpredictable results. The DTE can modify the silence expansion by using the <sel> subparameter.

The range is manufacturer specific with 128 as nominal. The largest range of numbers is 0 to 255. The DCE may limit the Silence Compression Sensitivity to a more narrow range, such as 120 to 136 or 120 to 128. Zero means disable silence compression. Refer to Table 17 to see the procedure to use this subparameter in long-term silence detection.

<sel>: The DTE can modify the amount of silence expansion by selecting a non-zero value. This subparameter represents the maximum amount of silence the DCE will expand a period of silence previously deleted with a non-zero <scs> subparameter. A selection of zero for the <sel> subparameter means that the DCE shall not modify the silence expansion.

The range is manufacturer specific in units of 0.1 seconds. The DCE shall ignore this subparameter if <scs> subparameter is zero (silence compression not active).

10.2.8.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if one or more of the following conditions apply:

1) if any of the subparameters are out of range; or

2) if any of the four subparameters is missing from the command tail.

In the event of any error, the DCE shall maintain the previous values for the three subparameters.

10.2.8.2 +VSM=?

The form of the response for this command follows.

+VSM=?

<cml>,<cmid>,<bps>,<tm>,<vsr>,<scs>,<sel>

where the <cml>, <cmid>, <bps>, <tm>, <vsr>, <scs>, <sel> subparameters make up a <compound range> (see 6.3.3.4.3). A <CR><LF> separates each description line from another. Each compression method may have one or more description lines. This would occur to enumerate different bits per sample or Timing Marks enable or disable for the given compression method. The OK result code follows the last description line.

10.2.8.2.1 Subparameter description

<cml>: This subparameter is a numerical label of the Compression Method. See the "#" column in Table 17 for a list of numerical labels.

<cmid>: This subparameter is a string describing the Compression Method. See Table 17 for identifiers.

<bps>: This subparameter is a <numeric constant> (see 6.3.3.3.1) that contains the average number of bits in the compressed sample not including silence compression.

<tm>: This subparameter is a <numeric constant> (see 6.3.3.3.1). If <tm>=0, the compression method does not support timing marks (see 5.4); otherwise the DCE supports timing marks for this Compression Method. If <tm> is non-zero, the integer represents the time interval between timing marks in units of 0.1 seconds.

<vsr>: This subparameter is a <range of values> (see 6.3.3.4.2) that contains the DCE supported range of voice samples per second of the analog signal.

<scs>: This subparameter is a <range of values> (see 6.3.3.4.2) that contains the DCE supported range of sensitivity settings for voice receives.

<sel>: This subparameter is a <range of values> (see 6.3.3.4.2) that contains the DCE supported range of expansion values for voice transmits.

10.2.8.2.2 Compression method identifiers

This Recommendation does not make any provisions to insure that manufacturer-specific compression identifiers are unique, except as shown in Table 17. Manufacturers compliant with this Recommendation may not use numeric labels in the range 0-127, except as indicated in Table 17. Manufacturers may list their compression method identifier by selecting additional identifiers, and numeric labels in the range 128-255, on a cooperative basis, with other manufacturers. Where compression type string identifiers overlap, it is expected that Manufacturers will cooperatively select unique author identifiers and numeric labels. This Recommendation does not make, or foresee to make, any provisions to enforce any policy, or to arbitrate conflicts, in the selection of compression methods identifiers.

The compression method identifiers for specified compression types (numeric labels in the range 0-127) shall have the form – <cmid> where <cmid> is the general classification of the compression method.

The compression method identifiers for manufacturer-specific coding (numeric labels in the range 128-255) shall have the form – <cmid>/<author> where <cmid> is the general classification of the compression method, and <author> is the source of the method. The source of the field may reference a published Recommendation or a proprietary method. The </> character shall not appear in the <cmid> and <author> fields. The start of the source field shall begin after the </> character. Each field shall not exceed 20 characters.

Table 17/V.253 – Compression method identifier numerics and strings

#	String identifier	Description
0	SIGNED PCM	Linear PCM sampling using two complement signed numbers
1	UNSIGNED PCM	Linear PCM sampling using unsigned numbers
2	RESERVED	
3	G.729.A	G.729 Annex A – Recommendation V.70 DSVD default coder.
4	G.711U	μ-Law companded PCM
5	G.711A	A-Law companded PCM
6	G.723	H.324 Low bit rate videotelephone default speech coder
7	G.726	ITU-T 40, 32, 24, 16 kit/s ADPCM.
8	G.728	H.320 Low bit rate videotelephone speech coder
9-127		Reserved for future standardization
128-255		Manufacturer specific

Example 14 – The following example illustrates inquiring about the DCE support of the compression methods and other data. The DCE reports that the DCE supports two compression methods. DTE originated commands and data are in bold face.

AT+VSM=?

```
0,"SIGNED PCM",12,0,(7200-8000,11025),(127-129),(0-50)
2,"IMA ADPCM",2,40,(7200),(128),(0-50)
OK
```

10.2.9 Beep tone duration timer

10.2.9.1 +VTD=<dur>

	Default	Mandatory
<dur>	100	100

This command causes the DCE to set the default DTMF/tone generation duration used in conjunction with the **+VTS** command (see 10.1.5).

This command does not affect the settings for the **ATD** command.

10.2.9.1.1 Subparameter description

<dur>: The permitted timer range is given by the **+VTD=?** command. The units are in 0.01 seconds. A value of zero specifies a manufacturer-specific time interval.

10.2.9.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <dur> subparameter is out of range.

10.3 Response controls (configuration commands)

10.3.1 Distinctive ring (ring cadence reporting)

10.3.1.1 +VDR=<enable>,<report>

	Default	Mandatory
<enable>	0	0,1
<report>	0	0-60

This command causes the DCE to enable or disable reporting of the ring cadence information, and to control the timing of the RING event code report if ring cadence reporting is enabled.

The form of the report is one line per ring period and one line per silence period. The DCE shall report the length of the ring period in the form – DROF=<number in units of 0.1 seconds> <CR><LF>, and the length of the silence period in the form – DRON=<number in units of 0.1 seconds>. The <LR> character is optional. The DCE may produce a RING event code after the DRON message if enabled by the <report> subparameter. The <report> subparameter should be set to a value larger than the expected off-times within a single pattern so that the RING event reports are issued only during the off-times between the complex patterns. A distinctive ring report will always begin with a DRON message. The DCE will report as much of the first ring period (on-time) as is delivered by the central office. Since the first ring period (on-time) may not be delivered in whole, software should regard the first DRON message possibly only as partial information regarding the first ring period (on-time).

The <DLE> shielded version of these messages (DCE in Voice Mode) is described in 7.1.2.

