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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATION

Public data networks – Network aspects

Echo, drop, generator and test DTEs for measurement of performance values in public data networks when providing international packet-switched services

ITU-T Recommendation X.139

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION X.139

ECHO, DROP, GENERATOR AND TEST DTEs FOR MEASUREMENT OF PERFORMANCE VALUES IN PUBLIC DATA NETWORKS WHEN PROVIDING INTERNATIONAL PACKET-SWITCHED SERVICES

Summary

This Recommendation provides functional specifications for test sets at international packet-switched gateways for evaluation of the performance international portions according to the parameters specified in X.130-Series Recommendations on PSPDN performance.

Source

ITU-T Recommendation X.139 was revised by ITU-T Study Group 7 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 9th of August 1997.

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.

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.

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As of the date of approval of this Recommendation, the ITU had/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

ECHO, DROP, GENERATOR AND TEST DTEs FOR MEASUREMENT OF PERFORMANCE VALUES IN PUBLIC DATA NETWORKS WHEN PROVIDING INTERNATIONAL PACKET-SWITCHED SERVICES

(revised in 1997)

1 Introduction and scope

1.1 General

This Recommendation defines echo, drop, generator and test DTEs for estimating the speed of service (delays and throughput) performance of packet-switched public data networks.

1.2 Parameters to be measured

The speed of service (delays and throughput) performance values for packet-switched public data networks defined in Recommendation X.135 are as follows:

– Call set-up delay (see clause 4/X.135).

– Data packet transfer delay (see clause 5/X.135).

– Throughput (see clause 6/X.135).

– Clear indication delay (see clause 7/X.135).

Note that Recommendation X.135 considers the Quality of Service for networks with 9600 bit/s and 64 kbit/s access speeds and that this Recommendation provides means for measuring the parameters for these speeds; higher speeds may be used in the future.

1.3 Accuracy requirements of measurement

The various performance measurement techniques provide differing accuracy capabilities. The accuracy required for the measurements will depend upon the use being made of the results. The accuracy requirements impact on the performance required of the echo, drop, generator and test DTE functions.

The measured value of the delay parameters included in Recommendation X.135 can be expected to be, in most cases, significantly greater than 100 ms. Consequently, an accuracy of approximately 10 ms or less, should be sufficient in these cases.

The measured value of throughput as specified in Recommendation X.135 for 9.6 kbit/s access signalling can be expected in most cases to be in the range of 1000 to 9000 bit/s. Consequently, an accuracy to within 100 bit/s or less, should be sufficient in these cases. Accuracy to within 100 bit/s or less will also be sufficient for the cases involving 64 kbit/s access signalling.

Recommendation X.138 provides detailed information on measurement architectures and, in Annex A, provides detailed information on the calculation of packet-switched network performance statistics and factors which can affect their observation.

1.4 Measurement method using echo, drop and generator DTEs

This subclause describes echo, drop, generator and test DTEs that can be used in estimating speed of service performance. Echo, drop and generator DTEs shall be available at international gateways for testing national and international portions.

It should be noted that there may be networks where the equipment providing the remote STE does not have X.25 ports. In such a case the network provider shall make another arrangement to provide the echo, drop and generator DTE functions.

An echo DTE is a DTE used in data packet transfer delay measurements providing the data loopback function of Recommendation X.138. A drop DTE performs the controlled, unmonitored sink function of 4.1/X.138, in a throughput capacity measurement. A generator DTE performs the functions of a controlled, unmonitored source in a throughput capacity measurement. Echo, drop and generator DTEs should respond to incoming call set-up requests with small (or fixed and known) delays. This will allow the echo, drop and generator DTEs to also perform the functions of an unmonitored sink in a call set-up delay measurement.

A test DTE is a device most commonly provided by the tester. It pairs with the echo, drop and generator DTEs and provides the functions of a controlled and monitored source and/or sink.

Clause 4 describes the procedures for using these echo, drop, generator and test DTEs. Clause 5 specifies them in greater detail. Clause 6 specifies where they will be located within networks.

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.

– ITU-T Recommendation X.1 (1996), *International user classes of service in, and categories of access to, public data networks and Integrated Services Digital Networks (ISDNs)*.

– ITU-T Recommendation X.2 (1996), *International data transmission services and optional user facilities in public data networks and ISDNs*.

– ITU-T Recommendation X.25 (1996), *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*.

– ITU-T Recommendation X.75 (1996), *Packet-switched signalling system between public networks providing data transmission services*.

– ITU-T Recommendation X.96 (1993), *Call progress signals in public data networks*.

– ITU-T Recommendation X.110 (1996), *International routing principles and routing plan for public data networks*.

– ITU-T Recommendation X.134 (1997), *Portion boundaries and packet-layer reference events: Basis for defining packet-switched performance parameters*.

– ITU-T Recommendation X.135 (1997), *Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched services*.

– ITU-T Recommendation X.136 (1997), *Accuracy and dependability performance values for public data networks when providing international packet-switched services*.

– ITU-T Recommendation X.137 (1997), *Availability performance values for public data networks when providing international packet-switched services*.

– ITU-T Recommendation X.138 (1997), *Measurement of performance values for public data networks when providing international packet-switched services*.

– CCITT Recommendation X.140 (1992), *General quality of service parameters for communication via public data networks*.

– ITU-T Recommendation X.213 (1995), *Information technology – Open Systems Interconnection – Network service definition*.

– CCITT Recommendation X.323 (1988), *General arrangements for interworking between Packet-Switched Public Data Networks (PSPDNs)*.

