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SERIES V: DATA COMMUNICATION OVER THE
TELEPHONE NETWORK

Wideband modems

**A 48/56/64 kbit/s data circuit-terminating
equipment standardized for use on digital point-
to-point leased circuits**

ITU-T Recommendation V.38

(Previously CCITT Recommendation)

ITU-T V-SERIES RECOMMENDATIONS
DATA COMMUNICATION OVER THE TELEPHONE NETWORK

- 1 – General
- 2 – Interfaces and voiceband modems
- 3 – **Wideband modems**
- 4 – Error control
- 5 – Transmission quality and maintenance
- 6 – Interworking with other networks

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

FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

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

ITU-T Recommendation V.38, was prepared by ITU-T Study Group 14 (1993-1996) and was approved by the WTSC (Geneva, October 9-18, 1996).

NOTE

1. In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.
2. The status of annexes and appendices attached to the Series V Recommendations should be interpreted as follows:
 - an *annex* to a Recommendation forms an integral part of the Recommendation;
 - an *appendix* to a Recommendation does not form part of the Recommendation and only provides some complementary explanation or information specific to that Recommendation.

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Recommendation V.38**A 48/56/64 kbit/s DATA CIRCUIT-TERMINATING EQUIPMENT STANDARDIZED FOR USE ON DIGITAL POINT-TO-POINT LEASED CIRCUITS***(revised in 1996)***1 Introduction**

This DCE is intended for use on 56-kbit/s and 64-kbit/s digital point-to-point leased circuits other than ISDN. The DCE is specified herein in terms of the DTE-to-DCE interface(s) and features including rate adaptation, end-to-end signalling, testing and multiplexing facilities. The line signal and the signalling rate that is used to connect this type of DCE locally to a 64-kbit/s digital bearer circuit is considered to be a national matter, and is hence not specified herein. The transmission scheme chosen should, however, be capable of providing an octet timing recovery where a rate adaptation as specified in clause 5 is employed. An octet timing may also become necessary where a rate adaptation of data signalling rates below 48 kbit/s is accomplished (see Appendix III).

The principal characteristics of the DCE are as follows:

- a) duplex mode of operation on digital leased circuits (see Note 1);
- b) gross bit rates of at least 56 kbit/s;
- c) signalling rates up to 56/64 kbit/s;
- d) rate adaptation of 48 kbit/s and 56 kbit/s into 64 kbit/s according to schemes specified in Recommendation V.110;
- e) inclusion of two different types of DTE-DCE functional interfaces;
- f) inclusion of testing facilities;
- g) optional provision of a means to differentiate between user and network data;
- h) optional inclusion of a multiplexer (for further study);
- i) optional inclusion of an equipment management function.

NOTE 1 – The implementation of an optional half-duplex mode of operation is for further study.

NOTE 2 – Figure I.1 gives a schematic block diagram of the arrangement of functional blocks (without the multiplexer function) inside the DCE.

NOTE 3 – The term “line signalling rate” as used in the context of this Recommendation refers to the signalling rate at the input of the transmitter of the transmission unit (see Figure I.1).

2 Signalling rates**2.1 Data signalling rates**

The recommended data signalling rates (user rates) are synchronous at 48 kbit/s, 56 kbit/s and 64 kbit/s. For certain national applications or upon bilateral agreement between Administrations, also other data signalling rates below 48 kbit/s are applicable (see Appendix III).

2.2 Signalling rates on line

Where the data signalling rate is 48 kbit/s or 56 kbit/s, a rate adaptation to 64 kbit/s as specified in clause 5 shall be performed at the connection to an international 64-kbit/s bearer circuit. The precise location where this adaptation takes place is a national matter.

NOTE – It should be noted that in some networks the provision of an octet timing may become necessary at the transition from transmission at 56 kbit/s to transmission at 64 kbit/s. Details are outside the scope of this Recommendation, and may be associated with the line signal transmission equipment used. However, a schematic possible scenario is depicted in Figure 3.

3 Differentiation between user and network data signals

In some cases it may be desirable to provide a means of differentiating between user and network data (e.g. fault detection). The following optional scrambler is provided as a means of accomplishing this differentiation.

NOTE – The potential provision of a scrambler/descrambler inside the transmission unit of the DCE (see Figure I.1) is a national matter, and outside the scope of this Recommendation.

3.1 Scrambler (64 kbit/s only)

Optionally and on bilateral agreement of the Administrations concerned, a self-synchronizing scrambler having the generating polynomial $1 + x^{-18} + x^{-23}$ may be included in the transmitter of the DCE.