10.3.1.1.1 Subparameter description

<enable>	<report>	Description
0	N/A	The DCE will not produce any ring cadence report. The DCE shall report other call progress event codes (including RING) as normal.
1	0	The DCE will only produce DROF and DRON messages. The DCE will not produce any RING event codes. The DCE shall report other call progress event codes as normal.
1	Non-zero	The DCE will only produce DROF and DRON messages. The DCE will produce a RING event code after <report>/10 seconds after the falling edge of the ring pulse (i.e. after the DRON report).
2-255	Reserved	Reserved for future standardization

10.3.1.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if any of the subparameters are out of range.

Example 15 – The following example illustrates the ring cadence reporting and RING event code reporting enabled. The example shows an on-time of 2.0 seconds and an off-time of 4.0 seconds. The enabling command for this example is **+VDR=1,5**. The RING event code appears 0.5 seconds after the DRON message. DTE originated commands and data are in bold face.

```
DRON=20
RING
DROF=40
DRON=20
RING
DROF=40
DRON=20
RING
DROF=40
```

Example 16 – The following example illustrates the Voice Mode version of the last example. The example shows one possible way of including the data into packets. DTE originated commands and data are in bold face.

```
<DLE><X>
DRON=20
RING
DROF=40
<DLE><.>
<DLE><X>
DRON=20
RING
DROF=40
<DLE><.>
<DLE><X>
DRON=20
RING
DROF=40
<DLE><.>
```

Example 17 – The following example shows a cadence with an on-time of 0.8 seconds, an off-time of 0.4 seconds, an on-time of 0.8 seconds and an off-time of 4.0 seconds. The enabling command for this example is **+VDR=1,5**. The RING event code appears 0.5 seconds after the last DRON message. DTE originated commands and data are in bold face.

```
<DLE><X>
DRON=8
DROF=4
```

DRON=8
RING
DROF=40
<DLE><.>
<DLE><X>
DRON=8
DROF=4
DRON=8
RING
DROF=40
<DLE><.>
<DLE><X>
DRON=8
DROF=4
DRON=8
RING
DROF=40
<DLE><.>

Example 18 – The following example illustrates the Call Waiting version of the last example. DTE originated commands and data are in bold face.

<DLE><X>
CWON=8
CWOF=4
CWON=8
RING
CWOF=40
<DLE><.>
<DLE><X>
CWON=8
CWOF=4
CWON=8
RING
CWOF=40
<DLE><.>
<DLE><X>
CWON=8
CWOF=4
CWON=8

RING

CWOF=40

<DLE><.>

10.3.2 Control tone cadence reporting

10.3.2.1 +VDT=<enable>,<report>

	Default	Mandatory
<enable>	0	0,1

This command allows the DCE to enable or disable reporting of the control tone cadence information in the frequency band used by the Ringing, BUSY, and Reorder/Fast Busy tones (usually in the 300 to 600 Hz range). This reporting is subject to the tone detection restrictions reported by the **+VLS=?** command. The DCE must be capable of monitoring at least one of these tones for the given **+VLS** setting, before the DCE can generate any cadence reports (assuming the DCE supports this command and cadence reporting is enabled). While this command is in effect, the DCE shall not produce the above-mentioned cadence information event reports.

The form of the report is one line per silence period and one line per ring period. The DCE shall report the length of the silence period in the form – CPOF=<number in units of 0.1 seconds> <CR><LF>, and the length of the ring period in the form – CPON=<number in units of 0.1 seconds>. The <LR> character is optional.

The <DLE> shielded version of these messages (DCE in Voice Mode) is described in 7.1.2.

10.3.2.1.1 Subparameter description

<enable>	<report>	Description
0	N/A	The DCE will not produce any control tone cadence report. The DCE shall report the control tone event codes as normal.
1	0	The DCE will only produce CPOF and CPON messages. The DCE will not produce any Ringing, BUSY, or Reorder/Fast Busy tones event codes. The DCE shall report other control tone event reports as normal.
1	Non-zero	For further study
2-255	Reserved	Reserved for future standardization

10.3.2.1.2 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the subparameter is out of range.

Example 19 – The following example illustrates the control tone cadence reporting enabled. The example shows an on-time of 2.0 seconds and an off-time of 4.0 seconds. The enabling command for this example is +**VDT=1**. DTE originated commands and data are in bold face. Note the absence of the Ringing, BUSY, and Reorder/Fast Busy tone event reports.

CPOF=40

CPON=20

CPOF=40

CPON=20

CPOF=40

CPON=20

Example 20 – The following example illustrates the Voice Mode version of the last example. The example shows one possible way of including the data into packets. DTE originated commands and data are in bold face. Note the absence of the Ringing, BUSY, and Reorder/Fast Busy tone event reports.

<DLE><X>

CPOF=40

CPON=20

<DLE><.>

<DLE><X>

CPOF=40

CPON=20

<DLE><.>

<DLE><X>

CPOF=40

CPON=20

<DLE><.>

10.4 DTE/DCE interface (configuration commands)

10.4.1 Buffer threshold setting

The DCE may optionally implement the **+ITF** command in Recommendation V.80 in order to control the setting of the transmit buffer flow control thresholds. Also, for interoperability with existing voice DTE, the DCE may optionally implement the **+VBT** command as described in Annex A.

10.4.2 Voice packet protocol

10.4.2.1 +VPP=<enable>

	Default	Mandatory
<enable>	0	0

This command causes the DCE to enable or disable the Packet Protocol for Voice Mode. This Recommendation extends the T.32 definitions of the protocol to accommodate the many new unsolicited result codes for voice.

Specifically, the protocol described in Recommendation T.32 was:

1) designed to support Facsimile DCE, such as those defined in Recommendations T.31 and T.32; and

2) designed to support communication on serial asynchronous connections, such as V.24 circuits.

With the DTE implementation of the necessary procedures, this protocol may be used to detect lost octets on the DCE-to-DTE serial link, and to recover the lost octets by requesting retransmission.

This protocol makes two assumptions: that data corruption is not a problem on the communications link, and that the last octet sent will never be lost due to data overrun (i.e. that newer octets always overwrite previous octets in the communications input buffer, this is the design of common UARTs).

For rates greater than 19 200 bit/s, the time between asynchronous characters is less than 1/1920 = 521 μs (μs = microseconds). There are many processes in common DTE (e.g. personal computers) that cause serial input channels to be neglected for longer than 500 μs; data loss is a constant hazard. If a character is lost in the received data, the playback of the voice data may be impaired or lost; if a character is lost in a DCE final result code, the connection may fail. This protocol permits recovery from such data loss so that no data are lost.

This Packet Protocol uses control characters defined in Recommendation T.50. Control characters are represented in this Recommendation by the defined mnemonic designation enclosed in angle brackets (e.g. <ACK>).

This Recommendation extends Recommendation T.32 to allow for full-duplex error detection and recovery. The differences are described below.

