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Foreword

This European Telecommunication Standard (ETS) has been produced by the Satellite Earth Stations and Systems (SES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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1 Scope

This European Telecommunication Standard (ETS) contains the requirements to be satisfied by Very Small Aperture Terminal (VSAT) systems for their interconnection to Packet Switched Public Data Networks (PSPDNs) implemented according to the CCITT Recommendation X.25 [1].

This ETS applies to the provision of Packet Switched Data Transmission services as defined in section 2 of CCITT Recommendation X.2 [2].

This ETS is applicable to both one-way and two way VSAT networks. In the case of one-way VSAT networks, the provision of the services as defined in section 2 of CCITT Recommendation X.2 [2] implies the implementation of return circuits using facilities of other networks (e.g. terrestrial networks).

This ETS deals with two types of specification:

a) Interface requirements (clause 5):

   Interface requirements are specified in order to ensure that the VSAT network and the PSPDN can be connected.

b) Connection quality recommendations (see clause 6):

   Connection quality recommendations are characteristics that contribute to maintaining a desirable quality of service and a uniform approach with regard to certain interfacing aspects, addressing and facilities.

   The inability to meet the recommendations does not, by itself, prevent the equipment being considered as compliant with this ETS.

Additional informative elements are provided in annex A.

2 Normative references

This European Telecommunication Standard (ETS) incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to, or revisions of, any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] CCITT Recommendation X.25 (1988): "Interface Between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

[2] CCITT Recommendation X.2 (1988): "International data transmission services and optional user facilities in public data networks and ISDNs".

[3] NET 2 (1988): "Approval requirements for DTEs to connect to PSPDNs using CCITT Recommendation X.25 interface".

[4] CCITT Recommendation X.134 (1988): "Portion boundaries and packet layer reference events: basis for defining packet-switched performance parameters".

[5] CCITT Recommendation X.135 (1988): "Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched services".

[6] CCITT Recommendation X.136 (1988): "Accuracy and dependability performance values for public data networks when providing international packet-switched services".

[7] CCITT Recommendation X.137 (1988): "Availability performance values for public data networks when providing international packet-switched services".

[8] CEPT Recommendation T/CAC 4 (1989): "Monitoring of network performance aspects of quality of international packet-switched services using externally derived indicators".

3 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

BER	Bit Error Ratio
DM	Disconnected Mode
DTE	Data Terminal Equipment
DCE	Data Circuit-Terminating Equipment
FCS	Frame Check Sequence
LAPB	Link Access Protocol Balanced
OSI	Open System Interconnection
P/F	Poll/Final bit
PSPDN	Packet Switched Public Data Network
PVC	Permanent Virtual Circuit
PvtDN	Private Data Network
RNR	Receive Not Ready
SVC	Switched Virtual Circuit
VSAT	Very Small Aperture Terminal

4 Interconnection scenarios

A VSAT network may be considered as a particular form of implementation of a Private Data Network (PvtDN). This type of PvtDN is not covered by CCITT Recommendation X.327.

The VSAT Data Terminal Equipment (DTE) connected to the PSPDN appears to the PSPDN as a normal X.25 DTE. The PSPDN makes no allowance and has no knowledge of the VSAT network.

Within the VSAT network two forms of communication are possible: real time direct connection (see subclause 4.1) and store and forward (see subclause 4.2).

4.1 Real time direct connection

In this scenario a real time connection is established between the application served by one of the VSATs and the application served by a DTE connected to the PSPDN. The Switched Virtual Circuit (SVC) or Permanent Virtual Circuit (PVC) over the PSPDN is extended over the VSAT network.

The following elements are identified in the connection and are shown in figure 1:

A: the applications (APPL) which require communication.

These applications communicate with each other by means of end-to-end protocols which are outside the scope of this ETS.

B: The application running at the remote DTE (B) shall implement a local interface to the remote VSAT (D).

This interface is not a subject of standardization. However the recommendations related to connection quality defined in clause 6 are based on the assumption that this interface satisfies CCITT Recommendation X.25 [1].

C: The remote VSAT provides an appropriate DCE interface (C).

D: The remote VSAT (D) provides the communication over the satellite.

The way in which this is done and the internal protocols of the VSAT network are outside the scope of this ETS.

E: The Hub station.

In the case of a star network this is the central station with which all the remote VSATs communicate.

F: The interface between the VSAT network and the PSPDN.

This is a DTE on the VSAT network side and may be implemented at either the HUB or at any of the remote VSAT stations. Under these circumstances two types of connection over the VSAT network can be distinguished:

- single hop connections which apply in meshed networks i.e. those that allow the direct communication between remote VSATs, and in star networks, in which the interface to the PSPDN is implemented exclusively at the HUB;