The message data sequence applied to the scrambler shall be effectively divided by the generating polynomial. The coefficients of the quotients of this division, taken in descending order, form the data sequence which shall appear at the output of the scrambler. The scrambler data output sequence thus shall be:

$$D_s = D_i \oplus D_s \cdot x^{-18} \oplus D_s \cdot x^{-23}$$

where:

D_s is the data sequence at the output of the scrambler

D_i is the data sequence applied to the scrambler

D_o is the data sequence at the output of the descrambler (see 3.2)

$\oplus$ denotes modulo 2 addition

$\cdot$ denotes binary multiplication

Figure 1 shows a suitable implementation.

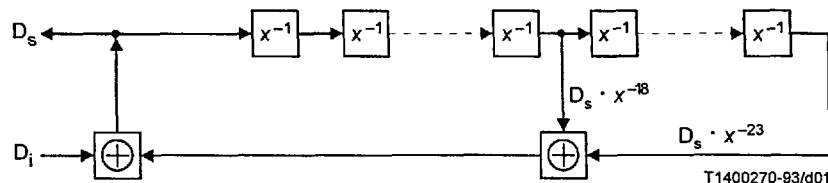


FIGURE 1/V.38
Scrambler

3.2 Descrambler (64 kbit/s only)

Where the optional scrambler specified in 3.1 is provided, also a self synchronizing descrambler having the polynomial $1 + x^{-18} + x^{-23}$ shall be provided in the receiver of the DCE. The message data sequence output by the receiver of the transmission unit (see Figure I.1) shall be effectively multiplied by the generating polynomial $1 + x^{-18} + x^{-23}$ to form the descrambled message. The coefficients of the recovered message sequence taken in descending order form the output data sequence D_o , which is given by:

$$D_o = D_s (1 \oplus x^{-18} \oplus x^{-23})$$

where the notation is defined in 3.1.

Figure 2 shows a suitable implementation.

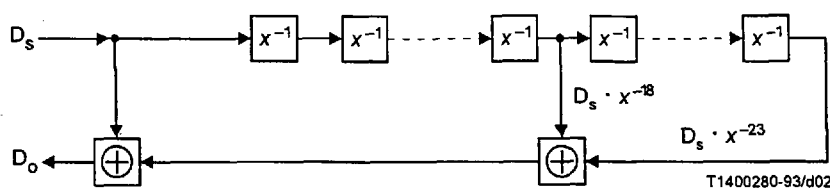


FIGURE 2/V.38

Descrambler**4 Interfaces**

One or both types of two functional interfaces shall be provided in the DCE, as specified below. It shall be possible that two DCEs in accordance with this Recommendation can interoperate, where in these DCEs the opposite types of interfaces are employed.

4.1 V.24-type interface**4.1.1 List of interchange circuits**

The interchange circuits shall be as in Table 1.

4.1.2 Electrical characteristics

Use of electrical characteristics conforming to Recommendation V.10 and/or V.11 is recommended as specified below, together with the use of the connector and pin assignment plan specified by ISO 4902, ISO/IEC 2110 or ISO/IEC 11569.

- i) Concerning circuits 103, 104, 113, 114 and 115, both the generators and the receivers shall be in accordance with Recommendation V.11.

NOTE – In certain instances where V.11 circuits are implemented on both sides of the interface, it may be necessary to add either serial impedance matching resistors or parallel cable terminating resistors as specified in Recommendation V.11 to ensure proper operation of the interchange circuits.

- ii) In the case of circuits 105, 106, 107, 108/2 and 109, generators shall comply with Recommendation V.10 or alternatively Recommendation V.11. The receivers shall comply with Recommendation V.10, category 1 or V.11 without termination.
- iii) In the case of all other circuits, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for category 2.

4.1.3 Operational requirements

The normal operation for this DCE is constant carrier, i.e. the condition of circuit 105 has no influence upon the line signal and upon remote circuit 109. The implementation of an optional half-duplex mode of operation is for further study.

Circuit 106 will follow OFF to ON or ON to OFF transitions on circuit 105 within 0.5 to 3.5 ms (this value is for further study). This time is from the application of an ON or OFF condition on circuit 105.

Optionally, the DCE may provide an end-to-end signalling of local circuit 105 to remote circuit 109. The method used could be as described in Recommendation V.13. Other methods are for further study.

Where, depending on the data signalling rate and the line signalling rate a rate adaptation as specified in clause 5 is employed, both circuits 106 and 109 shall be held in the OFF condition in the event of loss of frame synchronization.

Where the optional scrambler/descrambler function specified in clause 3 is provided, circuit 109 shall be switched to the OFF condition upon the reception of 256 consecutive bits in the binary ONE condition.

The criteria for the control of circuit 109 depending upon a received line signal or other out-of-service codes are a national matter, and are outside the scope of this Recommendation.