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Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment

Technologies de l'information — Communication de données — Protocole X.25 de couche paquet pour terminal de données

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) together form a system for worldwide standardization as a whole. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for approval before their acceptance as International Standards. They are approved in accordance with procedures requiring at least 75% approval by the national bodies voting.

International Standard ISO/IEC 8208 was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*.

This second edition cancels and replaces the first edition (ISO 8208:1987).

Annex A forms an integral part of ISO/IEC 8208. Annex B is for information only.

Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment

1 Scope

This International Standard specifies the procedures, formats and facilities at the Packet Layer for Data Terminal Equipment (DTE) operating in conformance with CCITT Recommendation X.25. Both Virtual Call and Permanent Virtual Circuit modes of operation are covered.

The Packet Layer protocol specified herein can be used in both Open Systems Interconnection (OSI) and non-OSI environments. When used within the context of OSI, the Packet Layer protocol is encompassed in the Network Layer of the OSI Reference Model, ISO 7498.

This International Standard covers DTE operation at the Packet Layer when accessing a public or private packet-switched network conforming to CCITT Recommendation X.25 by means of a dedicated path or a circuit-switched connection. It also covers the additional Packet Layer procedures necessary for two DTEs conforming to this International Standard to communicate directly (i.e., without an intervening packet-switched network) over a dedicated path, a circuit-switched connection, or a local area network (LAN).

This International Standard also covers private networks that use CCITT Recommendation X.25 to connect to packet-switched public data networks and that may also offer an X.25 interface to a DTE (see annex A).

The first edition of this International Standard was based on the 1984 CCITT Red Book text of Recommendation X.25. It also contained the necessary provisions for compatibility with the earlier 1980 CCITT Yellow Book text of Recommendation X.25. This second edition is based on the 1988 CCITT Blue Book text of Recommendation X.25. Retained within this second edition are the necessary provisions for compatibility with the 1984 and 1980 versions of X.25. The differences between the first and second editions of this International Standard are summarized in annex B.

It should be noted that this International Standard and CCITT Recommendation X.25 as it applies to DTEs are different in scope. This International Standard contains the specifications that Recommendation X.25 places on DTEs. In addition, this International Standard contains added specifications to facilitate interworking between DTEs and to cover direct DTE-to-DTE operation. This broader scope has to be recognized in the application of this International Standard.

2 Normative references

The following standards and recommendations contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards and recommendations are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards and recommendations listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The CCITT secretariat maintains a register of currently valid CCITT Recommendations.

ISO 7498 : 1984, *Information processing systems — Open Systems Interconnection — Basic Reference Model (see also CCITT Recommendation X.200, CCITT Blue Book, 1988).*

ISO 7776 : 1986, *Information processing systems — Data communications — High-level data link control procedures — Description of the X.25 LAPB-compatible DTE data link procedures.*

ISO 8348 : 1987, *Information processing systems - Data communications — Network service definition (see also CCITT Recommendation X.213, CCITT Blue Book, 1988).*

ISO 8348/Add. 2 : 1988, *Information processing systems — Data communications — Network service definition — Addendum 2: Network layer addressing (see also CCITT Recommendation X.213, CCITT Blue Book, 1988).*

ISO 8348/Add. 3 : 1988, *Information processing systems — Data communications — Network service definition — Addendum 3: Additional features of the network service (see also CCITT Recommendation X.213, CCITT Blue Book, 1988).*

ISO 8878 : 1987, *Information processing systems — Data communications — Use of X.25 to provide the OSI connection-mode network service (see also CCITT Recommendation X.223, CCITT Blue Book, 1988).*

ISO 8880-2 : 1990, *Information technology — Data communications — Protocol combinations to provide and support the OSI network service — Part 2: Provision and support of the connection-mode network service.*

ISO/IEC 8881 : 1989, *Information processing systems — Data communications — Use of the X.25 packet level protocol in local area networks.*

ISO/IEC 8886 : 1990, *Information technology — Data communications — Data link service definition for Open Systems Interconnection (see also CCITT Recommendation X.212, CCITT Blue Book, 1988).*

ISO/IEC 9574 : 1989, *Information technology — Telecommunications and information exchange between systems — Provision of the OSI connection-mode network service by packet mode terminal equipment connected to an Integrated Service Digital Network (ISDN).*

ISO/IEC TR 10029 : 1989, *Information technology — Telecommunications and information exchange between systems — Operation of an X.25 interworking unit.*

CCITT Recommendation D.12, *Measurement unit for charging by volume in the international packet-switched data transmission service, CCITT Blue Book, 1988.*

CCITT Recommendation X.2, *International data transmission services and optional user facilities in public data networks and ISDNs, CCITT Blue Book, 1988.*

CCITT Recommendation X.25, *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, CCITT Blue Book, 1988.*

CCITT Recommendation X.29, *Procedures for the exchange of control information and user data between a packet assembly/disassembly (PAD) facility and a packet mode DTE or another PAD, CCITT Blue Book, 1988.*

CCITT Recommendation X.31, *Support of packet mode terminal equipment by an ISDN, CCITT Blue Book, 1988.*

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 switched public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network, CCITT Blue Book, 1988.*

CCITT Recommendation X.96, *Call progress signals in public data networks, CCITT Blue Book, 1988.*

CCITT Recommendation X.244, *Procedure for the exchange of protocol identification during virtual call establishment on packet-switched public data networks, CCITT Blue Book, 1988.*

3 General considerations

This International Standard defines, from the viewpoint of a DTE, the Packet Layer, which governs the transfer of packets at a DTE/DCE or DTE/DTE interface.[1)] On the transmitting side, the Packet Layer in a sending DTE performs the basic function of packetizing messages delivered by a higher layer entity in the same DTE before giving the information to a Data Link Layer protocol for transmission to a DXE. On the receiving side, the Packet Layer in a DTE performs the basic functions of receiving packets from the Data Link Layer, checking packets for correctness, stripping off packet headers, and formulating messages from the packetized user data and passing them to a higher layer entity in the DTE.

This International Standard presents a description of the Packet Layer for "Virtual Call" service and "Permanent Virtual Circuit" service.

The following information is presented:

a) general considerations (clause 3);

b) procedures for exchanging packets across a DTE/DXE interface (clauses 4 through 11). Clause 5 applies to the setup and clearing procedures for Virtual Call service, while the other clauses apply to both Virtual Call service and Permanent Virtual Circuit service;

c) packet formats (clause 12);

d) procedures for optional user facilities that may be available on a DTE/DXE interface (clauses 13 and 14);

e) formats for optional user facilities and registration-facilities (clauses 15 and 16, respectively);

f) coding of the Diagnostic Code Field (clause 17);

g) timers and retransmission counts (clause 18);

h) state diagrams and state tables (clauses 19 and 20, respectively); and

i) applications of this International Standard to private networks that connect to a packet-switched public data network and that may also offer an X.25 interface to a DTE (see annex A).

To facilitate comprehension of this International Standard, a number of conventions have been adopted in the presentation of the text:

a) the names of states and packets are in full capitals;

b) the names of the optional user facilities, packet fields, causes and diagnostics are in initial capitals;

c) *italicized text* is used to denote differences between Virtual Call and Permanent Virtual Circuit service and between DTE/DTE and DTE/DCE interfaces (entire clauses or subclauses that pertain to one service or to one interface type are not italicized; the appropriate environment is denoted at the beginning of the clause or subclause);

d) terms not explicitly defined within this International Standard are taken from the referenced CCITT X-series recommendations.

The Packet Layer procedures in this International Standard are based on an underlying service (for example, that provided by

1) The term "DXE" is used in those contexts where it would not matter whether a DTE or a DCE was being referred to. Therefore, this International Standard can be viewed as defining the Packet Layer at the DTE/DXE interface.

ISO 7776 or, more generally, the provision of the OSI Data Link Service defined in ISO/IEC 8886) that provides:

a) a negligible residual-bit-error rate;

b) a negligible out-of-sequence rate; and

c) a negligible packet-loss and duplication rate.

The Packet Layer provides the following functional capabilities that facilitate reliable and efficient data communications:

a) multiplexing — the ability to support multiple communications;

b) data transfer — the ability to send and receive data;

c) flow control — the ability to control the flow of data;

d) interrupt transfer — the ability to send and receive a small amount of information independent of the data stream;

e) error control — the ability to detect Packet Layer errors;

f) reset and restart — the ability to reinitialize communication paths in the event that Packet Layer errors are encountered.

A number of design principles were used in the formulation of the Packet Layer procedures for DTEs specified in this International Standard:

a) conform fully to CCITT Recommendation X.25 for operation with a packet-switched network;

b) minimize the differences between operating with a packet-switched network and operating directly with another DTE;

c) provide, where possible, the opportunity for recovery from an error condition without incurring data loss at the Packet Layer;

d) align the services provided by the Packet Layer with the Network Layer services defined for Open Systems Interconnection; and

e) follow the organization of text in CCITT Recommendation X.25.

3.1 Compatibility with versions of CCITT Recommendation X.25

The Packet Layer procedures and formats specified in this International Standard are compatible with the 1988 (Blue Book) version of CCITT Recommendation X.25.

NOTE — The TOA/NPI capability introduced into the 1988 version of CCITT Recommendation X.25 is not included in this International Standard since CCITT has designated it for further study.

For DTEs needing to operate with the earlier versions of Recommendation X.25, the following restrictions apply.

3.1.1 Limitations for compatibility with X.25-1984

For DTEs needing to operate with the 1984 (Red Book) version of Recommendation X.25, the following 1988 capabilities are not used:

a) *expanded capabilities for the following optional user facilities*

— *Network User Identification (NUI) related facilities (see 13.21),*

— *RPOA related facilities (see 13.23), and*

— *Call Redirection and Call Deflection related facilities (see 13.25);*

for 1984 operation, Call Deflection and NUI Override were not defined and the NUI and RPOA facilities were not explicitly separated into subscription and negotiation facilities;

b) the following CCITT-specified DTE facilities

— *Priority (see 14.5), and*

— *Protection (see 14.6);*

for 1984 operation the above facilities were not defined;

c) coding of the following CCITT-specified DTE facilities were modified

— *Called Address Extension (see 15.3.2.1), and*

— *Calling Address Extension (see 15.3.2.2);*

for 1984 operation only BCD encoding of the addresses is permitted.

d) the throughput class of 64 000 bit/s; for 1984 operation the largest throughput class is 48 000 bit/s.

3.1.2 Limitations for compatibility with X.25-1980

For DTEs needing to operate with the 1980 (Yellow Book) version of Recommendation X.25, the following 1984 capabilities are not used in addition to those cited in 3.1.1:

a) maximum User Data Field lengths in DATA packets of 2 048 and 4 096 octets (see 6.2); for 1980 operation, the largest maximum User Data Field length allowed is 1 024 octets;

b) *Facility Fields in CALL REQUEST, INCOMING CALL, CALL ACCEPTED,* and *CALL CONNECTED packets with a length from 64 to 109 octets (see 12.2.1.1 and 12.2.2.1); for 1980 operation, this field is limited to 63 octets and bit 7 of the Facility Length Field shall be set to 0;*

c) cause codes with bit 8 set to one in *CLEAR REQUEST/INDICATION,* RESET REQUEST/INDICATION, and RESTART REQUEST/INDICATION packets (see 12.2.3.1.1, 12.5.1.1, and 12.6.1.1, respectively); for 1980 operation, this bit shall be set to zero;

d) *nonzero Address Length and Facility Length Fields in CLEAR REQUEST and CLEAR INDICATION packets (see 12.2.3.2); for 1980 operation, these length fields shall indicate zero octets and may only be present when the packet contains a Clear User Data Field;*

e) *the extended format for CLEAR CONFIRMATION packets (see 12.2.4.2); for 1980 operation, only the basic format may be used;*

f) Interrupt User Data Fields in INTERRUPT packets containing from two to 32 octets (see 12.3.2); for 1980 operation, this field shall contain exactly one octet;

g) the following optional user facilities:

— On-line Facility Registration (see 13.1),

— *Local Charging Prevention (see 13.20),*

— *Network User Identification (see 13.21),*

— *Charging Information (see 13.22),*

— *Hunt Group (see 13.24),*

— *Call Redirection and Call Deflection Notification (see 13.25),*

— *Called Line Address Modified Notification (see 13.26), and*

— *Transit Delay Selection and Indication (see 13.27);*

for 1980 operation, the above facilities cannot be used;

h) *expanded capabilities for the following optional user facilities:*

— *Closed User Groups (CUG): subscription to the Closed User Group With Outgoing and/or Incoming Access Facilities without a preferential CUG (see 13.14.2 and 13.14.3, respectively), use of the extended format of the CUG Selection Facility for indicating membership in more than 100 CUGs (see 13.14.6), and the use of the Closed User Group With Outgoing Access (CUG/OA) Selection Facility (see 13.14.7); for 1980 operation, all CUG subscriptions shall specify a preferential CUG, only the basic format of the CUG Selection Facility is allowed for indicating membership in 100 or less CUGs, and the CUG/OA Selection Facility cannot be used,*

— *Fast Select and Fast Select Acceptance (see 13.16 and 13.17, respectively): inclusion of a Clear User Data Field in CLEAR REQUEST and CLEAR INDICATION packets after call setup has been completed; for 1980 operation, the above packets can contain a Clear User Data Field only when sent or received in direct response to an INCOMING CALL or a CALL REQUEST packet, respectively, and*

— *RPOA Selection (see 13.23): use of the extended format of the RPOA Selection Facility to select one or more RPOAs, and agreement for a period of time with the DCE to a set of RPOAs to pertain to all CALL REQUEST packets; for 1980 operation, a DTE wishing to select an RPOA can only do so in a CALL REQUEST packet and can only use the basic format of the RPOA Selection Facility to select a single RPOA; and*

i) *the CCITT-specified DTE facilities and the associated facility marker (see clause 14 and 15.1, respectively); for 1980 operation, these facilities and the marker cannot be used.*

3.2 Environments

The DTE aspects of the Packet Layer protocol set forth in this International Standard are applicable to a number of environments including:

a) DTE/DCE operation:

— DTE access to a DCE via a dedicated path,

— DTE access to a DCE via a circuit-switched connection (circuit-switched data network, circuit-switched capability of an Integrated Services Digital Network (ISDN), or the switched telephone network). Additional considerations are given in 3.4.

NOTES

1 The situation where the "DTE" is a private network accessing a public network DCE is covered in annex A.

2 The DCE may be a packet-switched data network operating in accordance with CCITT Recommendation X.25 or a packet handler capability in an ISDN operating in accordance with CCITT Recommendation X.31.

b) DTE/DTE operation:

— DTE-to-DTE operation over a leased line (data network, ISDN or telephone network),

— DTE-to-DTE operation over a circuit-switched connection (circuit-switched data network, circuit-switched capability of an ISDN, or the switched telephone network). Additional considerations are given in 3.4,

— DTE-to-DTE operation over a Local Area Network (LAN). The provisions of ISO/IEC 8881 apply.

NOTE 3 — The situation where a "DTE" is a gateway on the LAN to other networks is covered in annex A.

Differences between DTE/DCE and DTE/DTE operation are enumerated in 3.3.

3.3 Differences in DTE/DTE and DTE/DCE operation

For the most part, much of the Packet Layer protocol described herein is independent of whether the DTE is connected to a DCE (e.g., X.25 network environment) or directly to another DTE. However, there are certain procedures within CCITT Recommendation X.25 that are not mandatory of a DTE but are required in a DTE/DTE environment. To minimize the number of differences that arise when considering whether connection is to a DCE or to another DTE, the following procedures are always required of a DTE:

a) *the Address Length Fields and the Facility Length Field shall be supplied in CALL ACCEPTED packets even if they indicate that no address and facility information, respectively, are present;*

b) the Diagnostic Code Field in RESTART REQUEST, *CLEAR REQUEST*, and RESET REQUEST packets shall be supplied even if it indicates "No Additional Information" (that is, although specific diagnostics are defined for particular error situations, a DTE may use more general codes as discussed in note 2 of table 25);

c) a DATA packet whose User Data Field is less than the maximum allowed and which has its D-bit set to 0 and M-bit set to 1 shall not be transmitted; and

d) upon notification that the Data Link Layer has completed its initialization procedures or that it has recovered from a failure in which the Data Link Layer was in the disconnected phase, the DTE shall transmit a RESTART REQUEST packet across the DTE/DXE interface.

However, for a few of the procedures described in the following clauses, consideration shall be given to whether the DTE is connected to a DCE or another DTE. For a DTE/DTE environment, these considerations are listed below.

a) *One of the DTEs shall act as a DCE for*

— *logical channel selection during Virtual Call setup (see figure 1),*

— *resolution of Virtual Call collision (see 5.2.5).*

(This choice is made independently for each of the DTE's Packet Layer entities; see 3.8.)

The restart procedure (see 4.5) may be used to determine which DTE acts as a DCE and which DTE maintains its role as a DTE with respect to the above items. (The procedures in 4.5 may be used in the general case of a DTE/DXE interface via a dedicated path or a circuit-switched connection. Alternatively, if a DTE is to operate only in a DTE/DCE environment or a DTE/DTE environment where, by administration, the roles can be predetermined and fixed, then the DTE may be initialized to act appropriately.)

b) A DTE shall be able to accept a RESTART INDICATION packet with a Restarting Cause Field of "DTE Originated," an event which does not occur in a DTE/DCE environment.

c) A DTE should not receive a RESTART, *CLEAR*, or RESET INDICATION packet with a Cause Field other than "DTE Originated" (although this may occur in a DTE/DCE environment). Therefore, the DTE may either handle such a packet as it does in a DTE/DCE environment (i.e., process the packet normally) or treat it as an error (DTE/DTE environment only).

d) A DTE may transmit a DIAGNOSTIC packet in the appropriate circumstances (see 11.1) only if it can suppress its generation when connected to a network.

e) *A DTE may ignore or treat as an error the receipt of facility codes that do not apply to a DTE/DTE environment.*

f) Use of the optional On-line Facility Registration Facility (see 13.1) requires agreement for each direction of registration-procedure initiation. That is, for a given direction of registration-procedure initiation, agreement to use this facility permits the initiating DTE to transmit REGISTRATION REQUEST packets and requires the responding DTE to process received REGISTRATION REQUEST packets. (In a DTE/DCE environment, a DTE will not receive a REGISTRATION REQUEST packet.)

g) Use of the optional Packet Retransmission Facility (see 13.4) requires agreement for each direction of transmission of DATA packets. That is, for a given direction of transmission of DATA packets, agreement to use this facility permits the destination DTE to transmit REJECT packets and requires the source DTE to process received REJECT packets. (In a DTE/DCE environment, a DTE will not receive a REJECT packet.)

h) *Use of optional Fast Select Facility (see 13.16) shall be agreed to by both DTEs prior to transmission of any call setup packets which utilize this facility. (In a DTE/DCE environment, such prior agreement is not required — a DTE may always use this facility at call setup.)*

i) *A called DTE which subscribes to the Flow Control Parameter Negotiation Facility (see 13.12) and/or the Throughput Class Negotiation Facility (see 13.13) will not receive, in an INCOMING CALL packet, a facility indication from which to negotiate if the calling DTE is satisfied with the default values and, thus, has not included the facility request in its CALL REQUEST packet. In a similar manner, a calling DTE which subscribes to these facilities will not receive, in a CALL CONNECTED packet, a facility indication if the called DTE is satisfied with the values in the INCOMING CALL packet and, thus, has not included a facility request in its CALL ACCEPTED packet. (In a DTE/DCE environment, these facility indications are always present if the DTE has subscribed to these facilities.)*

3.4 Operation over circuit-switched connections

When communications between a DTE and DXE involves a circuit-switched connection (e.g., through a circuit-switched data network, circuit-switched capability of an Integrated Services Digital Network, or through the switched telephone network), identification procedures may be required. Such procedures, including those at the Packet Layer, are defined in CCITT Recommendation X.32.

Most communications over a circuit-switched connection are between DTEs and DXEs that have been arranged, by some prior administrative procedure, to be compatible. Agreement must be reached, for example, as to what logical channels will be used, the window sizes to be used, and a number of other items pertaining to Packet Layer operation. In some cases, however, it may be desirable to allow for random communications, where a DTE accesses a DXE via a circuit-

switched connection without prior agreement (for example, an electronic mail-order service). To allow for this, the following subset of the Packet Layer procedures will be used:

a) the interface shall consist of a single two-way Virtual Call logical channel using Logical Channel Identifier 1;

b) the procedures described in 4.5 are required;

c) the default values for all applicable parameters listed in clause 18 shall apply; parameters T24, T25, T27, T28, R25, R27, and R28 and the procedures in 11.2, 11.3, 13.1, and 13.4 do not apply;

d) the reset procedures shall apply if erroneous DATA packets are received (see 11.3); and

e) no optional user facilities shall be allowed.

Extensions beyond this basic set of procedures and capabilities can be obtained through the use of procedures defined in CCITT Recommendation X.32.

3.5 Provision of the OSI Network Service

The Packet Layer protocol specified in this International Standard can be used to support the OSI connection-mode Network Service in a variety of environments (e.g., see ISO 8880-2). The Packet Layer protocol supports all the elements of the OSI connection-mode Network Service specified in ISO 8348 and its Addendum 3. Mappings to/from the Packet Layer protocol elements and the primitives and parameters of the connection-mode Network Service are described in ISO 8878. Additional provisions applicable in an ISDN environment are described in ISO/IEC 9574.

3.6 External Packet Layer interactions

The protocol described here is independent of any external considerations. However, the initiation of certain Packet Layer protocol procedures is directed by elements outside the protocol. Likewise, the occurrence of certain Packet Layer protocol events are to be reported appropriately. These external interactions include:

a) requesting, of the Data Link Layer, transmission of outgoing packets;

b) receiving, from the Data Link Layer, incoming packets;

c) accepting requests from a higher layer entity to initiate certain Packet Layer protocol procedures including:

— initialize the Packet Layer (see 4.1),

— *originate a Virtual Call (see 5.2.1),*

— *accept a Virtual Call (see 5.2.3),*

— *terminate a Virtual Call (see 5.5.1),*

— transfer data and interrupt information (see clause 6), and

— reinitialize a logical channel (see 8.1).

It is required that sufficient information be made available to the protocol to allow it to execute these procedures. Note that, in certain circumstances, the Packet Layer protocol can, on its own accord, *terminate* a *Virtual Call* or reinitialize a logical channel; and

d) reporting to a higher layer entity the occurrence of certain Packet Layer protocol events including:

— (re)initialization of all logical channels (see 4.2),

— *receipt of an incoming request to set up a Virtual Call (see 5.2.2),*

— *termination of a Virtual Call (see 5.5.2),*

— receipt of data and interrupt information (see clause 6), and

— reinitialization of a logical channel (see 8.2).

Along with the signal of their occurrence, the Packet Layer also provides to the higher layer entity any data associated with these events. In addition, the Packet Layer may also signal the status of the items listed in (c) above.

3.7 Logical channels

To enable simultaneous Virtual Calls and/or Permanent Virtual Circuits, logical channels are used. Each Virtual Call and Permanent Virtual Circuit is assigned a Logical Channel Identifier,[1)] which is a number in the range from 1 through 4 095. *For each Virtual Call, a Logical Channel Identifier is assigned during the call setup phase from a range of previously agreed-upon Logical Channel Identifiers. For each Permanent Virtual Circuit, a Logical Channel Identifier is assigned in agreement with the DXE.* (Logical Channel Identifier 0 shall not be assigned to a Virtual Call or a Permanent Virtual Circuit.)

A DTE's use of logical channels is agreed upon for a period of time with the DXE. Figure 1 shows the structure for assigning logical channels used for Virtual Calls and Permanent Virtual Circuits.

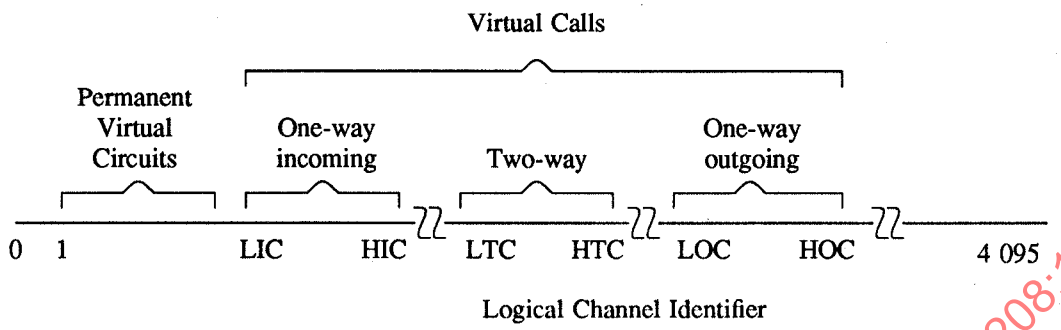
3.8 Packet Layer entity

The concept of communication via logical channels is native to Packet Layer terminology. It is conceivable, however, that a DTE may have one or more connections to one or more packet networks and/or to one or more DTEs without an intervening packet network. At this point, therefore, it is necessary to introduce the concept of a "Packet Layer entity." One such

1) A logical channel may be identified as one 12-bit field or two subfields containing 4 and 8 bits, respectively. When viewed as one field, the term "Logical Channel Identifier" or just "logical channel" is used; when viewed as two fields, the terms "logical channel group number" (4 bits) and "logical channel number" (8 bits) are used. The one-field interpretation will be used within this International Standard.

In the case of a single logical channel DTE/DXE interface, logical channel 1 will be used.

In the case of a multiple logical channel DTE/DXE interface, a range of logical channels will be agreed to according to the following diagram:



Logical channels 1 through LIC-1: range of logical channels which may be assigned to Permanent Virtual Circuits

Logical channels LIC through HIC: range of logical channels which are assigned as one-way incoming for Virtual Calls

Logical channels LTC through HTC: range of logical channels which are assigned as two-way for Virtual Calls

Logical channels LOC through HOC: range of logical channels which are assigned as one-way outgoing for Virtual Calls

Logical channels HIC+1 through LTC-1, HTC+1 through LOC-1, and HOC+1 to 4 095 are non-assigned logical channels

NOTES

1 The reference to the Logical Channel Identifiers is made according to a set of contiguous numbers from 0 (lowest) to 4 095 (highest) using the 12 bits made up of bits 4 through 1 of octet 1 and all bits of octet 2 of each packet (see 12.1.2). The numbering is binary-coded using bit positions 4 through 1 of octet 1 followed by bit positions 8 through 1 of octet 2, where bit 1 of octet 2 is the low-order bit.

2 Logical Channel Identifier 0 shall not be assigned to a Virtual Call or Permanent Virtual Circuit.

3 All logical channel boundaries are agreed upon with the DXE for a period of time.

4 In a DTE/DTE environment, one DTE views the range of Logical Channel Identifiers as presented here, whereas the other DTE views it as a DCE (e.g., the latter DTE views the range from LIC to HIC as one-way *outgoing*). This determination is discussed in 4.5.

5 In order to avoid frequent rearrangement of logical channels, not all logical channels within the range for Permanent Virtual Circuits are necessarily assigned.

6 In the absence of Permanent Virtual Circuits, logical channel 1 is available for LIC. In the absence of Permanent Virtual Circuits and one-way incoming logical channels, logical channel 1 is available for LTC. In the absence of Permanent Virtual Circuits, one-way incoming logical channels, and two-way logical channels, logical channel 1 is available for LOC.

7 The search algorithm of a DCE, or a DTE playing the role of a DCE in a DTE/DTE environment, for a logical channel for a new incoming call will be to use the lowest numbered logical channel in the READY state (p1) in the range of LIC to HIC and LTC to HTC.

8 In order to minimize the risk of call collision, the DTE search algorithm starts with the highest numbered logical channel in the READY state (p1) in the two-way logical channel or one-way outgoing logical channel ranges.

Figure 1 — Logical Channel Identifier Assignment

entity exists in a DTE for each DTE/DTE (without an intervening packet network) interface or for each DTE/DCE (packet network) interface. This is illustrated in figure 2. Deciding which entity to use to reach a particular destination is a function performed external to the protocol described here. The protocol discussed in this International Standard pertains to each Packet Layer entity in a DTE.

3.9 Packet types

Packet types and their use with Virtual Call and Permanent Virtual circuit services are given in table 1.

3.10 Procedures for initialization

Initialization of the Packet Layer corresponds to initialization of each logical channel in the Packet Layer entity. Prior to initial data transmission on any logical channel, the initialization procedure for the Data Link Layer shall be completed (e.g., in terms of the OSI connection-mode Data Link Service, this is the establishment of a Data Link connection). Then the DTE shall initiate the restart procedure.

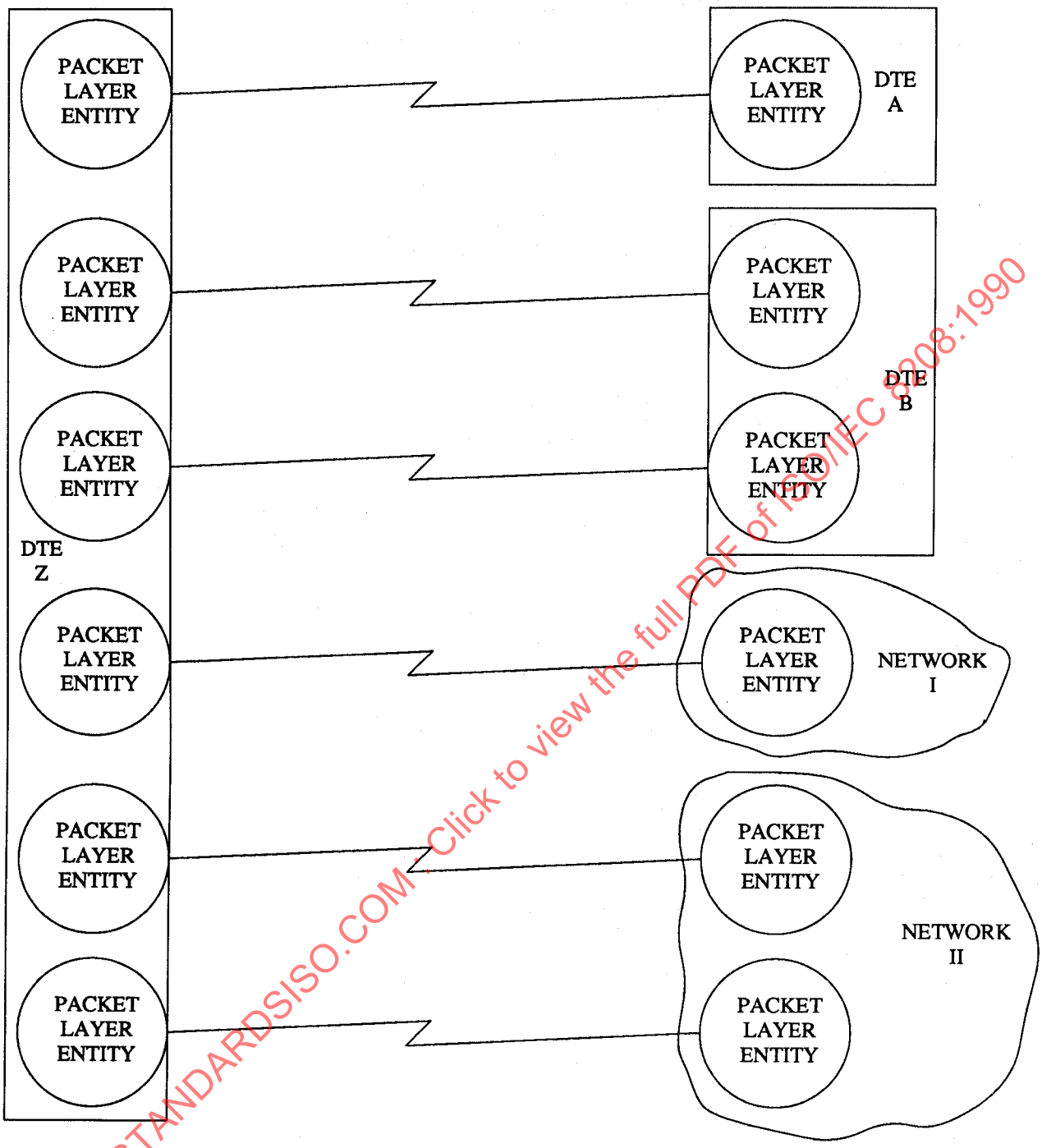


Figure 2 — Packet Layer Entities

Table 1 — Packet Groupings/Functions

Packet Group	Function	Packet Types	Service:* VC	PVC
Call Setup and Call Clearing	Establish and terminate a Virtual Call for DTE/DXE communication; may convey data for higher layer entity processing	CALL REQUEST	X	
		INCOMING CALL	X	
		CALL ACCEPTED	X	
		CALL CONNECTED	X	
		CLEAR REQUEST	X	
		CLEAR INDICATION	X	
		CLEAR CONFIRMATION	X	
Data and Interrupt	Convey data or interrupt information for higher layer entity processing	DATA	X	X
		INTERRUPT	X	X
		INTERRUPT CONFIRMATION	X	X
Flow Control and Reset	Control the flow of DATA packets across a DTE/DXE interface	RECEIVE READY	X	X
		RECEIVE NOT READY	X	X
		REJECT	X	X
		RESET REQUEST	X	X
		RESET INDICATION	X	X
		RESET CONFIRMATION	X	X
Restart	(Re)Initialize all communication between a DTE and a DXE	RESTART REQUEST	X	X
		RESTART INDICATION	X	X
		RESTART CONFIRMATION	X	X
Diagnostic	Pass error diagnostics to a DTE	DIAGNOSTIC	X	X
Registration	Perform registration procedure	REGISTRATION REQUEST	X	X
		REGISTRATION CONFIRMATION	X	X

*VC = Virtual Call
PVC = Permanent Virtual Circuit

See also:

— Restart procedures (clause 4).