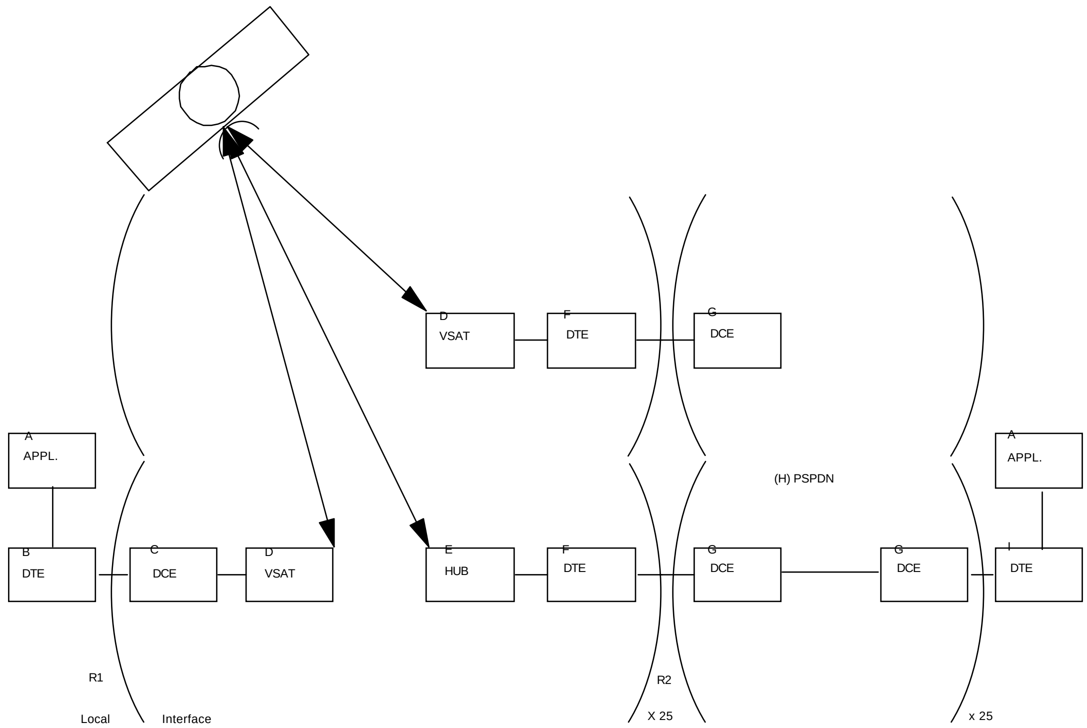
- double hop connections which apply in star VSAT networks which implement the DTE interface to the PSPDN at any of the remote VSATs. In these cases all communications are routed via the HUB and, therefore, require two satellite hops.

G: The PSPDN Data Circuit Equipment (DCE).

These are customer connection points which offer an X.25 interface to the PSPDN. These occur at the interface to the VSAT network and also at the interface to the customer.

H: This is a generic PSPDN which may be made up of a number of national and possibly international portions. These portions are defined in CCITT Recommendation X.134 [4] and their requirements for quality are defined in CCITT Recommendations X.135 [5], X.136 [6] and X.137 [7].

I: The remote DTE of the customer connected to the PSPDN where the corresponding application runs.



R1 = Bit rate at DTE(B) - DCE(C) interface
R2 = Bit rate at DTE(F) - DCE(G) interface

Figure 1: Real time direct connection scenario

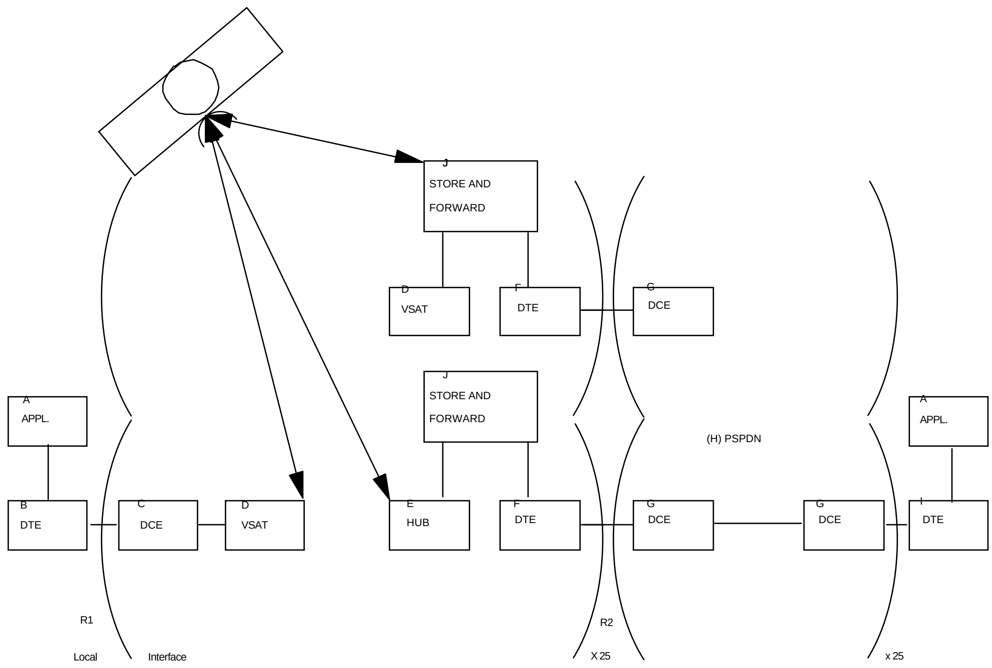
The use of the VSAT network to interconnect two PSPDNs is outside the scope of this ETS.

4.2 Store and forward

This scenario is depicted in figure 2.