3 Abbreviations

This Recommendation uses the following abbreviations:

DCE Data Circuit-terminating Equipment

DTE Data Terminal Equipment

OSI Open Systems Interconnection

RR Receiver Ready

STE Signalling Terminal Equipment

4 Measurement procedure

4.1 Call set-up delay

The call set-up delay is defined in 4.2/X.135. The relevant call set-up delay events are shown in Figure 2/X.135. The end-to-end call set-up delay is the call set-up delay between DTE boundaries, e.g. B_1 and B_n in Figure 2/X.135. This end-to-end delay excludes the called user response time.

This end-to-end call set-up delay can be estimated by measuring the time between the sending of a call request packet and the receipt of a call connected packet at the calling X.25 DTE boundary and subtracting the time between the incoming call packet and the call accepted packet at the called X.25 DTE boundary. For a call between the boundaries B_1 and B_n in Figure 2/X.135 this would correspond to the value of $(t_2 - t_1) - (t_4 - t_3)$.

Hence, this measurement can be performed at one portion boundary using a DTE at the remote end of the portion or portions to be measured (for example, an echo DTE), where that DTE has a known and fixed time between the receipt of an incoming call packet and its issue of a call accepted packet. This is shown in Figures 1a and 1b.

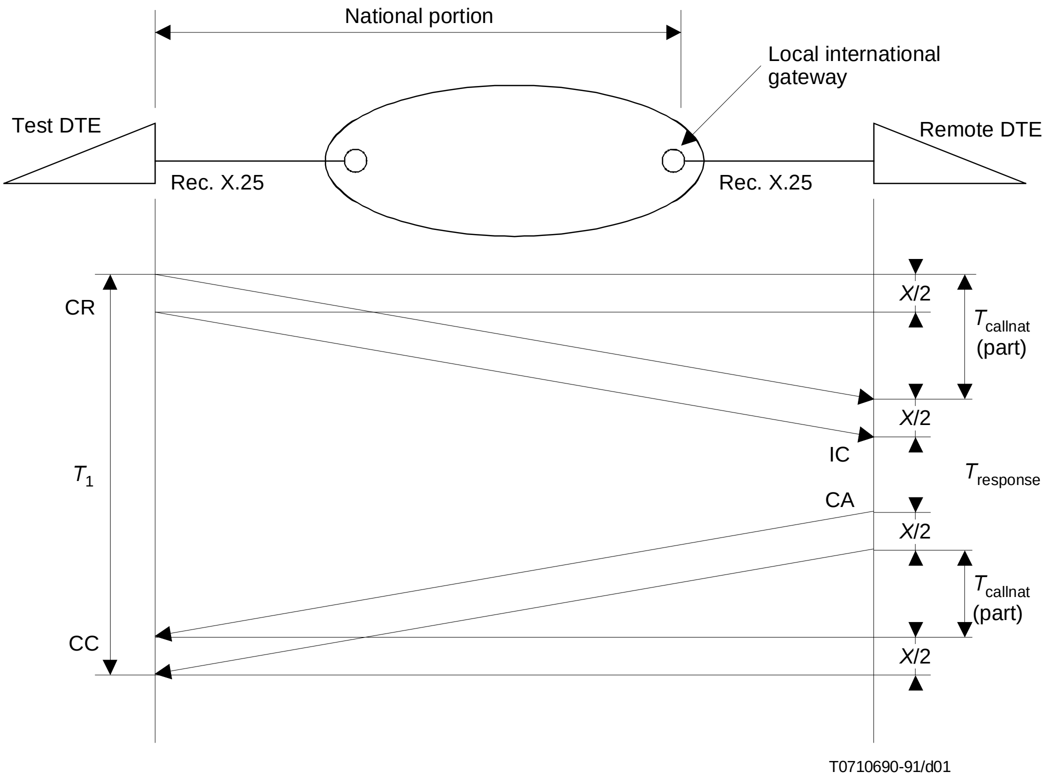

Figure 1a/X.139 – Call set-up delay measurement – National portion

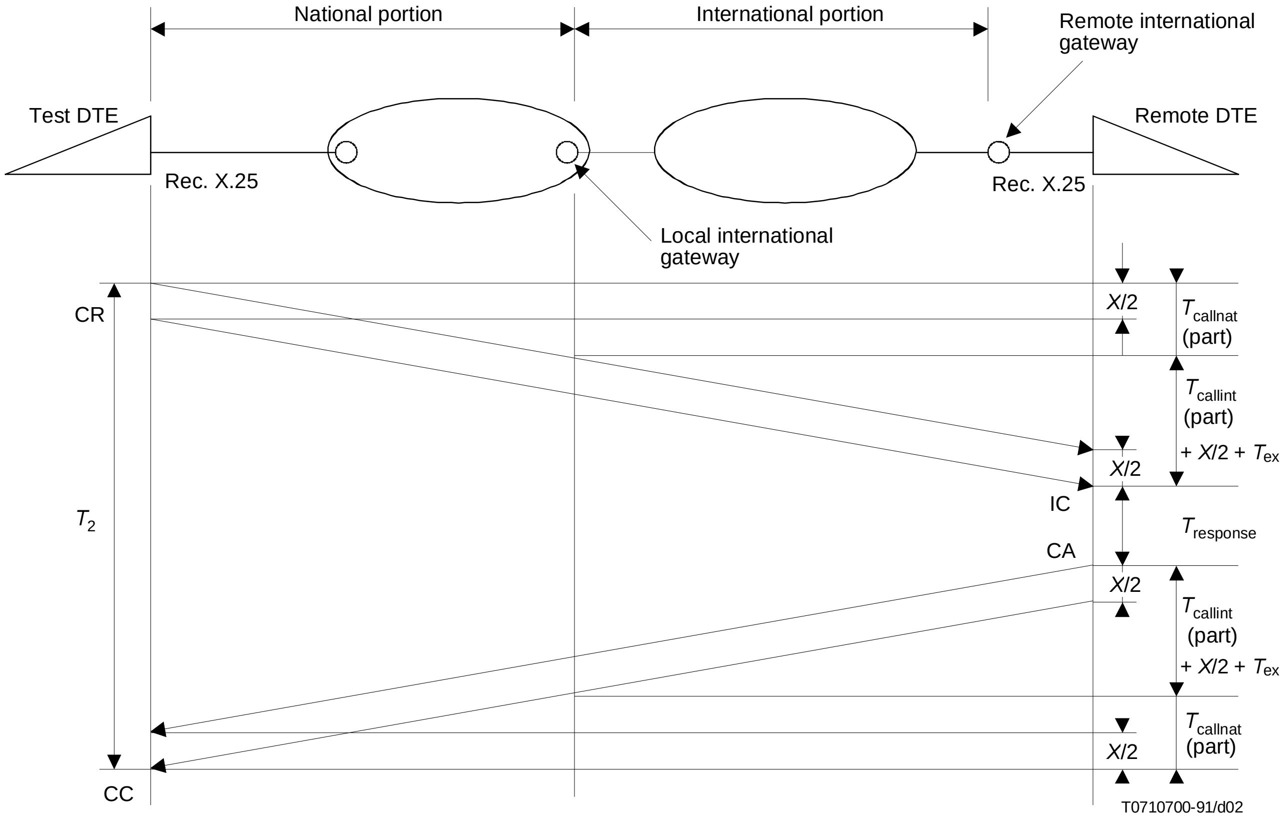

Figure 1b/X.139 – Call set-up delay measurement – International portion

Measurements are made under the following conditions:

– Conditions as specified in Recommendation X.135 for the observed virtual connection which should be used if the parameters as specified in Recommendation X.135 are to be measured. Other load conditions may be used for measurements made for other reasons.

– A basic call, in which none of the optional user facilities defined in Recommendation X.25 are used and no call user data is sent in the call request packet.

– Data link layer windows of entities outside the portion being measured are open (not flow controlled).

The call set-up delay of the portion(s) to be measured can be calculated as follows:

Define:

X	Access line signalling time (= 42 ms on a 9600 bit/s line) (see 4.3/X.135)