4 Procedures for restart

The restart procedure is used to initialize or reinitialize the Packet Layer DTE/DXE interface. The restart procedure simultaneously *clears all the Virtual Calls and resets all the Permanent Virtual Circuits* at the DTE/DXE interface (i.e., all the logical channels in a Packet Layer entity). *At the same time, it may also be used to determine how a DTE will subsequently select logical channels for Virtual Calls and how it resolves Virtual Call collisions (see 4.5).*

Figure 3 gives the schematic view of the restart procedure.

There are three states of a logical channel in relation to the restart procedure. As shown in figure 31, they are the PACKET LAYER READY (r1), DTE RESTART REQUEST (r2), and DXE RESTART INDICATION (r3) states. When entering state r1, *each Virtual Call logical channel is in the READY state (p1), whereas each Permanent Virtual Circuit logical channel is in the FLOW CONTROL READY state (d1)* (note that these states are contained within the PACKET LAYER READY state (r1)).

Table 32 specifies the actions taken by the DTE on the receipt of packets from the DXE as applied to the restart procedure.

4.1 Originating a restart request

A DTE indicates a restart request at any time by transmitting across the DTE/DXE interface a RESTART REQUEST packet and by starting the Restart Request Response Timer (T20). The interface for each logical channel is then in the DTE RESTART REQUEST state (r2). In this state, all packets except RESTART CONFIRMATION, RESTART INDICA-

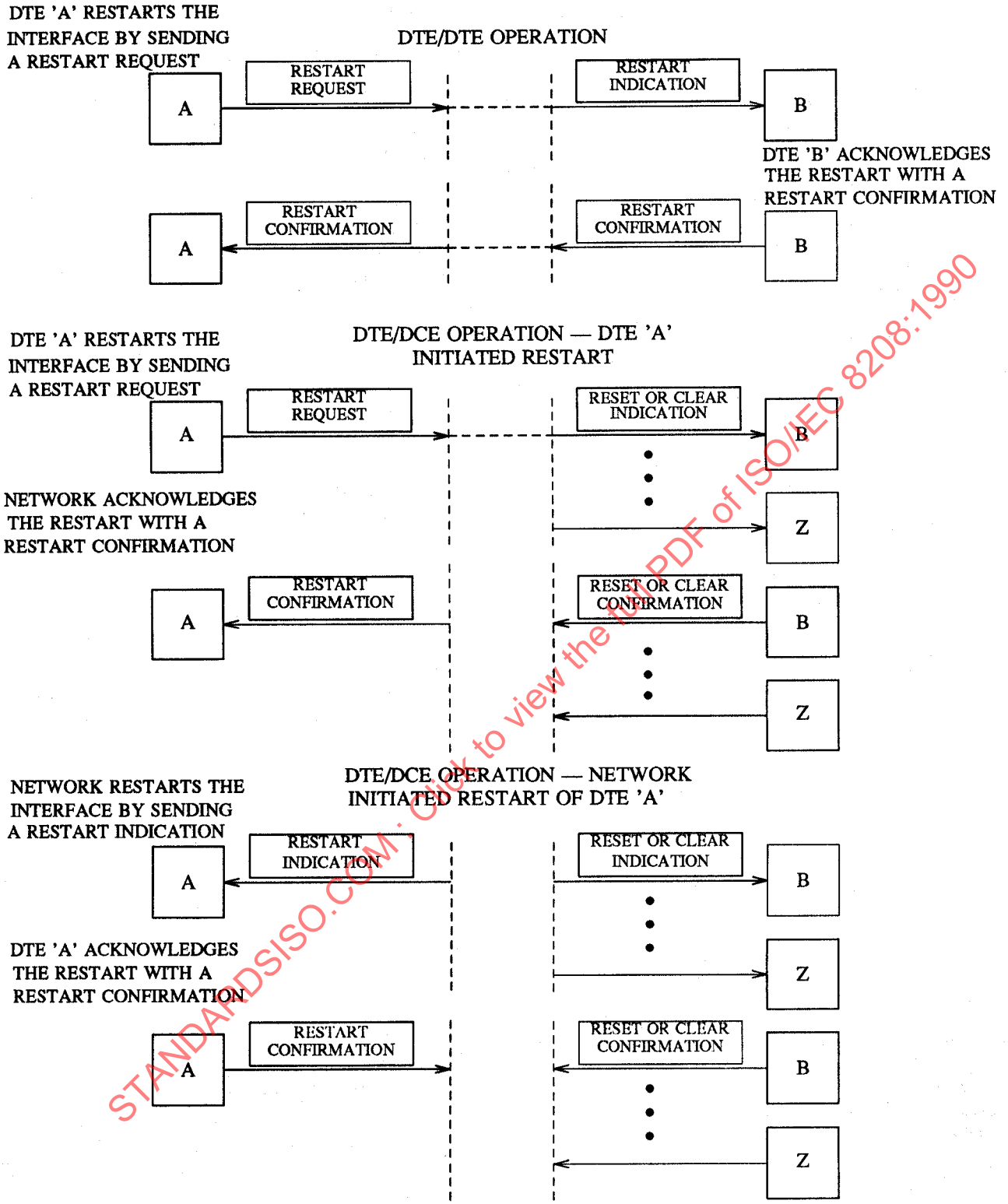


Figure 3 — Restart Schematic

TION, *REGISTRATION REQUEST (DTE/DTE environment only)*, REGISTRATION CONFIRMATION, and DIAGNOSTIC packets are ignored. Therefore, higher layer entities must be able to cope with the various possible situations that may occur.

The failure to receive a RESTART CONFIRMATION packet or a RESTART INDICATION packet before expiration of T20 after transmission of a RESTART REQUEST packet is considered an error. The restart procedure is retried up to a maximum number of times R20. After this, the Packet Layer notifies the appropriate entity that it has not received a confirmation of the restart procedure. Each logical channel then remains in the DTE RESTART REQUEST state (r2).

See also:

— RESTART REQUEST packet format (12.6.1 and figure 22);

— Restart Request Response Timer (T20) (table 26);

— Restart Request Retransmission Count (R20) (table 27);

— Receiving a restart indication (4.2);

— Restart collision (4.3);

— Restart confirmation (4.4):

— Packet Layer initialization and reinitialization (3.10 and clause 10).

4.2 Receiving a restart indication

Upon receipt of a RESTART INDICATION packet by a DTE, the interface for each logical channel is in the DXE RESTART INDICATION state (r3). In this state, a DTE considers subsequent receipt of any packet, other than another RESTART INDICATION, *REGISTRATION REQUEST (DTE/DTE environment only)*, REGISTRATION CONFIRMATION, and DIAGNOSTIC packets as an error. It discards any such packet and transmits a RESTART REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Packet Type Invalid For State r3."

The RESTART INDICATION packet specifies the reason for the restart. The restarting cause code, as well as the diagnostic code and an indication that a restarting procedure has taken place, is passed to a higher layer entity.

NOTE — *In a DTE/DTE environment, the RESTART INDICATION packet received by a DTE is the same as the RESTART REQUEST packet transmitted by the other DTE.*

After processing the RESTART INDICATION packet, the DTE transmits a RESTART CONFIRMATION packet across the DTE/DXE interface.

See also:

— RESTART INDICATION packet format (12.6.1 and figure 22);

— Restarting cause (12.6.1);

— Restart collision (4.3);

— Restart confirmation (4.4);

— Timers to consider when receiving a RESTART INDICATION packet (table 28).

4.3 Restart collision

Restart collision occurs when a DTE transmits a RESTART REQUEST packet (as described in 4.1) and then receives a RESTART INDICATION packet (as described in 4.2). In this case, a DTE does not transmit nor expect to receive a RESTART CONFIRMATION packet and considers that the restart is completed. However, if the procedures in 4.5 are used, then the DTE shall determine whether the Restarting Cause Field in the RESTART INDICATION packet indicates "DTE Originated." If so, then the DTE shall take no other action except to transmit another RESTART REQUEST packet after some randomly-chosen time delay. If this field does not indicate "DTE Originated," then the restart procedure is completed.

When the restarting procedure is completed, each *Virtual Call logical channel is in the READY state (p1) whereas each Permanent Virtual Circuit logical channel is in the FLOW CONTROL READY state (d1).*

4.4 Restart confirmation

When a DTE is prepared to acknowledge a restart, it transmits across the DTE/DXE interface a RESTART CONFIRMATION packet. At this time, the restarting procedure is considered completed.

Having initiated a restarting procedure, the DTE considers the restarting procedure completed when it receives a RESTART CONFIRMATION packet.

When the restarting procedure is completed, *each Virtual Call logical channel is in the READY state (p1) whereas each Permanent Virtual Circuit logical channel is in the FLOW CONTROL READY state (d1).*

In a network environment, the RESTART CONFIRMATION packet received from a DCE can only be interpreted universally as having local significance.

See also:

— RESTART CONFIRMATION packet format (12.6.2. and figure 23).

4.5 Determining "DTE" or "DCE" characteristics

The restart procedure can be used to determine whether the DTE acts as a DCE or maintains its role as a DTE with respect to logical channel selection during Virtual Call establishment and resolution of Virtual Call collision.

When prepared to initialize the Packet Layer, the DTE shall initiate the restart procedure (i.e., transmit a RESTART REQUEST packet). The determination is based on the response received from the DXE, as outlined below.

a) If the DTE receives a RESTART INDICATION packet with a restarting cause code that is not "DTE Originated" (i.e., it came from a DCE), then the DTE shall follow the procedures in 4.2, 4.3, and 4.4 as appropriate and maintain its role as a DTE.

b) If the DTE receives a RESTART INDICATION packet with a restarting cause code of "DTE Originated" (i.e., it came from another DTE) and it does not have an unconfirmed RESTART REQUEST packet outstanding (i.e., no restart collision), then the DTE shall confirm the restart (as in 4.4) and act as a DCE.

c) If the DTE receives a RESTART INDICATION packet with a restarting cause code of "DTE Originated" (i.e., it came from another DTE) and it does have an unconfirmed RESTART REQUEST packet outstanding (i.e., a restart collision), then the DTE shall consider this restart procedure completed (as in 4.3) but shall take no other action except to transmit another RESTART REQUEST packet after some randomly-chosen time delay.

d) If the DTE issues a RESTART REQUEST packet that is subsequently confirmed with a RESTART CONFIRMATION packet (as in 4.4), then the DTE shall maintain its role as a DTE.

NOTE — If a DTE operates only in a DTE/DCE environment or a DTE/DTE environment where, by administration, the roles can be predetermined and fixed, then the procedures discussed above are not needed. In these cases, the DTE may be initialized to act in the appropriate manner.

See also:

— Logical channel selection (figure 1);

— Virtual Call collision (5.2.5);

— Originating a restart request (4.1);

— Receiving a restart indication (4.2);

— Restart collision (4.3);

— Restart confirmation (4.4);

— Restarting cause (12.6.1).

5 Procedures for Virtual Call setup and clearing

This clause describes the setup and clearing procedures for Virtual Calls. It applies independently to each logical channel assigned to Virtual Call service at a DTE/DXE interface. (There are no setup and clearing procedures for Permanent Virtual Circuits.)

Figures 4 and 5 give a schematic view of how a Virtual Call is set up and cleared, respectively. This information is also shown in the state diagram of figure 32. Table 33 specifies actions taken by the DTE on the receipt of packets from the DXE as applied to the Virtual Call setup and clearing procedures.

5.1 Ready state

If there is no call in existence, a logical channel used for Virtual Calls is in the READY state (p1).

5.2 Procedures for Virtual Call setup

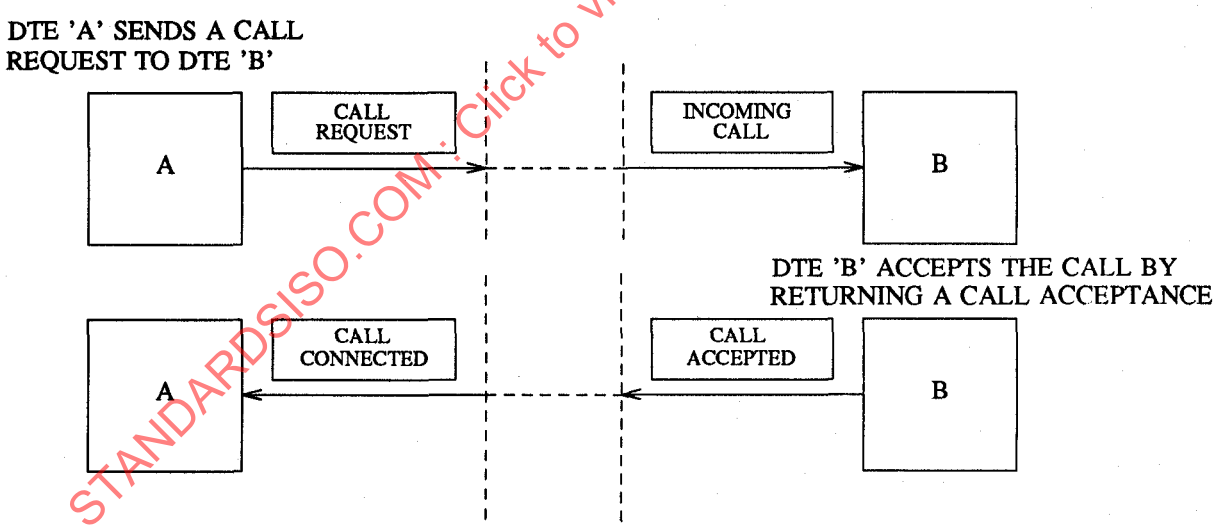
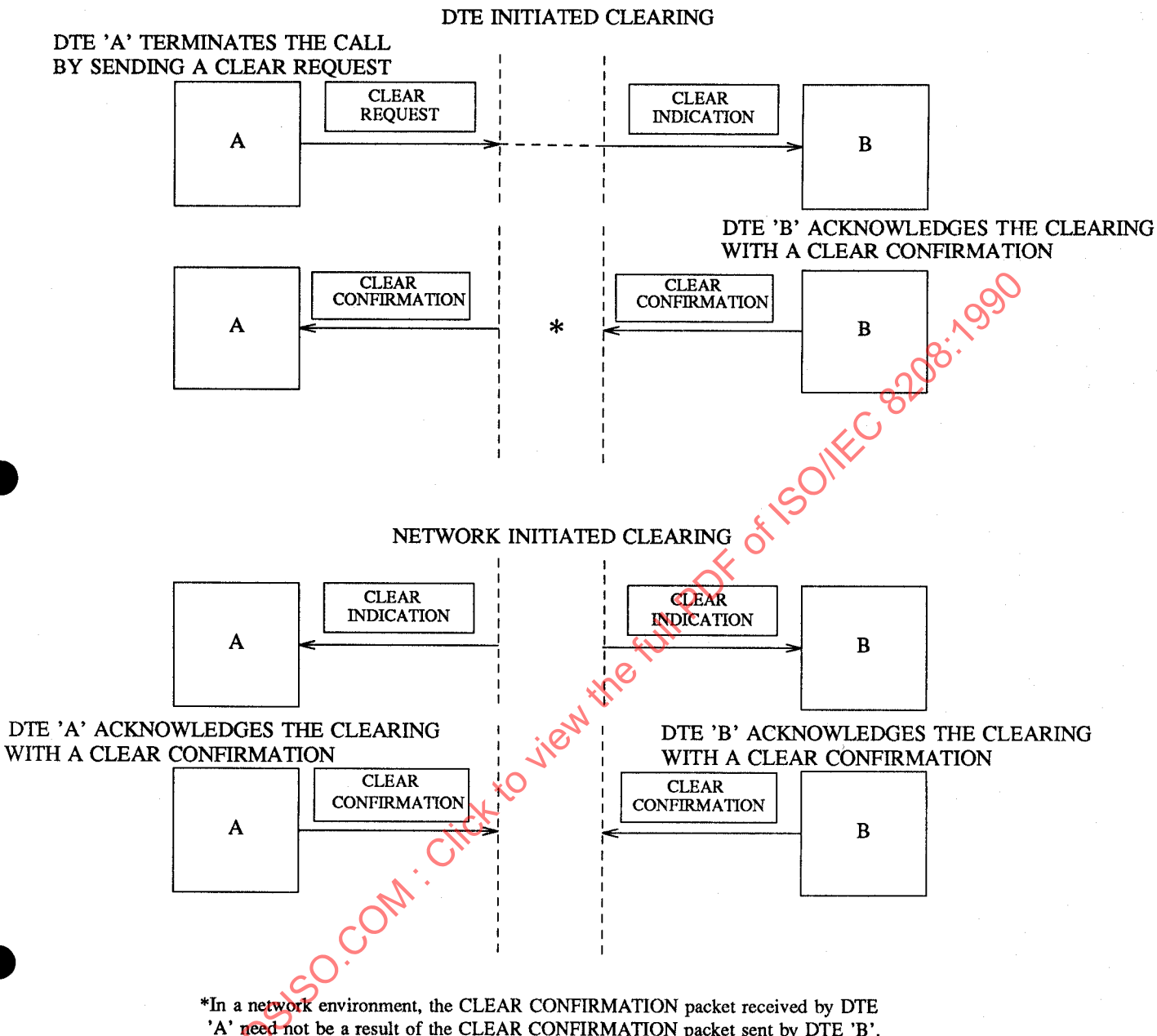


Figure 4 — Call Setup Schematic



*In a network environment, the CLEAR CONFIRMATION packet received by DTE 'A' need not be a result of the CLEAR CONFIRMATION packet sent by DTE 'B'.

Figure 5 — Call Clearing Schematic

5.2.1 Originating a Virtual Call

A DTE indicates a call request by transmitting across the DTE/DXE interface a CALL REQUEST packet and by starting the Call Request Response Timer (T21). The logical channel selected by the DTE is then in the DTE CALL REQUEST state (p2).

The CALL REQUEST packet may include the called-DTE address and the calling-DTE address. Each address is a sequence of up to 15 digits. This packet may also include any user data supplied by a higher layer entity to be sent to the remote DTE.

NOTES

1 The inclusion of the called-DTE address and the calling-DTE address in the CALL REQUEST packet is dependent upon the requirements of the interfacing DXE.

2 A DTE address may be a DTE network address or any other DTE identification agreed to for a period of time between the DTE and the DXE.

3 Procedures for determining how a DTE chooses a logical channel in the READY state (p1) when originating a Virtual Call are given in 4.5 and figure 1. If the DTE maintains its role as a DTE, then it chooses a logical channel starting at the high end of the range of logical channels agreed to with the DXE. *In a DTE/DTE environment, however, if the DTE acts as a DCE for these procedures, then it chooses a logical channel in the READY state (p1) starting at the low end of the range of logical channels.* In this way, the risk of call collision is minimized.

The failure to receive a CALL CONNECTED packet or a CLEAR INDICATION packet before expiration of T21 after transmission of a CALL REQUEST packet is considered an error. The Packet Layer clears the call with a cause indicating "DTE Originated" and the diagnostic "Timer Expired for Call Request."

See also:

- Call collision (5.2.5);
- Aborting a call request (5.4);
- Call Request Response Timer (T21) (table 26);
- CALL REQUEST packet format (12.2.1 and figure 11);
- Clearing procedures (5.5);
- Call setup procedures for use of the D-bit (6.3);
- Logical channel selection (figure 1).

5.2.2 Receiving an indication of an incoming call

A DTE receives an indication of an incoming call upon receipt of an INCOMING CALL packet from a DXE. The logical channel is then in the DXE INCOMING CALL state (p3).

The INCOMING CALL packet may include the calling-DTE address and the called-DTE address. The address information and any data received as part of this packet is forwarded to a higher layer entity. In addition, optional user facility information may also be passed to a higher layer entity.

NOTES

1 The inclusion of the calling-DTE address and the called-DTE address in the INCOMING CALL packet is dependent upon the operation of the interfacing DXE.

2 A DTE address may be a DTE network address or any other DTE identification agreed to for a period of time between the DTE and the DXE.

3 *In a DTE/DTE environment, the INCOMING CALL packet received by a DTE is the same as the CALL REQUEST packet transmitted by the other DTE.*

See also:

- INCOMING CALL packet format (12.2.1 and figure 11);
- Call collision (5.2.5);
- Accepting an incoming call (5.2.3);
- Rejecting an incoming call (5.3);
- Call setup procedures for use of the D-bit (6.3);
- Timers to consider when receiving an INCOMING CALL packet (table 28).

5.2.3 Accepting a Virtual Call

A DTE receiving an INCOMING CALL packet indicates its acceptance of the call by transmitting across the DTE/DXE interface a CALL ACCEPTED packet. This packet shall specify the same logical channel as that of the INCOMING CALL packet.

The specified logical channel is then in the FLOW CONTROL READY state (d1).

The decision of whether to accept a call is made by a higher layer entity before a CALL ACCEPTED packet may be returned by the Packet Layer. Furthermore, it may provide data to be returned to the calling DTE as part of the CALL ACCEPTED packet. Data may be returned only if the INCOMING CALL packet indicates the Fast Select Facility without a restriction on the response. A CALL ACCEPTED packet shall not be returned if the INCOMING CALL packet indicates the Fast Select Facility with a restriction on the response.

A call may be rejected, without informing a higher layer entity of its receipt, for reasons local to the Packet Layer (for example, a format error in the INCOMING CALL packet).

See also:

- CALL ACCEPTED packet format (12.2.2 and figure 12);
- Call setup procedures for use of the D-bit (6.3);
- Rejecting an incoming call (5.3);
- Optional User Facility for Fast Select (13.16).

5.2.4 Receiving a call acceptance indication

The receipt, by the calling DTE, of a CALL CONNECTED packet specifying the same logical channel as that specified in the CALL REQUEST packet indicates that the call has been accepted by the called DTE. The specified logical channel is then in the FLOW CONTROL READY state (d1).

Any address information and any data received as part of the CALL CONNECTED packet is forwarded to a higher layer entity. In addition, optional user facility information may also be passed to a higher layer entity.

NOTE — *In a DTE/DTE environment, the CALL CONNECTED packet received by a DTE is the same as the CALL ACCEPTED packet transmitted by the other DTE.*

See also:

— Nonacknowledgement of a call request (5.4);

— CALL CONNECTED packet format (12.2.2 and figure 12);

— Call setup procedures for use of the D-bit (6.3).

5.2.5 Call collision

Call collision occurs when a DTE transmits a CALL REQUEST packet (as described in 5.2.1) and then receives an INCOMING CALL packet (as described in 5.2.2) for the same logical channel. At this time, the logical channel is in the CALL COLLISION state (p5). Further action is dependent on whether the DTE maintains its role as a DTE or acts as a DCE for resolving call collision (as determined by the procedures in 4.5).

— If the DTE maintains its role as a DTE, then it shall ignore the INCOMING CALL packet and wait for the response from the DXE. The DTE should receive either a CALL CONNECTED packet (if the call is accepted by the remote DTE) or a CLEAR INDICATION packet for the same logical channel as that in the CALL REQUEST packet.

— *In a DTE/DTE environment, if the DTE acts as a DCE, then it shall cancel its call request and decide whether to transmit a CALL ACCEPTED packet or a CLEAR REQUEST packet.*

5.3 Rejecting a call

The previous subclauses described the procedures for accepting a Virtual Call. However, for a variety of reasons, a Virtual Call might not be accepted. For example, these can include:

a) rejection by the network because the call cannot be completed to the addressed DTE;

b) rejection by the network or the called DTE because of congestion;

c) rejection by the network or the called DTE because of a format error in the packet;

d) rejection by the network or the called DTE of some of the optional user facilities requested by the calling DTE; or

e) rejection by the called DTE initiated by a higher layer entity.

In any case, the DTE or DCE clears the call by transmitting the appropriate packet to the calling DTE. In those cases where an incoming call is rejected, a CALL ACCEPTED packet (as described in 5.2.3) is not transmitted.

See also:

— Clearing procedures (5.5).

5.4 Aborting a call request

The calling DTE may abort a call by clearing it before it has received a CALL CONNECTED or CLEAR INDICATION packet. This may be due to an abort initiated by a higher layer entity or the expiration of timer T21.

As noted previously, timer T21 is set by a DTE when it initiates a call request. Expiration of this timer (before receipt of an acceptance or a rejection for the call request) is considered a procedure error and results in the DTE clearing the call with a cause indicating "DTE Originated" and the diagnostic "Timer Expired For Call Request."

See also:

— Call Request Response Timer (T21) (table 26);

— Clearing procedures (5.5).

5.5 Procedures for Virtual Call clearing

A call or call request may be cleared by any party at any time. This may be done at call setup, for example, by the called DTE for the reasons cited in 5.3 or by the calling DTE for the reasons cited in 5.4. Either the called or calling DTE may terminate the Virtual Call either normally because of call completion or abnormally because of error detection.

5.5.1 Originating a Virtual Call clearing

A DTE indicates clearing of a Virtual Call at any time by transmitting across the DTE/DXE interface a CLEAR REQUEST packet specifying the logical channel and by starting the Clear Request Response Timer (T23). The logical channel is then in the DTE CLEAR REQUEST state (p6). In this state, the only acceptable packets on the logical channel are a CLEAR CONFIRMATION packet and a CLEAR INDICATION packet. Other types of packets on the logical channel are ignored. Therefore, higher layer entities must be able to cope with the various possible situations that may occur.

The failure to receive a CLEAR CONFIRMATION packet before the expiration of T23 is considered an error. The clearing procedure is retried up to a maximum number of times R23. After this, the Packet Layer notifies the appropriate entity that it has not received a confirmation of the clearing procedure. The logical channel then remains in the DTE CLEAR REQUEST state (p6).

The CLEAR REQUEST packet may contain data provided by a higher layer entity to be sent to the remote DTE. This may be done only if the CALL REQUEST and INCOMING CALL packets had indicated the Fast Select Facility. A DTE that aborts its own call after transmitting a CALL REQUEST packet and before receiving a response shall not transmit data in the CLEAR REQUEST packet.

See also:

— CLEAR REQUEST packet format (12.2.3 and figure 13);

— Clear Request Response Timer (T23) (table 26);

— Clear Request Retransmission Count (R23) (table 27);

— Optional User Facility for Fast Select (13.16);

— Receiving a clear indication (5.5.2);

— Clear collision (5.5.3);

— Clear confirmation (5.5.4).

5.5.2 Receiving an indication of Virtual Call clearing

Receipt of a CLEAR INDICATION packet indicates Virtual Call clearing. At this time, the logical channel is the DXE CLEAR INDICATION state (p7). In this state, a DTE considers subsequent receipt of packets on the logical channel, other than another CLEAR INDICATION packet, as an error. It discards any such packet and transmits a CLEAR REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Packet Type Invalid For State p7."

The CLEAR INDICATION packet specifies the reason for the clearing. The clearing cause code, as well as the diagnostic code and an indication that a clearing procedure has taken place, is passed to a higher layer entity. Any data and optional user facility information received in the CLEAR INDICATION packet is also forwarded to a higher layer entity.

NOTE — *In a DTE/DTE environment, the CLEAR INDICATION packet received by a DTE is the same as the CLEAR REQUEST packet transmitted by the other DTE.*

After processing the CLEAR INDICATION packet, the DTE transmits a CLEAR CONFIRMATION packet across the DTE/DXE interface.

See also

— CLEAR INDICATION packet format (12.2.3 and figure 13);

— Clearing cause (12.2.3);

— Clear collision (5.5.3);

— Clear confirmation (5.5.4);

— Timers to consider when receiving a CLEAR INDICATION packet (table 28).

5.5.3 Clear collision

Clear collision occurs when a DTE transmits a CLEAR REQUEST packet (as described in 5.5.1) and then receives a CLEAR INDICATION packet (as described in 5.5.2) for the same logical channel. In this case, a DTE does not transmit nor expect to receive a CLEAR CONFIRMATION packet and considers that the clearing is completed.

When the clearing procedure is completed, the logical channel is in the READY state (p1).

5.5.4 Clear confirmation

When a DTE is prepared to acknowledge a clear, it transmits a CLEAR CONFIRMATION packet across the DTE/DXE interface. At this time, the clearing procedure is considered completed.

Having initiated a clearing procedure, the DTE considers the clearing procedure completed when it receives a CLEAR CONFIRMATION packet.

When the clearing procedure is completed, the logical channel is in the READY state (p1).

In a network environment, the CLEAR CONFIRMATION packet received from a DCE can only be interpreted universally as having local significance. However, within some networks, clear confirmation may have end-to-end significance.

See also:

— CLEAR CONFIRMATION packet format (12.2.4 and figure 14).

6 Procedures for data and interrupt transfer

The data and interrupt transfer procedures described in this clause apply independently to each logical channel assigned for Virtual Calls or Permanent Virtual Circuits existing at the DTE/DXE interface.

Normal operation dictates that user data in DATA and INTERRUPT packets are all passed transparently and unaltered, either directly or through a network in the case of packet-DTE to packet-DTE communications. The order of bits in DATA and INTERRUPT packets is preserved. Packet sequences are delivered as complete packet sequences.

See also:

— DATA packet format (12.3.1 and figure 15);

— INTERRUPT packet format (12.3.2 and figure 16);

— Complete packet sequences (6.5).

6.1 States for data and interrupt transfer

For purposes of data and interrupt transfer, a logical channel must be in the FLOW CONTROL READY state (d1). *A Virtual Call logical channel is in state d1 after completion of call setup and prior to a clearing, reset, or restart procedure. A Permanent Virtual Circuit logical channel is continually in state d1 except during a reset or restart procedure.*

While in state d1, DATA, interrupt, flow control, reset, and REJECT (if subscribed to) packets may be transmitted across the DTE/DXE interface. While in a state other than d1, the above-mentioned packets may be discarded. Therefore, higher layer entities must be able to cope with the various possible situations that may occur.

See also:

— Restart procedures (clause 4);

— Call setup procedures (5.2);

— Clearing procedures (5.5);

— Flow control procedures (7.1);

— Reset procedures (clause 8);

— Nonreceipt of window-rotation information (11.2);

— Receipt of erroneous DATA packets (11.3);

— Optional User Facility for Packet Retransmission (13.4).

6.2 Maximum User Data Field length of DATA packets

The standard default maximum User Data Field length is 128 octets.

In addition, other (nonstandard) default maximum User Data Field lengths may be available from the following list: 16, 32, 64, 256, 512, 1 024, 2 048, and 4 096 octets.

From the combination of the standard default and the list of nonstandard defaults, if any, a maximum User Data Field length shall be selected for each direction of data transmission. *For Virtual Calls, this choice applies in common to all logical channels at the DTE/DXE interface. For Permanent Virtual Circuits, this choice is made separately for each logical channel.* These selections are agreed to for a period of time with the DXE. *In addition, negotiation of the maximum User Data Field length on a per Virtual Call basis is allowed if the Flow Control Parameter Negotiation Facility has been subscribed to.*

The User Data Field of DATA packets transmitted by a DTE shall contain an integral number of octets (see 12.1).

If the User Data Field in a DATA packet exceeds the locally-permitted maximum User Data Field length or if it is nonoctet aligned, then the receiving DTE shall invoke appropriate error-recovery procedures.

See also:

— Optional User Facility for Nonstandard Default Packet Sizes (13.9);

— Optional User Facility for Flow Control Parameter Negotiation (13.12);

— Receipt of erroneous DATA packets (11.3);

6.3 Delivery Confirmation bit

The setting of the Delivery Confirmation bit (D-bit) is used to indicate whether the DTE wishes to receive an end-to-end acknowledgement of delivery for data it is transmitting. To indicate data for which an end-to-end acknowledgement is desired, the DTE sets the D-bit to 1. Acknowledgement is given by means of the packet receive sequence number P(R). When the D-bit is set to 0, a subsequently-received P(R) has no significance with respect to acknowledgement.

NOTES

1 The use of the D-bit procedure does not obviate the need for a higher layer protocol agreed upon between the communicating DTEs. Such a protocol may be used with or without the D-bit procedure to recover from various error situations.

2 The setting of the D-bit is determined from instructions received from a higher layer entity.

The following is an optional mechanism that DTEs can use during Virtual Call establishment to negotiate whether to use the D-bit during the FLOW CONTROL READY state (d1).

If the calling DTE is willing to use the D-bit procedure, then it should set bit 7 in the General Format Identifier of the CALL REQUEST packet to 1; otherwise, it should set this bit to 0. If the called DTE is willing to use the D-bit procedure and receives an INCOMING CALL packet with bit 7 in the General Format Identifier set to 1, then it should set bit 7 in the General Format Identifier of the CALL ACCEPTED packet to 1; otherwise, it should set this bit to 0.

With this procedure, bit 7 in the General Format Identifier set to 1 in the CALL ACCEPTED and CALL CONNECTED packets indicates the D-bit procedure in 7.1.4 applies for the Virtual Call. If bit 7 in the General Format Identifier is set to 0 in the CALL ACCEPTED and CALL CONNECTED packets, then the DTEs should set the D-bit to 0 in all DATA packets.

If the DTE is unwilling to use the D-bit procedure and receives a DATA packet with the D-bit set to 1, then it shall reset the logical channel with a cause indicating "DTE Originated" and the diagnostic "D-bit Procedure Not Supported."

See also:

— Packet receive sequence number P(R) (7.1.3);

— Delivery confirmation (7.1.4);

— Procedures for Virtual Call setup (5.2);

— Reset procedures (clause 8).