In this scenario the delivery to or from the remote DTE (B) is performed over the VSAT system to a store-and-forward gateway (J) connected to the PSPDN via a DTE (F). The delivery to or from the remote DTE (I) takes place from the gateway over the PSPDN. The transmission of information between the DTE (B) and the DTE(I) is performed therefore in two separate transactions. This means there is no real time interaction between the remote DTE (B) and the remote DTE (I).

NOTE: The HUB (E) may or may not be present depending on the VSAT network architecture.



R1: Bit rate at the DTE(B) - DCE(C) interface
R2: Bit rate at the DTE(F) - DCE(G) interface

Figure 2: Store-and-forward gateway scenario

The elements involved in the connection are as defined in subclause 4.1 with one extra component:

J: the store-and-forward gateway between the VSAT system and the PSPDN.

This element is responsible for delivering the messages received from either the remote DTE (B), or the remote DTE (I), to its counterpart.

The gateway function can incorporate protocol conversion at either low functional layers or high functional layers. Such conversion is outside the scope of this ETS.

From the PSPDN point of view, the connection is performed with the applications residing in the gateway. As such, the services offered by the PSPDN and their quality of service is in no way affected by the VSAT system.

Assuming that the store-and-forward gateway is a normal DTE in the PSPDN, no special requirements are identified for addressing purposes. This function is be considered part of the user defined protocols and is therefore outside the scope of this ETS.

5 Interface requirements

Specification

The interface provided by a VSAT network to be connected to a PSPDN shall comply with CCITT Recommendation X.25 [1] at levels 1, 2 and 3.

Verification

The compliance of the interface characteristics provided by a VSAT network to be connected to a PSPDN shall be verified following the procedures specified in NET 2 [3].

6 Connection quality recommendations

6.1 General

The inclusion of a two-way VSAT network in a PSPDN network connection has an effect on the overall quality provided by the connection. It is therefore desirable that the portion of the connection provided by the VSAT network meets certain quality criteria.

CCITT Recommendations X.134 [4], X.135 [5], X.136 [6] and X.137 [7] provide an adequate set of parameters which are applicable to the definition of quality of service parameters in a VSAT network.

CEPT Recommendation T/CAC 4 [8] provides a set of verification procedures which are applicable to the definition of the verification of the quality of service parameters in a VSAT network. The verifications should be performed for each type of VSAT DTE interface with the PSPDN. The interfaces are those declared by the manufacturer.

VSAT networks which are restricted in their connectivity to pre-agreed subsets of users of the PSPDN, for instance by invoking Closed User Group (CUG) facilities, need not take consideration of these recommendations.

6.2 Base for the definition of the VSAT performance parameters

6.2.1 Portion boundaries

The definition of the connection portion and the connection portion boundaries applicable to the connection of a VSAT network to the PSPDN, is made along the principles defined in section 2 of CCITT Recommendation X.134 [4].

The VSAT network should be considered as a user-provided portion of the connection. This portion of the connection is defined as lying between:

- the local interface at the VSAT which for the purpose of this ETS should be according to CCITT Recommendation X.25 [1];

and

- the X.25 interface between the VSAT system and the PSPDN, as required in clause 5.

This is shown in figure 3 which is an extension of figure 2 of CCITT Recommendation X.134 [4].