$T_{callnat}$	Originating national portion of the call set-up delay
$T_{callint}$	International portion of the call set-up delay
T_{ex}	Call set-up delay through the remote gateway STE
$T_{response}$	Call set-up delay of the remote DTE
T_1	Measured call set-up time to the originating national network remote DTE
T_2	Measured call set-up time to the destination national network remote DTE
CR	Call Request packet
IC	Incoming Call packet
CA	Call Accepted packet
CC	Call Connected packet

Assuming that both the test DTE and the remote DTE are connected to the portion(s) to be measured by similar speed access lines, then:

$$\begin{aligned} T_1 &= X + T_{\text{callnat}} + T_{\text{response}} \\ T_2 &= X + T_{\text{callnat}} + T_{\text{callint}} + 2T_{\text{ex}} + T_{\text{response}} \end{aligned} \tag{4-1}$$

Hence:

$$\begin{aligned} T_{\text{callnat}} &= T_1 - X - T_{\text{response}} \\ T_{\text{callint}} &= (T_2 - T_1) - 2T_{\text{ex}} \end{aligned} \tag{4-2}$$

Note that in this Recommendation, the response time of the remote DTE has been defined to be significantly less than the delay to be measured. Hence T_{response} can either be assumed to be zero, in which case a measurement will yield a value which is slightly too high, or if T_{response} is known, a more accurate value will be obtained.

Note that the measurement of the call set-up delay for the international portion includes T_{ex}, the call set-up delay through the remote gateway STE. This delay can be subtracted if it is known or can be measured. If it is assumed to be zero, then the resulting error gives a result for the call set-up delay which is slightly too high.

4.2 Data packet transfer delay

The data packet transfer delay is defined in 5.1/X.135. It is the period of time that starts when a data packet creates a protocol event at a particular boundary B_i, and ends when this same packet creates a later protocol event at another boundary B_j.

Accurate measurement of data packet transfer delay requires synchronized real-time clocks located at the appropriate portion boundaries, however it is possible to measure the round trip delay of a packet between a test DTE and an echo DTE. The echo DTE receives packets and retransmits them on the same logical channel after a known and fixed time. This is shown in Figures 2a and 2b.