6.4 More Data mark

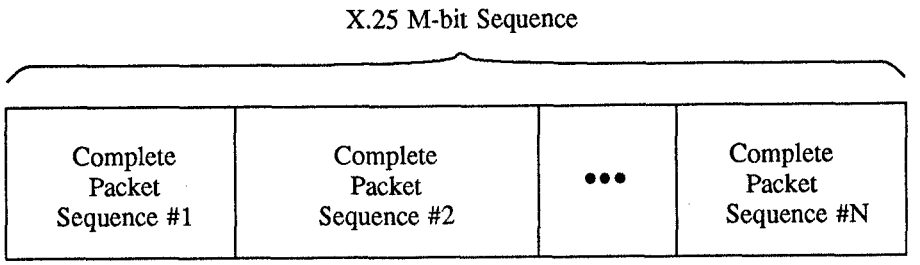
If a DTE or DXE wishes to indicate a sequence of more than one DATA packet, it uses the More Data mark (M-bit) as defined below.

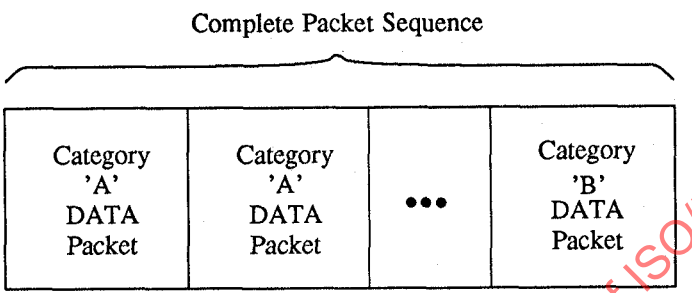
The M-bit can be set to 1 in any DATA packet except in a partially full DATA packet carrying the D-bit set to 0. When the M-bit is set to 1 in a full DATA packet or in a partially full DATA packet also carrying the D-bit set to 1, it indicates that more data is to follow. *Recombination of a DATA packet with the following DATA packet may only be performed within the network when the M-bit is set to 1 in a full DATA packet which also has the D-bit set to 0.*

A sequence of DATA packets with every M-bit set to 1 except for the last packet will be delivered as a sequence of DATA packets with the M-bit set to 1 except for the last packet when the original packets having the M-bit set to 1 are either full (irrespective of the setting of the D-bit) or partially full but have the D-bit set to 1. Within the scope of this International Standard, such sequences are used to delimit logical messages transmitted between higher layer entities. Such sequences are known as M-bit sequences. Figure 6 illustrates, for an M-bit sequence, the relationship between the D-bit settings, the M-bit settings, and whether the User Data Fields of DATA packets are full.

Two categories of DATA packets, A and B, have been defined as shown in table 2. *Table 2 also illustrates the network's treatment of the M- and D-bits for a Virtual Call or Permanent Virtual Circuit.* A DTE shall not transmit a partially full DATA packet with the M-bit set to 1 and the D-bit set to 0. Upon receipt of such a packet, the DTE shall reset the logical channel with a cause indicating "DTE Originated" and the diagnostic "Invalid Partially Full DATA Packet."

See also:





A Complete Packet Sequence contains zero or more Category 'A' DATA packets plus one Category 'B' DATA packet

D-bit	M-bit	User Data Field	Remarks
0	1	Full	Category 'A' DATA packet
1	1	<Full	Category 'B' DATA packet that marks the end of a CPS but not the end of an MBS
1	1	Full	
0	0	<Full	Category 'B' DATA packet that simultaneously marks the end of a CPS and an MBS
0	0	Full	
0	1*	<Full	
1	0	<Full	
1	0	Full	

*A network will change this M-bit to 0; therefore, a DTE shall never originate this Category 'B' packet. If a DTE receives this type of packet, then it shall reset the logical channel with a cause indicating "DTE Originated" and the diagnostic "Invalid Partially Full DATA Packet."

M-bit refers to the MORE DATA bit;

D-bit refers to the DELIVERY CONFIRMATION bit;

CPS refers to a Complete Packet Sequence; and

MBS refers to an M-bit Sequence.

Figure 6 — Packet Sequence Composition

Table 2 — Definition of Two Categories of Data Packets and Network Treatment of the M and D Bits

DATA Packet Received From Source DTE				Combining with Subsequent Packet(s) is Performed by the Network when Possible	DATA Packet Sent To Destination DTE (see Note 1)	
Category	M	D	Full		M	D
B	0 or 1	0	No	No	0 (see Note 2)	0
B	0	1	No	No	0	1
B	1	1	No	No	1	1
B	0	0	Yes	No	0	0
B	0	1	Yes	No	0	1
A	1	0	Yes	Yes (see Note 3)	1	0
B	1	1	Yes	No	1	1

NOTES

1 Refers to the delivered DATA packet whose last bit of user data corresponds to the last bit of user data, if any, that was present in the DATA packet sent by the source DTE.

2 The originating network will force the M-bit to 0.

3 If the DATA packet sent by the source DTE is combined with other packets, up to and including a category B packet, the M-bit and D-bit settings in the DATA packet received by the destination DTE will be according to that given in the two right-hand columns for the last DATA packet sent by the source DTE that was part of the combination.

— Fragmentation and reassembly of messages (6.7);

— Reset procedures (clause 8).

6.5 Complete packet sequence

A complete packet sequence is defined as being composed of a single category B packet and all contiguous preceding category A packets (if any). Category A DATA packets have the exact maximum User Data Field length with the M-bit set to 1 and the D-bit set to 0. All other DATA packets are category B packets. Figure 6 illustrates, for a complete packet sequence, the relationship between the D-bit settings, the M-bit settings, and whether the User Data Fields of DATA packets are full.

When transmitted by a source DTE, a complete packet sequence is always delivered to the destination DTE as a single complete packet sequence. (Note that an M-bit sequence may be comprised of one or more complete packet sequences as defined in this subclause.)

The remainder of this subclause pertains to network operation relative to transmission and delivery of packets in a complete packet sequence.

If the receiving DTE has a larger maximum User Data Field length than the transmitting DTE, then the DATA packets within a complete packet sequence will be combined within the network. They will be delivered in a complete packet sequence where each packet, except the last one, has the exact maximum User Data Field length, the M-bit set to 1, and the D-bit set to 0. The User Data Field of the last packet of the sequence may have less than the maximum length and the M- and D-bits set as described in table 2.

If the maximum length of the User Data Field is the same at both DTEs, then User Data Fields of DATA packets are delivered to the receiving DTE exactly as they have been received by the network, except as follows. If a full DATA packet with the M-bit set to 1 and the D-bit set to 0 is followed by an empty DATA packet, then the two packets may be merged so as to become a single category B full packet. If the last packet of a complete packet sequence transmitted by the source DTE has a User Data Field less than the maximum length, the M-bit set to 1 and the D-bit set to 0 (which a DTE is not permitted to send within the scope of this International

Standard), then the last packet of the complete packet sequence delivered by the network to the receiving DTE will have the M-bit set to 0.

If the receiving DTE has a smaller maximum User Data Field length than the transmitting DTE, then packets will be segmented within the network. The M- and D-bits will be set by the network as described to maintain complete packet sequences.

See also:

— D-bit (6.3);

— M-bit sequences (6.4 and figure 6).

6.6 Qualifier bit

In some cases, an indicator may be needed with the User Data Field of DATA packets to distinguish between two types of information carried in the field. It may be necessary to differentiate, for example, between user data and control information. An example of such a case is contained in CCITT Recommendation X.29. If such a mechanism is needed, an indicator called the Qualifier bit (Q-bit) may be used.

The use of the Q-bit is optional. If this mechanism is not needed, then the Q-bit is always set to 0. If the Q-bit mechanism is used, then the transmitting DTE shall set the Q-bit in all DATA packets of a complete packet sequence to the same value, either 0 or 1. The setting of the Q-bit in a complete packet sequence is determined from instructions received from a higher layer entity. Likewise, the setting the Q-bit for each complete packet sequence received is passed to a higher layer entity.

A complete packet sequence, which is transmitted with the Q-bit set to the same value in all DATA packets, is delivered as a complete packet sequence with the Q-bit set in all DATA packets to the value assigned by the transmitting DTE.

If the Q-bit is not set by the DTE to the same value in all the DATA packets of a complete packet sequence, the value of the Q-bit in any of the DATA packets or the corresponding complete packet sequence transferred to the distant DTE is not guaranteed by the network. Moreover, some networks may reset the Virtual Call or Permanent Virtual Circuit. If the Q-bit is not set to the same value in all DATA packets in a complete packet sequence, the receiving DTE shall reset the logical channel with a cause indicating "DTE Originated" and the diagnostic "Inconsistent Q-bit Settings."

DATA packets are numbered consecutively regardless of their Q-bit settings.

See also:

— Complete packet sequences (6.5 and figure 6);

— Numbering of packets (7.1.1);

— Reset procedures (clause 8).

6.7 Fragmentation and reassembly of messages

The Packet Layer provides the service of transmitting messages (also referred to as M-bit sequences) between peer higher layer entities. In a source DTE, the Packet Layer fragments (i.e., packetizes) a message into the appropriate number of DATA packets and sets the D-, M-, and Q-bits for each resulting packet. This process shall take into account the maximum User Data Field length allowed for the logical channel, the length and Q-bit setting for each complete packet sequence contained in the message, and whether end-to-end acknowledgement is requested for the message. If such acknowledgement is requested, then the D-bit is set to 1 in the last DATA packet of the message.

NOTE — It is permissible to fragment a message in such a way that results in a DATA packet containing a User Data Field of zero length.

In a receiving DTE, the Packet Layer reassembles the User Data Fields of DATA packets into a message. The message is passed to a higher layer entity with an indication of the length and Q-bit setting of each complete packet sequence, and an indication of whether the higher layer entity must confirm delivery of the message upon receipt.

See also:

— Maximum User Data Field Length of DATA packets (6.2);

— D-bit (6.3);

— M-bit sequences (6.4 and figure 6);

— Complete packet sequences (6.5 and figure 6);

— Q-bit (6.6);

— Delivery confirmation (7.1.4).

6.8 Procedures for interrupt

The interrupt procedure allows a DTE to transmit data to a remote DTE without following the flow control procedures applying to DATA packets. This data is contained in an INTERRUPT packet. The initiation of the interrupt procedure and the generation of the data are controlled by a higher layer entity. Upon receipt of an INTERRUPT packet, a signal indicating that an interrupt has occurred, along with the data, is passed to a higher layer entity.

Figure 7 gives a schematic view of the interrupt procedure.

The interrupt procedure can apply only in the FLOW CONTROL READY state (d1). Therefore, the interrupt procedure is abandoned as a result of a *clearing (Virtual Calls only)*, reset, or restart procedure. Within state d1, there are four states (two for each direction of interrupt transmission) that apply to the interrupt procedure. They are the DTE INTERRUPT READY (i1), DTE INTERRUPT SENT (i2), DXE INTERRUPT READY (j1), and DXE INTERRUPT SENT (j2) states, as shown in figure 34. Table 35 specifies the action taken by the DTE on the receipt of interrupt packets from the DXE as applied to the interrupt procedure.

The interrupt procedure has no effect on the data transfer procedures and the flow control procedures applying to the DATA packets on the Virtual Call or Permanent Virtual Circuit. For a given Virtual Call or Permanent Virtual Circuit, an INTERRUPT packet is delivered at or before the point in the stream of DATA packets at which the interrupt was generated. It must be processed as soon as it is received.

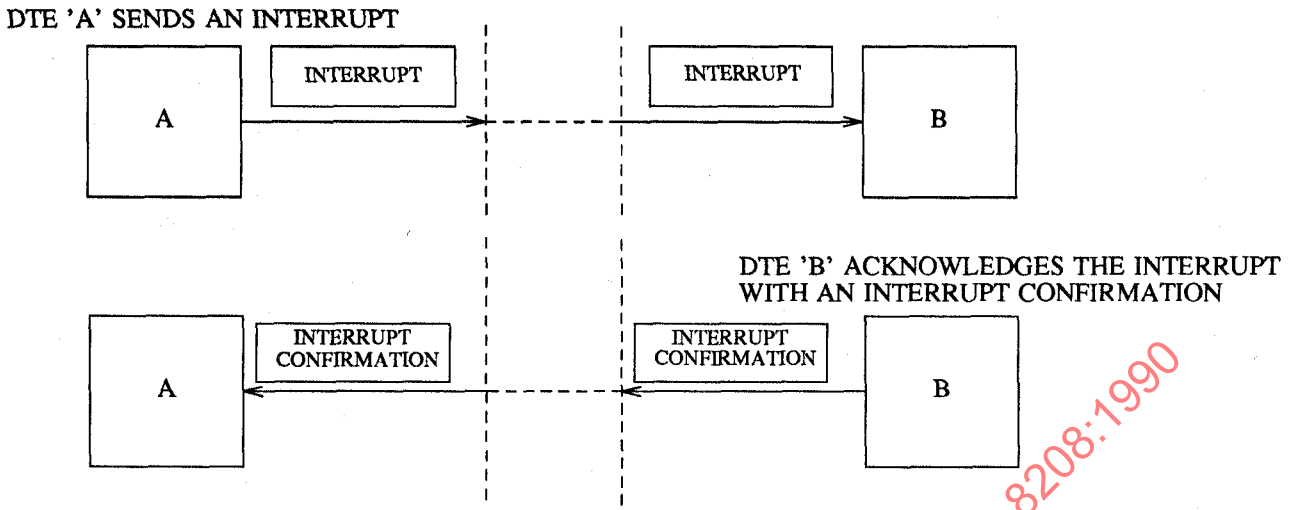


Figure 7 — Interrupt Transfer Schematic

An INTERRUPT packet may contain up to 32 octets of user data. If the User Data Field in an INTERRUPT packet exceeds 32 octets or if it is nonoctet aligned, then the receiving DTE shall invoke the reset procedure.

6.8.1 Interrupt transmission

Prior to transmitting an interrupt, the logical channel is in the DTE INTERRUPT READY state (i1). To send an interrupt, a DTE transmits across the DTE/DXE interface an INTERRUPT packet specifying the logical channel and the Interrupt User Data received from a higher layer entity and starts the Interrupt Response Timer (T26). At this time, the logical channel is in the DTE INTERRUPT SENT state (i2). In this state, the DTE cannot transmit a further INTERRUPT packet until the outstanding INTERRUPT packet is confirmed with an INTERRUPT CONFIRMATION packet.

The failure to receive an INTERRUPT CONFIRMATION packet before expiration of T26 after transmission of an INTERRUPT packet is considered an error. In this case, the DTE resets the logical channel with the cause indicating "DTE Originated" and the diagnostic "Timer Expired for Interrupt."

See also:

— INTERRUPT packet format (12.3.2 and figure 16);

— Interrupt Response Timer (T26) (table 26);

— Reset procedures (clause 8);

— Interrupt confirmation (6.8.3).

6.8.2 Receiving an interrupt

Prior to receiving an interrupt, the logical channel is in the DXE INTERRUPT READY state (j1). When a DTE receives an INTERRUPT packet from the DXE, the logical channel is in the DXE INTERRUPT SENT state (j2). In this state, receipt of a subsequent INTERRUPT packet before confirming the prior INTERRUPT packet is considered an error. In this case, the DTE resets the logical channel with a cause indicating "DTE Originated" and the diagnostic "Unauthorized Interrupt."

The Packet Layer passes an indication of the interrupt and the Interrupt User Data to a higher layer entity.

See also:

— Reset procedures (clause 8);

— Interrupt confirmation (6.8.3);

— Timers to consider when receiving an INTERRUPT packet (table 28).

6.8.3 Interrupt confirmation

A DTE confirms receipt of an INTERRUPT packet as soon as possible by transmitting across the DTE/DXE interface an INTERRUPT CONFIRMATION packet. At this time, the logical channel is in the DXE INTERRUPT READY state (j1).

When a DTE, having previously transmitted an INTERRUPT packet, receives an INTERRUPT CONFIRMATION packet, the logical channel is in the DTE INTERRUPT READY state (i1). At this time, the DTE may transmit a subsequent INTERRUPT packet across the DTE/DXE interface.

See also:

— INTERRUPT CONFIRMATION packet format (12.3.3 and figure 17).

6.9 Transit delay of DATA packets

Transit delay is an inherent characteristic of a Virtual Call or Permanent Virtual Circuit, common to the two directions of transmission. Transit delay is the DATA packet transfer delay expressed in terms of a mean value.

Selection of transit delay on a per Virtual Call basis and indication to both the calling and called DTEs of the value of the transit delay applying to a given Virtual Call may be made by the means of the Transit Delay Selection And Indication Facility.

See also:

— Optional User Facility for Transit Delay Selection And Indication (13.27).

7 Procedures for flow control

The procedures covering flow control of DATA packets described in this clause apply independently to each logical channel used for a Virtual Call or Permanent Virtual Circuit.

The flow control procedure can apply only in the FLOW CONTROL READY state (d1). Therefore, the flow control procedure is abandoned as a result of a *clearing (Virtual Calls only)*, reset, or restart procedure. Within state d1, there are four states (two for each direction of flow control) that apply to the flow control procedure. They are the DXE RECEIVE READY (f1), DXE RECEIVE NOT READY (f2), DTE RECEIVE READY (g1), and DTE RECEIVE NOT READY (g2) states, as shown in figure 35. Table 36 specifies the action taken by the DTE on the receipt of flow control, DATA, and REJECT (if subscribed to) packets from the DXE as applied to the flow control procedure.

The flow control procedure has no effect on the procedures applying to INTERRUPT packets on a Virtual Call or Permanent Virtual Circuit.

7.1 Flow control

At the DTE/DXE interface of a logical channel, the transmission of DATA packets is controlled separately for each direction and is based on authorizations from the receiver. Figure 8 shows schematically the flow control procedures discussed here.

On a Virtual Call or Permanent Virtual Circuit, flow control also allows a DTE to limit the rate at which the remote DTE can transmit DATA packets. This is achieved by the receiving DTE controlling the rate at which it accepts packets across the DTE/DXE interface. *In a DTE/DCE environment, it should be noted that there is a network-dependent limit on the number of DATA packets which may be in the network on the Virtual Call or Permanent Virtual Circuit.*

See also:

— Timers to consider when receiving a DATA packet (table 28).

7.1.1 Numbering of packets

Each DATA packet transmitted across the DTE/DXE interface for each direction of data transmission on a given Virtual Call or Permanent Virtual Circuit is sequentially numbered.

The sequence numbering of DATA packets is performed modulo 8. The packet sequence numbers cycle through the entire range from 0 through 7. The Extended Packet Sequence Numbering Facility may be provided at the DTE/DXE interface. If the Extended Packet Sequence Numbering Facility is selected, the sequence numbering of DATA packets is performed modulo 128 and the packet sequence numbers cycle through the entire range from 0 through 127. The modulo, 8 or 128, is the same for both directions of data transmission and is common to all logical channels in a Packet Layer entity.

Only DATA packets contain this sequence number, which is called the packet send sequence number P(S).

The first DATA packet to be transmitted across the DTE/DXE interface for a given direction of data transmission, when the logical channel has just entered the FLOW CONTROL READY state (d1), has a P(S) equal to 0. Subsequent DATA packets are numbered consecutively.

See also:

— Optional User Facility for Extended Packet Sequence Numbering (13.2).

7.1.2 Window description

At the DTE/DXE interface of a logical channel used for a Virtual Call or Permanent Virtual Circuit and for each direction of data transmission, a window is defined as the (modulo) ordered set of W consecutive packet send sequence numbers P(S) of the DATA packets authorized to cross the interface.

The packet send sequence number of the first of the W packets in the window is referred to as the "lower window edge." When a Virtual Call or Permanent Virtual Circuit has just entered the FLOW CONTROL READY state (d1), the window related to each direction of data transmission has a lower window edge equal to 0. The "upper window edge" is the P(S) of the last of the W packets authorized to cross the interface.

The P(S) of the first DATA packet not authorized to cross the interface is the value of the lower window edge plus W (modulo 8, or 128 when extended).

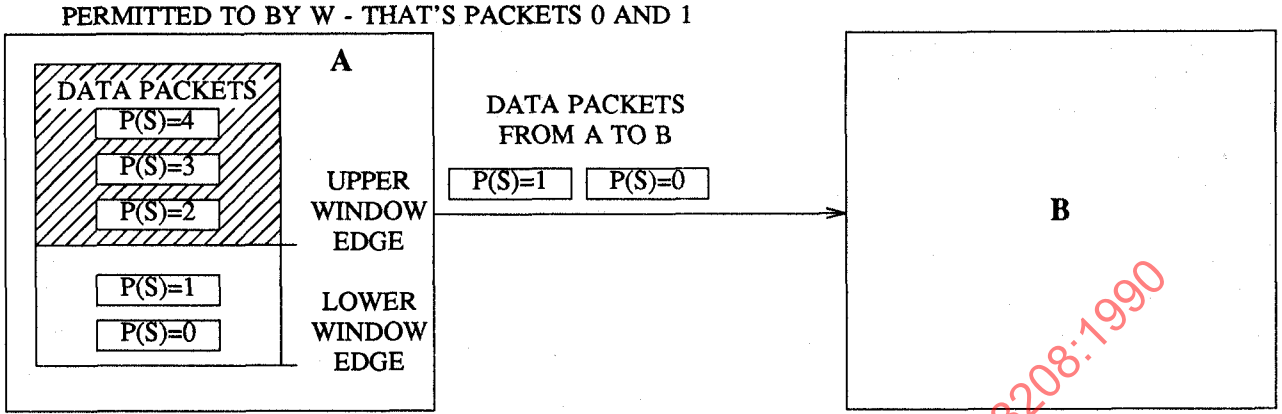
The standard default window size W is 2 for each direction of data transmission at the DTE/DXE interface.

In addition, other (nonstandard) default window sizes may be available.

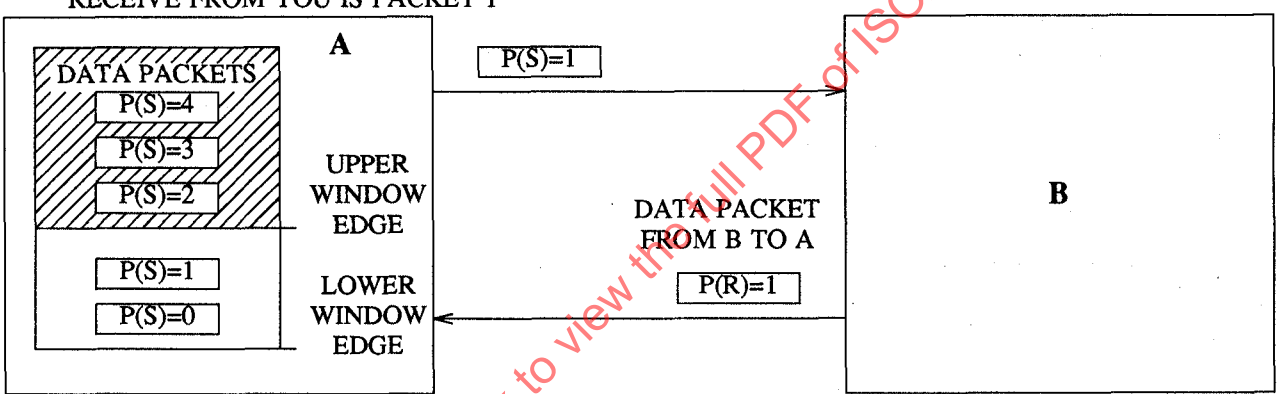
From the combination of the standard default and the list of nonstandard defaults, if any, a window size shall be selected for each direction of data transmission. *For Virtual Calls, this choice applies in common to all logical channels at the DTE/DXE interface. For Permanent Virtual Circuits, this choice is made separately for each logical channel.* These selections are agreed to for a period of time with the DXE. *In addition, negotiation of the window size on a per Virtual Call basis is allowed if the Flow Control Parameter Negotiation Facility has been subscribed to.*

ASSUME WINDOW SIZE W=2

A: LET ME SEND AS MANY SEQUENTIALLY NUMBERED DATA PACKETS AS I'M PERMITTED TO BY W - THAT'S PACKETS 0 AND 1



B: A, HERE'S SOME DATA FOR YOU. BY THE WAY, I HAVE RECEIVED ALL DATA PACKETS UP THROUGH 0 SO THE NEXT PACKET I'M EXPECTING TO RECEIVE FROM YOU IS PACKET 1



A: SO YOU GOT MY PACKET 0 AND EXPECT PACKET 1 NEXT. WELL, THAT'S ALREADY IN MY WINDOW (AND WAS SENT). I'LL MOVE MY WINDOW EDGES SO THAT PACKET 1 IS AT THE LOWER EDGE AND PACKET 2 IS AT THE UPPER EDGE. NOW I CAN SEND PACKET 2

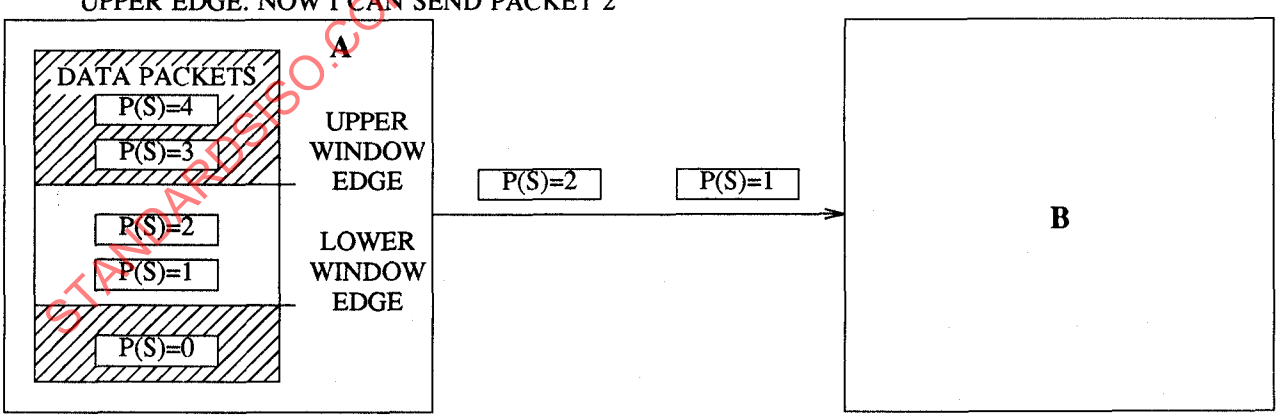


Figure 8 — Flow Control Schematic

See also:

— Optional User Facility for Nonstandard Default Window Sizes (13.10);

— Optional User Facility for Flow Control Parameter Negotiation (13.12).

7.1.3 Flow control principles

When the sequence number P(S) of the next DATA packet to be transmitted by a DTE or DXE is within the window, the DTE or DXE is authorized to transmit this DATA packet. When the P(S) of the next DATA packet to be transmitted is outside of the window, the DTE or DXE shall not transmit a DATA packet across the DTE/DXE interface.

When the sequence number P(S) of the DATA packet received by a DTE or DXE is next in sequence and is within the window, the DTE or DXE will accept this DATA packet. Receipt of a DATA packet containing a P(S) that is out of sequence (i.e., there is a duplicate or a gap in the P(S) numbering), outside the window, or not equal to 0 for the first DATA packet after entering the FLOW CONTROL READY state (d1) is considered by the DTE or DXE as a procedure error. *In a DTE/DCE environment, a DCE will reset the logical channel with a cause indicating "Local Procedure Error."* A DTE will reset the logical channel with a cause indicating "DTE Originated." In either case, the diagnostic will be "Invalid P(S)."

As an alternative for when a received DATA packet contains a P(S) that is out of sequence but inside the window, a DTE may use procedures (b) or (c) discussed in 11.3.

A number (modulo 8, or 128 when extended), referred to as a packet receive sequence number P(R), conveys across the DTE/DXE interface information from the receiver for the transmission of DATA packets. When transmitted across the DTE/DXE interface, a valid P(R) (as defined below) becomes the lower window edge. In this way, additional DATA packets may be authorized by the receiver to cross the DTE/DXE interface.

The packet receive sequence number, P(R), is conveyed in DATA, RECEIVE READY (RR), RECEIVE NOT READY (RNR), and REJECT (if subscribed to) packets.

The value of a received P(R) should be greater than or equal to the last P(R) received by a DTE or DXE and less than or equal to the P(S) of the next DATA packet to be transmitted by that DTE or DXE. If this is not the case, the DTE or DXE will consider the receipt of this P(R) as a procedure error and will reset the logical channel. *A DCE will indicate the cause as "Local Procedure Error."* A DTE will indicate the cause as "DTE Originated." In either case, the diagnostic will be "Invalid P(R)."

The P(R) returned in any of the above-mentioned packets is less than or equal to the P(S) (modulo 8, or 128 when extended) of the next DATA packet expected. It implies that the DTE or DXE transmitting the P(R) has accepted at least all DATA packets up to and including the packet numbered P(R) -1.

See also:

— RECEIVE READY packet (7.1.5);

— RECEIVE NOT READY packet (7.1.6);

— Reset procedures (clause 8);

— Receipt of erroneous DATA packets (11.3);

— Optional User Facility for Packet Retransmission (13.4);

— Optional User Facility for Extended Packet Sequence Numbering (13.2).

7.1.4 Delivery confirmation

When the D-bit is set to 0 in a DATA packet having P(S) = p, the significance of the returned P(R) corresponding to that DATA packet (i.e., P(R) ≥ p + 1) is a local updating of the window across the Packet Layer interface. *In a DTE/DCE environment, the returned P(R) does not signify that a P(R) has been received from the remote DTE. Furthermore, the achievable throughput is not constrained by the DTE-to-DTE round-trip delay across the network(s).*

When the D-bit is set to 1 in a DATA packet having P(S) = p, the significance of the returned P(R) corresponding to that DATA packet (i.e., P(R) ≥ p + 1) is an indication that a P(R) has been received from the remote DTE for all data bits in the DATA packet in which the D-bit had originally been set to 1.

If the DTE is unwilling to use the D-bit procedure and receives a DATA packet with the D-bit set to 1, then it shall reset the logical channel with a cause indicating "DTE Originated" and the diagnostic "D-bit Procedure Not Supported."

To achieve a greater degree of reliability, DTEs may use the D-bit procedure to signify receipt of data by a higher layer entity. Such use requires prior agreement between the two DTEs. When using this procedure, the sending Packet Layer sets the D-bit of the last DATA packet in an M-bit sequence to 1 if end-to-end receipt confirmation by a higher layer entity is desired. On receiving the last DATA packet of an M-bit sequence with the D-bit set to 1, the Packet Layer shall not return the corresponding P(R) until the data in this packet has been acknowledged by a higher layer entity. (It is for further study whether the Packet Layer need wait for acknowledgement by a higher layer entity of the data in a DATA packet with its D-bit set to 1 when the packet is not the last one in an M-bit sequence.) When this acknowledgement is received, the Packet Layer shall return this P(R) as soon as possible (e.g., without waiting for further DATA packets) to avoid the possibility of deadlocks. A DATA, RR, RNR, or REJECT (if subscribed to) packet may be used to convey the P(R) (see note 2 to 7.1.6). *Likewise, in a network environment, the DCE is required to send a P(R) to the DTE as soon as possible after the P(R) is received from the remote DTE.*

NOTES

1 *When a P(R) for a DATA packet with the D-bit set to 1 is outstanding, local updating of the window at the DTE/DCE interface will be deferred for subsequent DATA packets with the D-bit set to 0. Some networks may also defer updating the window for previous DATA packets (within the window) with the D-bit set to 0 until the corresponding P(R) for the packet with the outstanding D-bit set to 1 is transmitted to the DTE.*

2 *In a DTE/DCE environment, P(R) values corresponding to the data contained in DATA packets with the D-bit set to 1 need not be the same at the DTE/DCE interfaces at each end of a Virtual Call or Permanent Virtual Circuit.*

3 If the DTE has sent DATA packets with the D-bit set to 0, then the DTE should not wait for local updating of the window before initiating a resetting *or clearing* procedure.

See also:

— D-bit (6.3);

— M-bit sequence (6.4);

— Reset procedures (clause 8);

— Clearing procedures (5.5).

7.1.5 RECEIVE READY (RR) packets

RECEIVE READY (RR) packets are used by both a DTE and DXE to indicate a readiness to receive the W DATA packets within the window starting with P(R), where P(R) is indicated in the RR packet.

NOTE — The transmission of an RR packet with a particular P(R) value is not to be taken as a demand for retransmission of DATA packets which have already been transmitted.

See also:

— RECEIVE READY packet format (12.4.1 and figure 18).

7.1.6 RECEIVE NOT READY (RNR) packets

RECEIVE NOT READY (RNR) packets are used by both a DTE and DXE to indicate a temporary inability to accept additional DATA packets for a given Virtual Call or Permanent Virtual Circuit. A DTE or DXE receiving an RNR packet stops transmitting DATA packets on the indicated logical channel, but updates the window using the P(R) value of the RNR packet if the P(R) is valid. The receive-not-ready situation indicated by the transmission of an RNR packet is cleared by the transmission in the same direction of a RECEIVE READY or a REJECT (if subscribed to) packet, or by the initiation of a reset procedure.

NOTES

1 The transmission of an RR packet after transmission of an RNR packet is not to be taken as a demand for retransmission of DATA packets which have already been transmitted.

2 The RNR packet may be used to convey across the DTE/DXE interface the P(R) value corresponding to a DATA packet which had the D-bit set to 1 in the case that additional DATA packets cannot be accepted.

See also:

— RECEIVE NOT READY packet format (12.4.2 and figure 19);

— RECEIVE READY packet (7.1.5);

— Reset procedures (clause 8).

7.2 Throughput characteristics and throughput classes

A throughput class for one direction of transmission is an inherent characteristic of the Virtual Call or Permanent Virtual Circuit related to the amount of resources allocated to this Virtual Call or Permanent Virtual Circuit. It is a measure of the steady state throughput that can be provided under optimal conditions on a Virtual Call or Permanent Virtual Circuit. However, due to the statistical sharing of transmission and switching resources, it is not guaranteed that the throughput class can be reached 100 % of the time.