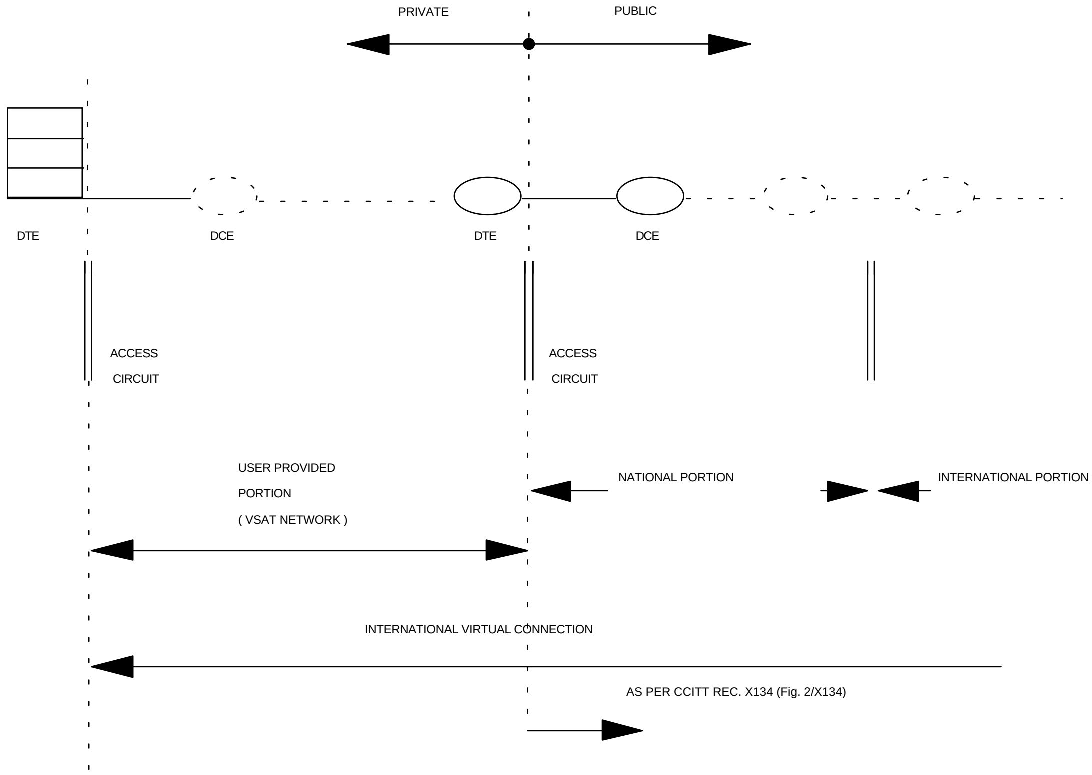


Figure 3: Identification of the boundaries of the user provided portion of the connection

6.2.2 Performance parameters

The definition of the performance of the user provided portion of the connection (VSAT network) is made with respect to the occurrence of performance related events.

Those events are defined in section 3 of CCITT Recommendation X.134 [4] for the X.25 interface.

The user provided portion of the connection is expected to translate those events between the two portion boundaries i.e. a CALL REQUEST packet at the X.25 interface of the remote terminal, becomes an equivalent CALL REQUEST packet at the X.25 interface to the PSPDN. The same applies for the other X.25 layer 3 packets.

6.2.3 System load

The performance recommendations are defined for VSAT networks submitted to their nominal traffic load. This load should be declared by the manufacturer and should be quoted when claiming compliance with this ETS.

The statement should provide at least an indication of:

a) the throughput of established traffic;

This is expressed as the number of packets per second and their size.

b) call processing load.

This is expressed as the number of call attempts and clear attempts handled by the system per unit of time (second, hour).

For the measurement of the VSAT network performances, the VSAT network is operated under its nominal BER condition.

NOTE: The definition of this parameter is under study by CCITT.

6.3 Delay performance

The VSAT network should meet the overall delay requirements given in subclauses 6.3.1 to 6.3.3.

The verification of the compliance with these limits should take place under the following overall conditions:

a) the VSAT is loaded with its nominal traffic load as specified in subclause 6.2.3;

b) the VSAT DTE interface (F) is connected to a test-DCE via a standard X.25 interface as used for customer service;

The responding X.25 port of the remote VSAT under test is a DCE port. This DCE port is connected to a test-DTE;

The test-DCE and test-DTE can, for example, be protocol analysers;

c) the X.25 interface(s) should be unloaded, i.e. SVCs should be in state p1 (ready), and if PVCs are defined, they should produce no traffic on the interface;

d) the interface characteristics should be as follows:

- frame level window of 7;
- default packet level window size of 2;
- default maximum data packet size of 128 octets;
- all data packets should be full i.e. 128 bytes of user data;
- D bit should be set to 0.

e) The maximum transmission delay of the DTE access circuit section of the user provided portion should be declared by the manufacturer.

The tests should be performed in a configuration where the transmission delay of this DTE access circuit section is maximum.

6.3.1 Call set up delay

Specification

The call set-up delay applicable to this ETS, should be as defined in section 2 of CCITT Recommendation X.135 [5].

The packet layer reference events applicable for the user provided portion of the connection defined in subclause 6.2.1 of this ETS, are listed in table 1.

The recommendations are based on the following assumptions:

a) the nominal traffic load is as defined in subclause 6.2.3;

b) the basic call does not require any of the facilities, available for selection by the user, as defined in CCITT Recommendation X.25 [1]. The user data field is not used;

c) the operation of the link layer does not meet either the busy condition (RNR) or the windows closed condition.

Table 1: Packet layer reference events used to measure the call set up delay

Connection Portion Boundary	X.134 Packet Layer Reference Event	
	Packet Event Initial	Packet Event Final
Remote VSAT X.25 interface Calling remote VSAT	2 (X.25)	3 (X.25)
Remote VSAT X.25 interface Called remote VSAT	1 (X.25)	4 (X.25)
PSPDN-VSAT X.25 interface Calling VSAT DTE	2 (X.25)	3 (X.25)
PSPDN-VSAT X.25 interface Called VSAT DTE	1 (X.25)	4 (X.25)

The call set-up time in the user provided portion of the connection is the difference between the call set up time at the boundaries that limit this portion of the connection.

The values defined are an average and a 95 % value. The average value is the average of the distribution of the call set-up time. The 95 % value is the delay value which should be satisfied for at least 95 % of all call set-ups.

The average value and the 95 % value of the call set up time, in the user provided portion of the connection should not exceed the limits given in table 2.

Table 2: Call set-up time recommended values

Statistic	User provided portion
Average (ms)	2 500 + X
95 % (ms)	3 500 + X

The value of X is given by X = 400/R1 (ms), where R1 is the data transmission bit rate expressed in Kbit/s of the access circuit between DTE B and DCE C in figures 1 and 2.

Verification

a) Verification of call set up delay from a test-DCE to a specific VSAT (the test-DCE simulates the Data Circuit-Terminating Equipments of the PSPDN):

The following steps are carried out:

- the test-DCE transmits a CALL REQUEST packet on a free logical channel. Except for the necessary addressing facilities to address the specific VSAT, there is no inclusion of any user facilities in the CALL REQUEST packet;
- the test-DCE waits for the corresponding CALL CONNECTED packet to arrive;
- the time between the start of the CALL REQUEST packet and the end of reception of the CALL CONNECTED packet is measured as the total call set-up time Tcc-cr.