1) Lengths of 11 hex and 13 hex are not permitted in either direction. Recommendation T.32 only allows the DCE to return packet lengths.
2) <ACK>, <NAK>, and <ENQ> are used for protocol control in both directions. Recommendation T.32 uses these characters in the DTE-to-DCE direction only.
3) <DLE><F> shields the <ACK> character in the data stream for both directions. Recommendation T.32 does not shield this character.
4) <DLE><U> shields the <NAK> character in the data stream for both directions. Recommendation T.32 does not shield this character.
5) <DLE><G> shields the <ENQ> character in the data stream for both directions. Recommendation T.32 does not shield this character.
6) <DLE><M> shields the <SOH> character in the data stream for both directions. Recommendation T.32 only shields this character in the DCE-to-DTE direction.
7) <DLE><W> shields the <ETB> character in the data stream for both directions. Recommendation T.32 only shields this character in the DCE-to-DTE direction.

10.4.2.1.1 Subparameter description

<enable>: A value of zero shall disable the Voice Packet Protocol. A value of one shall enable the protocol. The values 2-255 are reserved for future standardization.

10.4.2.1.2 Result codes

The DCE shall return the OK result code if the DCE accepts the command (sent at the current speed before the DCE switches the rate). The DCE shall return the ERROR result code if the <enable> subparameter is out of range.

10.4.3 Select DTE/DCE interface rate (turn off automatic rate detection)

10.4.3.1 +IPR=<rate>

	Default	Mandatory
<rate>	Manufacturer specific	Manufacturer specific

This command causes the DCE to select between various fixed DTE/DCE Interface Rates and automatic rate detection.

See also 6.2.10/V.250 (ex-V.25 *ter*).

See 6.4.5 for a discussion of the role of the DTE/DCE Inactivity Timer in a fixed DTE/DCE Interface Rate environment.

NOTE – For interoperability with existing DTE, the DCE may also support the **+VPR** command as defined in Annex A.

10.5 Speakerphone commands

The DCE may, optionally, implement Speakerphone functionality. The following commands control Speakerphone operation.

10.5.1 Voice speakerphone state

Note that the Voice Speakerphone State uses the Speakerphone section of the model Voice DCE (see clause 4 for a description of the DCE model).

In the Voice Speakerphone State, the DCE shall perform Acoustic Echo Cancellation and/or Line Echo Cancellation (in accordance with the **+VSP** command).

The Voice Speakerphone State has four different modes. One mode involves no data transfer between the DCE and DTE. The four possible configurations are illustrated below. Figure 3 illustrates **+VSP=1**; note that the DTE and DCE exchange no digitized voice data in this mode. Figures 4, 5, and 6 illustrate **+VSP=2**, **+VSP=3**, and **+VSP=4**, respectively; note that the DTE and DCE exchange digitized voice data for these modes. For all non-zero **+VSP** settings, if the DCE supports event reports (**+VEM=1**), the DCE shall send event reports to the DTE as indicated by the selected **+VLS** Command (see 10.2.4.2). The permitted **+VLS** pre-assigned indexes for this command are given in Table 15.

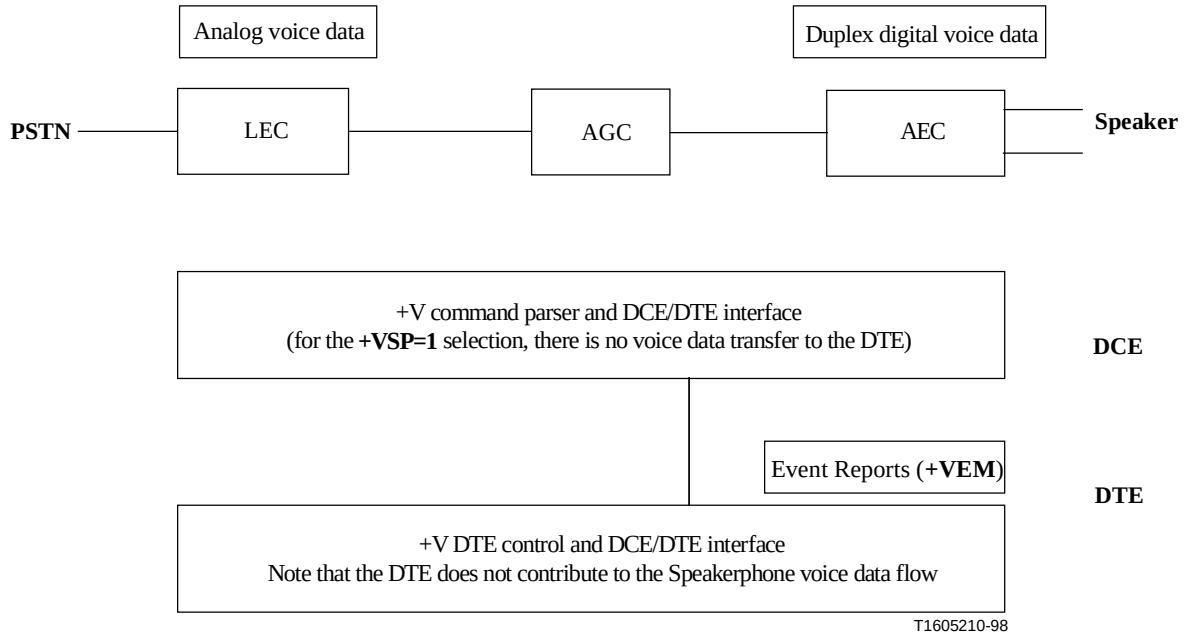


Figure 3/V.253 – PSTN ↔ DCE microphone and speaker (+VSP=1)