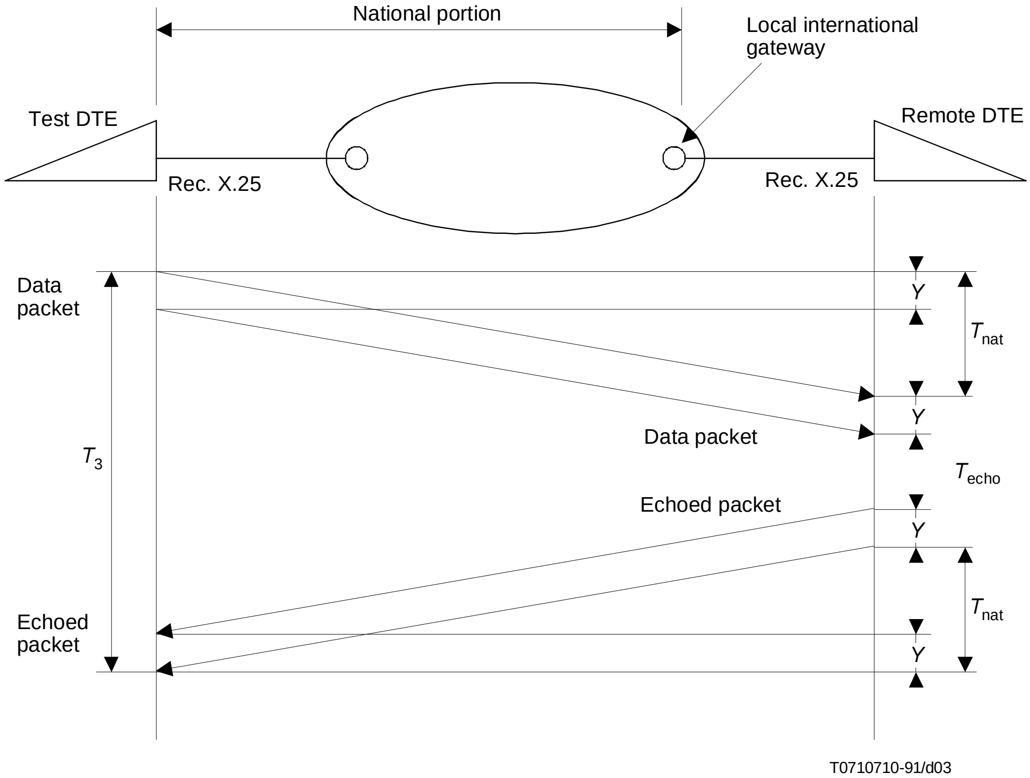

Figure 2a/X.139 – Data packet transfer delay measurement – National portion

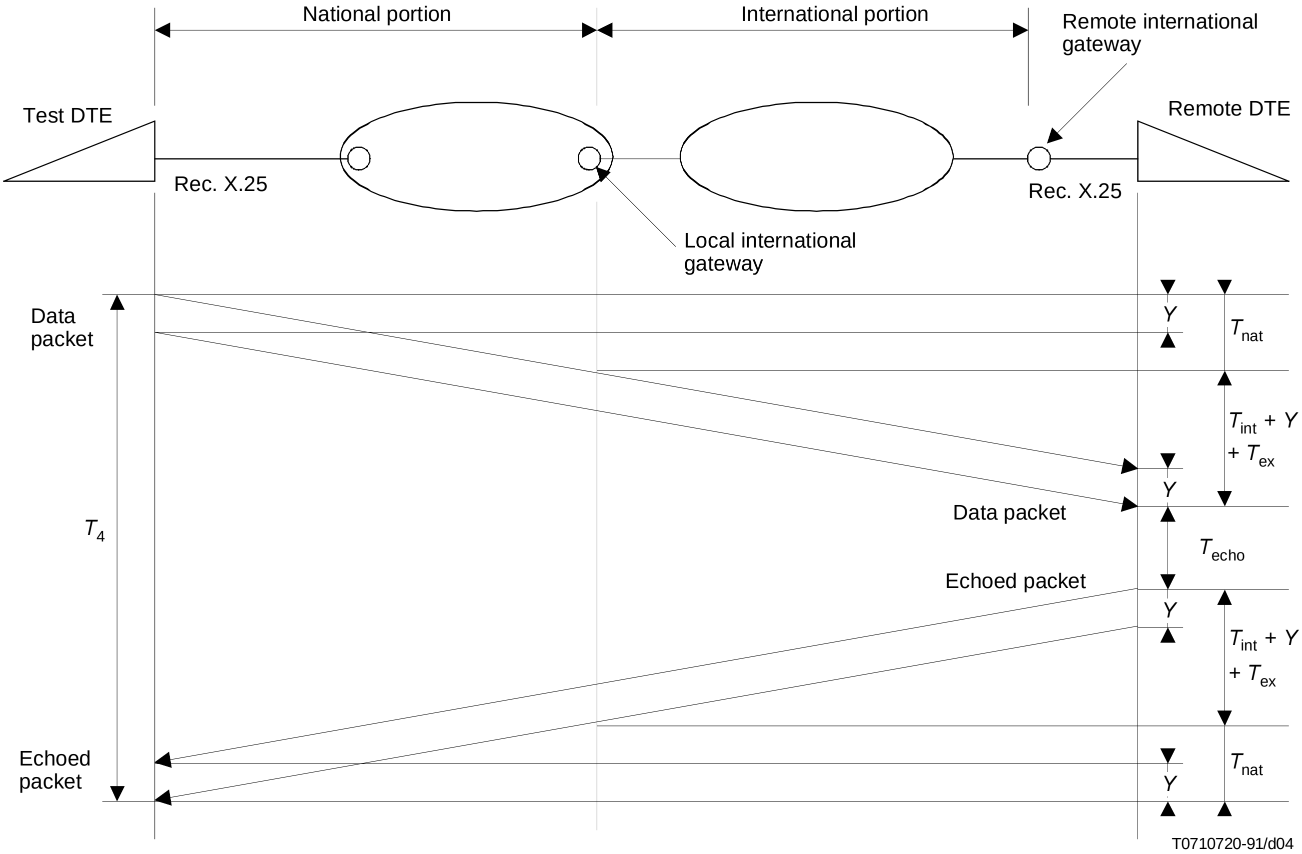

Figure 2b/X.139 – Data packet transfer delay measurement – International portion

Measurements are made under the following conditions:

– Conditions as specified in Recommendation X.135 for the observed virtual connection which should be used if the parameters as specified in Recommendation X.135 are to be measured. Other load conditions may be used for measurements made for other reasons.

– A user data field length of 128 octets.

– Data link and packet layer windows on the receiving DTE side of the portion being measured are open.