If any unexpected packet level protocol events or any unexpected link layer protocol event is received during a measurement, a new measurement is made.

The X.135 parameter call set up delay is estimated from this value by eliminating irrelevant delays on the access line(s) and delays in test equipment using the following formula:

$T_{cc\text{-}cr}$ - ([L_{cr}+L_{cc}]* 8/R_2) - d_p (ms)

where

$T_{cc\text{-}cr}$ is the total call set-up time in ms;

L_{cr} is the length of the CALL REQUEST packet in octets;

L_{cc} is the length of the CALL CONNECTED packet in octets;

d_p is the processing delay(s) in the test-DCE and/or test DTE in ms;

R_2 is the data transmission bit rate, in Kbit/s of the access circuit between DTE F and DCE G of figures 1 and 2.

The measurement is repeated a minimum of 1 000 times.

b) Verification of call set-up delay from a VSAT to a test-DCE.

Call requests are generated by a test-DTE which is connected to the VSAT used in the test. The procedure is as defined in subclause 6.3.1 paragraph a), except that it is now the test-DTE initiating the call set-up packets and the test-DCE that is the responding part.

The measurements are repeated a minimum of 1 000 times.

The average and the 95 % value should be computed and checked against the recommended values of table 2.

6.3.2 Data packet transfer delay

Specification

The data packet transfer delay applicable to this ETS is defined as the time elapsed from the moment that a data packet causes a packet layer reference event in one of the boundaries of the user provided portion of the connection, until the moment that the same data packet causes another packet layer reference event in the other boundary of the user provided portion of the connection.

The packet layer reference events applicable are defined in table 3.

Table 3: Packet layer reference events used to measure the data packet transfer delay

Connection Portion Boundary	X.134 Packet Layer Reference Event
	Packet Event Initial/Final
Remote VSAT X.25 interface /PSPDN-VSAT X.25 interface	10 a (X.25)
PSPDN-VSAT X.25 interface /Remote VSAT X.25 interface	9 a (X.25)

The average value and the 95 % value of the data packet transfer delay, in the user provided portion of the connection should not exceed the limits given in table 4.

The average value is the average of the distribution of the data packet transfer delay. The 95 % value is the value which should not be exceeded by 95 % of the data packet transfer delay values.

All these values are based on the following assumptions:

a) nominal traffic load in the busy hour as specified in subclause 6.2.3;

b) user data field length of 128 octets;

c) link and packet layer windows in the DTE side are open.

Table 4: Data packet transfer delay recommended values

Statistic	User provided portion
Average (ms)	1 200 + Y
95 % value (ms)	2 500 + Y

The value of Y is given by $Y = 1088/R_1$(ms), where R_1 is the transmission bit rate in Kbit/s, of the PSPDN access circuit between DTE B and DCE C in figures 1 and 2.

Verification

The verification of the data transfer delay across the user provided portion of the connection may be performed in either of the following two ways:

a) Measuring the round trip delay of an echoed packet.

This is similar to the method defined in CEPT Recommendation T/CAC 4 (1989) [8]. This method is applicable to systems in which data paths in both directions have the same statistical properties.

The following steps are carried out:

- the test-DCE makes a call to an echo function in the VSAT-application or in the test-DTE;

- one hundred data packets are transmitted from the test-DCE and the echoed packets received while the transaction times Trtd are measured.

Each measurement should conform to the following:

- each data transfer period begins at the start of the transmission of the data packet and ends at the end of the reception of the echoed packet, at the test-DCE interface;
- the entire period between the call set-up and the end of the tenth transaction interval should have no unexpected packet level protocol events.

The X.135 packet transfer delay parameter is estimated by the following formula:

$$T_{rtd}/2 - L_p * 8/R_2 - d_p/2$$

where:

T_{rtd} is the measured round-trip-delay in ms;

L_p is the length of the test packet;

d_p is the processing delay(s) in the test-DCE and/or test-DTE in ms;

R_2 is the data transmission bit rate, in Kbit/s, of the access circuit between DTE F and DCE G of figures 1 and 2.

The measurement is repeated a minimum of 10 times.

b) Measuring the time difference between generation and reception of the same packet. This method consists in measuring in absolute terms the time intervals between the instants of generation and arrival of the test packets.

This method is applicable to systems in which the data paths in either direction may not have the same statistical properties. In this case measurements should be carried out in both directions.

The following procedure is followed:

- a test-DCE simulates the PSPDN;
- a remote VSAT interface is equipped with a test-DTE;
- there should be a method to permit the synchronization of the internal clocks of these two units.

A possible method may be the colocation of the remote VSAT and the simulated PSPDN interface, and then using two separate ports of the same protocol analyzer to provide the test-DCE and test-DTE respectively.
The measurements are carried out as follows:

- a call is established from the remote VSAT to the test-DCE;
- one hundred data packets are transmitted in each direction;
- the generation time T_1 of each packet is recorded. This is the time of the transmission of the first bit following the closing flag of the data packet;
- the arrival time T_2 of each packet is recorded. This is the time of the reception of the first bit following the closing flag of the correctly received data packet;
- the difference T_2-T_1 is the value of the data transfer delay for each packet;
- the measurement is repeated 10 times.