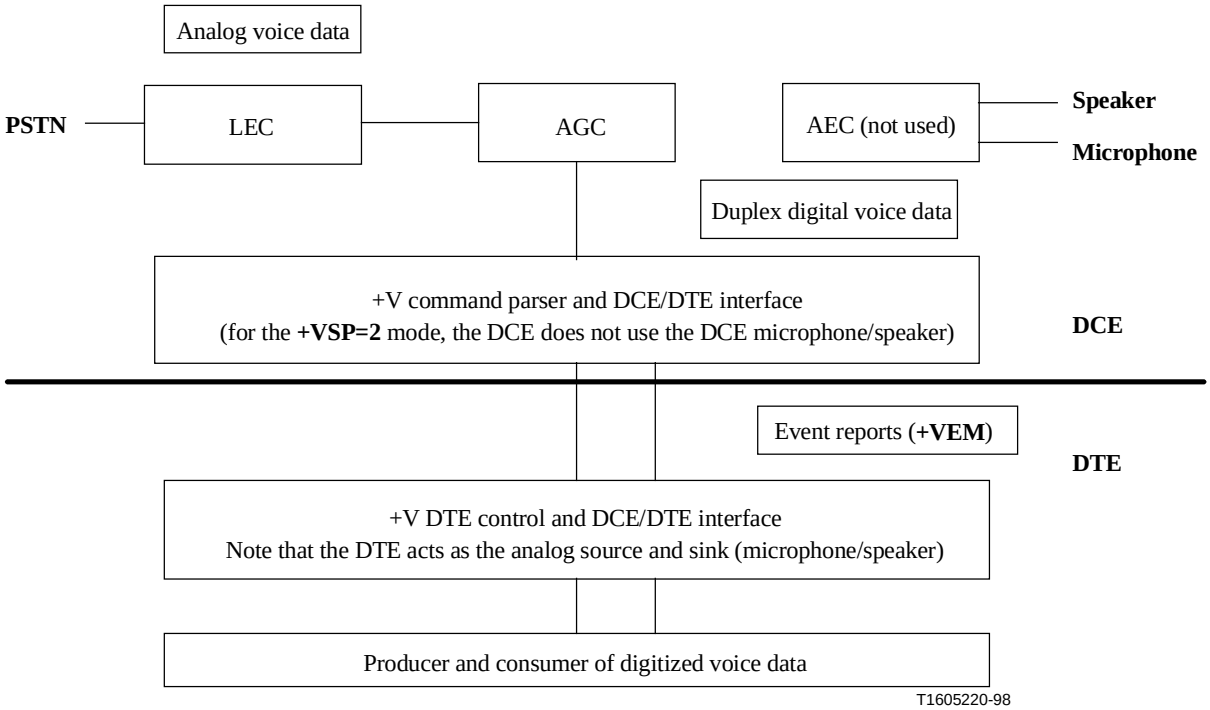


Figure 4/V.253 – PSTN ↔ DTE (+VSP=2)

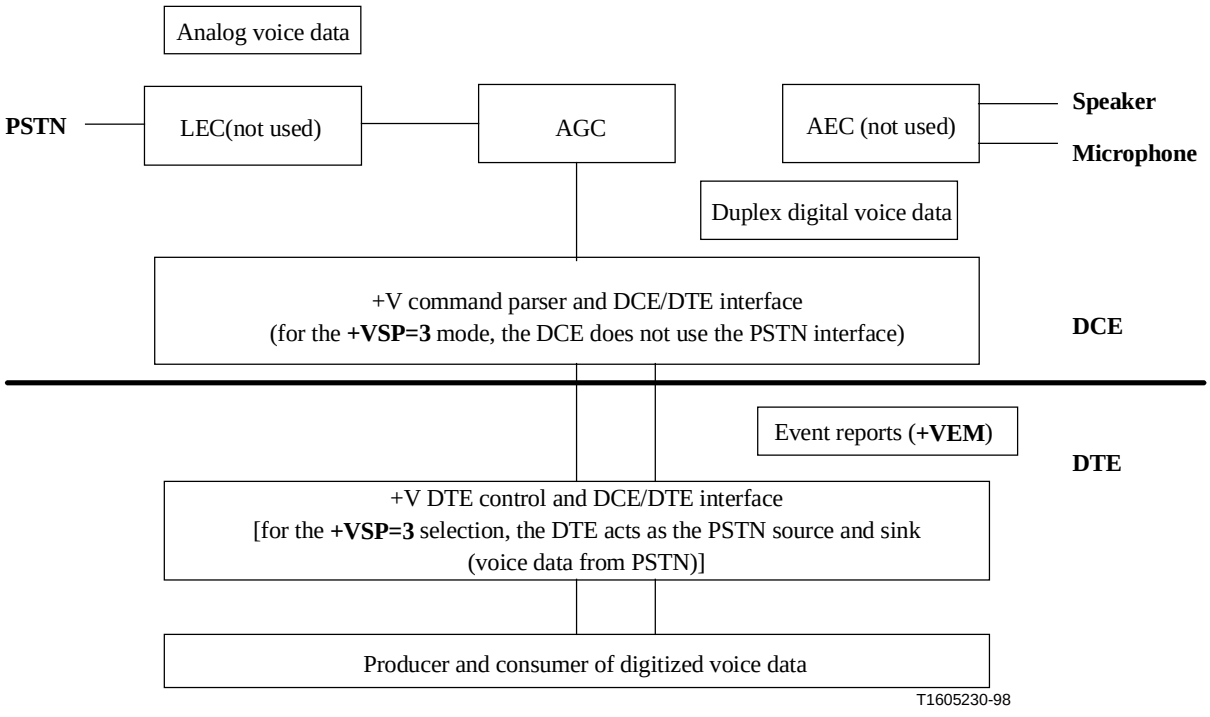


Figure 5/V.253 – DTE ↔ DCE microphone and speaker (+VSP=3)

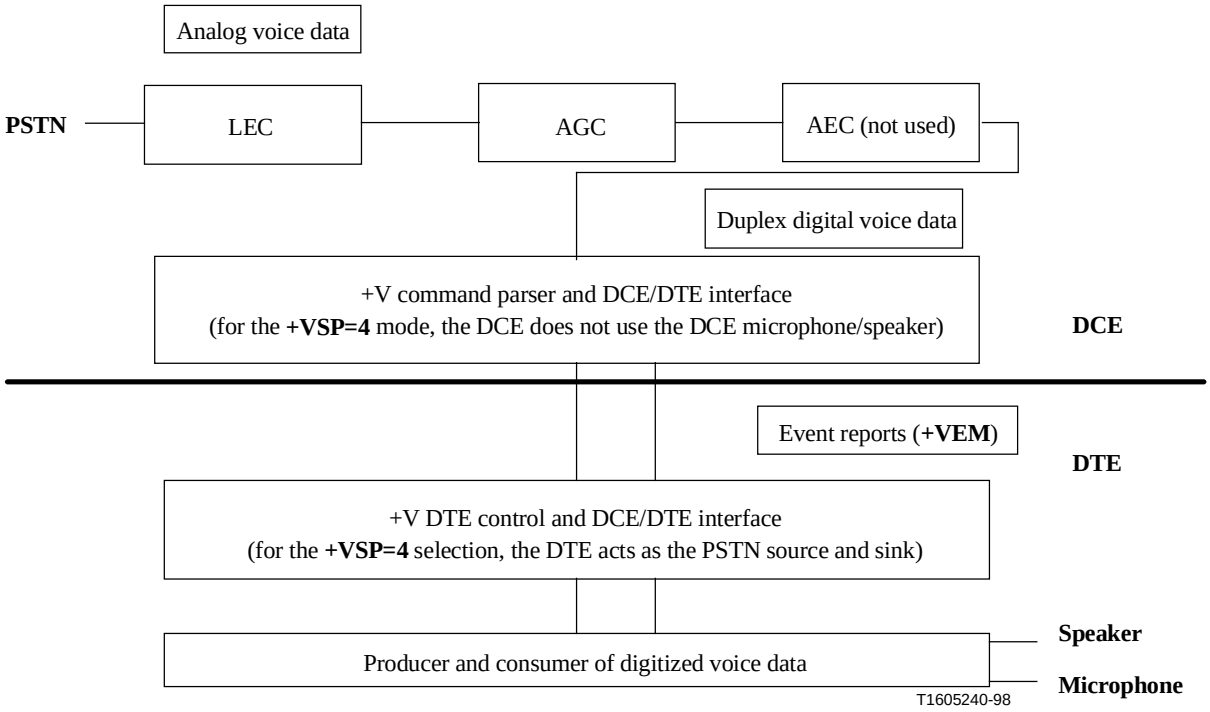


Figure 6/V.253 – DCE ↔ DTE microphone and speaker (+VSP=4)

10.5.1.1 +VSP=<mode>

	Default	Mandatory
<mode>	0 = Off	0 or 1

This command transitions the DCE from the Voice Command State to the Voice Speakerphone state.