The data packet transfer delay of the portion(s) to be measured can be calculated as follows:

Define:

Y Access line signalling time (= 113 ms for a 128 octet data packet on a 9600 bit/s line) (see 5.2/X.135)

T_{nat} Originating national portion of the data packet transfer delay

T_{int} International portion of the data packet transfer delay

T_{ex} Data packet transfer delay through the remote gateway STE

T_{echo} Delay of the echo DTE

T_3 Measured round trip delay to the originating national network echo DTE

T_4 Measured round trip delay to the destination national network echo DTE

Assuming that both the test DTE and the echo DTEs are connected to the portion(s) to be measured by similar speed access lines, then:

$$T_3 = 2(Y + T_{nat}) + T_{echo}$$
$$T_4 = 2(Y + T_{nat} + T_{int} + T_{ex}) + T_{echo} = T_3 + 2T_{int} + 2T_{ex} \quad (4\text{-}3)$$

Hence:

$$T_{nat} = \frac{T_3}{2} - Y - \frac{T_{echo}}{2}$$
$$T_{int} = \frac{(T_4 - T_3)}{2} - T_{ex} \qquad (4\text{-}4)$$

Note that in this Recommendation the response time of the echo DTE has been defined to be significantly less than the delay to be measured. Hence in obtaining a value for T_{nat}, T_{echo} can either be assumed to be zero, in which case a measurement will yield a value which is slightly too high, or if T_{echo} is known, a more accurate value will be obtained.

Note that the measurement of the data packet transfer delay for the international portion includes T_{ex}, the data packet transfer delay through the remote gateway STE. This delay can be subtracted if it is known or can be measured. If it is assumed to be zero then the resulting error gives a result for the data packet transfer delay which is slightly too high.

4.3 Throughput

Throughput is defined in 6.1/X.135. It is the number of user data bits successfully transferred in one direction across a portion per unit time. Successful transfer means that no user data bits are lost, added, or inverted in transfer.

As noted in 6.2/X.135, steady state throughput is the same when measured at every pair of portion boundaries of a virtual connection. Thus, assuming no user data bits are lost, added, or inverted in transfer, a steady state throughput measurement can be made at any single portion boundary within a virtual connection.

Throughput can be measured by a test DTE using a drop DTE at the remote end of the portion or portions to be measured. The drop DTE receives and acknowledges packets from the test DTE. The test DTE must be able to generate packets at rates far in excess of the network's handling capability. The drop DTE must have a capability of receiving packets such that it does not control the flow of the transmission of the data packets it is receiving. This is shown in Figures 3a and 3b.

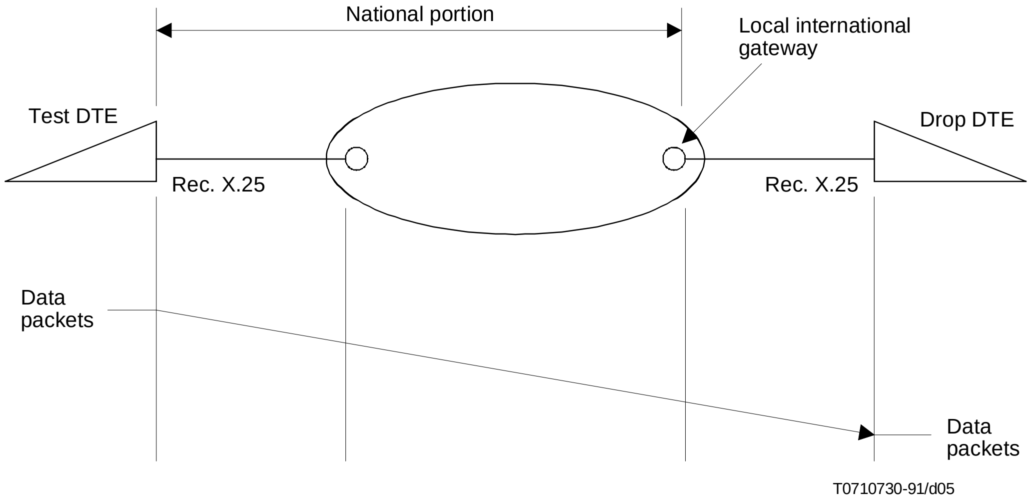

Figure 3a/X.139 – Throughput capacity measurement – National portion

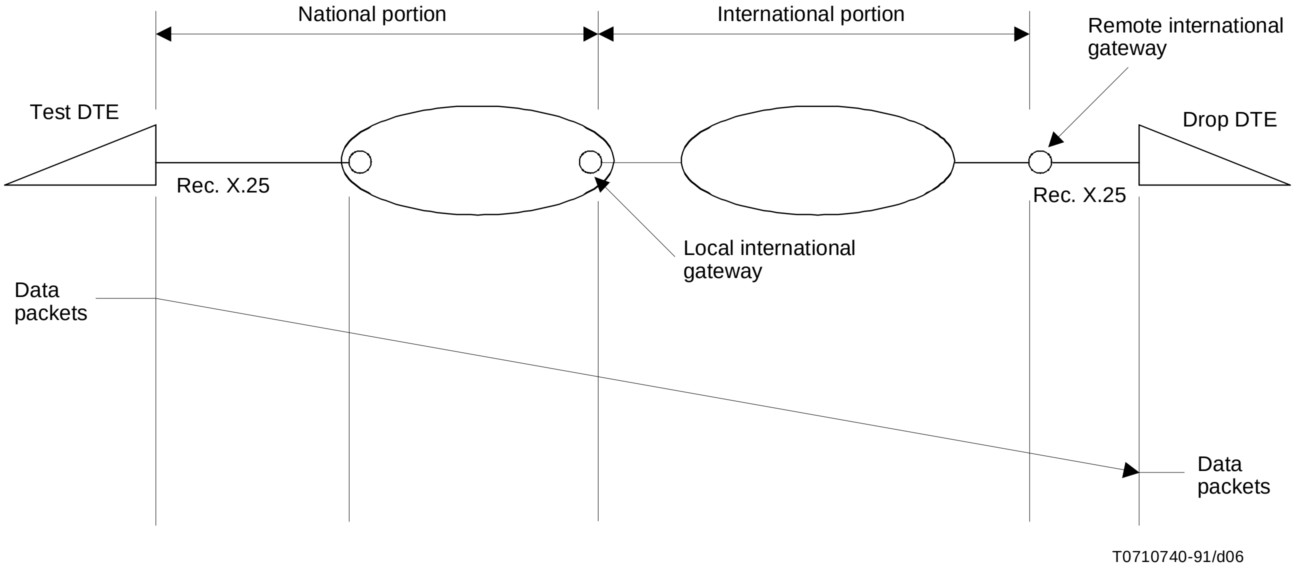

Figure 3b/X.139 – Throughput capacity measurement – International portion

Measurements are made under the following conditions for access circuit sections having signalling rates of 9600 bit/s *(64 kbit/s)*:

– Conditions as specified in Recommendation X.135 for the observed virtual connection which should be used if the parameters as specified in Recommendation X.135 are to be measured. Other load conditions may be used for measurements made for other reasons. No other traffic on the access circuit sections.

– 9600 bit/s *(64 kbit/s)* signalling rates on the access circuit sections. Higher signalling rates are for further study.

– A user data field length of 128 octets. Requested (and final negotiated) send throughput class corresponding to 9600 bit/s *(64 kbit/s)*. (Note that for 9600 bit/s calls only the throughput class finally applying to the call may be lower than the requested throughput class.)

– Packet layer window sizes of 5 *(33)* and data link layer window sizes of 5 *(33)* on the access circuit sections. (Note that the M bit should be set when traversing national or international virtual connection portions of type B.)

– D bit is set to 0.

– No unavailability (as defined in Recommendation X.137) during the observation period.

– No resets or premature disconnects (as defined in Recommendation X.136) during the observation period.

– Throughput capacity sample sizes of 400 *(660)* packets (in the case of the first measurement technique specified in 6.2/X.135) or 2 minutes (in the case of the alternative measurement technique specified in 6.2/X.135).

According to Table 8a/X.135, for access signalling rates of 9600 bit/s, the lowest worst-case throughput value is 2700 bit/s. This means that the time to send 400 data packets with 128 bytes of user data is 161 seconds (or 2 minutes 41 seconds). Hence a throughput measurement will be performed by sending 400 data packets and if after 2 minutes the test has not finished, it will be stopped. The throughput will then be calculated over the user data bits sent within those 2 minutes. In the case of access signalling rates of 64 kbit/s, the above procedure may be used with 660 data packets instead of 400.

To make measurements of throughput for higher speed access lines would require both the test DTE and the drop DTE to be connected to the network portions to be measured at that higher speed, it would not be sufficient to make the change only for the test DTE.

The throughput of the portion(s) to be measured can be calculated as follows:

Define:

T_5: Duration of the measurement [= the time to send 400 *(660)* packets if the first measurement technique in Annex B/X.135 is used, or 2 minutes if the alternative measurement technique is used].

N_1: The number of packets sent.

N_2: The number of user data bits per packet (= 1024 for the conditions described above).

Then, for 9600 bit/s access signalling rates:

– $\text{throughput} = \dfrac{N_1 \times N_2}{T_5}$;

– $\text{throughput} = \dfrac{400 \times 1024}{T_5}$;

– $\text{throughput} = \dfrac{409,600}{T_5}$ bit/s, if 400 packets were sent, as in the first technique; or

– $\text{throughput} = \dfrac{N_1 \times 1024}{120}$ bit/s, if the alternative technique was used.

The value as measured applies only in the direction from the test DTE to the drop DTE. It can be measured in the reverse direction by using a generator DTE to send packets back to the test DTE. The test should be made in only one direction at a time. The measurement technique and calculations are as above, with the test DTE including a drop function.

4.4 Clear indication delay

The clear indication delay is defined in 7.1/X.135. It is the period of time that starts when a clear request packet creates a protocol event at a boundary B_i, and ends when the corresponding clear request or clear indication packet creates a later protocol event at another boundary B_j. The specific protocol events are identified in Table 9/X.135.

Since clear indication delay is a one-way delay, it can only be accurately measured using synchronized real-time clocks.

An approximation to the clear indication delay can be obtained by measuring the data packet transfer delay for a packet of the same size as that for a clear request or clear indication packet. However, as networks process clear request packets and data packets differently, the result of such measurements should be interpreted with care. This matter is for further study.

5 Characteristics of echo, drop, generator and test DTEs

5.1 Common X.25 configuration and subscription parameters of the DTEs

The test, echo, drop and generator DTEs specified hereafter will have X.25 configuration and subscription parameters as follows.

The link layer protocol is LAPB-X.25 with a frame numbering modulus of 8 for 9.6 kbit/s operation and 128 for 64 kbit/s operation and corresponding frame window sizes of 5 and 33 (see Note 1). The maximum frame length is 1080 bits. The frame address is A as stated in 2.4.2/X.25.

The packet layer has a packet modulus of 8 for 9.6 kbit/s operation and 128 for 64 kbit/s operation. Only logical channel 1 will be used. The address fields contain one or two addresses according to the requirements of the network to which the DTE is connected (see Note 2). No facilities will be transmitted or received in the call request, call indication, call connected or call accepted packets (see Notes 3 and 4). The DTEs are connected to the network at 9600 bit/s or 64 kbit/s. Default throughput classes are 10 (9600 bit/s) or 13 (64 kbit/s). Default packet windows are 5 for 9600 bit/s access signalling and 33 for 64 kbit/s access signalling (see Note 3).

NOTE 1 – If a network does not allow a frame window of 5, then frame window in this case must be equal to or greater than the packet windows which apply to any calls.

NOTE 2 – Some networks allow only a complementary calling address in the call request packet and only a complementary called address in the incoming call packet. In such a case, there is only one address and the complementary address is empty.