The average value and the 95 % value are computed and checked against the recommended values in table 4.

6.3.3 Clear delay

The clear delay applicable to this ETS is defined as the time elapsed between the moment in which a CLEAR INDICATION packet creates a packet layer reference event in a boundary of the user provided connection portion and the moment when the corresponding CLEAR REQUEST or CLEAR INDICATION Packet creates a packet layer reference event in the other boundary.

The packet layer reference events applicable are defined in table 5.

Table 5: Packet layer reference event used to measure the clear delay indication

Connection Portion Boundary	X.134 Packet Layer Reference Event
	Packet Event Initial/Final
Remote VSAT X.25 interface /PSPDN-VSAT X.25 interface	6 (X.25)
PSPDN-VSAT X.25 interface /Remote VSAT X.25 interface	5 (X.25)

The average value and the 95 % value of the clear delay, in the user provided portion of the connection should not exceed the limits given in table 6.

The values are defined as an average and a 95 % probability value. The average value is the average of the distribution of the clear delay. The 95 % value is the value which should not be exceeded by 95 % of the clear delay values.

Those values are based on the following assumptions:

a) nominal traffic load is as specified in subclause 6.2.3 of this ETS;

b) link and packet layer windows in the DTE side are open;

c) extended format of the CLEAR REQUEST packet is not used.

Table 6: Clear delay recommended values

Statistic	User provided portion
Average (ms)	1 200 + Z
95 % (ms)	2 500 + Z

The value of Z is given by $Z = 80/R_1$ (ms) where R_1 is the transmission bit rate in Kbit/s, at the access circuit between DTE B and DCE C of figures 1 and 2.

Verification

There is no verification procedure for this parameter in CEPT Recommendation T/CAC 4 (1989) [8].

The verification of the clear delay across the user provided portion of the connection involves the measurement of the time of occurrence of the packet layer reference events 5 and 6 at two different interfaces. The fact that there may be internal reaction from the VSAT network following a clear request does not allow a measuring approach based in bouncing the events as defined for the verification procedures for call set-up and the data packet transfer delay.

Therefore the following direct measurement procedure is followed:

- a test-DCE simulates the PSPDN;

- a remote VSAT interface is equipped with a test-DTE;

- there should be a method that allows the synchronization of the internal calendar clocks of these two units.

A possible method may be the colocation of the remote VSAT and the simulated PSPDN interface, and then using two separate ports of the same protocol analyzer.

The measurements should be carried out as follows:

- a call is established from the remote VSAT to the DCE simulating the PSPDN. A minimum of 10 data packets should be transferred in each direction;

- a clear is initiated at the remote VSAT test DTE. The instant T_1 is the time when the first bit following the closing flag of the CLEAR REQUEST packet is sent. The instant T_2 is the time when the first bit after the closing flag of the successfully received CLEAR REQUEST packet is detected;

- the difference $T_2 - T_1$ is the value of the clear delay.

The measurements are repeated a minimum of 1 000 times.

The average value and the 95 % value should be computed and checked against the recommended values in table 6.

6.4 Throughput performance

Specification

Throughput, handled by a portion of a virtual connection, is the number of user data bits correctly transferred in one direction in a unit of time.

The packet layer reference events applicable to the calculation of the throughput are those defined in section 4.1 of CCITT Recommendation X.135 [5].

The definition of Throughput In Permanent Regime, and Throughput Capacity as per subclauses 4.2 and 4.3 of CCITT Recommendation X.135 [5] are also applicable.

Table 7 defines the Throughput Capacity that should be offered by the user provided portion of the connection in the most unfavourable conditions. The defined values are given in average and a 95 % value. The average value is the average value of the distribution of the channel capacity. The 95 % value is the value for which 95 % of all measurements should be exceeded. This is based on the following assumptions (section 4.4 of CCITT Recommendation X.135 [5]):

a) the VSAT system is loaded with the nominal traffic load, as defined in subclause 6.2.3 of this ETS;

b) the transmission bit rate, on the access circuit between DTE B and DCE C of figures 1 and 2, is equal to 9 600 bit/s;

c) the length of user data field is 128 octets. The requested Throughput Class should be 9 600 bit/s;

d) the packet layer window size is equal to two. Link layer window size is equal to seven in both boundaries;

e) bit D is set to 0 (no end-to-end acknowledgement);

f) the values apply to both ways of the communication;

g) full availability of the connection (in the sense defined in CCITT Recommendation X.137 [7]) during the observation period;

h) during the observation period neither re-initialisations, nor premature disconnections take place (as defined in CCITT Recommendation X.136 [6]);

j) the sizes of the samples of Throughput Capacity are 200 packets, or the amount transferred in two minutes (following either the first or the second measurement technique of those defined in section 4.2 of CCITT Recommendation X.135 [5]).

Table 7: Throughput capacity recommended values

Statistic	User provided portion
Average (bit/s)	2 400
95 % (bit/s)	2 000

Verification of throughput performance

This subclause follows very closely the definitions, requirements and procedures of CEPT Recommendation T/CAC 4 [8] with the necessary modifications to suit a VSAT network.