The optimal conditions for measurement include the following:

a) the access line characteristics of the local and remote interfaces do not constrain the throughput class;

NOTE 1 — In particular, because of the overhead due to the frame and packet headers, when the throughput class corresponding to the user class of service (i.e., access-line transmission rate) of the DTE is applicable to a Virtual Call or Permanent Virtual Circuit, a steady state throughput equal to that throughput class can never be reached.

b) the window sizes at the local and remote interfaces do not constrain the throughput;

c) the traffic characteristics of other logical channels at the local and remote interfaces do not constrain the throughput;

d) the receiving DTE is not flow controlling the DXE such that throughput class is not attainable;

e) the transmitting DTE sends only DATA packets that have the maximum User Data Field length; and

f) the D bit is not set to 1.

The throughput class is expressed in bits per second. At a DTE/DXE interface, the maximum User Data Field length is specified for a Virtual Call or Permanent Virtual Circuit and, thus, the throughput class can be interpreted by the DTE as the number of full DATA packets/second at the DTE/DXE interface.

In the absence of the Default Throughput Classes Assignment Facility, the default throughput classes for both directions of data transmission correspond to the user class of service (i.e., the access-line transmission rate) of the DTE but do not exceed the maximum throughput class supported by the DXE. *In addition, negotiation of the throughput classes on a per Virtual Call basis is allowed if the Throughput Class Negotiation Facility has been subscribed to.*

NOTE 2 — The sum of throughput classes of all Virtual Calls and Permanent Virtual Circuits supported at a DTE/DXE interface may be greater than the access-line transmission rate.

See also:

— D-bit (6.3 and 7.1.4);

— Procedures for flow control (clause 7);

— Optional User Facility for Default Throughput Classes Assignment (13.11);

— Optional User Facility for Throughput Class Negotiation (13.13).

8 Procedures for reset

The reset procedures described in this clause apply independently to each logical channel existing at the DTE/DXE interface.

The reset procedure is used to reinitialize a Virtual Call or Permanent Virtual Circuit. When a Virtual Call or Permanent Virtual Circuit at the DTE/DXE interface has just been reset, the following actions relative to the logical channel are taken.

a) With respect to DATA packets:

— those that have been transmitted are removed from the window,

— those that have not been transmitted but are contained in an M-bit sequence for which some DATA packets were transmitted are flushed from the queue of DATA packets awaiting transmission, and

— those that have been received but which do not constitute an entire M-bit sequence are flushed from the M-bit-sequence reassembly area (as an alternative, these packets may be passed to a higher layer entity with an indication that they do not constitute an entire M-bit sequence).

b) The lower window edge for each direction of data transmission is set to 0 and subsequently transmitted DATA packets are numbered starting from 0.

c) Any receive-not-ready condition that had existed prior to the reset is considered not to exist any longer.

d) Any outstanding INTERRUPT packet remains unconfirmed.

e) All timer and retransmission parameters relating to data and interrupt transfer are set back to their initial value (these include T24, T25, T26, T27, R25, and R27).

In network applications, the reset procedure removes in each direction all DATA, interrupt, and flow control packets that may be in the network associated with that logical channel.

Figure 9 gives a schematic view of the reset procedure.

The reset procedure can apply only in the DATA TRANSFER state (p4). In any other state, the reset procedure is abandoned. For example, when a *clearing (Virtual Calls only)* or restarting procedure is initiated, RESET REQUEST and RESET INDICATION packets are left unconfirmed. There are three states within p4 that apply to the reset procedure. They are the FLOW CONTROL READY (d1), DTE RESET REQUEST (d2), and DXE RESET INDICATION (d3) states, as shown in figure 33. *A Virtual Call logical channel is in state d1 when it enters state p4. A Permanent Virtual Circuit logical channel is continuously in state d1 except during a reset or restart procedure.*

Table 34 specifies the action taken by the DTE on the receipt of packets from the DXE as applied to the reset procedure.

See also:

— M-bit sequences (6.4 and figure 10);

— Flow control window (7.1.2);

— Timer parameters (table 26);

— Retransmission parameters (table 27).

8.1 Originating a reset request

A DTE indicates a reset request at any time by transmitting across the DTE/DXE interface a RESET REQUEST packet specifying the logical channel and by starting the Reset Request Response Timer (T22). The logical channel is then in the DTE RESET REQUEST state (d2). In this state, the DTE discards DATA, INTERRUPT, INTERRUPT CONFIRMATION, RECEIVE READY, RECEIVE NOT READY, and REJECT packets for the logical channel. Therefore, higher layer entities must be able to cope with the various possible situations that may occur.

The failure to receive a RESET CONFIRMATION packet before the expiration of T22 after transmission of a RESET REQUEST packet is considered an error. The reset procedure is retried up to a maximum number of times R22. After this, *for a Virtual Call logical channel, the Packet Layer clears the call with a cause indicating "DTE Originated" and the diagnostic "Timer Expired Or Retransmission Count Surpassed For Reset Request." For a Permanent Virtual Circuit logical channel, the Packet Layer notifies the appropriate entity; the logical channel then remains in the DTE RESET REQUEST state (d2).*

See also:

— RESET REQUEST packet format (12.5.1 and figure 20);

— Reset Request Response Timer (T22) (table 26);

— Reset Request Retransmission Count (R22) (table 27);

— Clearing procedures (5.5);

— Receiving a reset indication (8.2);

— Reset collision (8.3);

— Reset confirmation (8.4).

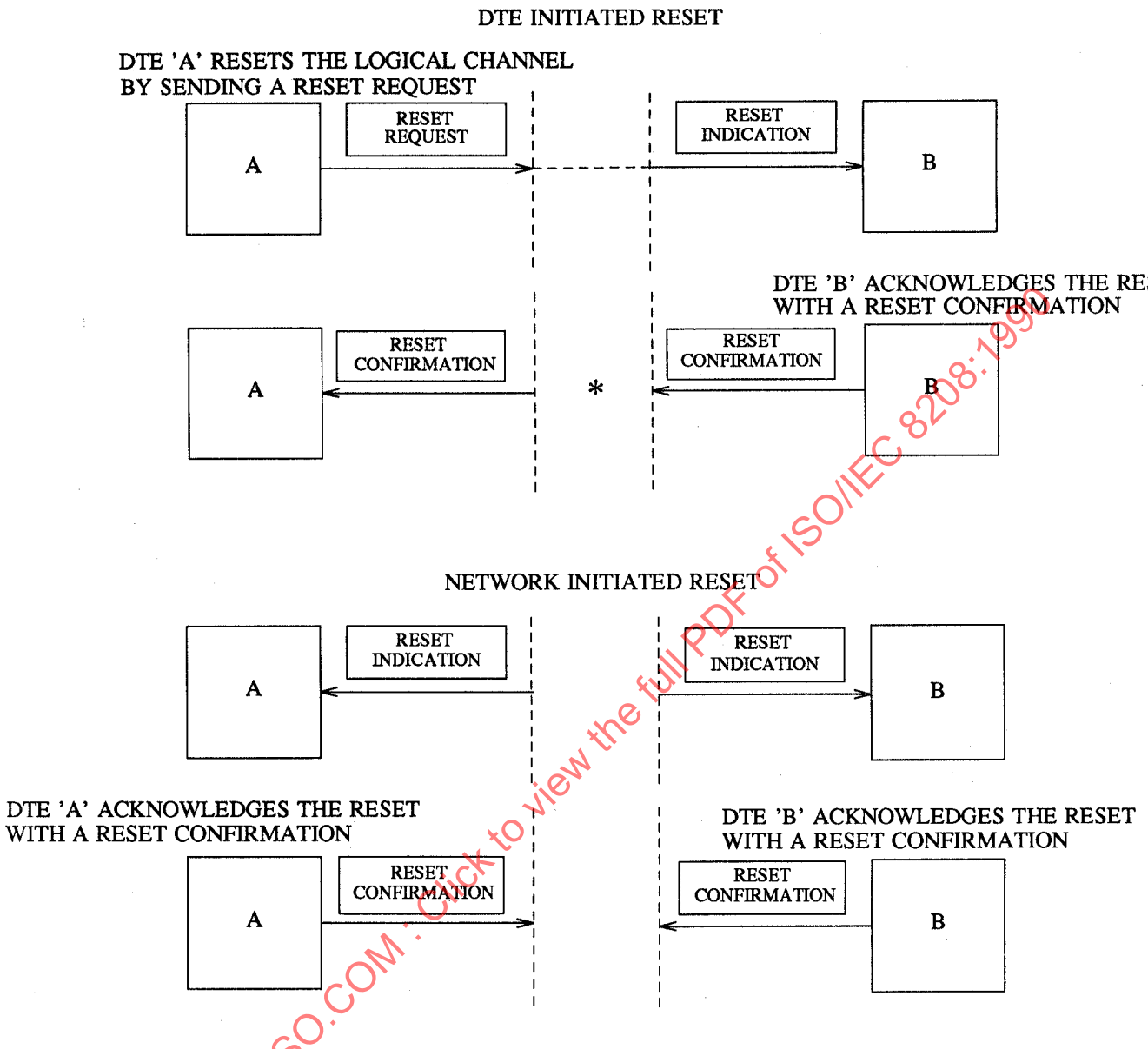
8.2 Receiving a reset indication

Upon receiving a RESET INDICATION packet, the indicated logical channel is in the DXE RESET INDICATION state (d3). In this state, a DTE considers subsequent receipt of any DATA, INTERRUPT, INTERRUPT CONFIRMATION, RECEIVE READY, RECEIVE NOT READY, or REJECT packets as an error. It discards any such packet and transmits a RESET REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Packet Type Invalid For State d3."

The RESET INDICATION packet specifies the reason for the resetting. The resetting cause code, as well as the diagnostic code and an indication that a resetting procedure has taken place, is passed to a higher layer entity.

NOTE — *In a DTE/DTE environment, the RESET INDICATION packet received by a DTE is the same as the RESET REQUEST packet transmitted by the other DTE.*

In a DTE/DCE environment, if a momentary failure occurs within the network, then a RESET INDICATION packet with the cause "Network Congestion" will be received from the



*In a network environment, the RESET CONFIRMATION packet received by DTE 'A' need not be a result of the RESET CONFIRMATION packet sent by DTE 'B'.

Figure 9 — Reset Schematic

DCE. If the network has a temporary inability to handle data traffic, then a RESET INDICATION packet with the cause "Network Out Of Order" will be received from the DCE. In this case, when the network can handle data traffic again, a Permanent Virtual Circuit will be reset with the cause "Network Operational."

After processing the RESET INDICATION packet, the DTE transmits a RESET CONFIRMATION packet across the DTE/DXE interface.

See also:

— RESET INDICATION packet format (12.5.1 and figure 20);

— Resetting cause (12.5.1);

— Reset collision (8.3);

— Reset confirmation (8.4);

— Timers to consider when receiving a RESET INDICATION packet (table 28).

8.3 Reset collision

Reset collision occurs when a DTE transmits a RESET REQUEST packet (as described in 8.1) and then receives a RESET INDICATION packet (as described in 8.2) for the same logical channel. In this case, a DTE does not transmit nor expect to receive a RESET CONFIRMATION packet and considers that the resetting is completed.

When the resetting procedure is completed, the logical channel is in the FLOW CONTROL READY state (d1).

8.4 Reset confirmation

When a DTE is prepared to acknowledge a reset, it transmits across the DTE/DXE interface a RESET CONFIRMATION packet. At this time, the resetting procedure is considered completed.

Having initiated a resetting procedure, the DTE considers the resetting procedure completed when it receives a RESET CONFIRMATION packet.

When the resetting procedure is completed, the logical channel is in the FLOW CONTROL READY state (d1).

In a network environment, the RESET CONFIRMATION packet received from a DCE can only be interpreted universally as having local significance. However, within some networks, reset confirmation may have end-to-end significance.

See also:

— RESET CONFIRMATION packet format (12.5.2 and figure 21).

9 Effects of clear, reset, and restart procedures on the transfer of packets

This clause pertains to a network environment.

All DATA and INTERRUPT packets generated by a DTE (or the network) before initiation by the DTE or the DCE of a *clear (Virtual Calls only)*, reset, or restart procedure at the local interface will either be delivered to the remote DTE before the DCE transmits the corresponding indication on the remote interface or be discarded by the network.

No DATA or INTERRUPT packets generated by a DTE (or the network) after the completion of a *restart (Permanent Virtual Circuits only)* or reset procedure at the local interface will be delivered to the remote DTE before the completion of the corresponding reset procedure at the remote interface.

When a DTE initiates a *clear (Virtual Calls only)*, reset, or restart procedure on its local interface, all DATA and INTERRUPT packets which were generated by the remote DTE (or the network) before the corresponding indication is transmitted to the remote DTE will either be delivered to the initiating DTE before DCE confirmation of the initial *clear (Virtual Calls only)*, reset, or restart request, or be discarded by the network.

NOTE — The maximum number of DATA packets which may be discarded is a function of network end-to-end delay and throughput characteristics and, in general, has no relation to the local window size. For Virtual Calls and Permanent Virtual Circuits on which all DATA packets are transferred with the D-bit set to 1, the maximum number of DATA packets which may be discarded in one direction of transmission is not larger than the window size of the direction of transmission.

10 Effects of Layers 1 and 2 on the Packet Layer

Changes of operational states of Layers 1 and/or 2 of the DTE/DXE interface do not implicitly change the state of any logical channel in a Packet Layer entity. Such changes, when they occur, are explicitly indicated at the Packet Layer by the use of restart, *clear (Virtual Calls only)*, or reset procedures, as appropriate.

An out-of-order condition on Layers 1 and/or 2 is defined as a condition in which:

a) frames cannot be transmitted or cannot be received across the DTE/DXE interface because of abnormal conditions caused, for instance, by a line fault between the DTE and DXE; or

b) the DTE has received or transmitted a Data Link Layer DISC command.

NOTE — Short Layer 1 outages (e.g., momentary loss of carrier) are not considered an out-of-order condition and the Data Link Layer and Packet Layer are not informed.

When the multilink procedure is used, an out-of-order condition is considered as having occurred when it is present at the same time for every single link procedure of the DTE/DXE interface, when the multilink resetting procedure is performed, or upon loss of multilink frame(s).

In terms of the OSI connection-mode Data Link Service, an out-of-order condition is considered to have occurred when the Data Link connection is released.

When such an out-of-order condition is detected, the DTE considers *those logical channels used for Virtual Calls to have been cleared and those used for Permanent Virtual Circuits to have been reset.*

In a DTE/DCE environment, the DCE will transmit to the remote end:

a) for each Permanent Virtual Circuit, a RESET INDICATION packet with the cause "Out Of Order;" and

b) for each existing Virtual Call, a CLEAR INDICATION packet with the cause "Out Of Order."

During the out-of-order condition, the DCE will:

a) for any incoming Virtual Call, clear the call with the cause "Out Of Order;"

b) for any DATA or INTERRUPT packet received from the remote DTE on a Permanent Virtual Circuit, reset the Permanent Virtual Circuit with the cause "Out Of Order;" and

c) for a RESET REQUEST packet received from the remote DTE on a Permanent Virtual Circuit, confirm the reset procedure to the remote DTE by either a RESET CONFIRMATION or RESET INDICATION packet.

When the out-of-order condition is recovered, the DTE should initiate the restart procedure. *For each Permanent Virtual Circuit in a DTE/DCE environment, each remote DTE will receive a RESET INDICATION packet.*

See also:

— Clearing procedures (5.5);

— Reset procedures (clause 8);

— Restart procedures (clause 4).

11 Error handling

An error as defined at the Packet Layer can be classified as follows:

a) syntactical errors — receipt of a packet that does not conform to the format specifications of the Packet Layer; examples of syntactical errors are:

— receipt of any packet with an invalid General Format Identifier,

— receipt of any packet with an unassigned Logical Channel Identifier (this includes any packets, other than Restart, Registration, and DIAGNOSTIC packets, that are received with a Logical Channel Identifier of 0),

— receipt of any packet with an invalid Packet Type Identifier, and

— receipt of a DATA packet with data that exceeds the maximum User Data Field length permitted on that logical channel;

b) logical errors — receipt of a packet that is not an acceptable input to the current state of the logical channel or whose value of P(R) or P(S) is invalid; examples of logical errors are:

— receipt of a CONFIRMATION packet (CLEAR, RESET, RESTART, or REGISTRATION) when the corresponding REQUEST packet has not been sent out,

— receipt of a second interrupt packet before an INTERRUPT CONFIRMATION packet has been sent,

— receipt of any packet whose value of P(R) is not greater than or equal to the last P(R) received or is not less than or equal to the next value of P(S) to be transmitted across the DTE/DXE interface, and

— receipt of a DATA packet whose value of P(S) is outside the window or is inside the window but out of sequence; and

c) transmission errors — errors resulting from the loss or delay of packets; examples of transmission errors are:

— nonreceipt of an appropriate response packet (e.g., a RESTART CONFIRMATION) after transmission of a RESTART REQUEST packet and before expiration of timer T20,

— nonreceipt of an appropriate response packet (e.g., a CALL CONNECTED) after transmission of a CALL REQUEST packet and before expiration of timer T21,

— nonreceipt of an appropriate response packet (e.g., a RESET CONFIRMATION) after transmission of a RESET REQUEST packet and before expiration of timer T22,

— nonreceipt of an appropriate response packet (e.g., a CLEAR CONFIRMATION) after transmission of a CLEAR REQUEST packet and before expiration of timer T23,

— nonreceipt of an appropriate response packet (e.g., an INTERRUPT CONFIRMATION) after transmission of an INTERRUPT packet and before expiration of timer T26, and

— nonreceipt of an appropriate response packet (e.g., a REGISTRATION CONFIRMATION) after transmission of a REGISTRATION REQUEST packet and before expiration of timer T28.

The above list of examples is not meant to cover all error conditions. Tables 31 through 36 summarize the actions a DTE follows upon detection of a syntactical or logical error. Tables 26 and 27 summarize the actions a DTE follows upon detection of a transmission error.

11.1 The DIAGNOSTIC packet

The DIAGNOSTIC packet is applicable in both DTE/DCE and DTE/DTE environments. However, in the former, only a DCE may transmit a DIAGNOSTIC packet. In a DTE/DTE environment, a DTE may transmit a DIAGNOSTIC packet only if it can suppress its generation when connected to a network.

The DIAGNOSTIC packet is used to indicate error conditions under circumstances where the usual methods of indication (i.e., reset, clear, and restart with cause and diagnostic) are inappropriate (see tables 31 and 32). The DIAGNOSTIC packet supplies information on error situations which are considered unrecoverable at the Packet Layer. Upon receipt of a DIAGNOSTIC packet, the Packet Layer passes an indication of its receipt and the associated error information to a higher layer entity.

A DIAGNOSTIC packet is issued only once per particular instance of an error condition. No confirmation is required to be issued by the DTE on receipt of a DIAGNOSTIC packet.

The possible extension of packet formats by the addition of new fields is for further study.

NOTE — Any such field:

a) would only be provided as an addition following all previously defined fields and not as an insertion between any of the previously defined fields;

b) would be transmitted to a DTE only when either the interfacing DXE has been informed that the receiving DTE is able to interpret this field and act upon it, or when the receiving DTE can ignore the field without adversely affecting the operation of the DTE/DXE interface (including charging); and

c) would not contain any information pertaining to an optional user facility to which the DTE has not subscribed, unless the DTE can ignore the facility without adversely affecting the operation of the DTE/DXE interface (including charging).

Bits of an octet are numbered 8 to 1, where bit 1 is the low-order bit and is transmitted first. Octets of a packet are consecutively numbered starting from 1 and are transmitted in this order.

For interoperability across all DTE/DXE interfaces, it is required that any additional field appended after the first three octets contain an integral number of octets. Receipt of a packet with a nonoctet-aligned field is considered an error. If the Data Link Layer does not provide error recovery for nonoctet-aligned packets, then appropriate error procedures for format errors, depending on the packet type, should be invoked at the Packet Layer.

Each packet to be transferred across the DTE/DXE interface is contained within the Data Link Layer Information Field that will delimit its length. Exactly one packet is contained in the Information Field. In terms of the OSI Data Link Service, each packet is transferred as the user data parameter of a single Data Link Service data unit.

12.1.1 General Format Identifier field

The General Format Identifier Field is a four-bit, binary-coded field which is provided to indicate the general format of the rest of the header. The General Format Identifier Field is located in bit positions 8, 7, 6, and 5 of octet 1, where bit 5 is the low-order bit (see table 3).

Bit 8 of the General Format Identifier is used for the Qualifier bit (Q-bit) in DATA packets. It is set to 0 in all other packets.

Bit 7 of the General Format Identifier is used for the delivery confirmation procedure in DATA packets and call setup packets. It is set to 0 in all other packets.

Table 3 — General Format Identifier

		OCTET 1 BITS: 8 7 6 5
Sequence numbering scheme modulo 8	Call Setup packets	0 X 0 1
	Call Clearing, Flow Control, Interrupt, REJECT, Reset, Restart, Registration, and DIAGNOSTIC packets	0 0 0 1
	DATA packets	X X 0 1
Sequence numbering scheme modulo 128	Call Setup packets	0 X 1 0
	Call Clearing, Flow Control, Interrupt, REJECT, Reset, Restart, Registration, and DIAGNOSTIC packets	0 0 1 0
	DATA packets	X X 1 0
General Format Identifier extension		0 0 1 1
Reserved for other applications		* * 0 0

* Undefined

NOTE — A bit which is indicated as an "X" may be set to either "0" or "1", as discussed in subsequent clauses.

Bits 6 and 5 are encoded for four possible indications. Two of the codes are used to distinguish packets using modulo 8 sequence numbering from packets using modulo 128 sequence numbering (i.e., corresponds to whether the DTE has subscribed to the Extended Packet Sequence Numbering Facility). The third code is used to indicate an extension to an expanded format for a family of General Format Identifier codes that are a subject of further study in CCITT. The fourth code is reserved for other applications.

NOTE — It is envisioned that other General Format Identifier codes could identify alternative packet formats.

See also:

— Optional User Facility for Extended Packet Sequence Numbering (13.2).

12.1.2 Logical Channel Identifier field

The Logical Channel Identifier Field[1)] appears in every packet in bit positions 4, 3, 2, and 1 of octet 1 and all bit positions of octet 2. This field is binary-coded using bit positions 4 through 1 of octet 1 followed by bit positions 8 through 1 of octet 2. Bit 1 of octet 2 is the low-order bit.

For each logical channel, this number has local significance in a DTE/DCE environment.

In Restart, DIAGNOSTIC, and Registration packets, this field is coded with all zeros.

12.1.3 Packet Type Identifier field

Each packet shall be identified in octet 3 according to table 4.

12.2 Call setup and call clearing packets

The following packets are used for setting up and clearing a Virtual Call:

a) CALL REQUEST and INCOMING CALL (12.2.1);

b) CALL ACCEPTED and CALL CONNECTED (12.2.2);

c) CLEAR REQUEST and CLEAR INDICATION (12.2.3); and

d) CLEAR CONFIRMATION (12.2.4).

See also:

— Procedures for setting up and clearing Virtual Calls (clause 5).

12.2.1 CALL REQUEST and INCOMING CALL packets

Figure 11 illustrates the format of CALL REQUEST and INCOMING CALL packets.

In a DTE/DCE environment, the CALL REQUEST packet and INCOMING CALL packet are two different "physical" packets because of the intervening network. However, in a DTE/DTE environment, the INCOMING CALL packet received by a DTE is the same as the CALL REQUEST packet sent by the other DTE.

12.2.1.1 Basic format

The first three octets consist of the General Format Identifier, the Logical Channel Identifier, and the Packet Type Identifier Fields, as described in 12.1.1 through 12.1.3. However, bit 7 of octet 1 (part of the General Format Identifier) is set as noted below.

12.2.1.1.1 General Format Identifier

Bit 7 of the General Format Identifier (octet 1) is set to 0 or 1 depending on whether the mechanism described in 6.3 is used (this mechanism is used to express the possible use of end-to-end data acknowledgement during the data-transfer phase).

12.2.1.1.2 Address Length fields

Octet 4 consists of field-length indicators for the calling- and called-DTE addresses. Bits 8, 7, 6, and 5 indicate the length of the calling-DTE address in semi-octets. Bits 4, 3, 2, and 1 indicate the length of the called-DTE address in semi-octets. Each address-length indicator is binary-coded, where bit 5 or 1 is the low-order bit of the indicator.

12.2.1.1.3 Address fields

The octets following the Address Length Fields consist of the called-DTE address when present, then the calling-DTE address when present.

Each digit of an address is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit.

Starting from the high-order digit, a DTE address is coded in consecutive octets, with two digits per octet. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5. When the total number of digits in the Called plus Calling DTE Address Fields is odd, the combined fields shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2, and 1 of the last octet of the combined fields.

NOTE — These fields may be used for optional addressing facilities such as abbreviated addressing. The optional addressing facilities employed, as well as the coding of those facilities, are for further study by CCITT.

12.2.1.1.4 Facility Length field

The octet following the Address Fields indicates the length of the Facility Field in octets. The facility-length indicator is binary-coded, where bit 1 is the low-order bit of the indicator.

12.2.1.1.5 Facility field

The Facility Field is present only when the DTE or DXE is

1) The Logical Channel Identifier Field can alternatively be viewed as consisting of two subfields: a Logical Channel Group Number Field and a Logical Channel Number Field. The Logical Channel Group Number Field is in bit positions 4, 3, 2, and 1 of octet 1. The Logical Channel Number Field is in all bit positions of octet 2. Both subfields are binary-coded, where bit 1 is the low-order bit. This alternative terminology is not used within this International Standard.

Table 4 (1 of 2) — Packet Type Identifier

PACKET TYPE		OCTET 3 BITS: (Note 1)							
FROM DTE TO DXE	FROM DXE TO DTE	8	7	6	5	4	3	2	1
Call Setup and Call Clearing									
CALL REQUEST	INCOMING CALL	0	0	0	0	1	0	1	1
CALL ACCEPTED	CALL CONNECTED	0	0	0	0	1	1	1	1
CLEAR REQUEST	CLEAR INDICATION	0	0	0	1	0	0	1	1
CLEAR CONFIRMATION	CLEAR CONFIRMATION	0	0	0	1	0	1	1	1
Data and Interrupt									
DATA	DATA	X	X	X	X	X	X	X	0
INTERRUPT	INTERRUPT	0	0	1	0	0	0	1	1
INTERRUPT CONFIRMATION	INTERRUPT CONFIRMATION	0	0	1	0	0	1	1	1
Flow Control and Reset									
RECEIVE READY	RECEIVE READY								
modulo 8	modulo 8	X	X	X	0	0	0	0	1
modulo 128[2]	modulo 128[2]	0	0	0	0	0	0	0	1
RECEIVE NOT READY	RECEIVE NOT READY								
modulo 8	modulo 8	X	X	X	0	0	1	0	1
modulo 128[2]	modulo 128[2]	0	0	0	0	0	1	0	1
REJECT[3]	REJECT[4]								
modulo 8	modulo 8	X	X	X	0	1	0	0	1
modulo 128[2]	modulo 128[2]	0	0	0	0	1	0	0	1
RESET REQUEST	RESET INDICATION	0	0	0	1	1	0	1	1
RESET CONFIRMATION	RESET CONFIRMATION	0	0	0	1	1	1	1	1
Restart									
RESTART REQUEST	RESTART INDICATION	1	1	1	1	1	0	1	1
RESTART CONFIRMATION	RESTART CONFIRMATION	1	1	1	1	1	1	1	1
Diagnostic									
DIAGNOSTIC[5]	DIAGNOSTIC[6]	1	1	1	1	0	0	0	1
Registration[7]									
REGISTRATION REQUEST	REGISTRATION REQUEST[8]	1	1	1	1	0	0	1	1
REGISTRATION CONFIRMATION[9]	REGISTRATION CONFIRMATION	1	1	1	1	0	1	1	1

Table 4 (2 of 2) — Packet Type Identifier

NOTES

1 A bit which is indicated as "X" may be set to either "0" or "1", as discussed in subsequent clauses.

2 Modulo 128 numbering is used only with the Extended Packet Sequence Numbering Facility.

3 A DTE may transmit a REJECT packet only if the optional Packet Retransmission Facility has been subscribed to for transmission of REJECT packets from DTE to DXE (see 13.4).

4 A DCE will never transmit a REJECT packet and, therefore, a DTE need not be able to process a received REJECT packet in a DTE/DCE environment. On the other hand, a DTE must be able to process a received REJECT packet in a DTE/DTE environment only if the agreement to use the optional Packet Retransmission Facility includes retransmission of DATA packets by the DTE.

5 A DTE may transmit a DIAGNOSTIC packet only in a DTE/DTE environment and only if it can be set to suppress its generation when connected to a network.

6 In a DTE/DCE environment, a DTE may receive a DIAGNOSTIC packet from a DCE if implemented by the network. In a DTE/DTE environment, a DTE may receive a DIAGNOSTIC packet from a DTE only if the transmitting DTE can be set to suppress its generation when connected to a network.

7 Registration packets are used only if the optional On-line Facility Registration Facility has been subscribed to (see 13.1).

8 A DCE will never transmit a REGISTRATION REQUEST packet and, therefore, a DTE need not be able to process a received REGISTRATION REQUEST packet in a DTE/DCE environment. On the other hand, a DTE must be able to process a received REGISTRATION REQUEST packet in a DTE/DTE environment only if the agreement to use the optional On-line Facility Registration Facility includes the DTE responding to registration-procedure initiation.

9 A DTE must not transmit a REGISTRATION CONFIRMATION packet in a DTE/DCE environment. On the other hand, a DTE must be able to transmit a REGISTRATION CONFIRMATION packet in response to a REGISTRATION REQUEST packet only if the agreement to use the optional On-line Facility Registration Facility includes the DTE responding to registration-procedure initiation.

using an optional user facility requiring some indication in the CALL REQUEST packet or INCOMING CALL packet.

The Facility Field contains an integral number of octets. The actual maximum length of this field depends on the facilities that are supported at the DTE/DXE interface. However, this maximum cannot exceed 109 octets.

See also:

— Coding of the Facility Field (clause 15).

12.2.1.1.6 Call User Data field

Following the Facility Field, the Call User Data Field may be present and has a maximum length of 16 octets. This field shall contain an integral number of octets, as indicated in 12.1.

When a Virtual Call is being established between two packet-mode DTEs, networks do not act on any part of the Call User Data Field (see CCITT Recommendation X.244).

12.2.1.2 Extended format

The extended format may be used only in conjunction with the Fast Select Facility (see 13.16). The extended format is identical to the basic format except that the Call User Data Field has a maximum length of 128 octets.

12.2.2 CALL ACCEPTED and CALL CONNECTED packets

Figure 12 illustrates the format of CALL ACCEPTED and CALL CONNECTED packets.

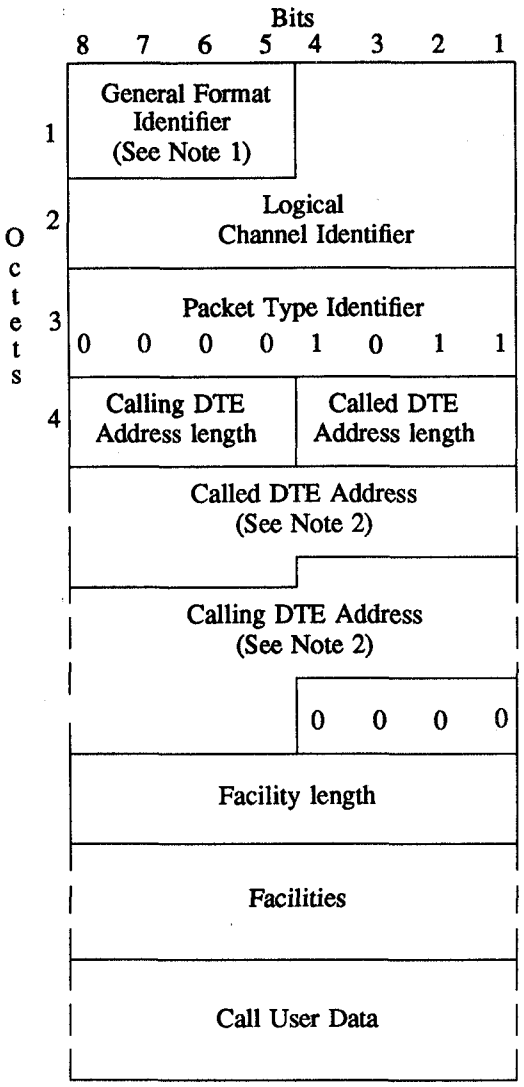
In a DTE/DCE environment, the CALL ACCEPTED packet and CALL CONNECTED packet are two different "physical" packets because of the intervening network. However, in a DTE/DTE environment, the CALL CONNECTED packet received by a DTE is the same as the CALL ACCEPTED packet sent by the other DTE.

12.2.2.1 Basic format

The first three octets consist of the General Format Identifier, the Logical Channel Identifier, and the Packet Type Identifier Fields, as described in 12.1.1 through 12.1.3. However, bit 7 of octet 1 (part of the General Format Identifier) is set as noted below.

12.2.2.1.1 General Format Identifier

Bit 7 of the General Format Identifier (octet 1) is set to 0 or 1 depending on whether the mechanism described in 6.3 is used (this mechanism is used to express the possible use of end-to-end data acknowledgement during the data-transfer phase).