The following only applies to **+VSP=2**,**+VSP=3**, and **+VSP=4**.

The DCE begins the Voice Speakerphone State by returning the CONNECT result code to the DTE. After this report, the DCE sends <DLE> shielded (described in 6.3.7) voice data to the DTE, and the DTE may send the <DLE> shielded (described in 6.3.7) voice data. See Table 12 for the list of possible action commands during a voice receive.

The DCE shall send and accept the voice data to and from the DTE in the format previously selected by the **+VSM** command. The DCE shall use the flow control method selected by the **+IFC** command.

The presence of gaps in the voice data stream, from the DTE to the DCE that is due to the DTE not providing voice data to the DCE in a timely manner, shall not cause the DCE to terminate the Voice Speakerphone State.

Note that the maintenance of transmit and receive voice data stream timing relationships between the DCE and DTE is outside the scope of this Recommendation.

The DTE shall signal the termination of the voice data stream by appending a <DLE><^> command and padding out to an octet boundary if necessary (Table 12). The DCE shall issue the <DLE><ETX> character pair (thereby ending the DCE-to-DTE voice data flow) followed by the OK result code, and return to the command mode after the DCE has completely transmitted the contents of its buffer. Note that in the period between the DTE has sent the DCE a <DLE><^> command and

before the DCE has responded with the OK result code, the DTE may issue a limited number of simple commands (i.e. <DLE><CAN>). See Table 12 and 8.3.2.

This Recommendation provides for two ways to leave the Voice Speakerphone State:

1) a <DLE><^> shielded code; and

2) a DTE/DCE Inactivity Timer time-out.

Item 1) is the DTE-initiated means of terminating the Voice Duplex State, and item 2) is a DCE-initiated means of terminating the Voice Duplex State. After termination of the Data State, the DCE shall enter the Voice Command State.

Note that the DCE shall not leave the Voice Speakerphone State upon receiving a <DLE><ETX> command or a <DLE><!> command and shall ignore the aforementioned commands. The use of these commands to transition to half-duplex states is for further study.

The permitted **+VLS** pre-assigned indexes for this command are given in Table 15.

10.5.1.1.1 Subparameter description

<mode>	**Speakerphone operation**
0	DCE goes back to Voice Command Mode
1	PSTN ↔ DCE Microphone and Speaker (see Figure 3)
2	PSTN ↔ DTE (see Figure 4)
3	DTE ↔ DCE Microphone and Speaker (see Figure 5)
4	PSTN ↔ DCE ↔ DTE Microphone and Speaker (see Figure 6)
5-127	Reserved for future standardization
128-255	Manufacturer specific

10.5.1.1.2 DCE event report capabilities

For a given **+VSM** setting, the DCE shall report the events given by the bitwise OR'ing of <tx event> and <rx event> subparameters of the **+VLS=?** Command (see 10.2.4.2) in accordance with the current **+VLS** setting.

10.5.1.1.3 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <mode> subparameter is out of range.

10.5.2 Microphone gain

10.5.2.1 +VGM=<gain>

	Default	**Mandatory**
<gain>	Manufacturer Specific	0-255

This command sets the microphone gain of the Speakerphone function. <gain> is an unsigned octet where values greater than 128 indicate a gain larger than nominal and values smaller than 128 indicate a gain smaller than nominal.

10.5.2.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <gain> subparameter is out of range.

10.5.3 Speaker gain

10.5.3.1 +VGS=<gain>

	Default	Mandatory
<gain>	Manufacturer Specific	0-255

This command sets the speaker gain of the Speakerphone function. <gain> is an unsigned octet where values greater than 128 indicate a gain larger than nominal and values smaller than 128 indicate a gain smaller than nominal.

10.5.3.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <gain> subparameter is out of range.

10.5.4 Train acoustic echo-canceller

10.5.4.1 +VTA

This command trains the Speakerphone function’s acoustic echo-canceller. It is optionally used in duplex speakerphone mode.

10.5.4.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command.

10.5.5 Train line echo-canceller

10.5.5.1 +VTH

This command trains the Speakerphone function’s line echo-canceller. It is optionally used in duplex speakerphone mode.

10.5.5.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command.

10.5.6 Speakerphone duplex mode

10.5.6.1 +VDX=<mode>

	Default	Mandatory
<mode>	0 or 1	0 or 1

This command sets the Speakerphone function’s operating mode to Half-duplex (mode = 0) or Duplex (mode = 1).

10.5.6.1.1 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <mode> subparameter is out of range.

10.5.7 +VEM=<mode>

	Default	Mandatory
<mode>	0 = off	0 or 1

This command enables the DCE to deliver event reports to the DTE while the DCE is in the Voice Speakerphone State. Note that the DCE need not maintain the same quality of Acoustic Echo Cancellation/Line Echo Cancellation (AEC/LEC) when the DCE provides event reporting functionality.

When enabled, the DCE shall report the events given by the bitwise OR'ing of <tx event> and <rx event> subparameters of the **+VLS=?** Command (see 10.2.4.2) in accordance with the current **+VLS** setting.

10.5.7.1 Result code

The DCE shall return the OK result code if the DCE accepts the command. The DCE shall return the ERROR result code if the <mode> subparameter is out of range.

ANNEX A

Interworking with existing voice DTE

The DCE may implement additional syntax for the V.250 (ex-V.25 *ter*) commands referred to in Table A.1, in order to interwork with existing Voice DTE which uses the +F syntax commands.