NOTE 3 – Some networks have a data packet acknowledgement which extends beyond the interface between the access line and the network. In such a case the packet window values impact heavily on the possible throughput. Then packet window negotiation is requested and will be used as follows:

– in order to measure the national portion to which the DTE is connected, packet windows of 5 will be requested by the calling test DTE;

– in order to measure an international portion, packet window values as great as possible, i.e. equal to the frame window, will be requested by the calling test DTE;

– the echo, drop and generator DTEs will always accept the packet window values proposed by the network.

NOTE 4 – Recommendation X.25 has only one subscription parameter for flow control negotiation, that is, both packet window negotiation and packet size negotiation. Hence, when the packet window negotiation applies, the test DTE will always request, explicitly or by default, packet size values of 128 octets. The echo, drop and generator DTEs will always enforce packet sizes of 128 octets.

NOTE 5 – In the case of 64 kbit/s access signalling, the M bit should be set when traversing a national or international virtual connection portion of type B.

5.2 Echo DTE

An echo DTE performs the data loopback functions in a data packet transfer delay measurement. It also performs the functions of a controlled, unmonitored sink (as described in clause 4/X.138) in a call set-up delay measurement.

The echo DTE will be permanently connected to the network using X.25.

The test DTE will establish a virtual call to the echo DTE for either call set-up or data packet transfer delay measurement.

The echo DTE will answer any call request packet, when not busy, in order to allow call set-up or data packet transfer delay measurement.

A clear request packet should be issued by the test DTE within 1 second after the measurement interval has ended. If the measurement is invalidated by either an unexpected packet level protocol event or by non-receipt of a data packet for echo within 30 seconds, a clear request packet should be issued by the echo DTE within one second.

Following receipt of an incoming call packet, the echo DTE will respond with a call accepted packet within a delay between 0 and 25 milliseconds.

The data field of each data packet received will be echoed back by the transmission of a data packet with the identical user data field contents within a delay between 0 and 20 milliseconds, except within the first 100 milliseconds following the issue of a call accepted packet (packets received within this 100 milliseconds may be ignored by the echo DTE).

The echo DTE will not generate interrupt packets nor spontaneously generate any data packets.

5.3 Drop DTE

A drop DTE performs the controlled, unmonitored sink functions (as described in clause 4/X.138) in a throughput capacity measurement or a call set-up delay measurement.

The drop DTE will be permanently connected to the network using X.25.

The test DTE will establish a virtual call to the drop DTE for throughput measurement.

A clear request packet should be issued by the test DTE within 1 second after the measurement interval has ended. If the measurement is invalidated by either an unexpected packet level protocol event or by non-receipt of a data packet for the drop function within 30 seconds, a clear request packet should be issued by the drop DTE within 1 second.

Following receipt of an incoming call packet, the drop DTE will respond with a call accepted packet within a delay between 0 and 25 milliseconds.

Each packet received will be acknowledged by the transmission of an RR packet within a delay between 0 and 20 milliseconds, except within the first 100 milliseconds following the issue of a call accepted packet (packets received within this 100 milliseconds may be ignored by the drop DTE).

The drop DTE will not generate interrupt packets nor spontaneously generate any data packets.

The drop DTE should be able to receive a continuous stream of packets with a data field of 128 octets, separated by one flag.

5.4 Generator DTE

A generator DTE performs the controlled, unmonitored source functions (as described in clause 2/X.138) in a throughput capacity measurement. It also provides the functions of a controlled, unmonitored sink in a call set-up delay measurement.

The generator DTE will be permanently connected to the network using X.25.

The test DTE may establish a virtual call to the generator DTE for throughput measurement in the reverse direction to that covered in 5.3 above.

A clear request packet should be issued by the test DTE within 1 second after the measurement interval has ended. If the measurement is invalidated by an unexpected packet level protocol event, a clear request packet should be issued by the generator DTE within one second.

Following receipt of an incoming call packet, the generator DTE will respond with a call accepted packet within a time between 0 and 25 milliseconds.

The generator DTE will not generate data packets within the first 100 milliseconds following the issue of a call accept packet.

The generator DTE will then send packets to the network until either 5 minutes have elapsed or the test DTE has cleared the call, whichever occurs sooner. The generator DTE will then issue a clear request packet or a clear confirmation packet as appropriate to the network.

The time interval between transmission of the last bit of one data packet and transmission of the first bit of the next data packet must not exceed 5 milliseconds, unless the issue of a previous packet resulted in closure of the DTEs packet level transmit window. If the window had been closed, the time interval between receipt of the last bit of the RR packet re-opening the DTEs packet level transmit window and the transmission of the first bit of the next data packet must not exceed 5 milliseconds. This implies that, while the packet level transmit window is kept open, the DTE will be able to use up to 90% of a 9.6 kbit/s access line capacity for user data.

The packets will have a user data field of 128 octets.

Any received data packets will be acknowledged and ignored.

Bit stuffing in the frame containing each transmitted data packet must not exceed 20 bits (i.e. produced by 20 sequences of 5 contiguous 1s).

The D bit is set to 0.

The generator DTE will not generate interrupt packets.

5.5 Test DTE

A test DTE works with the echo and drop DTEs and performs the functions of the controlled, monitored source (as described in clause 4/X.138) during call set-up delay measurements, data packet transfer delay measurements and throughput capacity measurements. It also works with generator DTEs and performs the function of a controlled, monitored sink (as described in clause 4/X.138) during throughput capacity measurements in the reverse direction.

The test DTE will clear the call within one second after all measurements are complete.

5.5.1 Call set-up delay measurement

For call set-up delay, the test DTE will send a call request packet to an echo, drop or generator DTE and measure the time taken to receive the corresponding call connected packet. The known response time of the echo, drop or generator DTE is subtracted to yield the call set-up delay measurement. If this response time is not known, it is assumed to be small and negligible.