NOTES

1 Coded 0X01 (modulo 8) or 0X10 (modulo 128).

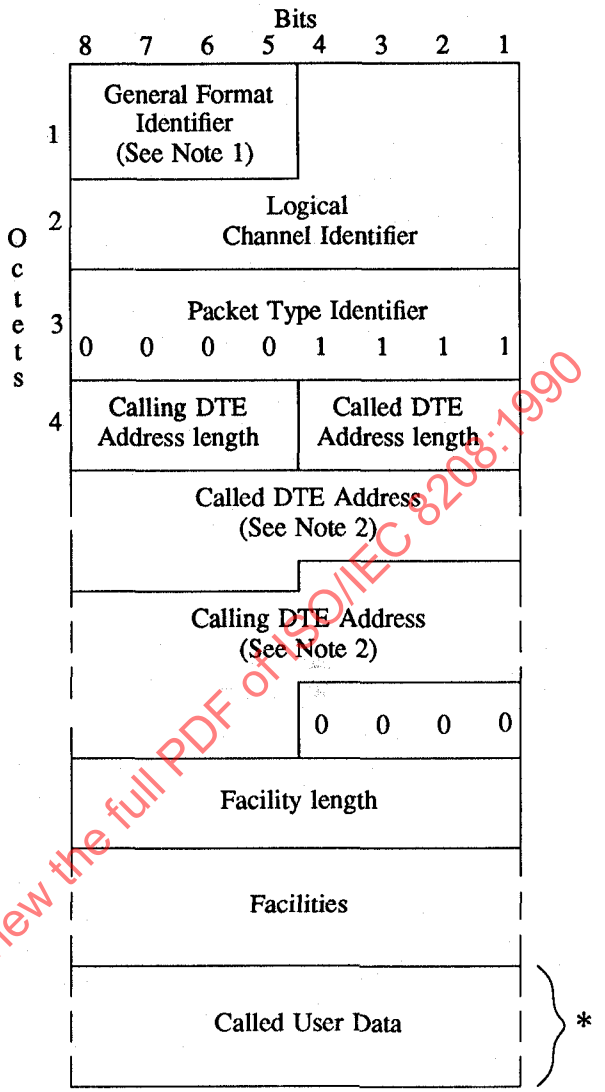
2 The figure is drawn assuming the number of address digits present in the Called DTE Address Field is odd and the number of address digits present in the Calling DTE Address Field is even.

Figure 11 — CALL REQUEST and INCOMING CALL Packet Format

12.2.2.1.2 Address Length fields

Octet 4 consists of field-length indicators for the calling- and called-DTE addresses. Bits 8, 7, 6, and 5 indicate the length of the calling-DTE address in semi-octets. Bits 4, 3, 2, and 1 indicate the length of the called-DTE address in semi-octets. Each address-length indicator is binary-coded, where bit 5 or 1 is the low-order bit of the indicator.

The use of the Address Length Fields in CALL ACCEPTED packets is mandatory, even if they are set to zero.



NOTES

1 Coded 0X01 (modulo 8) or 0X10 (modulo 128).

2 The figure is drawn assuming the number of address digits present in the Called DTE Address Field is odd and the number of address digits present in the Calling DTE Address Field is even.

*Used only in the extended format (see 12.2.2.2).

Figure 12 — CALL ACCEPTED and CALL CONNECTED Packet Format

12.2.2.1.3 Address fields

The octets following the Address Length Fields consist of the called-DTE address when present, then the calling-DTE address when present.

Each digit of an address is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit.

Starting from the high-order digit, a DTE address is coded in consecutive octets with two digits per octet. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5. When the total number of digits in the Called plus Calling DTE Address Fields is odd, the combined fields shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2, and 1 of the last octet of the combined fields.

NOTE — These fields may be used for optional addressing facilities such as abbreviated addressing. The optional addressing facilities employed, as well as the coding of those facilities, are for further study by CCITT.

12.2.2.1.4 Facility Length field

The octet following the Address Fields indicates the length of the Facility Field in octets. The facility-length indicator is binary-coded, where bit 1 is the low-order bit of the indicator.

The use of the Facility Length Field in CALL ACCEPTED packets is mandatory, even if it is set to zero.

12.2.2.1.5 Facility field

The Facility Field is present only when the DTE or DXE is using an optional user facility requiring some indication in the CALL ACCEPTED packet or CALL CONNECTED packet.

The Facility Field contains an integral number of octets. The actual maximum length of this field depends on the facilities that are supported at the DTE/DXE interface. However, this maximum cannot exceed 109 octets.

See also:

— Coding of the Facility Field (clause 15).

12.2.2.2 Extended format

The extended format may be used only in conjunction with the Fast Select Facility (see 13.16). The extended format is identical to the basic format except that the Called User Data Field may be present.

Called User Data field:

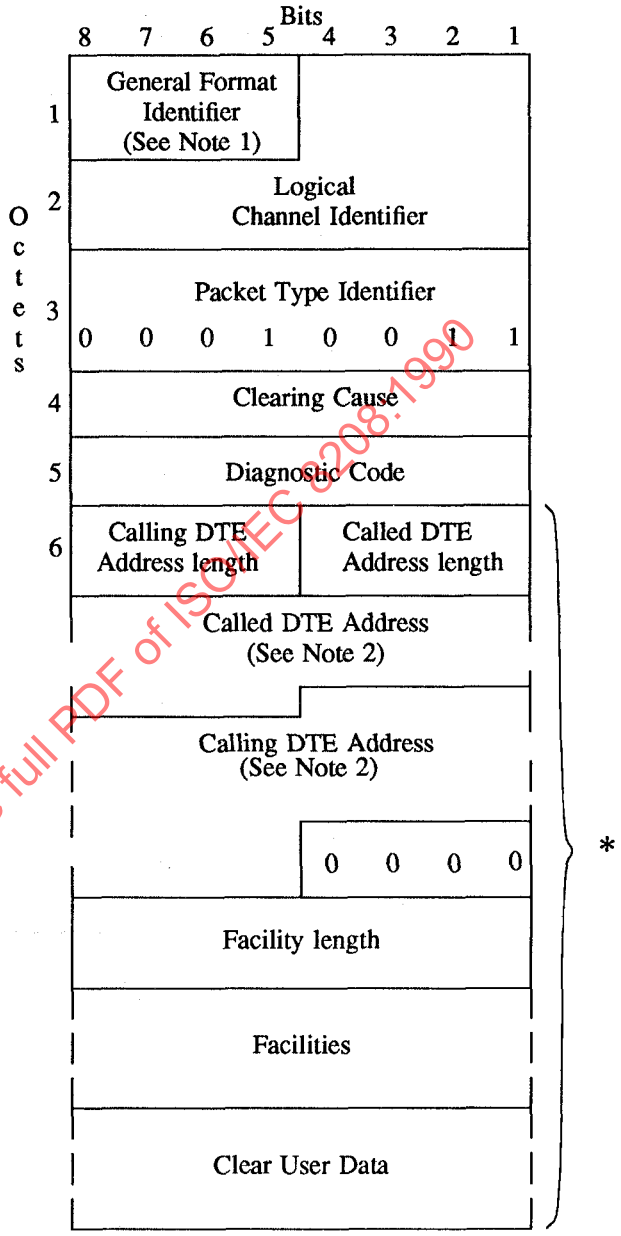
Following the Facility Field, the Called User Data Field may be present and has a maximum length of 128 octets. This field shall contain an integral number of octets, as indicated in 12.1.

When a Virtual Call is being established between two packet-mode DTEs, networks do not act on any part of the Called User Data Field (see CCITT Recommendation X.244).

12.2.3 CLEAR REQUEST and CLEAR INDICATION packets

Figure 13 illustrates the format of CLEAR REQUEST and CLEAR INDICATION packets.

In a DTE/DCE environment, the CLEAR REQUEST packet and CLEAR INDICATION packet are two different "physical" packets because of the intervening network. However, in a DTE/DTE environment, the CLEAR INDICATION packet received by a DTE is the same as the CLEAR INDICATION packet sent by the other DTE.



NOTES

1 Coded 0001 (modulo 8) or 0010 (modulo 128).

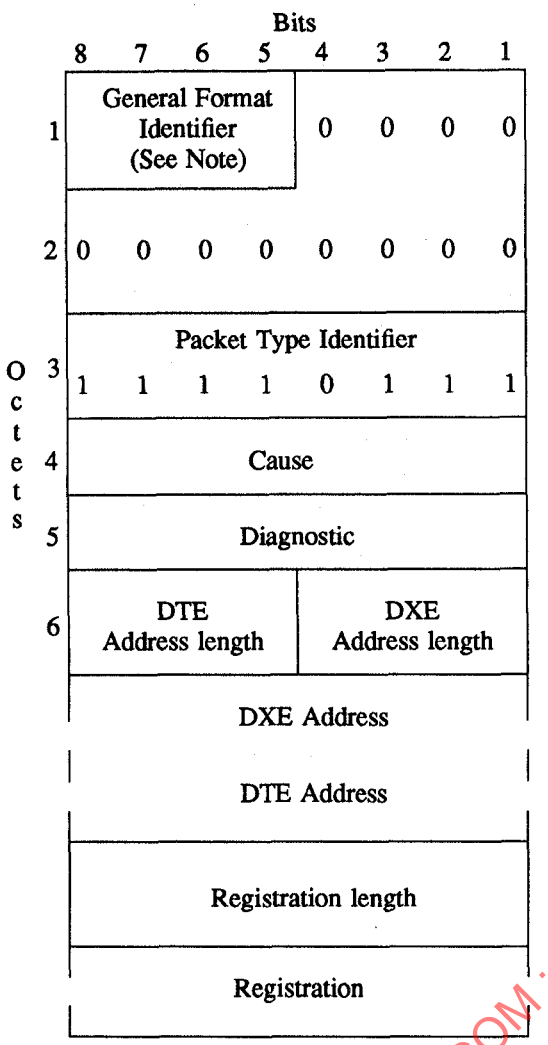
2 The figure is drawn assuming the number of address digits present in the Called DTE Address Field is odd and the number of address digits present in the Calling DTE Address Field is even.

*Used only in the extended format (see 12.2.3.2).

Figure 13 — CLEAR REQUEST AND CLEAR INDICATION Packet Format

12.2.3.1 Basic format

The first three octets consist of the General Format Identifier, the Logical Channel Identifier, and the Packet Type Identifier Fields, as described in 12.1.1 through 12.1.3.



NOTE — Coded 0001 (modulo 8) or 0010 (modulo 128)

Figure 27 — REGISTRATION CONFIRMATION Packet Format

These fields are coded with all zeros under the procedures in this International Standard.

12.9.2.4 Address fields

These fields are not present under the procedures in this International Standard.

12.9.2.5 Registration Length field

The octet following the Address Fields indicates the length of the Registration Field in octets. The registration-length indicator is binary-coded, where bit 1 is the low-order bit of the indicator.

12.9.2.6 Registration field

The Registration Field is used to indicate which optional user facilities are available and which are currently in effect. The Registration Field contains an integral number of octets. The actual maximum length of this field depends on the capabilities supported at the DTE/DXE interface. However, this maximum cannot exceed 109 octets.

See also:

— Coding of the Registration Field (clause 16).

13 Procedures for optional user facilities

A number of optional user facilities are available for use between a DTE and a DXE. Table 9 summarizes these optional user facilities.

13.1 On-line Facility Registration

On-line Facility Registration is an optional user facility agreed to for a period of time by the DTE and DXE. This user facility, if subscribed to, permits a DTE to request registration of optional user facilities and/or to obtain the current values of such facilities as understood by the interfacing DXE.

In a DTE/DTE environment, separate agreement to use the facility is required for each direction of registration-procedure initiation. For initiation of the registration procedure in a given direction, use of this facility permits the initiating DTE to

Table 8 — Coding of the Cause Field in REGISTRATION CONFIRMATION Packets

CAUSE	OCTET 4 BITS: 8 7 6 5 4 3 2 1
Invalid Facility Request	0 0 0 0 0 0 1 1
Network Congestion	0 0 0 0 0 1 0 1
Local Procedure Error	0 0 0 1 0 0 1 1
Registration/Cancellation Confirmed	0 1 1 1 1 1 1 1

Table 9 (1 of 2) — Packet Layer Optional User Facilities

Optional User Facility	Classification[1]: VC*	Classification[1]: PVC*	Agree For Period Of Time?	Applies Per Call?	Applies To DTE/DTE Operation? (Note 6)
On-line Facility Registration	A	A	Yes	No	Yes[2]
Extended Packet Sequence Numbering	A	A	Yes	No	Yes
D-bit Modification	A	A	Yes	No	No
Packet Retransmission	A	A	Yes	No	Yes[2]
Incoming Calls Barred	E	—	Yes	No	No[3]
Outgoing Calls Barred	E	—	Yes	No	No[3]
One-way Logical Channel Outgoing	E	—	Yes	No	Yes
One-way Logical Channel Incoming	A	—	Yes	No	Yes
Nonstandard Default Packet Sizes	A	A	Yes	No	Yes
Nonstandard Default Window Sizes	A	A	Yes	No	Yes
Default Throughput Classes Assignment	A	A	Yes	No	Yes
Flow Control Parameter Negotiation	E	—	Yes	Yes[4]	Yes
Throughput Class Negotiation	E	—	Yes	Yes[4]	Yes
Closed User Group related facilities					
—Closed User Group	E	—	Yes	No	No
—Closed User Group With Outgoing Access	A	—	Yes	No	No
—Closed User Group With Incoming Access	A	—	Yes	No	No
—Incoming Calls Barred Within a Closed User Group	A	—	Yes	No	No
—Outgoing Calls Barred Within a Closed User Group	A	—	Yes	No	No
—Closed User Group Selection	E	—	No	Yes[4]	No
—Closed User Group With Outgoing Access Selection	A	—	No	Yes[4]	No
Bilateral Closed User Group related facilities					
—Bilateral Closed User Group	A	—	Yes	No	No
—Bilateral Closed User Group With Outgoing Access	A	—	Yes	No	No
—Bilateral Closed User Group Selection	A	—	No	Yes[4]	No
Fast Select	E	—	No	Yes	Yes[5]
Fast Select Acceptance	E	—	Yes	No	No[3]
Reverse Charging	A	—	No	Yes	No

Table 9 (2 of 2) — Packet Layer Optional User Facilities

Optional User Facility	Classification[1]: VC*	PVC*	Agree For Period Of Time?	Applies Per Call?	Applies To DTE/DTE Operation? (Note 6)
Reverse Charging Acceptance	A	—	Yes	No	No
Local Charging Prevention	A	—	Yes	No	No
Network User Identification related facilities					
—NUI Subscription	A	—	Yes	No	No
—NUI Override	A	—	Yes	No	No
—NUI Selection	A	—	No	Yes[4]	No
Charging Information	A	—	Yes	Yes	No
RPOA related facilities					
—RPOA Subscription	A	—	Yes	No	No
—RPOA Selection	A	—	No	Yes	No
Hunt Group	A	—	Yes	No	No
Call Redirection and Call Deflection related facilities					
—Call Redirection	A	—	Yes	No	No
—Call Deflection Subscription	A	—	Yes	No	No
—Call Deflection Selection	A	—	No	Yes[4]	No
—Call Redirection or Call Deflection Notification	A	—	No	Yes	No
Called Line Address Modified Notification	A	—	No	Yes	No
Transit Delay Selection And Indication	E	—	No	Yes	No

*VC = Virtual Call
PVC = Permanent Virtual Circuit

NOTES

1 The classification indicates whether the facility must be provided by an X.25 network (an E - Essential facility), may optionally be provided by an X.25 network (an A - Additional facility), or does not apply (shown as a dash) as given in CCITT Recommendation X.2.

2 In a DTE/DTE environment, use of these facilities is agreed to separately for each direction of transmission.

3 In a DTE/DTE environment, these facilities may apply only through the use of the On-line Facility Registration Facility.

4 These per Virtual Call facilities cannot be used unless the corresponding facility has been agreed to for a period of time.

5 In a DTE/DTE environment, use of this facility requires agreement by both DTEs for a period of time.

6 Annex A and ISO/IEC TR 10029 apply in lieu of this column for DTE-to-DTE operation in the case where one DTE is acting as an intermediate system exporting facilities of a packet network to one or more other DTEs.

transmit REGISTRATION REQUEST packets and requires the responding DTE to process received REGISTRATION REQUEST packets, as described below. In a DTE/DCE environment, the DTE is always the initiator of the registration procedure while the DCE is always the responder.

13.1.1 General procedures for On-line Facility Registration

This subclause describes the general procedures for using the On-line Facility Registration Facility. The registration procedure itself does not affect the state of any logical channel. Specific procedures depend on the facility to be negotiated and are discussed in 13.1.2.

13.1.1.1 Requesting facility registration

This subclause applies to a DTE only when it acts as an initiator for the registration procedure.

A DTE requests registration of optional user facilities and/or obtains the current values of optional user facilities, as applicable, by transmitting across the DTE/DXE interface a REGISTRATION REQUEST packet and by starting the Registration Request Response Timer (T28).

A REGISTRATION REQUEST packet may be sent without attempting to register any optional user facilities (i.e., without a Registration Field) to obtain the current values of the applicable optional user facilities or to avoid requesting facilities or values of facilities that are not available.

Having sent a REGISTRATION REQUEST packet, the DTE should wait for the REGISTRATION CONFIRMATION packet before sending a CALL REQUEST packet.

The failure to receive a REGISTRATION CONFIRMATION packet before expiration of T28 after transmission of a REGISTRATION REQUEST packet is considered an error. The registration procedure is retried up to a maximum number of times R28. After this, the Packet Layer notifies the appropriate entity that it has not received a confirmation of the registration procedure.

See also:

- — REGISTRATION REQUEST packet format (12.9.1 and figure 26);
- — Receiving a response to facility registration (13.1.1.3);
- — Registration Request Response Timer (T28) (table 26);
- — Registration Request Retransmission Count (R28) (table 27).

13.1.1.2 Processing a facility registration request

This subclause applies to a DTE only in a DTE/DTE environment when it acts as a responder for the registration procedure. It always applies to a DCE when the registration procedure is used.

The DCE or DTE receiving a REGISTRATION REQUEST packet (even if the packet has no Registration Field) will, as a result, report the availability and the current values of all optional user facilities applicable to the interface by transmitting across the DTE/DXE interface a REGISTRATION CONFIRMATION packet. Optional user facilities that are not subject to the registration procedure will not be reported in the REGISTRATION CONFIRMATION packet. The REGISTRATION CONFIRMATION packet also contains an appropriate cause code.

When a REGISTRATION CONFIRMATION packet is returned, the facilities values indicated in the packet are in effect for any subsequent Virtual Calls. The values of certain facilities can be modified only when there are no existing Virtual Calls (i.e., all logical channels used for Virtual Calls are in the READY state — p1). When these facilities take effect and when there is one or more Permanent Virtual Circuits at the DTE/DXE interface, a restart procedure is initiated. *In a DTE/DCE environment, the DCE transmits a RESTART INDICATION packet with a cause indicating "Registration/Cancellation Confirmed" and the diagnostic "No Additional Information." A RESET INDICATION packet is also transmitted by the DCE across the remote DTE/DCE interface with the cause "Remote DTE Operational" and the diagnostic "No Additional Information." In a DTE/DTE environment, the DTE transmitting a REGISTRATION CONFIRMATION packet also transmits a RESTART REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Registration/Cancellation Confirmed."*

If the DCE or DTE cannot make all of the modifications requested in a REGISTRATION REQUEST packet, then it will not alter the values of some facilities. Circumstances in which all of the modifications requested cannot be made include:

a) conflict in facilities settings (e.g., requesting the Reverse Charging Acceptance Facility when the Local Charging Prevention Facility is in effect); and

b) when the interface has at least one Virtual Call established when attempting to negotiate those facilities that require all Virtual Call logical channels to be in the READY state (p1); this includes the collision of an INCOMING CALL packet and a REGISTRATION REQUEST packet.

If the requested value of a particular facility is not permitted, then the DCE or DTE will report in the REGISTRATION CONFIRMATION packet:

a) if the facility has a boolean value, the value permitted;

b) if the facility has a numeric value and the requested value is greater than the maximum-permitted value of that facility, the maximum-permitted value; or

c) if the facility has a numeric value and the requested value is less than the minimum-permitted value of that facility, the minimum-permitted value.

NOTE — The values shown in the REGISTRATION CONFIRMATION packet represent the current values in effect.

If, in a DTE/DTE environment, a DTE receives a REGISTRATION REQUEST packet after having transmitted its own REGISTRATION REQUEST packet, then the registration procedure is considered cancelled with no effect and no REGISTRATION CONFIRMATION packet is returned. The DTE may transmit another REGISTRATION REQUEST packet after some randomly-chosen time delay.

See also:

— REGISTRATION CONFIRMATION packet format (12.9.2 and figure 27);

— Facilities that can be modified only when all Virtual Calls are in the READY state (13.1.2.5);

— Restart procedures (clause 4).

13.1.1.3 Receiving a response to facility registration

This subclause applies to a DTE only when it acts as an initiator for the registration procedure.

The REGISTRATION CONFIRMATION packet received in response to a REGISTRATION REQUEST packet, which was sent either with or without a Registration Field, always contains information regarding the availability and the current values of all optional user facilities applicable to the DTE/DXE interface. The DTE may choose either to accept the values reported in this packet or to attempt to negotiate other values by transmitting another REGISTRATION REQUEST packet across the DTE/DXE interface.

The facility values reported in a REGISTRATION CONFIRMATION packet are in effect for any subsequent Virtual Calls. In addition, when there is one or more Permanent Virtual Circuits at the DTE/DXE interface, the values of those facilities that can be modified only when there are no existing Virtual Calls (i.e., all logical channels used for Virtual Calls are in the READY state (p1)) take effect at the completion of a restart procedure. *In a DTE/DCE environment, the DTE will also receive a RESTART INDICATION packet from the DCE with a cause indicating "Registration/Cancellation Confirmed" and the diagnostic "No Additional Information." In a DTE/DTE environment, the DTE receiving a REGISTRATION CONFIRMATION packet will also receive a RESTART INDICATION packet with a cause indicating "DTE Originated" and the diagnostic "Registration/Cancellation Confirmed."* In either case, a RESTART CONFIRMATION packet is transmitted in response to the RESTART INDICATION packet.

Those optional user facilities for which a modification was requested in the REGISTRATION REQUEST packet but for which there is no corresponding facility indicated in the REGISTRATION CONFIRMATION packet are not supported or are not permitted to be negotiated with the On-line Facility Registration Facility.

See also:

— REGISTRATION CONFIRMATION packet format (12.9.2 and figure 27);

— Facilities that can be modified only when all Virtual Calls are in the READY state (13.1.2.5);

— Restart procedures (clause 4).

13.1.1.4 Effects of fault conditions on registration

A fault condition in a DTE that acts as an initiator for the registration procedure may affect the values of the optional user facilities previously registered through the registration procedure. In this case, the DTE should transmit a REGISTRATION REQUEST packet without a Registration Field to ascertain the current values of the optional user facilities as understood by the interfacing DXE.

A fault condition within the network may effect the values of the optional user facilities previously registered through the registration procedure. In this case, the DCE initiates a restart procedure to inform the DTE of the failure. When the DCE initiates a restart procedure with the cause "Network Congestion" or "Network Operational," the facilities values previously negotiated may be affected. (When the DCE initiates a restart procedure with the cause "Local Procedure Error," the facilities values are not affected.)

A fault condition within a DTE that acts as a responder for the registration procedure in a DTE/DTE environment may affect the values of the optional user facilities previously registered through the registration procedure. In this case, the DTE initiates a restart procedure with a cause of "DTE Originated" to inform the other DTE of the failure. If the diagnostic is "DTE Operational" or "DTE Not Operational," then the facilities values previously negotiated may be affected; otherwise the facilities values are not affected.

When a DTE that acts as an initiator for the registration procedure receives a RESTART INDICATION packet indicating that the facilities values may have been affected, it should send a REGISTRATION REQUEST packet without a Registration Field to verify the facilities values previously negotiated. A second REGISTRATION REQUEST packet may be sent, if necessary, to negotiate particular facilities.

13.1.2 Registration procedures for specific optional user facilities

The registration procedure for a specific optional user facility depends on the facility. Table 10 classifies, for the purposes of registration, the optional user facilities according to the registration-procedure requirements applying to them.

The absence of a registration-facility in a REGISTRATION REQUEST packet means no modification to the previous agreement is desired for the concerned facilities.

The absence of a registration-facility in a REGISTRATION CONFIRMATION packet means that the concerned facilities are not supported or are not permitted to be negotiated with the On-line Facility Registration Facility.

DTEs should ignore registration-facilities that they do not support or do not know.

See also:

— Coding of the Registration Facilities (clause 16).

13.1.2.1 Class 1 optional user facilities

The registration procedure does not apply to optional user facilities in Class 1. These optional user facilities are:

a) those facilities for which negotiation is not permitted:

— On-line Facility Registration (13.1),

— Closed User Group related facilities (13.14),

— Bilateral Closed User Group related facilities (13.15),

— Network User Identification related facilities (13.21), and

Table 10 (1 of 2) — Classification of Optional User Facilities for Registration

Class And Characteristics Of Optional User Facilities[1]	Optional User Facility[2]	Registration Facility[3] Used In: REG.REQ.* Packet To Request Values For Facilities	REG.CONF.* Packet To Indicate Current Values Of Facilities	REG.CONF.* Packet To Indicate Facility Available In DXE	Registration Applicable to DTE/DTE Operation?[4]
Class 1: Facilities for which registration does not apply (See 13.1.2.1)	On-line Facility Registration	—	—	—	—
	Closed User Group related facilities	—	—	—	—
	Bilateral Closed User Group related facilities	—	—	—	—
	Fast Select	—	—	—	—
	NUI related facilities	—	—	—	—
	RPOA Subscription	—	—	—	—
	Hunt Group	—	—	—	—
	Call Redirection and Call Deflection related facilities	—	—	—	—
	Transit Delay Selection and Indication	—	—	—	—
Class 2: Facilities that cannot be negotiated but whose values can be ascertained (See 13.1.2.2)	Local Charging Prevention	—	a	—	No
Class 3: Facilities that apply on a per Virtual Call basis and whose availability for use can be ascertained by a DTE (these correspond to certain Additional facilities that a DTE may use, if implemented by the DCE, with no need for prior agreement with the DCE) (See 13.1.2.3)	Reverse Charging	—	—	b	No
	Charging Information (per Virtual Call basis)	—	—	b	No
	RPOA Selection	—	—	b	No
	Called Line Address Modified Notification	—	—	b	No
Class 4: Facilities that are always available and whose use can be invoked/revoked by a DTE at any time (these correspond to certain Essential facilities whose use a DTE and DXE must agree to for a period of time) (See 13.1.2.4)	Incoming Calls Barred	c	c	—	Yes
	Outgoing Calls Barred	c	c	—	Yes
	Flow Control Parameter Negotiation	c	c	—	Yes
	Throughput Class Negotiation	c	c	—	Yes
	Fast Select Acceptance	c	c	—	Yes

Table 10 (2 of 2) — Classification of Optional User Facilities for Registration

Class And Characteristics Of Optional User Facilities[2] (Reference Section)	Optional User Facility[2]	Registration Facility[3] Used In: REG.REQ.* Packet To Request Values For Facilities	REG.CONF.* Packet To Indicate Current Values Of Facilities	REG.CONF.* Packet To Indicate Facility Available In DXE	Registration Applicable to DTE/DTE Operation?[4]
Class 5: Facilities that apply to the DTE/DXE interface and whose availability for negotiation can be ascertained and a value negotiated (these correspond to certain Additional facilities whose use a DTE and DXE must agree to for a period of time) (Section 13.1.2.5)	Reverse Charging Acceptance	c	c	b	No
	Charging Information (per interface basis)	c	c	b	No
	Nonstandard Default Packet Sizes	e	e	b	Yes
	Nonstandard Default Window Sizes	f	f	b	Yes
	Default Throughput Classes Assignment	g	g	b	Yes
	Logical Channel Ranges[2]	h[5]	h	b	Yes
	Extended Packet Sequence Numbering	d[5]	d	b	Yes
	Packet Retransmission	d[5]	d	b	Yes
	D-bit Modification	d[5]	d	b	No

*REG.REQ. = REGISTRATION REQUEST packet
REG.CONF. = REGISTRATION CONFIRMATION packet

NOTES

1 The categorization of facilities as Essential or Additional is given in table 9.

2 The term "optional user facility" with regard to the registration procedure includes Logical Channel Ranges parameters. These parameters are inclusive of the One-way Logical Channel Outgoing and One-Way Logical Channel Incoming Facilities. The values subject to negotiation are the associated parameters (i.e., boundary points) of the one-way incoming logical channels (LIC and HIC), two-way logical channels (LTC and HTC), and one-way outgoing logical channels (LOC and HOC).

3 The registration procedure makes use of eight "registration-facilities." These registration-facilities, which are used only in support of the registration procedure, are:

a. the "Non-negotiable Facilities Values" Registration-Facility
b. the "Availability Of Facilities" Registration-Facility
c. the "Facilities That May Be Negotiated At Any Time" Registration-Facility
d. the "Facilities That May Be Negotiated Only When All Logical Channels Used For Virtual Calls Are in State p1" Registration-Facility
e. the "Nonstandard Default Packet Sizes" Registration-Facility
f. the "Nonstandard Default Window Sizes" Registration-Facility
g. the "Default Throughput Classes Assignment" Registration-Facility and
h. the "Logical Channel Types Ranges" Registration-Facility.

The Registration-Facilities in (e), (f), and (g) above are used to negotiate the optional user facilities with the same name. However, the registration-facility is distinct from the optional user facility.

4 "No" means that the corresponding bit in the registration-facility is always set to 0.

5 Values for these facilities may be requested only when all logical channels used for Virtual Calls are in state p1.

— Hunt Group (13.24);

b) those facilities for which negotiation is not needed (these are Essential facilities that a DTE may request on a per Virtual Call basis at any time):

— Fast Select (13.16), and

— Transit Delay Selection and Indication (13.27);

c) those facilities that only a DCE uses:

— Call Redirection or Call Deflection Notification (13.25.3); and

d) those facilities for which the applicability of the registration procedure is for further study by CCITT:

— RPOA Subscription (13.23.1),

— Call Redirection (13.25.1), and

— Call Deflection related facilities (13.25.2).

13.1.2.2 Use of registration-facilities applicable to Class 2 optional user facilities

There is one Class 2 optional user facility: Local Charging Prevention (13.20).

The registration procedure can be used only to ascertain the values of Class 2 optional user facilities. It cannot be used to invoke or revoke these facilities.

To ascertain the values of Class 2 optional user facilities, the DTE shall transmit across the DTE/DCE interface a REGISTRATION REQUEST packet with or without any registration-facilities. The "Non-negotiable Facilities Values" Registration-Facility is used by the DCE in a REGISTRATION CONFIRMATION packet to specify the values of the Class 2 optional user facilities.

13.1.2.3 Use of registration-facilities applicable to Class 3 optional user facilities

There are four Class 3 optional user facilities:

a) Reverse Charging (13.18);

b) Charging Information (per Virtual Call basis) (13.22);

c) RPOA Selection (13.23.2); and

d) Called Line Address Modified Notification (13.26).

The registration procedure can be used only to determine the availability for use of Class 3 optional user facilities. It is not used to invoke or revoke these facilities. To ascertain the availability for use of Class 3 optional user facilities, the DTE shall transmit across the DTE/DCE interface a REGISTRATION REQUEST packet with or without any registration-facilities. The "Availability Of Facilities" Registration-Facility is used by the DCE in a REGISTRATION CONFIRMATION packet to specify whether optional user facilities are available for use by the DTE. If this registration-facility indicates that a Class 3 optional user facility is available for use, then the DTE may request it on subsequent Virtual Calls.

13.1.2.4 Use of registration-facilities applicable to Class 4 optional user facilities

There are five Class 4 optional user facilities:

a) Incoming Calls Barred (13.5);

b) Outgoing Calls Barred (13.6);

c) Flow Control Parameter Negotiation (13.12);

d) Throughput Class Negotiation (13.13); and

e) Fast Select Acceptance (13.17).

The "Facilities That May Be Negotiated At Any Time" Registration-Facility is used by a DTE in a REGISTRATION REQUEST packet to specify whether optional user facilities are to be invoked or revoked. (The REGISTRATION REQUEST packet transmitted across the DTE/DXE interface may also contain other registration-facilities.)

The "Facilities That May Be Negotiated At Any Time" Registration-Facility is used by the DCE or DTE in a REGISTRATION CONFIRMATION packet to specify whether optional user facilities are invoked or revoked. If this registration-facility indicates that the Flow Control Parameter Negotiation and/or Throughput Class Negotiation Facilities are invoked, then the DTE may negotiate them on subsequent Virtual Calls. If this registration-facility indicates that the Incoming Calls Barred, Outgoing Calls Barred, and/or Fast Select Acceptance Facilities are invoked, then they are in effect for subsequent Virtual Calls.

NOTES

1 Invocation/revocation of the Incoming Calls Barred and/or Outgoing Calls Barred Facilities does not alter the values of the parameters for the ranges of logical channel types (LIC, HIC, LTC, HTC, LOC, and HOC).

2 *In a DTE/DTE environment, the registration procedure may be applied to the Incoming Calls Barred, Outgoing Calls Barred, and Fast Select Acceptance Facilities (these facilities do not usually apply in this environment). The Incoming Calls Barred and Outgoing Calls Barred Facilities may be invoked/revoked to control Virtual Call initiation on the DTE/DTE interface. Negotiation of the Fast Select Acceptance Facility may be used to determine the ability of both DTEs to support the Fast Select Facility when used during Virtual Call setup.*

13.1.2.5 Use of registration-facilities applicable to Class 5 optional user facilities

There are eight Class 5 optional user facilities:

a) Extended Packet Sequence Numbering (the exact method for negotiating this facility is being studied by CCITT) (13.2) - Class 5.1;

b) D-bit Modification (13.3) - Class 5.1;

c) Packet Retransmission (13.4) - Class 5.1;

d) Nonstandard Default Packet Sizes (13.9) - Class 5.2;

e) Nonstandard Default Window Sizes (13.10) - Class 5.2;

f) Default Throughput Classes Assignment (13.11) - Class 5.2;

g) Reverse Charging Acceptance (13.19) - Class 5.1; and

h) Charging Information (per-interface basis) (13.22) - Class 5.1.