Table A.1/V.253 – Common functions in V.250 (ex-V.25 *ter*) and T.31

Function	V.25 *ter* command	V.25 *ter* reference	+F syntax command	Recommended implementation
Modem ID	+GMI	6.1.4	+FMI	+FMI has same definition as +GMI
Model ID	+GMM	6.1.5	+FMM	+FMM has same definition as +GMM
Revision ID	+GMR	6.1.6	+FMR	+FMR has same definition as +GMR
Port Rate	+IPR	6.2.10	+FPR	See Table A.2
Flow Control	+IFC	6.2.12	+FLO	See Table A.2
Buffer Threshold	+ITF	8.4/V.80	+VBT	
port Rate	+IPR		+VPR	

Table A.2/V.253 – +F syntax command implementation

DTE Command	DCE action	Description or notes
+FMI?	Execute +GMI?	Report DCE Manufacturer ID
+FMM?	Execute +GMM?	Report DCE model ID
+FMR?	Execute +GMR?	Report DCE revision ID
+FLO=0	Execute +IFC=0,0	Turn off flow control
+FLO=1	Execute +IFC=1,1	Select DC1/DC3 flow control
+FLO=2	Execute +IFC=2,2	Select Ckt 106/133 flow control
+FPR=0	Execute +IPR=0	Select automatic rate detection
+FPR=1	Execute +IPR=2400	Set DTE-DCE rate to 2400 bit/s
+FPR=2	Execute +IPR=4800	Set DTE-DCE rate to 4800 bit/s
+FPR=4	Execute +IPR=9600	Set DTE-DCE rate to 9600 bit/s
+FPR=8	Execute +IPR=19 200	Set DTE-DCE rate to 19 200 bit/s
+FPR=10	Execute +IPR=38 400	Set DTE-DCE rate to 38 400 bit/s
+FPR=18	Execute +IPR=57 600	Set DTE-DCE rate to 57 600 bit/s
+FLO=? (if all values listed above are supported)	Report (0,1,2)	DCE support DC1/DC3 and Ckt 106/133 flow control
+FPR=? (if all values listed above are supported)	Report (0,1,2,4,8,10,18)	DCE supports 2400, 4800, 9600, 19 200, 38 400 and 57 600 bit/s
+FLO? (if +IFC=0,0)	Report 0	DTE-DCE flow control is disabled
+FLO? (if +IFC=1,1)	Report 1	DTE-DCE flow control is DC1/DC3
+FLO? (if +IFC=2,2)	Report 2	DTE-DCE flow control is V.24 Ckt 106/133
+FLO? (all other +IFC settings)	Report 255	255 indicates invalid setting
+FPR? (if +IPR=0)	Report 0	DTE-DCE rate is automatically detected
+FPR? (if +IFC=2400)	Report 1	DTE-DCE rate is 2400 bit/s
+FPR? (if +IFC=4800)	Report 2	DTE-DCE rate is 4800 bit/s
+FPR? (if +IFC=9600)	Report 4	DTE-DCE rate is 9600 bit/s
+FPR? (if +IFC=19 200)	Report 8	DTE-DCE rate is 19 200 bit/s
+FPR? (if +IFC=38 400)	Report 10	DTE-DCE rate is 38 400 bit/s
+FPR? (if +IFC=57 600)	Report 18	DTE-DCE rate is 57 600 bit/s
+FPR? (all other +IPR settings)	Report 255	255 indicates invalid setting

APPENDIX I

DTE originated commands and data are in bold face.

I.1 Suggested compression method and sample rate selection

AT+VSM=?	DTE inquires about the compression methods and bits per sample options
DCE reports two compression methods: 1) PCM, twelve bits per sample, timing marks, sampling rates of 7200-8000 and 11 025, three levels of silence compression sensitivity, and silence clip to 0.5 seconds; 2) same as 1) without silence compression. 0,"SIGNED PCM",12,40,(7200-8000,11025),(127-129),(0-50) 0,"SIGNED PCM",12,0,(7200-8000,11025),(0),(0) OK	
AT+VSM=0	The DTE selects the first compression method with the intent of querying the event detection capabilities of the DCE
OK	DCE agrees
AT+VSM=1	The DTE selects the second compression method with the intent of querying the event detection capabilities of the DCE
OK	DCE agrees
AT+VLS?	DCE inquires about what analog source/destinations are available
0,"",0A000100,0E601800,1A803840 1, "T",0A000100,0E601800,1A803840 4,"S",0A000100,0E601800,1A803840 6,"M",0A000100,0E601800,1A803840 OK	DCE reports that a microphone and speaker are available
AT+VSD=?	DCE inquires about what end of voice receive silence detection capabilities are available
(127-129),(50-200) OK	DCE reports three levels of sensitivity and a time interval between 5.0 and 20.0 seconds
At some time later, the DTE wishes to transmit or receive a voice message. The DTE selects: 1) the first compression method at 7200 sampling rate, enables silence compression with nominal silence sensitivity, and no silence clipping; 2) sets end of receive silence detection at nominal silence sensitivity setting and for 5.0 seconds. **AT+VSM=0,7200,128,0; +VSD=128,50**	
OK	DCE agrees

I.2 Recording a welcome message

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8;+VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued a **+VSM=?** command earlier. Note that timing marks are not present.
OK	DCE agrees
AT+VSD=127,20	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording)
OK	DCE agrees
AT+VLS=6	DCE selects the microphone
OK	DCE agrees
AT+VRX	DTE selects the Voice Receive state
CONNECT	DCE agrees
<Data>	DCE delivers, <DLE> shielded and silence compressed, voice data across the DTE/DCE interface.
<DLE><NUL>	DTE strokes the Inactivity Timer
<DLE></>	DCE reports the start of a possible DTMF tone (see 7.6)
<DLE><*><DLE><*>	DCE reports a DTMF * detection for 140 milliseconds (within a 70 millisecond resolution)
<DLE><~>	DCE reports the end of the DTMF * detection. Since the DTE has no need for a DTMF response, DTE ignores it.
<Data>	DCE delivers more voice data
<DLE><q>	DCE indicates detection of a long period of silence
<Data>	DCE delivers more voice data (probably silence)
<DLE><!>	DTE wishes to end the record by sending an abort command
<DLE><ETX> OK	DCE indicates the end of the voice data stream and returns back to Voice Command State
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE switches to the Data Mode Command State and automatic rate detection. **AT+VIT=0;+IPR=0;+FCLASS=0**	
OK	DCE agrees

I.3 Play back the welcome message

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8;+VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of playing a message with less distortion, and at 7200 samples per second. Assume that the DTE issued a **+VSM=?** command earlier.
OK	DCE agrees
AT+VLS=4	DCE selects the speaker. The DCE had reported earlier that a speaker was available.
OK	DCE agrees
AT+VTX	DTE selects the Voice Transmit state
CONNECT	DCE agrees
<Data>	DTE delivers, <DLE> shielded and silence compressed, voice data across the DTE/DCE interface.
<DLE><ETX>	DTE indicates the end of the voice data stream
OK	DCE indicates that it is in Voice Command State
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE switches to the Data Mode Command State and automatic rate detection. **AT+VIT=0;+IPR=0;+FCLASS=0**	
OK	DCE agrees

I.4 Answer the phone, play the greeting message and record a message

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8;+VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued a **+VSM=?** command earlier.
OK	DCE agrees
AT+VSD=127,20	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording)