If the call set-up delay measurements are to be compared with the values in Recommendation X.135, then all of the relevant X.135 measurement conditions are applicable.

NOTE – The X.135 conditions specify that the call request packets should not include a user data field. However, in certain cases the user data field is used to request functions from a combined echo, drop and generator DTE. If these user data fields are small (for example, 1-4 octets) the resulting increase in the measured time is considered to be small and acceptable relative to the X.135 values.

5.5.2 Data packet transfer delay measurement

For data packet transfer delay measurements, the test DTE will send packets to an echo DTE through the network portion(s) to be measured.

For data packet delay, the test DTE will send each test data packet and then wait for the echoed packet to be received back from the echo DTE prior to sending the next test packet. This ensures that the windows on both the test DTE and echo DTE access lines are open. The time between sending the test data packet and receiving the corresponding echoed data packet is measured. The known response time of the echo DTE is subtracted to yield the data packet transfer delay measurement. If this response time is not known, it is assumed to be small and negligible.

If the delay measurements are to be compared with the values in Recommendation X.135, then all of the relevant X.135 measurement conditions are applicable.

5.5.3 Throughput capacity measurement (test DTE as a source)

For throughput measurement, the test DTE will send successive data packets to a drop DTE through the network portion(s) to be measured.

The test DTE will not generate data packets within the first 100 milliseconds following receipt of the call connected packet.

If the throughput capacity measurements are to be compared with the values in Recommendation X.135, all of the relevant X.135 measurement conditions are applicable. It is recommended that the time interval between transmission of the last bit of one data packet and transmission of the first bit of the next data packet must not exceed 5 milliseconds, unless the issue of a previous packet resulted in closure of the DTEs packet level transmit window. If the window had been closed, the time interval between receipt of the last bit of the RR packet re-opening the DTEs packet level transmit window and the transmission of the first bit of the next data packet must not exceed 5 milliseconds. This implies that, while the packet level transmit window is kept open, the DTE will be able to use up to 90% of a 9.6 kbit/s access line capacity for user data. Bit stuffing in the frame containing each transmitted data packet must not exceed 20 bits (i.e. produced by 20 sequences of 5 contiguous 1s). The throughput capacity measurement shall consist of either the sending of data packets for two minutes or the sending of 400 data packets (see 6.4/X.135).

Before the start of the measurement, the test DTE may send data packets for 10 seconds in order to ensure that its measurement of throughput capacity is taken during the "steady state" of data packet transfer.

5.5.4 Throughput capacity measurements (test DTE as a sink)

For a throughput capacity measurement, the test DTE may receive successive data packets from a generator DTE through the network portion(s) to be measured. The measurement may be terminated by the test DTE by issuing a clear request packet, even though data packets may still be arriving. If the test DTE does not clear the call, the generator DTE will terminate the test as specified in 5.4.

If the throughput measurements are to be compared with the values in Recommendation X.135, all the relevant X.135 measurement conditions are applicable. Each packet received will be acknowledged by the transmission of an RR packet within a delay between 0 and 20 milliseconds, except within the first 100 milliseconds following the issue of a call accepted packet (packets received within this 100 milliseconds may be ignored by the test DTE). The throughput capacity measurement shall consist of either the receiving of data packets for 2 minutes or the receiving of 400 data packets (see 4.4/X.135).

Before the start of the measurement, the test DTE may receive data packets for 10 seconds in order to ensure that its measurement of throughput capacity is taken during the "steady state" of data packet transfer.

6 Network location for echo, drop, generator and test DTEs

Since the objective of this Recommendation is to provide a means of measuring the Quality of Service parameters for the various network portions defined in Recommendation X.134, the echo, drop or generator DTEs shall be connected to X.25 ports on each STE providing connection to an international portion, as shown in Figure 4. It would be convenient to have an echo, drop or generator DTE connected to a representative port on the remote national portion. The X.121 addresses of these echo, drop and generator DTEs shall be made known to the data network operator community.

In order to measure the parameters as specified in Recommendation X.135, the test DTE should be connected to the network so as to measure a typical "worst case" connection for the parameter being measured. Other locations may be used to measure the parameters under other conditions.

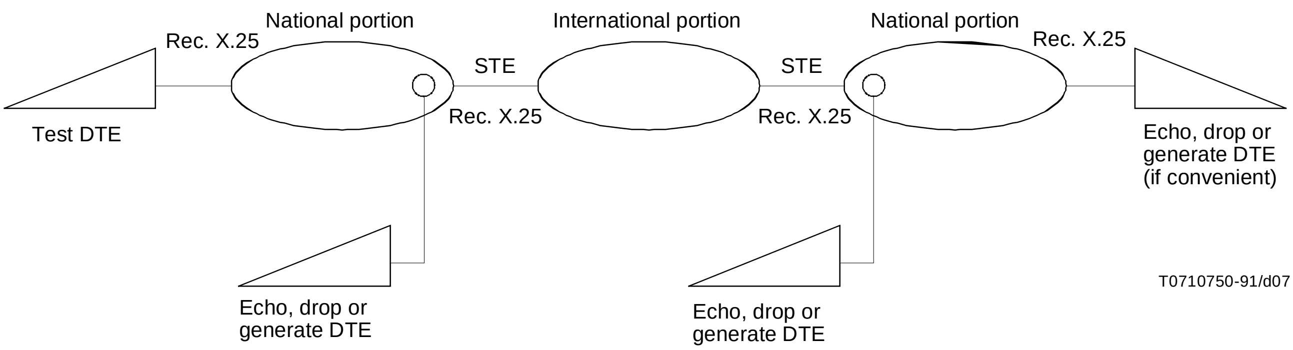

Figure 4/X.139 – Network location for echo, drop, generator and test DTEs

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