The set of logical channel range parameters (LIC, HIC, LTC, HTC, LOC and HOC) is also included in Class 5.2. This set encompasses the One-way Logical Channel Outgoing Facility (13.7) and the One-way Logical Channel Incoming Facility (13.8).

NOTES

1 Class 5 optional user facilities are further categorized by whether they have a boolean value (Class 5.1) or a numeric value (Class 5.2).

2 In this subclause, "optional user facilities" also refers to the set of parameters associated with the different logical channel types.

3 The registration procedure for the Nonstandard Default Packet Sizes, Nonstandard Default Window Sizes, and Default Throughput Classes Assignment Facilities applies to the use of these facilities for Virtual Calls only. The registration procedure does not apply to the use of these facilities for Permanent Virtual Circuits.

To ascertain the availability for negotiation of Class 5 optional user facilities, the DTE transmits across the DTE/DXE interface a REGISTRATION REQUEST packet with or without any registration-facilities. The "Availability Of Facilities" Registration-Facility is used by the DCE or DTE in a REGISTRATION CONFIRMATION packet to specify whether optional user facilities are available for negotiation by the DTE. If this registration-facility indicates that a Class 5 optional user facility is available for negotiation, then the DTE may negotiate a value for it in a subsequent REGISTRATION REQUEST packet.

The procedure for registering a value for such a facility is dependent on whether the facility has a boolean value (Class 5.1) or a numeric value (Class 5.2).

NOTE 4 — A DTE may attempt to register a value for a Class 5 optional user facility without ascertaining whether it is available for negotiation.

To register a value for one or more optional user facilities in this class, the DTE transmits across the DTE/DXE interface a REGISTRATION REQUEST packet containing the appropriate registration-facilities as shown in table 10. The appropriate registration-facilities, as indicated in table 10, are used by the DXE in a REGISTRATION CONFIRMATION packet to specify a value for each Class 5 optional user facility applicable to the DTE/DXE interface.

13.1.2.5.1 Registering values for Class 5.1 (Boolean) optional user facilities

The appropriate registration-facilities (see table 10) are used by a DTE in a REGISTRATION REQUEST packet to specify whether optional user facilities are to be invoked or revoked. (The REGISTRATION REQUEST packet transmitted across the DTE/DXE interface may also contain other registration-facilities.)

The appropriate registration-facilities are used by the DCE or DTE in a REGISTRATION CONFIRMATION packet to specify whether optional user facilities are invoked or revoked.

13.1.2.5.2 Registering values for Class 5.2 (Numeric) optional user facilities

The appropriate registration-facilities (see table 10) are used in a REGISTRATION REQUEST packet to specify the numeric values that the DTE wishes to negotiate for the corresponding Class 5.2 optional user facilities. (The REGISTRATION REQUEST packet transmitted across the DTE/DXE interface may also contain other registration-facilities.)

When using the "Logical Channel Types Ranges" Registration-Facility, the values to be negotiated are the parameters (i.e., boundary points) associated with the one-way incoming logical channels (LIC and HIC), two-way logical channels (LTC and HTC), and one-way outgoing logical channels (LOC and HOC) as shown in figure 1. The relationships between LIC, HIC, LTC, HTC, LOC, and HOC shown in figure 1 shall be maintained. When there are no one-way incoming logical channels, LIC and HIC are equal to zero. When there are no two-way logical channels, LTC and HTC are equal to zero. When there are no one-way outgoing logical channels, LOC and HOC are equal to zero. In addition, the "Logical Channel Types Ranges" Registration-Facility also indicates the total number of logical channels that the DTE wishes to use for Virtual Calls. This total is equal to the sum of the number of one-way incoming logical channels, two-way logical channels, and one-way outgoing logical channels.

The appropriate registration-facilities are used by the DCE or DTE in a REGISTRATION CONFIRMATION packet to specify the values of the corresponding Class 5.2 optional user facilities. The relationship between the values of Class 5.2 optional user facilities, if any, in a REGISTRATION REQUEST packet and those in the REGISTRATION CONFIRMATION packet is as follows:

a) if the requested value is acceptable, then the requested value is shown;

b) if the requested value is greater than the maximum-permitted value of that facility, then the value shown is the maximum-permitted value; and

c) if the requested value is less than the minimum-permitted value of that facility, then the value shown is the minimum-permitted value.

13.2 Extended Packet Sequence Numbering

Extended Packet Sequence Numbering is an optional user facility agreed to for a period of time by the DTE and DXE. It applies in common to all logical channels at the DTE/DXE interface.

This user facility, if subscribed to, provides sequence numbering of packets performed modulo 128. In the absence of this facility, the sequence numbering of packets is performed modulo 8.

13.3 D-bit Modification

This optional user facility applies only to a DTE/DCE environment.

D-bit Modification is an optional user facility agreed to for a period of time by the DTE and DCE. It applies in common to

all logical channels at the DTE/DCE interface. This facility is only intended for use by those pre-D-bit DTEs which were designed for operation on public data networks that support end-to-end P(R) significance. It allows these DTEs to continue to operate with end-to-end P(R) significance within a national network.

For communications within the national network, this user facility, if subscribed to

a) changes from 0 to 1 the value of bit 7 of the General Format Identifier in all CALL REQUEST and CALL ACCEPTED packets and the value of the D-bit in all DATA packets received from the DTE, and

b) sets to 0 the value of bit 7 of the General Format Identifier in all INCOMING CALL and CALL CONNECTED packets and the value of the D-bit in all DATA packets transmitted to the DTE.

For international operation, conversion (b) above applies and conversion (a) above does not apply. Other conversion rules for international operation are for bilateral agreement between Administrations.

See also:

— Delivery Confirmation bit (6.3 and 7.1.4).

13.4 Packet Retransmission

Packet Retransmission is an optional user facility agreed to for a period of time by the DTE and DXE. It applies in common to all logical channels at the DTE/DXE interface. The procedures for using this facility to request retransmission of DATA packets apply only while a logical channel is in the FLOW CONTROL READY state (d1).

In a DTE/DTE environment, separate agreement to use this facility is required for each direction of data transmission. For the transmission of DATA packets in a given direction, use of this facility permits the DTE receiving the DATA packets to transmit REJECT packets and requires the DTE transmitting the DATA packets to process received REJECT packets, as described below. In a DTE/DCE environment, a DTE subscribing to this facility may transmit REJECT packets but will never receive REJECT packets.

13.4.1 Requesting DATA packet retransmission

A DTE requests retransmission of one or several consecutive DATA packets by transmitting across the DTE/DXE interface a REJECT packet specifying the logical channel and a packet receive sequence number P(R) and by starting the Reject Response Timer (T27). The value of this P(R) shall be greater than or equal to the P(R) last sent by the DTE and less than the P(S) of the next DATA packet to be transmitted by the interfacing DXE. If the P(R) is outside this range, the DXE receiving the REJECT will initiate a reset procedure. *A DCE will indicate the cause as "Local Procedure Error" whereas a DTE will indicate the cause as "DTE Originated."* In either case, the diagnostic will be "Invalid P(R)."

The failure to receive the requested DATA packet before expiration of timer T27 is considered an error. The REJECT packet is retransmitted up to a maximum number of times R27. After this, the DTE resets the logical channel with a cause indicating "DTE Originated" and the diagnostic "Timer Expired Or Retransmission Count Surpassed For Reject."

NOTE 1 — A DCE or DTE receiving a REJECT packet is not obligated to retransmit the requested DATA packets in such a timely fashion so as to prevent the transmitting DTE's T27 timer from expiring. Therefore, such a timer should be used with caution.

Until the requested DATA packet is received, other DATA packets received on the logical channel should be discarded.

NOTE 2 — A DTE receive-not-ready situation indicated by the prior transmission of a RECEIVE NOT READY packet is cleared by the transmission of a REJECT packet.

See also:

— REJECT packet format (12.8 and figure 25);

— Retransmission Response Timer (T27) (table 26);

— Reject Retransmission Count (R27) (table 27);

— RESET procedures (clause 8);

— Receive-not-ready situation (7.1.6).

13.4.2 Processing a retransmission request

In a DTE/DCE environment, receipt of a REJECT packet by a DTE is considered an error; in this event, the DTE resets the logical channel. In a DTE/DTE environment, both DTEs shall agree on the use of this facility. Failing such agreement, receipt of a REJECT packet is considered an error and the logical channel is reset. When the DTE resets the logical channel, the cause should indicate "DTE Originated" with the diagnostic "Unidentified Packet" or "Reject Not Subscribed To."

When receiving a REJECT packet, a DTE or DXE initiates, on the specified logical channel, retransmission of DATA packets. The P(S) of the first retransmitted DATA packet is equal to the P(R) indicated in the REJECT packet. DATA packets up to the P(S) of the last DATA packet transmitted before receipt of the REJECT packet are also retransmitted. Until the DXE or DTE transfers across the DTE/DXE interface a DATA packet with a P(S) equal to the P(R) indicated in the REJECT packet, the DTE or DXE will consider the receipt of another REJECT packet as a procedure error and will reset the logical channel. *In a DTE/DCE environment, a DCE will indicate the cause as "Local Procedure Error." In a DTE/DTE environment, a DTE will indicate the cause as "DTE Originated."* In either case, the diagnostic will be "Unauthorized Reject."

Those DATA packets within the window and pending initial transmission may follow the retransmitted DATA packet(s).

NOTE — A DTE receive-not-ready situation indicated by the prior reception of a RECEIVE NOT READY packet is cleared by the reception of a REJECT packet.

See also:

— Reset procedures (clause 8);

— Receive-not-ready situation (7.1.6);

— Timers to consider when receiving a REJECT packet (table 28).

13.5 Incoming Calls Barred

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Incoming Calls Barred is an optional user facility agreed to for a period of time by the DTE and DCE. This facility applies to all logical channels used at the DTE/DCE interface for Virtual Calls.

This user facility, if subscribed to, prevents incoming Virtual Calls from being presented to the DTE. The DTE may originate outgoing Virtual Calls.

NOTES

1 Logical channels used for outgoing Virtual Calls retain their full-duplex capability.

2 When incoming calls are barred, some networks may permit a DTE to place a Virtual Call to itself (i.e., the called address is the address of the calling DTE).

13.6 Outgoing Calls Barred

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Outgoing Calls Barred is an optional user facility agreed to for a period of time by the DTE and DCE. This facility applies to all logical channels used at the DTE/DCE interface for Virtual Calls.

This user facility, if subscribed to, prevents the DCE from accepting outgoing Virtual Calls from the DTE.

The DTE may receive incoming Virtual Calls.

NOTE — Logical channels used for incoming Virtual Calls retain their full-duplex capability.

13.7 One-way Logical Channel Outgoing

This optional user facility applies only to Virtual Call service.

One-way Logical Channel Outgoing is an optional user facility agreed to for a period of time by the DTE and DXE. This user facility, if subscribed to, restricts the logical channel's use to originating outgoing Virtual Calls only.

NOTE 1 — A one-way outgoing logical channel used for Virtual Calls retains its full-duplex capability.

The rules according to which Logical Channel Identifiers can be assigned to one-way outgoing logical channels for Virtual Calls are given in figure 1.

NOTE 2 — If all the logical channels for Virtual Calls are one-way outgoing at a DTE/DXE interface, then the effect is equivalent to the Incoming Calls Barred Facility (except that note 2 to 13.5 does not apply).

See also:

— Optional User Facility for Incoming Calls Barred (13.5).

13.8 One-way Logical Channel Incoming

This optional user facility applies only to Virtual Call service.

One-way Logical Channel Incoming is an optional user facility agreed to for a period of time by the DTE and DXE. This user facility, if subscribed to, restricts the logical channel's use to receiving incoming Virtual Calls only.

NOTE 1 — A one-way incoming logical channel used for Virtual Calls retains its full-duplex capability.

The rules according to which Logical Channel Identifiers can be assigned to one-way incoming logical channels for Virtual Calls are given in figure 1.

NOTE 2 — If all the logical channels for Virtual Calls are one-way incoming at a DTE/DXE interface, then the effect is equivalent to the Outgoing Calls Barred Facility.

See also:

— Optional User Facility for Outgoing Calls Barred (13.6).

13.9 Nonstandard Default Packet Sizes

Nonstandard Default Packet Sizes is an optional user facility agreed to for a period of time by the DTE and DXE. This user facility, if subscribed to, provides for the selection of a default packet size for each direction of data transmission from the list of packet sizes supported by the DTE and DXE. Some DXEs may constrain the default packet size to be the same for both directions of data transmission across the DTE/DXE interface. The default packet size used by a DTE shall always be capable of being set to 128. In the absence of this facility, the default packet size for each direction of data transmission is 128 octets.

NOTE — The term "packet size" refers to the maximum length of the User Data Field in a DATA packet.

Values other than the default packet sizes may be negotiated for a Virtual Call by means of the Flow Control Parameter Negotiation Facility. Values other than the default packet sizes may be agreed to for a period of time for each Permanent Virtual Circuit.

See also:

— Optional User Facility for Flow Control Parameter Negotiation (13.12).

13.10 Nonstandard Default Window Sizes

Nonstandard Default Window Sizes is an optional user facility agreed to for a period of time by the DTE and DXE. This user facility, if subscribed to, provides for the selection of a default window size for each direction of data transmission from the list of window sizes supported by the DTE and DXE. Some DXEs may constrain the default window size to be the same for both directions of data transmission across the DTE/DXE interface. The default window size used by a DTE shall always be capable of being set to 2. In the absence of this facility, the default window size for each direction of data transmission is 2.

Values other than the default window sizes may be negotiated for a Virtual Call by means of the Flow Control Parameter

Negotiation Facility. Values other than the default window sizes may be agreed to for a period of time for each Permanent Virtual Circuit.

See also:

— Optional User Facility for Flow Control Parameter Negotiation (13.12).

13.11 Default Throughput Classes Assignment

Default Throughput Classes Assignment is an optional user facility agreed to for a period of time by the DTE and DXE. This user facility, if subscribed to, provides for the selection of a default throughput class for each direction of data transmission from the list of throughput classes supported by the DTE and DXE. Some DXEs may constrain the default throughput classes to be the same for both directions of data transmission. In the absence of this facility, the default throughput classes correspond to the user class of service (i.e., access-line transmission rate) of the DTE. *In a DTE/DCE environment, they may not exceed the maximum throughput class supported by the DCE.*

The default throughput classes are the maximum throughput classes which may be associated with any Virtual Call at the DTE/DXE interface. Values other than the default throughput classes may be negotiated for a Virtual Call by means of the Throughput Class Negotiation Facility. Values other than the default throughput classes may be agreed to for a period of time for each Permanent Virtual Circuit.

See also:

— Optional User Facility for Throughput Class Negotiation (13.13);

— Throughput Class values (15.2.2.2).

13.12 Flow Control Parameter Negotiation

This optional user facility applies only to Virtual Call service.

Flow Control Parameter Negotiation is an optional user facility agreed to for a period of time by the DTE and DXE for Virtual Calls. This user facility, if subscribed to, permits negotiation on a per Virtual Call basis of the flow control parameters. The flow control parameters are the packet size and window size at the DTE/DXE interface for each direction of data transmission.

NOTE 1 — The term "packet size" refers to the maximum length of the User Data Field in a DATA packet.

In the absence of the Flow Control Parameter Negotiation Facility, the flow control parameters to be used at a particular DTE/DXE interface are the default packet sizes and the default window sizes.

NOTE 2 — The default window size is either 2 or the value selected via the Nonstandard Default Window Sizes Facility. The default packet size is either 128 or the value selected via the Nonstandard Default Packet Sizes Facility.

When the calling DTE has subscribed to the Flow Control Parameter Negotiation Facility, it may separately request, in the CALL REQUEST packet, packet sizes and/or window sizes for both directions of data transmission of the Virtual Call. If particular window sizes are not explicitly requested in the CALL REQUEST packet, then the DXE will assume that the default window sizes were requested for both directions of data transmission. If particular packet sizes are not explicitly requested, then the DXE will assume that the default packet sizes were requested for both directions of data transmission.

When a called DTE has subscribed to the Flow Control Parameter Negotiation Facility, each INCOMING CALL packet indicates the packet sizes and window sizes from which DTE negotiation can start (*in a DTE/DTE environment, such an indication is present only if the calling DTE has provided it in its CALL REQUEST packet*). No relationship has to exist between the packet sizes (P) and/or window sizes (W) requested in the CALL REQUEST packet and those indicated in the INCOMING CALL packet (*except in a DTE/DTE environment where the CALL REQUEST and INCOMING CALL packets are really the same packet*). The called DTE may request window sizes and/or packet sizes with facilities in the CALL ACCEPTED packet. The only valid facility requests in the CALL ACCEPTED packet, as a function of the facility indications in the INCOMING CALL packet, are given in table 11. If a facility request is not made in the CALL ACCEPTED packet, then the called DTE is assumed to have accepted the values indicated in the INCOMING CALL packet. *In a DTE/DTE environment, if no facility indication was present in the INCOMING CALL packet and no facility request is made in the CALL ACCEPTED packet, then the called DTE is assumed to have accepted the default values.*

In a DTE/DCE environment, when the calling DTE has subscribed to the Flow Control Parameter Negotiation Facility, every CALL CONNECTED packet indicates the packet sizes and window sizes to be used at the interface for the call. In a DTE/DTE environment, absence of a facility indication in the CALL CONNECTED packet indicates that the called DTE has accepted the values in the INCOMING CALL packet or, if none, the default values. The only valid facility indications in the CALL CONNECTED packet, as a function of the facility requests in the CALL REQUEST packet, are given in table 12.

A network may have constraints requiring the flow control parameters used for a call to be modified before indicating them to the DTE in the INCOMING CALL packet or CALL CONNECTED packet; e.g., the ranges of parameter values available on various networks may differ.

Window sizes and packet sizes need not be the same at each end of a Virtual Call in a DTE/DCE environment.

The role of a DCE in negotiating the flow control parameters may be network-dependent.

See also:

— Flow control procedures (7.1);

— Optional User Facility for Nonstandard Default Packet Sizes (13.9);

— Optional User Facility for Nonstandard Default Window Sizes (13.10);

— Coding of the packet-size request (15.2.1 and 15.2.2.1.1);

Table 11 — Valid Flow Control Parameter Requests in CALL ACCEPTED Packet in Response to Flow Control Parameter Indications in INCOMING CALL Packet

Parameter Indication	Valid Parameter Request
W(indicated) ≥ 2	W(indicated) ≥ W(requested) ≥ 2
W(indicated) = 1	W(requested) = 1 or 2
P(indicated) ≥ 128	P(indicated) ≥ P(requested) ≥ 128
P(indicated) < 128	P(indicated) ≤ P(requested) ≤ 128

Table 12 — Valid Flow Control Parameter Indications in CALL CONNECTED Packet in Response to Flow Control Parameter Requests in CALL REQUEST Packet

Parameter Request	Valid Parameter Indication
W(requested) ≥ 2	W(requested) ≥ W(indicated) ≥ 2
W(requested) = 1	W(indicated) = 1 or 2
P(requested) ≥ 128	P(requested) ≥ P(indicated) ≥ 128
P(requested) < 128	P(requested) ≤ P(indicated) ≤ 128

— Coding of the window-size request (15.2.1 and 15.2.2.1.2).

13.13 Throughput Class Negotiation

This optional user facility applies only to Virtual Call service.

Throughput Class Negotiation is an optional user facility agreed to for a period of time by the DTE and DXE for Virtual Calls. This user facility, if subscribed to, permits negotiation on a per Virtual Call basis of the throughput classes. The throughput classes are considered independently for each direction of data transmission.

When the calling DTE has subscribed to the Throughput Class Negotiation Facility, it may request, in the CALL REQUEST packet, the throughput classes for both directions of data transmission of the Virtual Call. If particular throughput classes are not explicitly requested in the CALL REQUEST packet, then the DXE will assume that the default values were requested for both directions of data transmission.

When a called DTE has subscribed to the Throughput Class Negotiation Facility, each INCOMING CALL packet will indicate the throughput classes from which DTE negotiation may start (*in a DTE/DTE environment, such an indication is present only if the calling DTE has provided it in its CALL REQUEST packet*). When provided, these throughput classes are less than or equal to the ones selected by the calling DTE, either explicitly, or by default if the calling DTE has not subscribed to the Throughput Class Negotiation Facility or has not explicitly requested throughput class values in the CALL REQUEST packet. *In a DTE/DTE environment, the called DTE should assume that the default throughput classes were requested if no indication is present in the INCOMING CALL packet. In a DTE/DCE environment, the throughput classes indicated to the called DTE will also not be greater than the default throughput classes, respectively for each direction of transmission, at the calling and the called DTE/DCE interfaces. They may be further constrained by internal limitations of the network.*

The called DTE may request, with a facility in the CALL ACCEPTED packet, the throughput classes that should finally apply to the Virtual Call. The only valid values of throughput classes in the CALL ACCEPTED packet are those that are less than or equal to the ones (respectively for each direction of data transmission) indicated in the INCOMING CALL packet.

If the called DTE does not make any throughput class facility request in the CALL ACCEPTED packet, then the throughput classes finally applying to the Virtual Call will be the ones indicated in the INCOMING CALL packet.

In a DTE/DCE environment, if the called DTE has not subscribed to the Throughput Class Negotiation Facility, the throughput classes finally applying to the Virtual Call are less than or equal to the ones selected at the calling DTE/DCE interface, and less than or equal to the default values defined at the called DTE/DCE interface.

When the calling DTE has subscribed to the Throughput Class Negotiation Facility, every CALL CONNECTED packet will indicate the throughput classes finally applying to the Virtual Call. *In a DTE/DTE environment, such an indication is present only if the called DTE has provided it in its CALL ACCEPTED packet; in its absence, the calling DTE should assume the throughput classes requested in its CALL REQUEST packet or, if none, the default throughput classes apply.*

In a DTE/DCE environment, when neither the calling DTE nor the called DTE has subscribed to the Throughput Class Negotiation Facility, the throughput classes applying to the Virtual Call will not be higher than the ones agreed to as defaults at the calling and called DTE/DCE interfaces. They may be further constrained to lower values by the network, e.g., for international service.

NOTES

1 Since both the Throughput Class Negotiation and Flow Control Parameter Negotiation Facilities can be applied to a single call, the achievable throughput will depend on how the D-bit is manipulated.

2 Users are cautioned that the choice of too small a window size and packet size at a DTE/DXE interface (made by use of the Flow Control Parameter Negotiation Facility) may adversely affect the attainable throughput class of a Virtual Call. This is likewise true of flow control mechanisms adopted by the DTE to control data transmission from the DXE.

See also:

— Coding of the Throughput Class Negotiation Facility (15.2.1 and 15.2.2.2);

— Optional User Facility for Default Throughput Classes Assignment (13.11);

— Optional User Facility for Flow Control Parameter Negotiation (13.12).

13.14 Closed User Group related facilities

These optional user facilities apply only to Virtual Call service in a DTE/DCE environment.

The set of closed user group (CUG) optional user facilities enables users to form groups of DTEs to and/or from which access is restricted. Different combinations of access restrictions to and/or from DTEs having one or more of these facilities result in various combinations of accessibility within a network environment. Figure 28 shows some of the possibilities that exist for a hypothetical situation.

There are seven CUG-related facilities: five of these are facilities that each DTE and the network may agree to for a period of time; the other two facilities permit the CUG selected for a given Virtual Call to be indicated. These seven facilities are:

a) Closed User Group (13.14.1): this is the basic facility that enables a DTE to belong to one or more CUGs;

b) Closed User Group With Outgoing Access (13.14.2): this is a variant of (a) that also enables the DTE to make outgoing calls to DTEs in the open part of the network (i.e., to DTEs not belonging to any CUG), and to DTEs in other CUGs having the incoming access capability (see (c) below);

c) Closed User Group With Incoming Access (13.14.3): this is a variant of (a) that also enables the DTE to receive incoming calls from DTEs in the open part of the network (i.e., from DTEs not belonging to any CUG), and from DTEs in other CUGs having the outgoing access capability (see (b) above);

d) Incoming Calls Barred Within A Closed User Group (13.14.4): this is a supplementary facility to (a), or (b) and/or (c) that prevents the DTE from receiving any incoming calls from DTEs in a specified CUG;

e) Outgoing Calls Barred Within A Closed User Group (13.14.5): this is a supplementary facility to (a), or (b) and/or (c) that prevents the DTE from making any outgoing calls to DTEs in a specified CUG;

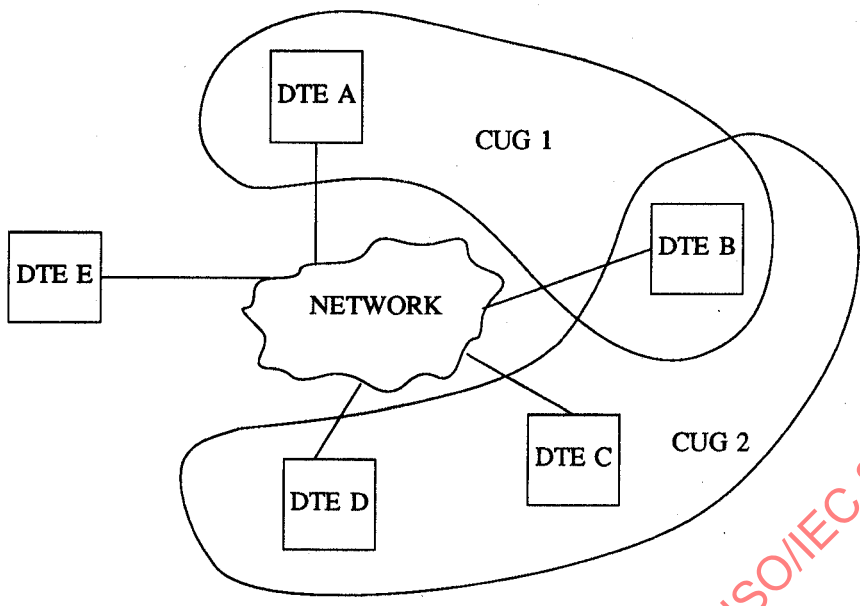
f) Closed User Group Selection (13.14.6): this facility provides for the specification of the CUG pertaining to a specific Virtual Call; and

g) Closed User Group With Outgoing Access Selection (13.14.7): this is a variant of (f) that also enables a DTE or DCE to signal that outgoing access should apply for the Virtual Call.

A DTE may belong to one or more CUGs. Each DTE belonging to at least one CUG agrees with the network to have either the Closed User Group Facility, or one or both of the Closed User Group With Outgoing Access and the Closed User Group With Incoming Access Facilities. For each CUG to which a DTE belongs, either or none of the Incoming Calls Barred Within A Closed User Group or the Outgoing Calls Barred Within A Closed User Group Facilities may apply for that DTE. Different combinations of CUG facilities may apply for different DTEs belonging to the same CUG.

Depending on the CUG-related subscriptions and the number of CUGs that the DTE belongs to, a preferential CUG may also be required to be specified by the DTE. Specification of a preferential CUG allows a CUG to be designated for a given Virtual Call without explicitly indicating it in a CALL REQUEST or INCOMING CALL packet.

When a DTE belonging to one or more CUGs places a Virtual Call, the DTE may explicitly indicate in the CALL REQUEST packet the CUG selected by using the Closed User Group Selection Facility or the Closed User Group With Outgoing Access Selection Facility (see the note). When a DTE belonging to one or more CUGs receives a Virtual Call, the CUG selected may be explicitly indicated in the INCOMING CALL packet through the use of the Closed User Group Selection Facility or the Closed user Group With Outgoing Access Selection Facility.



CLOSED USER GROUP (CUG) INFORMATION

DTE	SUBSCRIPTION	CAN MAKE CALLS TO	CAN RECEIVE CALLS FROM
A	CUG With Outgoing Access • CUG 1	B, D, E	B
B	CUG With Incoming Access • CUG 1 • CUG 2 With Outgoing Calls Barred	A	A, C, D, E
C	CUG • CUG 2	B	D
D	CUG With Incoming Access • CUG 2 With Incoming Calls Barred	B, C	A, E
E	No CUG Subscription	B, D	A

Figure 28 — Allowable Connections in Hypothetical Closed User Group Environment

NOTE — For a given Virtual Call, only one of the above-mentioned selection facilities can be present.

The number of CUGs to which a DTE can belong is network dependent.

13.14.1 Closed User Group

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Closed User Group is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, enables the DTE to belong to one or more CUGs. A CUG permits the DTEs belonging to the group to communicate with each other but precludes communication with all other DTEs.

When the DTE belongs to more than one CUG, then a preferential CUG shall be specified.

When the Closed User Group Facility is subscribed to, then only the Closed User Group Selection Facility is applicable for use at the DTE/DCE interface.

13.14.2 Closed User Group With Outgoing Access

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Closed User Group With Outgoing Access is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, enables the DTE to belong to one or more closed user groups and to originate Virtual Calls to DTEs in the open part of the network (i.e, to DTEs *not* belonging to any CUG) and to DTEs belonging to other CUGs with the incoming access capability.

When the Closed User Group With Outgoing Access Facility is subscribed to and the network offers to the DTE the capability of choosing not to have a preferential CUG and the DTE has chosen not to have a preferential CUG, then both the Closed User Group Selection Facility and the Closed User Group With Outgoing Access Selection Facility are applicable for use at the interface. In all other cases of subscription to the Closed User Group With Outgoing Access Facility, the DTE shall specify a preferential CUG and only the Closed User Group Selection Facility is applicable for use at the interface.

13.14.3 Closed User Group With Incoming Access

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Closed User Group With Incoming Access is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, enables the DTE to belong to one or more closed user groups and to receive incoming calls from DTEs in the open part of the network (i.e., from DTEs not belonging to any CUG) and from DTEs belonging to other CUGs with the outgoing access capability.

When the Closed User Group With Incoming Access Facility is subscribed to and the network offers to the DTE the capability of choosing not to have a preferential CUG and the DTE has chosen not to have a preferential CUG, then both the Closed User Group Selection Facility and the Closed User Group With Outgoing Access Selection Facility are applicable for use at the interface. In all other cases of subscription to the Closed User Group With Incoming Access Facility, the DTE shall specify a preferential CUG and only the Closed User Group Selection Facility is applicable for use at the interface.

13.14.4 Incoming Calls Barred Within A Closed User Group

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Incoming Calls Barred Within A Closed User Group is an optional user facility agreed to for a period of time by the DTE and DCE. This user facility, if subscribed to for a given CUG, permits the DTE to originate Virtual Calls to DTEs in this CUG but precludes the reception of incoming calls from DTEs in this CUG.

13.14.5 Outgoing Calls Barred Within A Closed User Group

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Outgoing Calls Barred Within A Closed User Group is an optional user facility agreed to for a period of time by the DTE and DCE. This user facility, if subscribed to for a given CUG, permits the DTE to receive Virtual Calls from DTEs in this CUG but prevents the DTE from originating Virtual Calls to DTEs in this CUG.

13.14.6 Closed User Group Selection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Closed User Group Selection is an optional user facility which may be used on a per Virtual Call basis. This facility may be requested or received by a DTE only if it has subscribed to the Closed User Group Facility, or to the Closed User Group With Outgoing Access Facility and/or the Closed User Group With Incoming Access Facility.

The Closed User Group Selection Facility may be used by the calling DTE in the CALL REQUEST packet to specify the CUG selected for a Virtual Call.

The Closed User Group Selection Facility is used in the INCOMING CALL packet to indicate to the called DTE the CUG selected for a Virtual Call.

The number of CUGs to which a DTE can belong is network dependent. If the maximum value of the index assigned for use by the DTE to select the CUG is 99 or less, the basic format of the Closed User Group Selection Facility shall be used. If the maximum value of the index assigned is between 100 and 9 999, the extended format of the Closed User Group Selection Facility shall be used.

Some networks may permit a DTE to use either the basic or extended format of the Closed User Group Selection Facility when the index is 99 or less.

NOTE — When a DTE subscribes to less than 101 CUGs, the network should be able to agree on a maximum value of the index smaller than 100 if requested by the DTE.

The appearance, in a CALL REQUEST packet, of both formats

or a format inconsistent with the number of CUGs subscribed to is an error for which the network clears the call with a cause indicating "Invalid Facility Request."

The significance of the presence of the Closed User Group Selection Facility in CALL REQUEST and INCOMING CALL packets is given in tables 13 and 14, respectively.

See also:

— Coding of the Closed User Group Selection Facility (15.2.1 and 15.2.2.3).

13.14.7 Closed User Group With Outgoing Access Selection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Table 13 — Meaning of Closed User Group Related Facilities in CALL REQUEST Packets

<table>
<tr><th rowspan="2">CUG subscription of the calling DTE</th><th colspan="3">Contents of CALL REQUEST Packet (see Note 1)</th></tr>
<tr><th>Closed User Group Selection Facility</th><th>Closed User Group With Outgoing Access Selection Facility</th><th>Neither Closed User Group Selection nor Closed User Group With Outgoing Access Selection Facility</th></tr>
<tr><td>CUG with preferential (see Note 2)</td><td rowspan="2">CUG specified (see Note 3)</td><td rowspan="5">Not allowed (call cleared)</td><td rowspan="2">Preferential or only CUG (See Note 3)</td></tr>
<tr><td>CUG/IA with preferential</td></tr>
<tr><td>CUG/OA with preferential</td><td rowspan="2">CUG specified + outgoing access (see Note 3)</td><td rowspan="2">Preferential or only CUG + outgoing access (see Notes 4, 5)</td></tr>
<tr><td>CUG/IA/OA with preferential</td></tr>
<tr><td>CUG/IA without preferential</td><td rowspan="3">CUG specified (see Note 3)</td><td>Not allowed (call cleared)</td></tr>
<tr><td>CUG/OA without preferential</td><td rowspan="2">CUG specified + outgoing access (see Notes 4, 5)</td><td rowspan="3">Outgoing Access</td></tr>
<tr><td>CUG/IA/OA without preferential</td></tr>
<tr><td>No CUG</td><td>Not allowed (call cleared)</td><td>Not allowed (call cleared)</td></tr>
</table>

IA = Incoming Access
OA = Outgoing Access

NOTES

1 The inclusion of both the Closed User Group Selection Facility and the Closed User Group With Outgoing Access Selection Facility is not allowed in the CALL REQUEST packet.