OK	DCE agrees
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE selects the Data Mode with automatic rate detection, and disables automatic DCE answering. The DCE waits for a phone call. This Recommendation does not require the DCE to wait in Data Mode. **AT+VIT=0;+IPR=0;+FCLASS=0;S0=0**	
OK	DCE agrees
RING	At sometime later on, some remote station calls
DCE switches to the Voice Mode. The DCE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with a value of 60 seconds. **AT+FCLASS=8;+VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
<DLE><R>	DCE detects another ring (at 38 400 bit/s)
AT+VLS=2	DCE answers the phone
OK	DCE indicates that it is in Voice Command State
AT+VTX	DTE selects the Voice Transmit state
CONNECT	DCE agrees
<Data>	DTE plays the welcome message
<DLE><ETX>	DTE indicates the end of the voice data stream
OK	DCE indicates that it is in Voice Command State
AT+VTS=[933,0,120]	DTE annotates the greeting message with a 1.2 beep
OK	DCE is ready for another voice command
AT+VSM=132,7200,0,0	DTE selects a low bit compression scheme to save disk space
OK	DCE agrees
AT+VRX	DTE selects the Voice Receive state
CONNECT	DCE agrees
<Data>	DCE delivers, <DLE> shielded and silence compressed, voice data across the DTE/DCE interface.
<DLE><NUL>	DTE strikes the Inactivity Timer
<DLE><b>	DCE indicates detection of the busy tone and cadence. The remote station has probably disconnected.
<Data>	DCE delivers more voice data
<DLE><b>	DCE indicates another detection of the busy tone and cadence. The DTE now considers the remote station has disconnected.
<Data>	DCE delivers more voice data
<DLE><NUL>	DTE wishes to end the record by sending an abort command

<DLE><ETX> OK	DCE indicates the end of the voice data stream and returns back to Voice Command State
AT+VIT=0;H	DTE hangs up the phone, and by implication, the DCE switches to Data Mode with automatic rate detection. Note that if the DTE had issued the **+VLS=0** command instead of the **ATH** command, the DCE would not perform the implied actions of the **ATH** command. See 9.1.2 for a description of the implied actions.
OK	DCE agrees (at 38 400 bit/s). The DCE is now in automatic rate detection operation in Data Mode.

I.5 Answer the phone, record a message and receive a facsimile

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8;+VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued an **AT+VSM=?** command earlier.
OK	DCE agrees
AT+VSD=127,20	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording)
OK	DCE agrees
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE selects the Data Mode Command State with automatic rate detection, and disables automatic DCE answering. The DCE waits for a phone call. This Recommendation does not require the DCE to wait in Data Mode. **AT+VIT=0;+IPR=0;+FCLASS=0;S0=0**	
OK	DCE agrees
RING	At sometime later on, some remote station calls.
DCE switches to the Voice Mode. The DCE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with a value of 60 seconds. **AT+FCLASS=8; +VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
<DLE><R>	DCE detects another ring (at 38 400 bit/s)
AT+VLS=2	DCE answers the phone
OK	DCE indicates that it is in Voice Command State
AT+VTX	DTE selects the Voice Transmit state

CONNECT	DCE agrees
<Data>	DTE plays the welcome message
<DLE><ETX>	DTE indicates the end of the voice data stream
OK	DCE indicates that it is in Voice Command State
AT+VTS=[933,0,12]	DTE annotates the greeting message with a 1.2 beep
OK	DCE is ready for another voice command
AT+VSM=2,7200,0,0	DTE selects a low bit compression scheme to save disk space
OK	DCE agrees
AT+VRX	DTE selects the Voice Receive state
CONNECT	DCE agrees
<Data>	DCE delivers, <DLE> shielded and silence compressed, voice data across the DTE/DCE interface.
<DLE><NUL>	DTE strikes the Inactivity Timer
<DLE></>	DCE reports the start of a possible DTMF tone (see 7.6)
<DLE><5><DLE><5>	DCE reports a DTMF 5 detection for 140 milliseconds (within a 70 millisecond resolution)
<DLE><~>	DCE reports the end of the DTMF 5 detection. For this example, DTMF 5 means finish with the voice message and a switch to the facsimile mode.
<DLE><!>	DTE wishes to end the record by sending an abort command
<DLE><ETX> OK	DCE indicates the end of the voice data stream, and returns back to Voice Command State.
DTE selects to disable automatic hangups while in Service Class 2 (**+FKS** command results in Telco on-hook). The DTE switches the DCE to Service Class 2. **AT+VNH=1;+VIT=0;+FCLASS=2**	
OK	DCE agrees
ATA	DCE starts the facsimile receive

I.6 Answer the phone and determine it is a facsimile

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8; +VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued a **+VSM=?** command earlier.
OK	DCE agrees
AT+VSD=127,20	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording)

OK	DCE agrees
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE selects the Data Mode Command State with automatic rate detection, and disables automatic DCE answering. The DCE waits for a phone call. This Recommendation does not require the DCE to wait in Data Mode. **AT+VIT=0;+IPR=0;+FCLASS=0;S0=0**	
OK	DCE agrees
RING	At sometime later on, some remote station calls.
DCE switches to the Voice Mode. The DCE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with a value of 60 seconds. **AT+FCLASS=8; +VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
<DLE><R>	DCE detects another ring (at 38 400 bit/s)
AT+VLS=2	DCE answers the phone
OK	DCE indicates that it is in Voice Command State
AT+VTX	DTE selects the Voice Transmit state
CONNECT	DCE agrees
<Data>	DTE plays the welcome message
<DLE><c>	DCE has detected the T.30 calling tone
<DLE><ETX>	DTE indicates the end of the voice data stream
OK	DCE indicates that it is in Voice Command Mode
DTE does not select to disable automatic hangups (disabling automatic hangups is not necessary in Service Class 1). The DTE switches the DCE to Service Class 1. **AT+VIT=0;+FCLASS=1**	
OK	DCE agrees
ATA	DCE starts the facsimile receive

I.7 Answer the phone and execute a facsimile protocol

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8; +VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued an **AT+VSM=?** command earlier.