The Transmitted Throughput is defined as the average rate of user data across the calling X.25 interface to the called X.25 interface, expressed in bit/s.

The Received Throughput is defined as the average rate of user data across the calling X.25 interface from the called X.25 interface, expressed in bit/s.

To make a single measurement of Transmitted Throughput from the VSAT network, a test-DCE makes a call and generates data as defined in the specification to a Drop Function in the VSAT (either in the internal VSAT application or in the external test-DTE). This function is able to accept the data without causing any limitation in the throughput.

To make a single measurement of Received Throughput from the VSAT network, the test-DCE makes a call to a generator function in the VSAT either in the internal VSAT application or in the external test-DTE. This generator function should be able to generate data as defined in the specification.

Each measurement should conform to the following:

- the measured interval is between 55 and 65 seconds;

- the measured interval begins not less than 10 seconds after the start of transmission, or successful reception of the first data packet of data of the call;

- the entire period between the call set up and end of the measurement interval does not have premature CLEAR or RESET.

The Transmitted Throughput is calculated as the number of data packets sent during the measurement interval, multiplied by 1 024 bits per packet and divided by the measurement interval length in seconds.

The Received Throughput is calculated as the number of data packets received during the measurement interval, multiplied by 1 024 bits per packet and divided by the measurement interval length in seconds.

The measurement is repeated a minimum of 10 times for both directions (Transmitted and Received Throughput).

Annex A (informative): Additional elements to this ETS

A.1 Interface information

A.1.1 Level 1

The VSAT interface with the PSPDN takes place over dedicated X.25 ports of the PSPDN in conformity with CCITT Recommendations X.21 and X.21 bis.

In some cases the access from the VSAT interfacing site to the PSPDN may take place over switched connections as defined in CCITT Recommendation X.32.

A.1.2 Level 2

A.1.2.1 LAPB link

To avoid link set-up problems, the VSAT DTE should implement all of the possible methods of link set-up described in CCITT Recommendation X.25 [1] sections 2.4.4, 2.4.6 and 2.4.7, which should be available for selection at installation time. It should consequently comply with all four link set-up tests detailed in section 9.1 of NET 2 [3].

It should in any case demonstrate that it complies with the link set-up method relevant to the PSPDN to which it wishes to attach.

A.1.2.2 Invalid information frames

A VSAT DTE may encounter two different reactions to an information frame of greater than N1 bits, where N1 is as described in section 2.4.8.5 of CCITT Recommendation X.25 [1]. The PSPDN DCE may either issue a frame reject with the P/F bit set to one, or it may discard the frame. This will depend upon its interpretation of the error involved and whether it is waiting to receive the FCS on detecting an over length frame.

Therefore the VSAT DTE should:

a) correctly handle timer recovery due to a discard as in section 2.4.8.1 of CCITT Recommendation X.25 [1];

b) correctly handle a FRMR with the P/F bit set to 1 as in section 2.4.7 of CCITT Recommendation X.25 [1].

A.1.2.3 Unsolicited responses

The DM (Disconnect mode) response may be used by the DCE or DTE to request a link set-up to the other party. The reaction to this is defined in section 2.3.4.8 of CCITT Recommendation X.25 [1].

The reaction to other unsolicited responses is not well defined, a number of variations exist.

Therefore, the VSAT DTE should:

a) be capable of handling the reactions of the PSPDN DCE to which it requires connection;

b) react to unsolicited responses as specified in NET 2 [3], subclause 9.7.

A.1.3 Level 3

A.1.3.1 Call packet types

The VSAT DTE should use call packet types compatible with the PSPDN to which it is attempting to connect. This may render certain facility negotiations, referred to in clause A.3, impossible. In this case the VSAT DTE should be made part of a Closed User Group (CUG).

A.1.3.2 Restart handling

The VSAT DTE should handle restart packets in a manner compatible with the PSPDN to which it wishes to interface.

A.1.3.3 Reset handling

The VSAT DTE should handle reset packets in a manner compatible with the PSPDN to which it wishes to interface.

A.1.3.4 Permanent Virtual Circuits (PVCs)

An X.25 PVC is always in the data transfer state unless it is actually in the process of resetting. Call packets are not allowed on a PVC. Consequently, remote VSAT addresses from the PSPDN to the VSAT DTE should be passed within data packets. However, any such mechanism is outside the scope of this ETS.

A.1.3.5 Packet fragmentation and concatenation

The X.25 flow control parameters (i.e. packet and window sizes) affect the efficiency of the throughput over the PSPDN. Since the protocols on either side of the VSAT DTE are completely independent they do not directly affect performance of the VSAT system. However packet fragmentation or concatenation may be carried out within the VSAT DTE in order to maximize performance on either, or both, sides of the interface.

A.1.4 OSI network layer service

Until such time as all PSPDNs provide the facilities necessary to implement the network layer service and bearing in mind that moves are being made to change certain aspects of the OSI model start up procedures, a full network service is not required.