2 CUG without preferential is not allowed.

3 If outgoing calls are barred within the specified CUG or within the preferential or only CUG, then the call is cleared.

4 If outgoing calls are barred within the specified CUG or within the preferential or only CUG, then only outgoing access applies.

5 For international calls, if the destination network does not support the Closed User Group With Outgoing Access Selection Facility, the call may be cleared even if the called DTE belongs to the specified CUG or to the open world, or has incoming access.

Table 14 — Meaning of Closed User Group Related Facilities in INCOMING CALL Packets

<table>
<tr><th rowspan="2">CUG subscription of the called DTE</th><th colspan="3">Contents of INCOMING CALL Packet (see Note 1)</th></tr>
<tr><th>Closed User Group Selection Facility</th><th>Closed User Group With Outgoing Access Selection Facility</th><th>Neither Closed User Group Selection nor Closed User Group With Outgoing Access Selection Facility</th></tr>
<tr><td>CUG with preferential (see Note 2)</td><td rowspan="2">CUG specified (see Note 3)</td><td rowspan="4">Not applicable</td><td rowspan="2">Preferential or only CUG (see Note 3)</td></tr>
<tr><td>CUG/OA with preferential</td></tr>
<tr><td>CUG/IA with preferential</td><td rowspan="2">CUG specified + incoming access (see Note 4)</td><td rowspan="2">Preferential or only CUG + incoming access (see Note 5)</td></tr>
<tr><td>CUG/IA/OA with preferential</td></tr>
<tr><td>CUG/OA without preferential</td><td rowspan="3">CUG specified (see Note 3)</td><td>Not applicable</td></tr>
<tr><td>CUG/IA without preferential</td><td rowspan="2">CUG specified + incoming access (see Note 4)</td><td rowspan="3">Incoming Access</td></tr>
<tr><td>CUG/IA/OA without Preferential</td></tr>
<tr><td>No CUG</td><td>Not applicable</td><td>Not applicable</td></tr>
</table>

IA = Incoming Access
OA = Outgoing Access

NOTES

1 The DCE will never include both the Closed User Group Selection Facility and the Closed User Group With Outgoing Access Selection Facility in an INCOMING CALL packet.

2 CUG without preferential is not allowed.

3 When incoming calls are barred within this CUG, the call is blocked; there is no incoming call.

4 When incoming calls are barred within this CUG, only incoming access applies and the INCOMING CALL packet contains neither the Closed User Group Selection Facility nor the Closed User Group With Outgoing Access Selection Facility.

5 When incoming calls are barred within this CUG, only incoming access applies.

Closed User Group With Outgoing Access Selection is an optional user facility which may be used on a per Virtual Call basis. This facility can only be used if the network offers to the DTE the capability not to have a preferential CUG and the DTE has chosen not to have a preferential CUG. This facility may be requested by a DTE only if the DTE has subscribed to the Closed User Group With Outgoing Access Facility, or to both the Closed User Group With Outgoing Access and Closed User Group With Incoming Access Facilities. This facility may be received by a DTE only if it has subscribed to the Closed User Group With Incoming Access Facility, or to both the Closed User Group With Incoming Access and Closed User Group With Outgoing Access Facilities.

The Closed User Group With Outgoing Access Selection Facility may be used by the calling DTE in the CALL REQUEST packet to specify the CUG selected for a Virtual Call and to indicate that outgoing access is also desired.

The Closed User Group With Outgoing Access Selection Facility is used in the INCOMING CALL packet to indicate to the called DTE the CUG selected for a Virtual Call and that outgoing access had applied at the calling DTE.

The number of CUGs to which a DTE can belong is network dependent. If the maximum value of the index assigned for use by the DTE to select the CUG is 99 or less, the basic format of the Closed User Group With Outgoing Access Selection

Facility shall be used. If the maximum value of the index assigned is between 100 and 9 999, the extended format of the Closed User Group With Outgoing Access Selection Facility shall be used.

Some networks may permit a DTE to use either the basic or extended format of the Closed User Group With Outgoing Access Selection Facility when the index is 99 or less.

NOTE — When a DTE subscribes to less than 101 closed user groups, the network should be able to agree to a maximum value of the index smaller than 100 if requested by the DTE.

The appearance, in a CALL REQUEST packet, of both formats or a format inconsistent with the number of CUGs subscribed to is an error for which the network clears the call with a cause indicating "Invalid Facility Request."

The significance of the presence of the Closed User Group With Outgoing Access Selection Facility in CALL REQUEST and INCOMING CALL packets is given in tables 13 and 14, respectively.

See also:

— Coding of the Closed User Group With Outgoing Access Selection Facility (15.2.1 and 15.2.2.4).

13.14.8 Absence of both CUG-Selection Facilities

The significance of the absence of both the Closed User Group Selection Facility and the Closed User Group With Outgoing Access Selection Facility in CALL REQUEST and INCOMING CALL packets is given in tables 13 and 14, respectively.

13.15 Bilateral Closed User Group related facilities

These optional user facilities apply only to Virtual Call service in a DTE/DCE environment.

The set of bilateral closed user group (BCUG) optional user facilities enables pairs of DTEs to form bilateral relations allowing access between each other while limiting access to or from other DTEs with which such a relation has not been formed. Different combinations of access restrictions for DTEs having these facilities result in various combinations of accessibility within a network environment.

There are three BCUG-related facilities: two of these are facilities that each DTE and the network may agree to for a period of time; the other facility permits the BCUG selected for a given Virtual Call to be indicated. The three facilities are:

a) Bilateral Closed User Group (13.15.1): this is the basic facility that enables a DTE to belong to one or more BCUGs;

b) Bilateral Closed User Group With Outgoing Access (13.15.2): this is a variant of (a) that also enables the DTE to make outgoing calls to DTEs in the open part of the network (i.e., to DTEs not belonging to any BCUG); and

c) Bilateral Closed User Group Selection (13.15.3): this facility provides for the specification of the BCUG pertaining to a specific Virtual Call.

A DTE may belong to one or more BCUGs. Each DTE belonging to at least one BCUG has either the Bilateral Closed User Group Facility or the Bilateral Closed User Group With Outgoing Access Facility. For a given BCUG, it is permissible for one DTE to subscribe to the Bilateral Closed User Group Facility while the other DTE subscribes to the Bilateral Closed User Group With Outgoing Access Facility.

When a DTE belonging to one or more BCUGs places a Virtual Call, the DTE should indicate in the CALL REQUEST packet the BCUG selected by using the Bilateral Closed User Group Selection Facility. When a DTE belonging to one or more BCUGs receives a Virtual Call, the BCUG selected will be indicated in the INCOMING CALL packet through the use of the Bilateral Closed User Group Selection Facility.

The number of BCUGs to which a DTE can belong is network dependent.

A DTE may, at the same time, have one of the Bilateral Closed User Group related facilities and one or more of the Closed User Group related facilities described in 13.14. The CUG and BCUG facilities are independent of one another. For example, a call within a CUG is not regarded as an outgoing access call in relation to the BCUG-related facilities.

13.15.1 Bilateral Closed User Group

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Bilateral Closed User Group is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, enables the DTE to belong to one or more BCUGs. A BCUG permits a pair of DTEs that bilaterally agree to communicate with each other to do so but precludes communication with all other DTEs.

13.15.2 Bilateral Closed User Group With Outgoing Access

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Bilateral Closed User Group With Outgoing Access is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, enables the DTE to belong to one or more BCUGs and to originate Virtual Calls to DTEs in the open part of the network (i.e., to DTEs not belonging to any BCUG).

13.15.3 Bilateral Closed User Group Selection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Bilateral Closed User Group Selection is an optional facility which may be used on a per Virtual Call basis. This facility should be requested or will only be received by a DTE if it has subscribed to the Bilateral Closed User Group Facility or to the Bilateral Closed User Group With Outgoing Access Facility.

The Bilateral Closed User Group Selection Facility is used by the calling DTE in the CALL REQUEST packet to specify the BCUG selected for a Virtual Call. The called-DTE address length should be coded all zeros.

The Bilateral Closed User Group Selection Facility is used in the INCOMING CALL packet to indicate to the called DTE the BCUG selected for a Virtual Call. The calling-DTE address length is coded all zeros.

See also:

— Coding of the Bilateral Closed User Group Selection Facility (15.2.1 and 15.2.2.5).

13.16 Fast Select

This optional user facility applies only to Virtual Call service.

Fast Select is an optional user facility which may be requested by a DTE for a given Virtual Call. *In a DTE/DCE environment, a DTE may use this facility without prior agreement. In a DTE/DTE environment, prior agreement between the two DTEs is required to use this facility. Such an agreement permits both DTEs to originate calls with this facility and requires them to process received calls using this facility.*

If, in a DTE/DCE environment, a DTE places a call using Fast Select to a DTE that has not subscribed to the Fast Select Acceptance Facility, then the call will be cleared by the network with a cause indicating "Fast Select Acceptance Not Subscribed." If, in a DTE/DTE environment, a DTE places a call to a DTE that did not agree to use Fast Select, then the called DTE may clear the call with a cause indicating "DTE Originated" and the diagnostic "Fast Select Not Subscribed."

DTEs can request Fast Select on a per Virtual Call basis by means of the Fast Select Facility in a CALL REQUEST packet using any logical channel which can be used for originating Virtual Calls.

The Fast Select Facility, if requested in the CALL REQUEST packet and if it indicates no restriction on response:

a) allows the CALL REQUEST packet to contain a Call User Data Field of up to 128 octets;

b) authorizes the DXE to transmit to the calling DTE, during the DTE CALL REQUEST state (p2), a CALL CONNECTED or CLEAR INDICATION packet with a Called or Clear User Data Field, respectively, of up to 128 octets; and

c) authorizes the calling DTE and the DXE to transmit, after call setup has been completed, a CLEAR REQUEST or a CLEAR INDICATION packet with a Clear User Data Field of up to 128 octets.

The Fast Select Facility, if requested in the CALL REQUEST packet and if it indicates restriction on response:

a) allows the CALL REQUEST packet to contain a Call User Data Field of up to 128 octets; and

b) authorizes the DXE to transmit to the calling DTE, during the DTE CALL REQUEST state (p2), a CLEAR INDICATION packet with a Clear User Data Field of up to 128 octets (the DXE is not authorized to transmit a CALL CONNECTED packet).

The Call User Data Field, Called User Data Field, and Clear User Data Field can not be fragmented for delivery across the DTE/DXE interface.

The Call User Data Field, Called User Data Field, and Clear User Data Field shall contain an integral number of octets, as indicated in 12.1.

The significance of the CALL CONNECTED packet, as well as the CLEAR INDICATION packet with a cause of "DTE Originated" as a direct response to the CALL REQUEST packet with the Fast Select Facility, is that the CALL REQUEST packet with the Call User Data Field has been received by the called DTE.

All other procedures for processing a Virtual Call in which the Fast Select Facility has been requested are not affected by the request.

See also:

— Call Setup and Call Clearing packets (12.2);

— Coding of the Fast Select Facility (15.2.1 and 15.2.2.6);

— Optional User Facility for Fast Select Acceptance (13.17).

13.17 Fast Select Acceptance

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Fast Select Acceptance is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, authorizes the DCE to transmit to the DTE incoming calls which request the Fast Select Facility. In the absence of this facility, the DCE will not transmit to the DTE any incoming calls which request the Fast Select Facility.

If the called DTE has subscribed to the Fast Select Acceptance Facility, it will be advised that Fast Select, as well as an indication of whether there is a restriction on the response, has been requested through the inclusion of the Fast Select Facility in the INCOMING CALL packet.

The presence of the Fast Select Facility indicating no restriction on response in an INCOMING CALL packet permits the called DTE:

a) to issue, as a direct response to this packet, a CALL ACCEPTED packet with a Called User Data Field of up to 128 octets;

b) to issue, at any time, a CLEAR REQUEST packet with a Clear User Data Field of up to 128 octets; and

c) to receive, after call setup has been completed, a CLEAR INDICATION packet with a Clear User Data Field of up to 128 octets.

The presence of the Fast Select Facility indicating restriction on response in an INCOMING CALL packet permits the called DTE to issue, as a direct response to this packet, a CLEAR REQUEST packet with a Clear User Data Field of up to 128 octets; the called DTE is not authorized to send a CALL ACCEPTED packet.

The Call User Data Field, Called User Data Field, and Clear User Data Field can not be fragmented for delivery across the DTE/DXE interface.

The Call User Data Field, Called User Data Field, and Clear User Data Field shall contain an integral number of octets, as indicated in 12.1.

All other procedures for processing a Virtual Call in which the Fast Select Facility has been requested are not affected by the request.

See also:

— Call Setup and Call Clearing packets (12.2);

— Optional User Facility for Fast Select (13.16);

— Clearing procedures (5.5);

— Coding of the Fast Select Facility (15.2.1 and 15.2.2.6).

13.18 Reverse Charging

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Reverse Charging is an optional user facility which may be requested by a DTE for a given Virtual Call. When used, this facility requests that the network charge all costs associated with the ensuing Virtual Call to the called DTE.

See also:

— Optional User Facility for Reverse Charging Acceptance (13.19);

— Coding of the Reverse Charging Facility (15.2.1 and 15.2.2.6).

13.19 Reverse Charging Acceptance

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Reverse Charging Acceptance is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, authorizes the DCE to transmit to the DTE incoming calls which request the Reverse Charging Facility. In the absence of the facility, the DCE will not transmit to the DTE incoming calls which request the Reverse Charging Facility.

See also:

— Optional User Facility for Reverse Charging (13.18).

13.20 Local Charging Prevention

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Local Charging Prevention is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, authorizes the DCE to prevent the establishment of Virtual Calls which the subscriber must pay for by:

a) not transmitting to the DTE incoming calls which request the Reverse Charging Facility; and

b) ensuring that the charges are made to another party whenever the DTE originates a call. This other party can be determined by using any of a number of actions, both procedural and administrative. The procedural methods that may be used by the DTE include:

— requesting reverse charging using the Reverse Charging Facility, or

— identifying a third party using the Network User Identification Facility.

When the party to be charged for a Virtual Call has not been established, the DCE that receives the CALL REQUEST packet will apply reverse charging to the call.

NOTE — For an interim period of time, some networks may choose to enforce local charging prevention by clearing the call when the party to be charged has not been established.

See also:

— Optional User Facility for Reverse Charging (13.18);

— Optional User Facility for Network User Identification (13.21).

13.21 Network User Identification (NUI) related facilities

These optional user facilities apply only to Virtual Call service in a DTE/DCE environment.

The set of Network User Identification (NUI) related facilities enables the DTE to provide information to the network for purposes of billing, security, network management, or to invoke subscribed facilities.

This set is composed of three optional user facilities. The NUI Subscription Facility and the NUI Override Facility may be agreed to for a period of time for Virtual Calls. A DTE may subscribe to one or both of these facilities. When one or both of the facilities are subscribed to, one or more network user identifiers are also agreed to for a period of time. A given network user identifier may be either specific or common to the NUI Subscription Facility and the NUI Override Facility. The network user identifier is transmitted by the DTE to the DCE in the NUI Selection Facility. The network user identifier is never transmitted to the remote DTE.

13.21.1 NUI Subscription

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

NUI Subscription is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, enables the DTE to provide information to the network for billing, security, or network management purposes on a per call basis. This information is provided by the DTE in the CALL REQUEST packet or in the CALL ACCEPTED packet by using the NUI Selection Facility. It may be used whether or not the DTE has also subscribed to the Local Charging Prevention Facility. If the DCE determines that the network user identifier is invalid or that the NUI Selection Facility is not present when required by the network, it will clear the call.

See also:

— Optional User Facility for Local Charging Prevention (13.20);

— Optional User Facility for NUI Selection (13.21.3).

13.21.2 NUI Override

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

NUI Override is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. When this user facility is subscribed to, one or more network user identifiers are also agreed for a period of time. Associated with each network user identifier, is a set of subscription-time optional user facilities. When one of these network user identifiers is provided in a CALL REQUEST packet by means of the NUI Selection Facility, the set of subscription-time optional user facilities associated with it overrides the facilities which apply to the interface. This override does not apply to other existing calls or subsequent calls on the interface. It remains in effect for the duration of the particular call to which it applies.

The optional user facilities that may be associated with a network user identifier when the NUI Override Facility has been subscribed to are specified in table 15. The optional user facilities which have been agreed to for a period of time for the interface and which are not overridden by using the NUI Override Facility remain in effect.

See also:

— Optional User Facility for NUI Selection (13.21.3).

13.21.3 NUI Selection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

NUI Selection is an optional user facility which may be requested by a DTE for a given Virtual Call. This user facility may be requested by a DTE only if it has subscribed to the NUI Subscription Facility and/or the NUI Override Facility. The NUI Selection Facility permits the DTE to specify which network user identifier is to be used in conjunction with the NUI Subscription Facility and/or the NUI Override Facility.

NUI Selection may be requested in a CALL REQUEST packet if the selected network user identifier has been agreed to in conjunction with the NUI Subscription Facility or the NUI Override Facility. NUI Selection may be requested in a CALL ACCEPTED packet if the selected network user identifier has been agreed to in conjunction with the NUI Subscription Facility.

Some networks may require that the NUI Selection Facility be requested by the DTE in every CALL REQUEST packet and, possibly, in every CALL ACCEPTED packet transmitted on a given DTE/DCE interface, when the NUI Subscription Facility has been agreed to for a period of time for the interface.

If the network determines that the network user identifier is invalid or that any of the optional user facilities requested in the CALL REQUEST packet are not allowed for the DTE, it will clear the call.

See also:

— Coding of the NUI Selection Facility (15.2.1 and 15.2.2.7).

13.22 Charging Information

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Charging Information is an optional user facility which may be either agreed to for a period of time by the DTE and DCE for all Virtual Calls or requested by a DTE for a given Virtual Call.

A DTE, if it is the DTE to be charged for a call, can request the Charging Information Facility on a per Virtual Call basis. This is done by means of the Charging Information Request Facility in the CALL REQUEST packet or the CALL ACCEPTED packet.

If a DTE subscribes to the Charging Information Facility for a period of time, then the facility is in effect for the DTE, if it is the DTE to be charged for a call, without sending the facility request in a CALL REQUEST or CALL ACCEPTED packet.

The DCE will use the Charging Information Indication Facilities in the CLEAR INDICATION or CLEAR CONFIRMATION packet to indicate to the DTE to be charged information about the charge for that call and/or other information which makes it possible for the user to calculate the charge.

See also:

— Coding of the Charging Information Request Facility (15.2.1 and 15.2.2.8.1);

— Coding of the Charging Information Indication Facilities (15.2.1 and 15.2.2.8.2 through 15.2.2.8.4).

13.23 RPOA related facilities

These optional user facilities apply only to Virtual Call service in a DTE/DCE environment.

The set of RPOA optional user facilities provides for the calling DTE's designation of a sequence of one or more RPOA transit network(s) within the originating country through which the call is to be routed when more than one RPOA transit network exists at a sequence of one or more gateways. In the case of international calls, this capability includes the selection of an international RPOA in the originating country.

In the absence of both the RPOA Subscription Facility and the RPOA Selection Facility, no user designation of RPOA transit networks is in effect.

13.23.1 RPOA Subscription

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

RPOA Subscription is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, applies (unless overridden for a single Virtual Call by the RPOA Selection Facility) to all Virtual Calls where more than one RPOA transit network exists at a sequence of one or more gateways. The RPOA Subscription Facility provides a sequence of RPOA transit

Table 15 — Subscription-time Optional User Facilities that may be Associated with a Network User Identifier in Conjunction with the NUI Override Facility

Subscription-time optional user facility	May be associated with a NUI
On-line Facility Registration	No
Extended Packet Sequence Numbering	No
D-bit Modification	No
Packet Retransmission	No
Incoming Calls Barred	No
Outgoing Calls Barred	No
One-way Logical Channel Outgoing	No
One-way Logical Channel Incoming	No
Nonstandard Default Packet Sizes	Yes
Nonstandard Default Window Sizes	Yes
Default Throughput Classes Assignment	Yes
Flow Control Parameter Negotiation (subscription-time)	Yes
Throughput Class Negotiation (subscription-time)	Yes
Closed User Group	Yes
Closed User Group With Outgoing Access	Yes
Closed User Group With Incoming Access	No
Incoming Calls Barred Within a Closed User Group	No
Outgoing Calls Barred Within a Closed User Group	No
Bilateral Closed User Group	Yes
Bilateral Closed User Group with Outgoing Access	Yes
Fast Select Acceptance	No
Reverse Charging Acceptance	No
Local Charging Prevention	No
Charging Information (subscription-time)	Yes
RPOA Subscription	Yes
Hunt Group	No
Call Redirection	No
Call Deflection Subscription	No

networks through which calls are to be routed.

See also:

— Optional User Facility for RPOA Selection (13.23.2).

13.23.2 RPOA Selection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

RPOA Selection is an optional user facility which may be requested by a DTE for a given Virtual Call. It is not necessary to subscribe to the RPOA Subscription Facility in order to use this facility. This facility, when used for a given Virtual Call, applies for this Virtual Call only where more than one RPOA transit network exists at a sequence of one or more gateways. The RPOA Selection Facility provides a sequence of RPOA transit networks through which the call is to be routed. The presence of this facility in a CALL REQUEST packet completely overrides the sequence of RPOA transit networks that may have been specified by the RPOA Subscription Facility.

If the DTE selects only one RPOA transit network, either the basic or extended format of the RPOA Selection Facility may be used. If the DTE selects more than one RPOA transit network, the extended format of the RPOA Selection Facility shall be used. The appearance of both formats in a CALL REQUEST packet will be treated as a facility code not allowed.

See also:

— Optional User Facility for RPOA Subscription (13.23.1);

— Coding of the RPOA Selection Facility (15.2.1 and 15.2.2.9).

13.24 Hunt Group

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Hunt Group is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, distributes incoming calls having an address associated with the hunt group across a designated grouping of DTE/DCE interfaces.

Selection is performed for an incoming Virtual Call if there is at least one idle logical channel, excluding one-way outgoing logical channels, available for Virtual Calls on any of the DTE/DCE interfaces in the group. Once a Virtual Call is assigned to a DTE/DCE interface, it is treated as a regular call.

When Virtual Calls are placed to a hunt group address in the case where specific addresses have also been assigned to the individual DTE/DCE interfaces, the CLEAR INDICATION packet (when no CALL ACCEPTED packet has been transmitted) or the CALL CONNECTED packet transferred to the calling DTE optionally will contain the called DTE address of the selected DTE/DCE interface. It will also contain the Called Line Address Modified Notification Facility indicating the reason why the called DTE address is different from the one originally requested.

Virtual Calls may be originated by the DTEs on the DTE/DCE interfaces belonging to the hunt group; these are handled in the normal manner. In particular, the calling DTE address transferred to the remote DTE in the INCOMING CALL packet is the hunt group address unless the DTE/DCE interface has a specific address assigned. Permanent Virtual Circuits may be assigned to DTE/DCE interfaces belonging to the hunt group. These Permanent Virtual Circuits are independent of the operation of the hunt group. Some networks may apply Virtual Call subscription-time optional user facilities in common to all DTE/DCE interfaces in the hunt group, place a limit on the number of DTE/DCE interfaces in the hunt group, and/or constrain the size of the geographic region that can be served by a single hunt group.

See also:

— Optional User Facility for Called Line Address Modified Notification (13.26).

13.25 Call Redirection and Call Deflection related facilities

These optional user facilities apply only to Virtual Call service in a DTE/DCE environment.

The set of call redirection and call deflection optional user facilities enables the redirection or the deflection of calls destined to one DTE (the "originally-called DTE") to another DTE (the "alternative DTE"). The Call Redirection Facility allows the DCE, in specific circumstances, to redirect calls destined to the originally-called DTE; no INCOMING CALL packet is transmitted to the originally-called DTE when such a redirection is performed. The call deflection related facilities allow the originally-called DTE to deflect individual incoming Virtual Calls after reception of the INCOMING CALL packet. A DTE may subscribe to the Call Redirection Facility, to the Call Deflection Subscription Facility, or to both.

When a call to which the Call Redirection Facility or the Call Deflection Facility applies is cleared, the clearing cause is that generated during the last attempt to reach a called DTE/DCE interface.

Call redirection or call deflection is limited to the network of the DTE originally called.

The basic service is limited to one call redirection or call deflection. In addition, some networks may permit a chaining of several call redirections or call deflections. In all cases, networks will ensure that loops are avoided and that the connection establishment phase has a limited duration, consistent with the DTE timer T21.

When the Virtual Call is redirected or deflected, the CLEAR INDICATION packet, when no CALL ACCEPTED packet has been transmitted by any DTE, or the CALL CONNECTED packet transferred to the calling DTE will contain the called address of the alternative DTE and the Called Line Address Modified Notification Facility, indicating the reason why the called address is different from the one originally requested.

When the Virtual Call is redirected or deflected, some networks may indicate to the alternative DTE that the call was redirected or deflected, the reason for redirection or deflection, and the address of the originally-called DTE, using the Call Redirection or Call Deflection Notification Facility in the INCOMING CALL packet.

See also:

— Call Request Response Timer (T21) (table 26);

— Optional User Facility for Called Line Address Modified Notification (13.26).

13.25.1 Call Redirection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Call Redirection is an optional user facility agreed to for a period of time by the DTE and DCE for Virtual Calls. This user facility, if subscribed to, redirects incoming calls destined to this DTE when:

a) the DTE is out of order, or

b) the DTE is busy.

Some networks may provide call redirection only in case (a). Some networks may offer, in addition:

c) systematic call redirection due to a prior request by the subscriber according to criteria other than (a) and (b) above, agreed to between the network and the subscriber.

In addition, some networks may offer either one of the following (mutually exclusive) capabilities:

a) a list of alternative DTEs (say, C1, C2, ...) is stored by the network of the originally-called DTE (say, DTE B). Consecutive attempts of call redirection are tried to each of these addresses, in the order of the list, up to the completion of the call;

b) call redirection may be logically chained; if DTE C has subscribed to call redirection to DTE D, a call originally redirected from DTE B to DTE C may be redirected to DTE D; call redirections and call deflections may also be chained.

The order of call-setup processing at the originally-called DCE, as well as at the alternative DCE, will be according to the sequence of Call Progress Signals in CCITT Recommendation X.96. For those networks that provide systematic call redirection with the prior request of the called DTE, the systematic call redirection request will have the highest priority in the call-setup processing sequence at the originally-called DCE.

13.25.2 Call Deflection Related Facilities

13.25.2.1 Call Deflection Subscription

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Call Deflection Subscription is an optional user facility agreed to for a period of time by the DTE and DCE. This user facility, if subscribed to, enables the DTE to request, by using the Call Deflection Selection Facility, that an individual call presented to it by transmission of an INCOMING CALL packet be deflected to an alternative DTE.

The DCE may use a network timer, with a value agreed to with the subscriber, to limit the time between the transmission to the originally-called DTE of an INCOMING CALL packet and the request by this originally-called DTE to deflect the call. Once this timer has expired, the originally-called DTE will no longer be permitted to use the Call Deflection Selection Facility to deflect the call. If the originally-called DTE tries to deflect the call after the expiration of this timer, the network clears the call.

13.25.2.2 Call Deflection Selection

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Call Deflection Selection is an optional user facility which may be used on a per Virtual Call basis. This facility may be requested by a DTE only if it has subscribed to the Call Deflection Subscription Facility.

The Call Deflection Selection Facility may be used by the called DTE in the CLEAR REQUEST packet only in direct response to an INCOMING CALL packet to specify the alternative DTE address to which the call is to be deflected. When requested for a given Virtual Call, the network deflects the call to the alternative DTE and does not respond to the calling DTE as a result of the clearing at the originally-called DTE/DCE interface.

If the Call Deflection Selection Facility is used in the CLEAR REQUEST packet, then the DTE must also include any CCITT-specified DTE facilities and user data to be sent to the alternative DTE. Up to 16 octets of user data may be included in the CLEAR REQUEST packet if the original call was established without fast select; up to 128 octets of user data may be included in the CLEAR REQUEST packet if the original call was established with fast select. If no CCITT-specified DTE facilities are included in the CLEAR REQUEST packet, then there will be none in the INCOMING CALL packet to the alternative DTE. If no clear user data is included in the CLEAR REQUEST packet, then no call user data will be included in the INCOMING CALL packet to the alternative DTE.

NOTE — For an interim period, some networks may not allow a deflected INCOMING CALL packet's contents to be modified, in which case a deflecting DTE is not permitted to use any user data or CCITT-specified DTE facilities in the CLEAR REQUEST packet.

The X.25 facilities that are present in the INCOMING CALL packet transmitted to the alternative DTE are those that would have been present in the INCOMING CALL packet if the call was a direct call from the calling DTE to the alternative DTE; moreover, the Call Redirection or Call Deflection Notification Facility may also be present, if supported by the network.

Bit 7 of the General Format Identifier in the INCOMING CALL packet transmitted to the originally called DTE and to the alternative DTE has the same value as the bit in the CALL REQUEST packet.

If the network offers only the basic service and if a call redirection or call deflection has already been performed, the DCE clears the call when the Call Deflection Selection Facility is used.

See also:

— Optional User Facility for Fast Select (13.16);

— Coding of the Call Deflection Selection Facility (15.2.1 and 15.2.2.10).

13.25.3 Call Redirection or Call Deflection Notification

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Call Redirection or Call Deflection Notification is a user facility used by the DCE in the INCOMING CALL packet to inform the alternative DTE that the call has been redirected or deflected, why the call was redirected or deflected, and the address of the originally-called DTE.

The following reasons can be indicated with the use of the Call Redirection or Call Deflection Notification Facility:

a) Call redirection due to originally-called DTE out of order;

b) Call redirection due to originally-called DTE busy;

c) Call redirection due to prior request from the originally-called DTE for systematic call redirection;

d) Call deflection by the originally-called DTE.

Some networks may also use the following reason in network-dependent cases:

e) Call distribution within a hunt group.

See also:

— Coding of the Call Redirection or Call Deflection Notification Facility (15.2.1 and 15.2.2.11).

13.26 Called Line Address Modified Notification

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Called Line Address Modified Notification is an optional user facility used by the DCE or DTE.

It is used by the DCE in the CALL CONNECTED or CLEAR INDICATION packet to indicate to the calling DTE the reason

that the called address in the packet is different from that specified in the CALL REQUEST packet.

When more than one address applies to a DTE/DCE interface, the Called Line Address Modified Notification Facility is used by the DTE, in a CLEAR REQUEST packet (only in response to an INCOMING CALL packet) or in a CALL ACCEPTED packet, when the called DTE address present in these packets is different from that specified in the INCOMING CALL packet. When this facility is received from the DTE, the DCE will clear the call if the called DTE address is not one of those applying to the interface.

NOTE — The DTE should be aware that a modification of any part of the Called DTE Address Field without notification by the Called Line Address Modified Notification Facility may cause the call to be cleared.

The following reasons can be indicated with the use of the Called Line Address Modified Notification Facility in CALL CONNECTED or CLEAR INDICATION packets transmitted by the DCE to the calling DTE:

a) call redirection due to originally-called DTE out of order;

b) call redirection due to originally-called DTE busy;

c) call redirection due to prior request from the originally-called DTE for systematic call redirection;

d) call deflection by the originally-called DTE;

e) called-DTE originated (if more than one address applies to the DTE/DCE interface);

f) call distribution within a Hunt Group.

When several reasons could apply to the same call, the reason to be indicated by the network in the CALL CONNECTED or the CLEAR INDICATION packet by means of the Called Line Address Modified Notification Facility is as specified below:

a) the indication of a call redirection or call deflection in the network has precedence over the indication of distribution within a hunt group or over a called DTE originated indication;

b) the called-DTE originated indication has precedence over the indication of distribution within a hunt group;

c) when several call redirections or call deflections have been performed, the first one has precedence over the others.

The called DTE address indicated in the CALL CONNECTED or the CLEAR INDICATION packet should correspond to the last DTE which has been reached or attempted to be reached.

In CALL ACCEPTED or CLEAR REQUEST packets, the reason indicated in conjunction with the use of the Called Line Address Modified Notification Facility should be "Called DTE Originated."

See also:

— Coding of the Called Line Address Modified Notification Facility (15.2.1 and 15.2.2.12);

— Optional User Facility for Hunt Group (13.24);

— Optional User Facilities for Call Redirection and Call Deflection (13.25).

13.27 Transit Delay Selection and Indication

This optional user facility applies only to Virtual Call service in a DTE/DCE environment.

Transit Delay Selection and Indication is an optional user facility which may be requested by a DTE for a given Virtual Call. This facility permits selection and indication, on a per Virtual Call basis, of the transit delay applicable to that Virtual Call.

The calling DTE, if it wishes to specify a desired transit delay for a Virtual Call, indicates the desired value by means of the Transit Delay Selection and Indication Facility in the CALL REQUEST packet.

The network, when able to do so, should allocate resources and route the Virtual Call in a manner such that the transit delay applicable to that call does not exceed the desired transit delay.