OK	DCE agrees
AT+VSD=127,20	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording)
OK	DCE agrees
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE selects the Data Mode Command State with automatic rate detection, and disables automatic DCE answering. The DCE waits for a phone call. This Recommendation does not require the DCE to wait in Data Mode. **AT+VIT=0;+IPR=0;+FCLASS=0;S0=0**	
OK	DCE agrees
RING	At sometime later on, some remote station calls.
DCE switches to the Voice Mode. The DCE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with a value of 60 seconds. **AT+FCLASS=8;+VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
<DLE><R>	DCE detects another ring (at 38 400 bit/s)
AT+VLS=2	DCE answers the phone
OK	DCE indicates that it is in Voice Command State
AT+VTX	DTE selects the Voice Transmit state
CONNECT	DCE agrees
<Data>	DTE plays the welcome message
<DLE><ETX>	DTE indicates the end of the voice data stream
OK	DCE indicates that it is in Voice Command State
AT+VTS=[933,0,12]	DTE annotates the greeting message with a 1.2 beep
OK	DCE is ready for another voice command
AT+VRX	DTE selects the Voice Receive state
CONNECT	DCE agrees
<Data>	DCE delivers, <DLE> shielded and silence compressed, voice data across the DTE/DCE interface.
<DLE><NUL>	DTE strikes the Inactivity Timer
<DLE><s>	The DCE has determined that the remote station has not sent any voice data
<Data>	DCE delivers more voice data
<DLE><!>	DTE wishes to end the record by sending an abort command
<DLE><ETX> OK	DCE indicates the end of the voice data stream and returns back to Voice Command State

DTE does not select to disable automatic hangups (disabling automatic hangups is not necessary in Service Class 1). The DTE switches the DCE to Service Class 1. **AT+VIT=0;+FCLASS=1**	
OK	DCE agrees
ATA	DCE starts the facsimile receive

I.8 Answer the phone and execute a data handshake

DCE switches to the Voice Mode. The DTE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with 60 seconds. **AT+FCLASS=8; +VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
AT+VSM=0,7200,0,0	DTE changes its DTE/DCE Interface Rate to 38 400 bit/s and selects a compression method with the least sensitive setting, with the goal of recording a message with less distortion, and at 7200 samples per second. Assume that the DTE issued an **+VSM=?** command earlier.
OK	DCE agrees
AT+VSD=127,20	DTE selects a silence detection period of 2 seconds with the least sensitive setting (for detecting the end of voice recording)
OK	DCE agrees
AT+VLS=0	DTE deselects all devices
OK	DCE agrees
DTE selects the Data Mode Command State with automatic rate detection and disables automatic DCE answering. The DCE waits for a phone call. This Recommendation does not require the DCE to wait in Data Mode. **AT+VIT=0;+IPR=0;+FCLASS=0;S0=0**	
OK	DCE agrees
RING	At sometime later on, some remote station calls.
DCE switches to the Voice Mode. The DCE selects a fixed DTE/DCE Interface Rate. The DTE knows from the sample rate selected earlier and the bits per sample that the DTE/DCE Interface Rate should be 38 400 bit/s. The DTE/DCE Inactivity Timer starts with a value of 60 seconds. **AT+FCLASS=8; +VIT=60;+IPR=16**	
OK	DCE agrees (at the old DTE/DCE Interface Rate)
<DLE><R>	DCE detects another ring (at 38 400 bit/s)
AT+VLS=2	DCE answers the phone
OK	DCE indicates that it is in Voice Command State
AT+VTX	DTE selects the Voice Transmit state
CONNECT	DCE agrees
<Data>	DTE plays the welcome message
<DLE><ETX>	DTE indicates the end of the voice data stream
OK	DCE indicates that it is in Voice Command State

AT+VTS=[933,0,12]	DTE annotates the greeting message with a 1.2 beep
OK	DCE is ready for another voice command
AT+VRX	DTE selects the Voice Receive state
CONNECT	DCE agrees
<Data>	DCE delivers, <DLE> shielded and silence compressed, voice data across the DTE/DCE interface.
<DLE><NUL>	DTE strikes the Inactivity Timer
<DLE><S>	The DCE has determined that the remote station has not sent any voice data
<Data>	DCE delivers more voice data
<DLE><!>	DTE wishes to end the record by sending an abort command
<DLE><ETX> OK	DCE indicates the end of the voice data stream and returns back to Voice Command State
DTE selects to disable automatic hangups while in Service Class 0 (**ATH** command results in Telco on-hook). The DTE switches the DCE to Service Class 2. **AT+VNH=1;+VIT=0;+FCLASS=0**	
OK	DCE agrees
ATA	DCE starts the Data Mode

APPENDIX II

II.1 Projected DTE/DCE interface rates at different sampling rates

Bits per sample	Projected DTE/DCE interface Rate @ 7.2 kHz sampling rate	Projected DTE/DCE interface Rate @ 8 kHz sampling rate
0.50	4 800	9 600
1	9 600	19 200
2	19 200	19 200
3	38 400	38 400
4	38 400	57 600
5	57 600	57 600
6	57 600	115 200
7	115 200	115 200
8	115 200	115 200
9	115 200	115 200
10	115 200	115 200
11	115 200	115 200
12	115 200	Fast
13	Fast	Fast

II.2 Common analog source/destination hardware configurations

Table II.1 lists some common applications (Common Applications). The table forms the basis for pre-assigned values for the **+VLS=<label>** command (presented in Table 15).

Table II.1 contains several pieces of data.

Table II.1/V.253 – Common analog source/destination hardware configurations

Id (Note 1)		DTE data (Note 2)	T	M0	M1	S0	S1	H0	L	Note 3
1	Simple DCE	X	X							1
2	Speaker Phone		X	X		X				7
3			X	X			X			10
4			X		X	X				12
5			X		X		X			13
6	Answer Machine	X	X			X				5
7	w/ Monitoring	X	X				X			9
8	Record Announcement	X		X						6
9	Locally	X			X					11
10		X						X		14
11		X							X	2
12	Play Messages	X				X				4
13	Locally	X					X			8
=10		X						X		14
=11		X							X	2
=2	Record Conversation	X	X	X		X				7
=3		X	X	X			X			10
=4		X	X		X	X				12
=5		X	X		X		X			13

Table II.1/V.253 – Common analog source/destination hardware configurations *(concluded)*

Id (Note 1)		DTE data (Note 2)	T	M0	M1	S0	S1	H0	L	Note 3
14		X	X					X		15
15		X	X						X	3
0										0

NOTE 1 – The first column of Table II.1 has some numbers with equal signs in front of the number. These numbers are configurations that are the same as some preceding row if one ignores the "DTE Data" column (same primitives, but ignoring the case if the DCE is receiving data from the DTE or not). Numbers without equal signs identified unique Voice I/O configurations.

NOTE 2 – The third column until the tenth column of Table II.1 illustrates which of the primitives are used in building the Common Applications.

NOTE 3 – The eleventh column of Table II.1 lists the standard <index> parameter values in the **+VLS=?** command for commonly used configurations. The reader should refer to Table 15 for a list of the standard values and a verbal description of the device configuration.

APPENDIX III

North American network documents

North American Network signals such as Bong (Calling Card prompt) and SIT are defined in these documents.

– Bellcore TR-TSY-000219: CLASS^{sm} Feature: Distinctive Ringing/Call Waiting FSD 01-01-1110.

– Bellcore TR-NPL-000275: Notes on the BOC Intra_LATA Networks, 1986.

– Bellcore TR-TSY-00030 and TR-TSY-00031: Detail signalling method and data format used in Custom Local Area Signalling Services (CLASS^{sm}) in the United States and Canada.

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