INTERNATIONAL TELECOMMUNICATION UNION

ITU-T V.21

TELECOMMUNICATION
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OF ITU

DATA COMMUNICATION
OVER THE TELEPHONE NETWORK

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300 BITS PER SECOND DUPLEX MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK [1)]

ITU-T Recommendation V.21

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation V.21 was published in Fascicle VIII.1 of the *Blue Book*. This file is an extract from the *Blue Book.* While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

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Recommendation V.21

300 BITS PER SECOND DUPLEX MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK[1)]

(Geneva, 1964; amended at Mar del Plata, 1968,
and at Geneva, 1972, 1976 and 1980,
and at Malaga-Torremolinos, 1984)

Note - The modem, designed for use on connections set up by switching in the general telephone network, can obviously be used on leased lines.

A system of data transmission at a low data signalling rate, such that data could be transmitted over a telephone circuit operated alternatively for telephone calls and data transmissions, using simple input/output equipment and easy operating procedures, would be economical.

The data signalling rate must be such as to allow the use of current types of data sources and sinks, especially electromechanical devices.

The system for data transmission will be duplex, either for simultaneous two-way data transmission or for the transmission of signals sent in the backward direction for error-control purposes. The transmission must be such that use can be made of normal telephone circuits, and this applies both to the bandwidth available and to the restrictions imposed by signalling in the telephone networks.

The two correspondents are brought into contact by a telephone call, and the circuit is put into the data-transmission position:

a) manually by agreement between the operators, or

b) automatically.

For these reasons, the CCITT

unanimously declares the following view

1 Data transmission may take place at low data signalling rates on telephone calls set up on switched telephone circuits (or on leased telephone circuits).

2 The communication circuit for data transmission is a duplex circuit whereby data transmission in both directions simultaneously is possible at 300 bit/s or less.

The modulation is a binary modulation obtained by frequency shift, resulting in a modulation rate being equal to the data signalling rate.

Note - Attention is drawn to the fact that there may be in operation some old-type V.21 modems for which the maximum data signalling rate is 200 bit/s.

3 For channel No. 1, the nominal mean frequency is 1080 Hz.

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1) See Note under § 2 of this Recommendation.

For channel No. 2, it is 1750 Hz.

The frequency deviation is ± 100 Hz. In each channel, the higher characteristic frequency (F_A) corresponds to a binary 0.

The characteristic frequencies[2)] as measured at the modulator output must not differ by more than ± 6 Hz from the nominal figures.

A maximum drift frequency of ± 6 Hz is assumed for the line. Hence the demodulation equipment must tolerate drifts of ± 12 Hz between the frequencies received and their nominal values.

4 Data may be transmitted by synchronous or asynchronous procedures. With synchronous operation, the modem will not have to provide the signals which would be necessary to maintain synchronism when transmission is not proceeding.

5 When echo control device disabling is required, it is recommended that the procedures specified in Recommendation V.25 be followed.

6 The maximum power output of the modem into the line shall not exceed 1 mW.

The power level of the modem should be adjusted to make allowance for loss between this equipment and the point of entry to an international circuit, so that the corresponding nominal level of the signal at the international circuit input shall not exceed - 13 dBm0 (see Recommendation V.2, § 2).

7 a) When both channels are used for simultaneous both-way data transmission, channel No. 1 is used for transmission of the caller's data (i.e. the person making the telephone call) towards the called station, while channel No. 2 is used for transmission in the other direction.

b) When one channel is used for data transmission and the other is used for transmission of check signals, service signals, etc., only, it is channel No. 1 which is used for transmission from the calling to the called station regardless of the direction in which the data are transmitted.

c) The procedure for the assignment of the channels described under a) and b) above applies in the case of the general service of data transmission, making it possible to transmit data or check signal, service signal, etc., bilaterally between any two subscribers. In special cases which do not come under this rule, the procedure of assignment of the channels is determined by the prior agreement between the correspondents, bearing in mind the requirement proper to each service.

8 Interchange circuits

8.1 *List of interchange circuits essential for the modems when used on the general switched telephone network or non switched leased telephone circuits* (see Table 1 /V.21)

The configurations of interchange circuits are those essential for the particular switched network or leased circuit requirement indicated. Where one or more of such requirements are provided in a modern, then all of the appropriate interchange circuit facilities should be provided.

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2)The nominal characteristic frequencies;

channel No. *1* (F_A = 1180 Hz and F_z = 980 Hz);

channel No. 2 (F_A = 1850 Hz and F_z= 1650 Hz).