However some facilities, specified in CCITT Recommendation X.25 [1], annex G, are recommended for the VSAT DTE in sections 4 and 5. The VSAT DTE should be capable of supporting all facilities detailed in annex G to CCITT Recommendation X.25 [1], in order to facilitate future implementation of a network layer service as defined in ISO 8348 and ISO 8878, when the PSPDN becomes capable of supporting it. Until such time, the VSAT DTE should implement a sub-network-dependent convergence protocol as defined in standard ECMA-112 or ISO 8878.

A.2 Addressing information

Two options are provided for addressing a particular remote VSAT from the PSPDN DTE.

The method for addressing a particular remote PSPDN DTE from the remote VSAT is not within the scope of this ETS as it is internal to the VSAT network.

A.2.1 Extended address facility

The called address extension facility is defined in annex G to CCITT Recommendation X.25 [1]. It allows up to 40 digits to be included in a facility field of a CALL REQUEST packet.

When calling from the PSPDN, the X.121 address of the VSAT DTE is contained in the address block of a CALL REQUEST packet. Any subaddress is passed in the called address extension parameter field.

Where this facility is available, it should be used to pass the address of the remote VSAT to the VSAT DTE. The address should be encoded as specified in Addendum 2 to ISO 8348.

A.2.1.1 Call user data field

In cases where the X.25 network complies with versions of X.25 earlier than 1984, the extended address facility should be implemented by an alternative means described in the Standards ECMA-112. The called address extension is passed in the call user data field of a CALL REQUEST packet.

In this case the first octet of the call user data field should be encoded as defined in ISO 8348 and CCITT Recommendation X.244.

The X.25 CALL REQUEST packet in most cases contains a 16 octet call user data field. Using ECMA-112 will absorb a significant number of the available octets especially if the transit delay negotiation facility is also implemented.

A.2.2 CCITT Recommendation X.121 subaddressing

If neither of the above methods can be implemented, then the remote VSAT address should be encoded as part of the X.121 address of the VSAT DTE. The subaddress digits should then be BCD digits as specified in CCITT Recommendation X.121.

All current European X.25 networks are capable of transferring at least two subaddressing digits appended to the X.121 network address. Some are capable of transferring as many as eight nationally, up to a total of 14 digits including the national number. The number of digits available for subaddressing depends on the PSPDN to which the VSAT is attached. These digits are passed transparently by the network.

Two subaddress digits allow up to one hundred terminals to be addressed. If the VSAT network has more than one hundred terminals and only two digits available, then additional national numbers should be allocated to the VSAT DTE. The VSAT DTE should decode the address accordingly.

If multiple national numbers are used they should not form part of a hunt group or the VSAT DTE will be unable to correctly determine the required remote VSAT address.

A.3 Facilities information

A.3.1 DTE facilities

The VSAT DTE should implement all the essential DTE facilities specified in CCITT Recommendation X.2 [2], table 5. Some will not yet have been implemented by the PSPDN in which case the DTE should make use of a suitable convergence protocol.

A.3.1.1 End-to-end transit delay facility

This facility is defined in annex G, section 3.3.2 of CCITT Recommendation X.25 [1]. It should be used either as defined in this annex if the PSPDN supports it, or as defined in Standard ECMA-112 in order to inform the remote DTE of larger than usual delays.

It is only necessary in outgoing calls. Only the first two bytes should be used to inform of the cumulative transit delay. Other octets of this facility may be used if desired.

A.3.2 DCE facilities

The VSAT DTE should be capable of handling all the essential DCE facilities specified in CCITT Recommendation X.2 [2], table 3, either as specified in CCITT Recommendation X.25 [1], or by making use of the relevant convergence protocol (this requires further study).

A.3.3 VSAT specific facilities

Additional facilities specific to VSAT systems can be envisaged such as selective broadcast where a message is broadcast to a certain group of remote VSATs. The method of doing so is outside the scope of this ETS.

A.4 Additional quality of service information

A.4.1 Accuracy and dependability performance

The implementers of VSAT networks are reminded of the existence of accuracy and dependability requirements for public networks as defined in CCITT Recommendation X.136 [6]. VSAT systems suppliers should aim to meet the accuracy and dependability requirements specified for the national type B portion of the connection.

A.4.2 Availability performance

The implementers of VSAT networks are reminded of the existence of availability requirements for public networks as defined in CCITT Recommendation X.137 [7]. VSAT systems suppliers should aim to meet the availability requirements specified for the national type B portion of the connection.

Annex B (informative): Bibliography

- CCITT Recommendation X.21 (1988): "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for synchronous operation on public data networks".

- CCITT Recommendation X.21 bis (1988): "Use on public data networks of Data Terminal Equipment (DTE) which is designed for interfacing to synchronous V-Series modems".

- CCITT Recommendation X.32: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and accessing a packet public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network".

- CCITT Recommendation X.121 (1988): "International numbering plan for public data networks".

- CCITT Recommendation X.244 (1988): "Procedure for the exchange of protocol identification during virtual call establishment on packet switched public data networks".

- CCITT Recommendation X.327 (1988): "General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and private data networks for the provision of data transmission services".

- ISO 8348: "Information Processing Systems - Data Communications - Network service definition".

- ISO 8878: "Information Processing Systems - Data Communications - Use of X.25 to provide the OSI connection-mode network service".

- ECMA-112 X.25 (1980): "Subnetwork-Dependent Convergence Protocol".

History

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