TABLE 1/V.21

Interchange circuit		General switched telephone network including terminals equipped for manual calling, manual answering, automatic calling, automatic answering (Note 1)	Non-switched leased telephone circuits (Note 1)	
Number	Designation		Point-to-point	Multipoint
102	Signal ground or common return	X	X	X
103	Transmitted data	X	X	X
104	Received data	X	X	X
105	Request to send	-	X (Note 2)	X
106	Ready for sending	X	X	X
107	Data set ready	X	X	X
108/1	Connect data set to line	X (Note 3)	X	X
108/2	Data terminal ready	X (Note 3)	X (Note 4)	-
109	Data channel received line signal detector	X	X	X
125	Calling indicator	X	-	-
126	Select transmit frequency	-	-	X

Note 1 - All essential interchange circuits and any others which are provided shall comply with the functional and operational requirements of Recommendation V.24. All interchange circuits indicated by X shall be properly terminated in the data terminal equipment and in the data circuit-terminating equipment in accordance with the appropriate Recommendation for electrical characteristics (see § 9).

Note 2 - Circuit 105 is not required when alternate voice/data service is used on non-switched leased point-to-point circuits.

Note 3 - The circuit shall be capable of operation as circuit 108/1 - *connect data set to line* or circuit 108/2 - *data terminal ready* depending on its use.

Note 4 - In the leased point-to-point case, where alternate voice/data service is to be provided, circuit 108/2 may be used optionally.

8.2 *Response times of circuits 106 and 109*

8.2.1 *Definitions*

8.2.1.1 Circuit 109 response times are the times that elapse between the connection or removal of a tone to or from the modem receive line terminals and the appearance of the corresponding ON or OFF condition on circuit 109.

The test tone should have a frequency corresponding to the characteristic frequency of binary 1 and be derived from a source with an impedance equal to the nominal input impedance of the modem under test.

The level of the test tone should fall into the level range between 1 dB above the actual threshold, of the received line signal detector and the maximum admissible level of the received signal. At all levels within this range the measured response times shall be within the specified limits.

8.2.1.2 Circuit 106 response times are the times from the connection of an ON or OFF condition on:

- circuit 105 (where it is provided) to the appearance of the corresponding OFF or ON condition on circuit 106;
- circuit 109 (where circuit 105 is not provided) to the appearance of the corresponding ON or OFF condition on circuit 106.

8.2.2 *Response times*

TABLE 2/V.21

Circuit 106		
OFF to ON	20-50 ms (see Note 1)	400-1000 ms (see Note 2)
ON to OFF	≤ 2ms	
Circuit 109		
OFF to ON	≤ 20 ms (see Note 1)	300-700 ms (see Note 2)
ON to OFF	20-80 ms	

Note 1 - These times are used on leased point-to-point networks without alternate voice data facilities and on leased multipoint facilities.

Note 2 - These times are used in the general switched network service and on leased point-to-point circuits with alternate voice data.

8.3 *Threshold of data channel received line signal detector*

Level of received line signal at received line signal terminals of modem for all types of connection, i.e. general switched telephone network or non-switched leased telephone circuit:

greater than	-43 dBm	circuit 109 ON
less than	-48 dBm	circuit 109 OFF

The condition of circuit 109 for levels between -43 dBm and -48 dBm is not specified except that the signal detector shall exhibit a hysteresis action such that the level at which the OFF to ON transition occurs shall be at least 2 dB greater than for the ON to OFF transition.

Where transmission conditions are known on switched or leased circuits, Administrations should be permitted at the time of modem installation to change these response levels of the received line signal detector to less sensitive values (e.g. -33 dBm and -38 dBm respectively).

8.4 *Fault condition of interchange circuits*

See Recommendation V.28, § 7 for association of the receiver failure detection types).

8.4.1 The DTE should interpret a fault condition on circuit 107 as an OFF condition using failure detection type 1.

8.4.2 The DCE should interpret a fault condition on circuits 105 and 108 as an OFF condition using failure detection type 1.

8.4.3 All other circuits not referred to above may use failure detection type 0 or 1.

9 Electrical characteristics of interchange circuits

Use of electrical characteristics conforming to Recommendation V.28 is recommended together with the connector and pin assignment plan specified by ISO 2110.

Note - Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and that Study Group XVII has agreed that the work shall proceed to develop a more efficient, all-balanced, interface for the V-Series application which minimises the number of interchange circuits.

10 The following information is provided to assist equipment manufacturers:

a) The nominal range of attenuations in subscriber-to-subscriber connections is from 5 to 30 dB at the reference frequency (800 or 1000 Hz), assuming up to 35 dB attenuation at the frequency 1750 Hz.

b) The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

Reference

[1] CCITT Recommendation *Echo suppressors,* Vol. III, Rec. G.164.