The INCOMING CALL packet transmitted to the called DTE and the CALL CONNECTED packet transmitted to the calling DTE will both contain the indication of the transit delay applicable to the Virtual Call. This transit delay may be less than, equal to, or greater than the desired transit delay requested in the CALL REQUEST packet.

See also:

— Coding of the Transit Delay Selection and Indication Facility (15.2.1 and 15.2.2.13);

— Transit delay (6.9).

14 Procedures for optional CCITT-specified DTE facilities

The optional CCITT-specified DTE facilities described in this clause apply only to Virtual Call service.

The facilities described in this clause supplement the other procedures in this International Standard to support the Open Systems Interconnection (OSI) Network Service Definition. These facilities follow the CCITT-specified DTE Facility Marker defined in 15.1 and are applicable to both DTE/DCE and DTE/DTE operation. These facilities are passed unchanged by public data networks. In certain circumstances, some of these facilities may be modified by gateways and/or private networks as set forth below.

14.1 Calling Address Extension

Calling Address Extension is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. It provides for the transparent conveyance in CALL REQUEST and INCOMING CALL packets of the calling Network Address. The calling Network Address is passed to a higher layer entity in the called DTE.

See also:

— Coding of the Calling Address Extension Facility (15.3.1 and 15.3.2.1).

14.2 Called Address Extension

Called Address Extension is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. It provides for the transparent conveyance in CALL REQUEST

and INCOMING CALL packets of the called Network Address supplied by a higher layer entity in the calling DTE. It also provides for the transparent conveyance of the responding Network Address in CALL ACCEPTED and CALL CONNECTED packets (for the case of call acceptance) and in the CLEAR REQUEST and CLEAR INDICATION packets (for the case of call rejection). The responding Network Address is passed to a higher layer entity in the calling DTE.

See also:

— Coding of the Called Address Extension Facility (15.3.1 and 15.3.2.2).

14.3 Minimum Throughput Class Negotiation

Minimum Throughput Class Negotiation is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. The calling DTE indicates for each direction of data transmission a minimum-acceptable value for the throughput class by means of the Minimum Throughput Class Negotiation Facility in the CALL REQUEST packet. These two values are conveyed transparently to the called DTE in the INCOMING CALL packet. Gateways, private networks, and the called DTE may clear the call if resources necessary to support the minimum-acceptable throughput classes are not available. Gateways, private networks, and the called DTE may use the Throughput Class Negotiation Facility to determine whether public data networks can support the minimum-acceptable throughput classes and should clear the call if the public data network cannot support these values.

The absence of this facility indicates that the calling DTE does not place a lower limit on the acceptable throughput class. The values conveyed by this facility are supplied by a higher layer entity in the calling DTE and passed to a higher layer entity in the called DTE.

See also:

— Optional User Facility for Throughput Class Negotiation (13.13);

— Coding of the Minimum Throughput Class Negotiation Facility (15.3.1 and 15.3.2.3).

14.4 End-to-End Transit Delay Negotiation

End-to-End Transit Delay Negotiation is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. The calling DTE indicates the cumulative transit delay of the Packet Layer and lower layer protocols in the DTE, including the effects of the access line transmission rate, by means of the End-to-End Transit Delay Negotiation Facility in the CALL REQUEST packet. The cumulative transit delay value is conveyed transparently by public data networks and is updated by gateways and the called DTE as the call setup is progressed. Gateways and the called DTE may use the Transit Delay Selection and Indication Facility introduced by the preceding network in performing the computation of the cumulative transit delay.

In addition to the cumulative transit delay, the calling DTE may optionally indicate a desired (target) value for the end-to-end transit delay. If the target value is indicated, the calling DTE may optionally indicate a maximum-acceptable value for the end-to-end transit delay. These values, when present, are provided by a higher layer entity in the calling DTE and are conveyed transparently to the called DTE in the INCOMING CALL packet. The absence of these facilities indicates that the calling DTE did not provide a target value and/or an upper limit on the transit delay.

Gateways, private networks, and the called DTE should clear the call if the cumulative transit delay exceeds the maximum-acceptable transit delay, if specified. The maximum-acceptable transit delay, when present, and the cumulative transit delay as computed by the Packet Layer of the called DTE are passed to a higher layer entity in the called DTE.

The cumulative transit delay computed by the Packet Layer of the called DTE is indicated in the CALL ACCEPTED packet, conveyed transparently to the calling DTE in the CALL CONNECTED packet, and passed to a higher layer entity in the calling DTE.

See also:

— Optional User Facility for Transit Delay Selection And Indication (13.27);

— Coding of the End-to-End Transit Delay Negotiation Facility (15.3.1 and 15.3.2.4).

14.5 Priority

Priority is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. The calling DTE may indicate in the CALL REQUEST packet the target and lowest-acceptable values for the priority of data on a connection, priority to gain a connection, and priority to keep a connection. The values, when present, are provided by a higher layer entity in the calling DTE and are conveyed transparently by public data networks.

Gateways, private networks, and the called DTE may reduce the target values as necessary, and may clear the call if they cannot support the lowest-acceptable values. Values received by the called DTE are passed to a higher layer entity which will return selected values. These selected values are indicated by the called DTE in the CALL ACCEPTED packet, conveyed transparently to the calling DTE in the CALL CONNECTED packet, and passed to a higher layer entity in the calling DTE.

See also:

— Coding of the Priority Facility (15.3.1 and 15.3.2.5).

14.6 Protection

Protection is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. The calling DTE may indicate in the CALL REQUEST packet the target and lowest-acceptable values for protection. The values, when present, are provided by a higher layer entity in the calling DTE and are conveyed transparently by public data networks.

Gateways, private networks, and the called DTE may reduce the target values, as necessary, and may clear the call if they cannot support the lowest-acceptable values. Values received by the called DTE are passed to a higher layer entity which will return selected values. These selected values are indicated by the called DTE in the CALL ACCEPTED packet, conveyed

transparently to the calling DTE in the CALL CONNECTED packet, and passed to a higher layer entity in the calling DTE.

See also:

— Coding of the Protection Facility (15.3.1 and 15.3.2.6).

14.7 Expedited Data Negotiation

Expedited Data Negotiation is an optional CCITT-specified DTE facility which may be used for a given Virtual Call. The calling DTE uses the Expedited Data Negotiation Facility in the CALL REQUEST packet to indicate whether it wishes to use the expedited data-transfer procedures (i.e., the interrupt procedures). This indication is provided by a higher layer entity in the calling DTE. This facility is conveyed transparently by public data networks but may be set to non-use of the expedited data-transfer procedures by gateways and private networks that do not support them.

If the higher layer entity in the called DTE wishes to use the expedited data-transfer procedures and the facility received in the INCOMING CALL packet indicates use of these procedures, then use of these procedures is indicated in the CALL ACCEPTED packet and conveyed transparently in the CALL CONNECTED packet. Otherwise, non-use of the expedited data-transfer procedures is indicated in these packets.

The indication in the CALL CONNECTED packet of whether use of the expedited data-transfer procedures has been agreed to is passed to a higher layer entity in the calling DTE.

See also:

— Interrupt Procedures (6.8);

— Coding of the Expedited Data Negotiation Facility (15.3.1 and 15.3.2.7).

15 Format for Facility Field in call setup/clearing packets

The formats described in this clause apply only to optional user and CCITT-specified DTE facilities that may be present in the call setup and call clearing packets used in conjunction with the Virtual Call service.

The general coding structure for the Facility Field is given in 15.1. The coding of the Facility Field for optional user facilities is given in 15.2 and the coding of the Facility Field for CCITT-specified DTE facilities is given in 15.3.

15.1 General

The Facility Field is present only when the DTE and/or DXE are using an optional user or CCITT-specified DTE facility requiring some indication in the CALL REQUEST, INCOMING CALL, CALL ACCEPTED, CALL CONNECTED, CLEAR REQUEST, CLEAR INDICATION, or CLEAR CONFIRMATION packet.

The Facility Field contains one facility element for each facility or group of facilities requested. The first octet of each facility element is the Facility Code Field, which indicates the code for the facility or facilities requested. The remaining octets of a facility element contain the Facility Parameter Field length, when present, and then the Facility Parameter Field.

NOTES

1 The action taken by the DTE when a facility code appears more than once is to use the last one. A DTE should not repeat a facility code.

2 A DTE may either ignore or treat as an error those facility codes that are not supported *or that do not apply in a DTE/DTE environment.* If the DTE chooses to treat these situations as an error, then it transmits a CLEAR REQUEST packet across the DTE/DXE interface with a cause indicating "DTE Originated" and the diagnostic "Facility Not Allowed."

In order to specify facility parameters consisting of 1, 2, 3, or a variable number of octets, the facility codes are divided into four classes by making use of bits 8 and 7 of the Facility Code Field. The general class coding of the Facility Code Field is shown in table 16. The general formats for the four classes of facility elements are shown in figure 29.

Table 16 — General Class Coding for Facility Code Fields

Class	BITS: 8	7	6	5	4	3	2	1	Meaning
A	0	0	X	X	X	X	X	X	single-octet parameter field
B	0	1	X	X	X	X	X	X	double-octet parameter field
C	1	0	X	X	X	X	X	X	triple-octet parameter field
D	1	1	X	X	X	X	X	X	variable-length parameter field

The Facility Code Field is binary-coded and, without extension, provides for a maximum of 64 facility codes for Classes A, B, and C, and 63 facility codes for Class D, giving a total of 255 facility codes.

Facility code 11111111 is reserved for extension of the facility codes. The octet following this octet indicates an extended facility code having the format A, B, C, or D, as defined above. Repetition of facility code 11111111 is permitted, resulting in additional extensions.

A facility code may be assigned to identify a number of specific facilities, each having a bit in the Facility Parameter Field indicating facility requested/facility not requested. In this situation, the Facility Parameter Field is binary-coded, with each bit position relating to a specific facility. A 0 indicates that the facility related to the particular bit is not requested; a 1 indicates that the facility related to the particular bit is requested. Parameter bit positions not assigned to a specific facility are set to 0. If none of the facilities represented by the facility code are requested for a Virtual Call, then the facility code and its associated Facility Parameter Field need not be present.

For facility codes in Class D, the octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. The Facility Parameter Field length is binary-coded, where bit 1 is the low-order bit of the indicator.

The coding of the Facility Parameter Field is dependent on the facility being requested.

There are four categories of facilities:

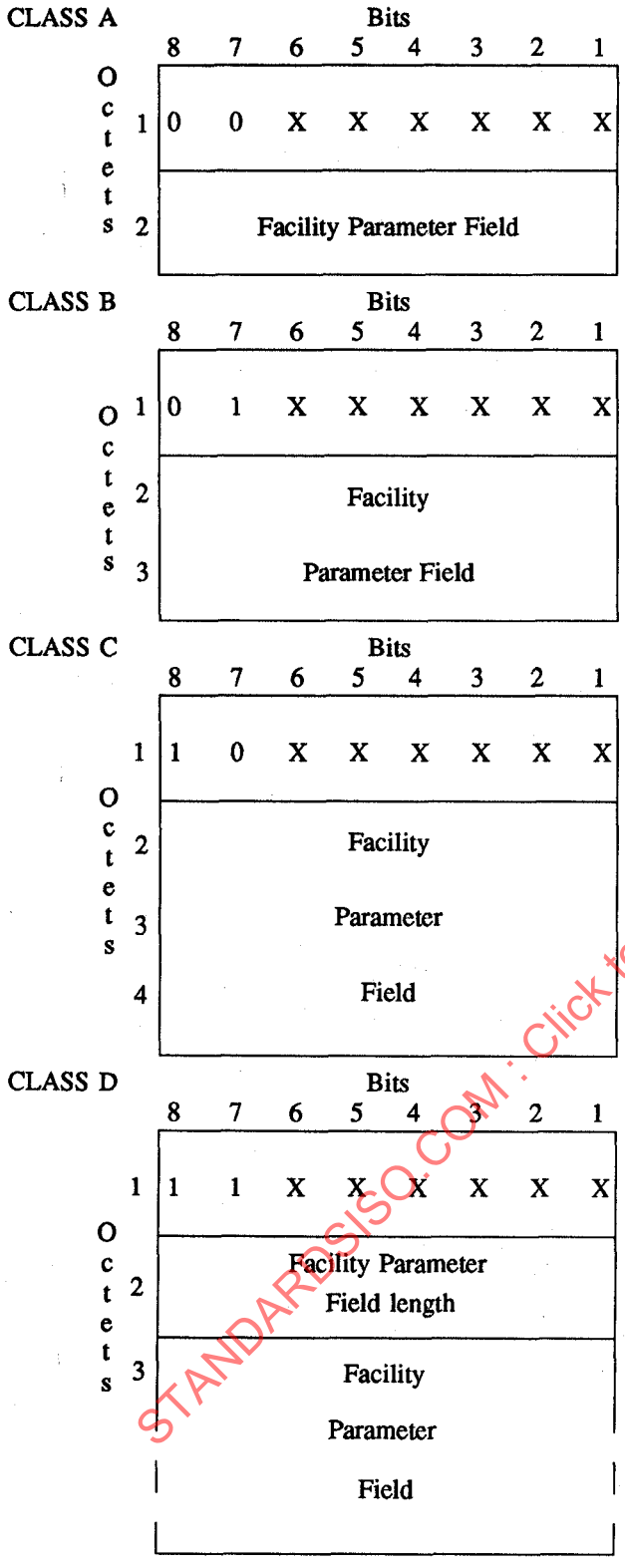


Figure 29 — Generalized Formats of Facility Elements

a) X.25 facilities defined in clause 13;

b) non-X.25 facilities provided by the local network;

c) non-X.25 facilities provided by the remote network (only in the case of internetwork Virtual Calls); and

d) CCITT-specified DTE facilities defined in clause 14.

Facility Markers, consisting of two octets, are used to separate requests for X.25 facilities from requests for the other three categories of facilities described above. When several categories of facilities are simultaneously present, the Facility Markers are used to separate these categories of facilities from each other. In this case, however, requests for X.25 facilities shall precede the other requests and requests for CCITT-specified DTE facilities shall follow the other requests.

The first octet of a Facility Marker is a Facility Code Field and is set to zero. The coding of the second octet, which is a Facility Parameter Field, depends on the category of facilities, as shown below.

Bits 8 7 6 5 4 3 2 1	Category of Facilities
0 0 0 0 0 0 0 0	non-X.25 facilities supported by the network in the case of an intranetwork call or non-X.25 facilities supported by the network of the calling DTE in the case of an internetwork call
1 1 1 1 1 1 1 1	non-X.25 facilities supported by the network of the called DTE in the case of an internetwork call
0 0 0 0 1 1 1 1	CCITT-specified DTE facilities

15.2 Coding of the Facility Field for optional user facilities

The coding of the Facility Code Field and the format of the Facility Parameter Field are the same in the various call setup and clearing packets in which they are used.

15.2.1 Coding of the Facility Code Field

Table 17 gives the coding of the Facility Code Field for each optional user facility and indicates the packet types in which they may be present.

15.2.2 Coding of the Facility Parameter Field

The coding of the Facility Parameter Field is dependent upon the specific optional user facility. To facilitate possible latter extensions, DTEs may be tolerant in receiving Facility Parameter Fields containing values which are presently reserved.

15.2.2.1 Flow Control Parameter Negotiation facility

15.2.2.1.1 Packet Sizes

The packet size for the direction of data transmission from the called DTE is indicated in bits 4, 3, 2, and 1 of the first octet

Table 17 (1 of 2) — Coding of the Facility Code Field

Facility	Packet types in which the facility may be present							Facility Code Bits:
	CALL REQUEST	INCOMING CALL	CALL ACCEPTED	CALL CON-NECTED	CLEAR REQUEST	CLEAR INDICA-TION	CLEAR CONFIR-MATION	8 7 6 5 4 3 2 1
Flow Control Parameter Negotiation								
—packet size	X	X	X	X				0 1 0 0 0 0 1 0
—window size	X	X	X	X				0 1 0 0 0 0 1 1
Throughput Class Negotiation	X	X	X	X				0 0 0 0 0 0 1 0
Closed User Group Selection								
—basic format	X	X						0 0 0 0 0 0 1 1
—extended format	X	X						0 1 0 0 0 1 1 1
Closed User Group With Outgoing Access Selection								
—basic format	X	X						0 0 0 0 1 0 0 1
—extended format	X	X						0 1 0 0 1 0 0 0
Bilateral Closed User Group Selection	X	X						0 1 0 0 0 0 0 1
Fast Select	X	X						0 0 0 0 0 0 0 1 (Note 1)
Reverse Charging	X	X						
NUI Selection	X		X (Note 2)					1 1 0 0 0 1 1 0
Charging Information								
—requesting service	X		X					0 0 0 0 0 1 0 0
—indicating monetary unit						X	X	1 1 0 0 0 1 0 1
—indicating segment count						X	X	1 1 0 0 0 0 1 0
—indicating call duration						X	X	1 1 0 0 0 0 0 1
RPOA Selection								
—basic format	X							0 1 0 0 0 1 0 0
—extended format	X							1 1 0 0 0 1 0 0
Call Deflection Selection					X (Note 4)			1 1 0 1 0 0 0 1
Call Redirection or Deflection Notification		X						1 1 0 0 0 0 1 1

15.2.2.8.3 Indicating Segment Count

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has the value n x 8, where n is the number of different tariff periods managed by the network. The Facility Parameter Field follows the length and indicates the segment count for each tariff period. Each segment count is represented in the Facility Parameter Field by eight octets. The first four octets indicate the number of segments sent to the DTE. The following four octets indicate the number of segments received from the DTE.

Each digit is coded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 of each semi-octet is the low-order bit of each digit. Bits 4 through 1 of the last octet represent the lowest-order digit of the segment count.

Segment size and the specific packet types to be counted are a matter of the Administration in the case of national calls and are specified in CCITT Recommendation D.12 for international calls.

NOTE — The relationship between a particular tariff period and its place in the Facility Parameter Field is a national matter. The order is given by each Administration.

15.2.2.8.4 Indicating Call Duration

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has the value n x 4, where n is the number of different tariff periods managed by the network. The Facility Parameter Field follows the length and indicates the call duration for each tariff period.

Each call duration is represented in the Facility Parameter Field by four octets. The first octet indicates number of days, the second indicates number of hours, the third indicates number of minutes, and the fourth indicates number of seconds for the call. Each digit is coded in a semi-octet in binary-coded decimal, where bit 5 or bit 1 of each semi-octet is the low-order bit of each digit. Bits 4 through 1 of each octet represent the low-order digit.

NOTE — The relationship between a particular tariff period and its place in the Facility Parameter Field is a national matter. The order is given by each Administration.

15.2.2.9 RPOA Selection facility

15.2.2.9.1 Basic format

The two-octet Facility Parameter Field contains the Data Network Identification Code (DNIC) for the requested initial RPOA transit network and is in the form of four decimal digits.

Each digit is coded in a semi-octet in binary-coded decimal, where bit 5 of the first octet is the low-order bit of the first digit, bit 1 of the first octet is the low-order bit of the second digit, bit 5 of the second octet is the low-order bit of the third digit, and bit 1 of the second octet is the low-order bit of the fourth digit.

15.2.2.9.2 Extended format

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has the value of n x 2 where n is the number of RPOA transit networks selected. The Facility Parameter Field follows the length and indicates the DNIC for each RPOA transit network.

Each DNIC, which is in the form of four decimal digits, is represented in the Facility Parameter Field by two octets. Each digit is coded in a semi-octet in binary-coded decimal, where bit 5 of the first octet is the low-order bit of the first digit, bit 1 of the first octet is the low-order bit of the second digit, bit 5 of the second octet is the low-order bit of the third digit, and bit 1 of the second octet is the low-order bit of the fourth digit.

RPOA transit networks should appear in the Facility Parameter Field in the order that the calling DTE wishes them to be traversed.

15.2.2.10 Call Deflection Selection facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has the value n + 2, where n is the number of octets necessary to hold the called address of the DTE to which the call is to be deflected (the alternative DTE).

The first octet of the Facility Parameter Field indicates the reason for the DTE deflecting the call. The coding of this octet is:

Bits 8 7 6 5 4 3 2 1	Reason
1 1 0 0 0 0 0 0	Call deflection by the originally-called DTE
1 1 0 0 0 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE busy[1)]
1 1 0 0 1 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE out of order[1)]
1 1 0 0 1 1 1 1	Call deflection by gateway as a result of call redirection due to prior request from originally-called DTE for systematic call redirection[1)]

1) Applies where the originally-called DTE is on a private network and the call redirection is to a DTE address on the public network that presented the incoming call to the private network.

NOTE — These codes are passed transparently to the DTE to which the call is deflected and to the calling DTE. If bits 8 and 7 are not set to 1 by the called DTE, they are forced to this value by the DCE.

The second octet of the Facility Parameter Field indicates the number of digits in the alternative DTE address. This address-length indicator is binary-coded, where bit 1 is the low-order bit. Its value does not exceed 15.

The following octets contain the alternative DTE address. Each digit of the address is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit.

Starting from the high-order digit of the address, the address is coded in octet 3 and consecutive octets of the Facility Parameter Field, with two digits per octet. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5.

When the number of semi-octets of the alternative DTE address is odd, a semi-octet with zeros in bits 4, 3, 2, and 1 is inserted after the last semi-octet in order to maintain octet alignment.

15.2.2.11 Call Redirection or Call Deflection Notification facility

The octet following the Facility Code Field indicates the length, in octets, of the Facility Parameter Field and has the value n + 2, where n is the number of octets necessary to hold the originally-called DTE address.

The first octet of the Facility Parameter Field indicates the reason for the call redirection or call deflection. The coding of this octet is:

Bits 8 7 6 5 4 3 2 1	Reason
0 0 0 0 0 0 0 1	Call redirection due to originally-called DTE busy
0 0 0 0 0 1 1 1	Call distribution within a hunt group[1]
0 0 0 0 1 0 0 1	Call redirection due to originally-called DTE out of order
0 0 0 0 1 1 1 1	Call redirection due to prior request from originally-called DTE for systematic call redirection
1 1 0 0 0 0 0 0	Call deflection by the originally-called DTE[2]
1 1 0 0 0 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE busy[2),3]
1 1 0 0 1 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE out of order[2),3]
1 1 0 0 1 1 1 1	Call deflection by gateway as a result of call redirection due to prior request from originally-called DTE for systematic call redirection[2),3]

1) This value may be used by some networks for network-dependent reasons.

2) These codes are those set by the DTE in the Call Deflection Selection Facility (see 15.2.2.10).

3) Applies where the originally-called DTE is on a private network and the call redirection is to a DTE address on the public network that presented the incoming call to the private network.

The second octet of the Facility Parameter Field indicates the number of digits in the originally-called DTE address. This address-length indicator is binary-coded, where bit 1 is the low-order bit. Its value does not exceed 15.

The following octets contain the originally-called DTE address. Each digit of the address is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit.

Starting from the high-order digit of the address, the address is coded in octet 3 and consecutive octets of the Facility Parameter Field, with two digits per octet. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5.

When the number of semi-octets of the originally-called DTE address is odd, a semi-octet with zeros in bits 4, 3, 2 and 1 is inserted after the last semi-octet in order to maintain octet alignment.

15.2.2.12 Called Line Address Modified Notification facility

The coding of the one-octet Facility Parameter Field is:

Bits 8 7 6 5 4 3 2 1	Reason
X 0 0 0 0 0 0 1	Call redirection due to originally-called DTE busy[1]
X 0 0 0 0 1 1 1	Call distribution within a hunt group[1]
X 0 0 0 1 0 0 1	Call redirection due to originally-called DTE out of order[1]
X 0 0 0 1 1 1 1	Call redirection due to prior request from originally-called DTE for systematic call redirection[1]
1 1 0 0 0 0 0 0	Call deflection by the originally-called DTE[2]
1 1 0 0 0 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE busy[2),3]
1 1 0 0 1 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE out of order[2),3]
1 1 0 0 1 1 1 1	Call deflection by gateway as a result of call redirection due to prior request from originally-called DTE for systematic call redirection[2),3]

1) The bit indicated as "X" set to 0 indicates that the called line address modification occurred in a public data network and set to 1 indicates it occurred in a private network.

2) These codes are those set by the DTE in the Call Deflection Selection Facility (see 15.2.2.10).

3) Applies where the originally-called DTE is on a private network and the call redirection is to a DTE address on the public network that presented the incoming call to the private network.

NOTE — Bit 8, when received from the DTE and when it is not set to 1, is forced to 1 by the DCE.

15.2.2.13 Transit Delay Selection And Indication facility

The Facility Parameter Field contains two octets.

Transit delay is expressed in milliseconds and is binary coded, with bit 8 of octet 1 being the high-order bit and bit 1 of octet 2 being the low-order bit. The expressed transit delay may have a value from 0 to 65 534 (all bits set to 1 but the low-order bit).

NOTE — During the interim period when this optional user facility is not yet supported by all networks, the transit delay indicated in the CALL CONNECTED packet transmitted to the calling DTE will have a value of 65 535 (all ones) when either a transit network involved in the Virtual Call or the destination network does not support this facility. This value should be interpreted by the calling DTE as an indication that the actual transit delay cannot be transmitted to it.

15.3 Coding of the Facility Field for CCITT-specified DTE facilities

The coding of the Facility Code Field and the format of the Facility Parameter Field are the same in the various call setup and clearing packets in which they are used.

15.3.1 Coding of the Facility Code Field

Table 19 gives the coding of the Facility Code Field for each CCITT-specified DTE Facility and indicates the packet types in which they may be present. These facilities are conveyed after the CCITT-specified DTE Facility Marker.

15.3.2 Coding of the Facility Parameter Field

The coding of the Facility Parameter Field is dependent upon the specific CCITT-specified DTE facility. To facilitate possible latter extensions, DTEs may be tolerant in receiving Facility Parameter Fields containing values which are presently reserved.

15.3.2.1 Calling Address Extension facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has a value of n + 1, where n is the number of octets necessary to hold the calling-address extension. The Facility Parameter Field follows the length and indicates the calling-address extension.

The first octet of the Facility Parameter Field indicates, in bits 8 and 7, the use of the calling-address extension, as shown below.

Bits 8	Bits 7	Use of Calling Address Extension
0	0	To carry a calling address assigned according to ISO 8348/Add. 2
0	1	Reserved
1	0	Other (to carry a calling address not assigned according to ISO 8348/Add. 2)
1	1	Reserved

Table 19 — Coding of the Facility Code Field

Facility	Packet types in which the facility may be present						Facility Code Bits:
	CALL REQUEST	INCOMING CALL	CALL ACCEPTED	CALL CONNECTED	CLEAR REQUEST	CLEAR INDICATION	8 7 6 5 4 3 2 1
Calling Address Extension	X	X			X (See Note)		1 1 0 0 1 0 1 1
Called Address Extension	X	X	X	X	X	X	1 1 0 0 1 0 0 1
Minimum Throughput Class Negotiation	X	X			X (See Note)		0 0 0 0 1 0 1 0
End-to-End Transit Delay Negotiation	X	X	X	X	X (See Note)		1 1 0 0 1 0 1 0
Priority	X	X	X	X	X (See Note)		1 1 0 1 0 0 1 0
Protection	X	X	X	X	X (See Note)		1 1 0 1 0 0 1 1
Expedited Data Negotiation	X	X	X	X	X (See Note)		0 0 0 0 1 0 1 1

Note — Only when the Call Deflection Selection Facility is used.

Bits 6, 5, 4, 3, 2, and 1 of this octet indicate the number of semi-octets (up to a maximum of 40) in the calling-address extension. This address-length indicator is binary-coded, where bit 1 is the low-order bit.

The following octets contain the calling-address extension.

If bits 8 and 7 of the first octet of the Facility Parameter Field are coded "00", the following octets are encoded using the preferred binary encoding (PBE) defined in ISO 8348/Add. 2. Starting from the high-order digit of the Initial Domain Part (IDP), the address is coded in octet 2 and consecutive octets of the Facility Parameter Field. Each digit, with padding digits applied as necessary, is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5. The Domain Specific Part (DSP) of the address follows the IDP and is coded in decimal or binary, according to the PBE. If the syntax of the DSP is decimal, each digit is coded in binary-coded decimal (with the same rules applying to the DSP as to the IDP above). If the syntax of the DSP is binary, each octet of the calling-address extension contains an octet of the DSP.

If bits 8 and 7 of the first octet of the Facility Parameter Field are coded "10", each digit of the calling-address extension is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit. Starting from the high-order digit, the address is coded in octet 2 and consecutive octets of the Facility Parameter Field with two digits per octet. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5.

When necessary, the Facility Parameter Field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2, and 1 of the last octet of the field.

15.3.2.2 Called Address Extension facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has a value of n + 1, where n is the number of octets necessary to hold the called-address extension. The Facility Parameter Field follows the length and indicates the called-address extension.

The first octet of the Facility Parameter Field indicates, in bits 8 and 7, the use of the called-address extension, as shown below.

Bits		Use of Called Address Extension
8	7	
0	0	To carry a called address assigned according to ISO 8348/Add. 2
0	1	Reserved
1	0	Other (to carry a called address not assigned according to ISO 8348/Add. 2)
1	1	Reserved

Bits 6, 5, 4, 3, 2, and 1 of this octet indicate the number of semi-octets (up to a maximum of 40) in the called-address extension. This address-length indicator is binary-coded, where bit 1 is the low-order bit.

The following octets contain the called-address extension.

If bits 8 and 7 of the first octet of the Facility Parameter Field are coded "00", the following octets are encoded using the preferred binary encoding (PBE) defined in ISO 8348/Add. 2. Starting from the high-order digit of the Initial Domain Part (IDP), the address is coded in octet 2 and consecutive octets of the Facility Parameter Field. Each digit, with padding digits applied as necessary, is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5. The Domain Specific Part (DSP) of the address follows the IDP and is coded in decimal or binary, according to the PBE. If the syntax of the DSP is decimal, each digit is coded in binary-coded decimal (with the same rules applying to the DSP as to the IDP above). If the syntax of the DSP is binary, each octet of the called-address extension contains an octet of the DSP.

If bits 8 and 7 of the first octet of the Facility Parameter Field are coded "10", each digit of the called-address extension is coded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit. Starting from the high-order digit, the address is coded in octet 2 and consecutive octets of the Facility Parameter Field with two digits per octet. In each octet, the higher-order digit is coded in bits 8, 7, 6, and 5.

When necessary, the Facility Parameter Field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2, and 1 of the last octet of the field.

15.3.2.3 Minimum Throughput Class Negotiation facility

The one-octet Facility Parameter Field contains the minimum throughput class for both directions of data transmission. The minimum throughput class for the direction of data transmission from the called DTE is indicated in bits 8, 7, 6, and 5. The minimum throughput class for the direction of data transmission from the calling DTE is indicated in bits 4, 3, 2, and 1.

The four bits indicating each throughput class are binary-coded and correspond to throughput classes as indicated in table 20.

15.3.2.4 End-to-End Transit Delay Negotiation facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It has the value 2, 4, or 6. The Facility Parameter Field follows the length and indicates the transit-delay values.

The first and second octets of the Facility Parameter Field contain the cumulative transit delay. The third and fourth octets are optional and, when present, contain the desired (target) end-to-end transit delay. If the third and fourth octets are present, then the fifth and sixth octets are optional. When present, these octets contain the maximum-acceptable end-to-end transit delay. The absence of the optional octets in the CALL REQUEST and INCOMING CALL packets indicates that these parameters are not important for the call. The optional octets are not present in CALL ACCEPTED and CALL CONNECTED packets.

Transit delay is expressed in milliseconds and is binary-coded, where bit 8 of the first of a pair of octets is the high-order bit and bit 1 of the second of a pair of octets is the low-order bit.

Table 20 — Coding of Throughput Classes

bits: or bits: 4	3	2	1	Throughput Class (bits/s)
0	0	0	0	Reserved
0	0	0	1	Reserved
0	0	1	0	Reserved
0	0	1	1	75
0	1	0	0	150
0	1	0	1	300
0	1	1	0	600
0	1	1	1	1 200
1	0	0	0	2 400
1	0	0	1	4 800
1	0	1	0	9 600
1	0	1	1	19 200
1	1	0	0	48 000
1	1	0	1	64 000
1	1	1	0	Reserved
1	1	1	1	Reserved

The value of all ones for cumulative transit delay indicates that the cumulative transit delay is unknown or exceeds 65 534 ms.

15.3.2.5 Priority facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. It may take the value 1, 2, 3, 4, 5, or 6.

The first, second, and third octets of the Facility Parameter Field contain the target (CALL REQUEST packet), available (INCOMING CALL packet), or selected (CALL ACCEPTED and CALL CONNECTED packets) values for (i) the priority of data on a connection, (ii) priority to gain a connection, and (iii) priority to keep a connection, respectively. The fourth, fifth, and sixth octets of the Facility Parameter Field in CALL REQUEST and INCOMING CALL packets contain the lowest-acceptable values for (i) the priority of data on connection, (ii) priority to gain a connection, and (iii) priority to keep a connection, respectively.

When the facility is present in CALL REQUEST and INCOMING CALL packets, octets 2 through 6 of the Facility Parameter Field are optional. For example, if the only values to be specified are the target and lowest-acceptable values for priority to gain a connection, then the Facility Parameter Field will contain at least 5 octets with octets 1, 3, and 4 containing the value "unspecified", and octets 2 and 5 containing the specified values. When the facility is present in the CALL ACCEPTED and CALL CONNECTED packets, octets 2 and 3 are optional.

The range of specified values for each sub-parameter is 0 (lowest priority) to 14 (highest priority). The value 255 (all ones) indicates "unspecified." All other values (i.e., 15 through 254) are reserved.

15.3.2.6 Protection facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets.

Bits 8 and 7 of the first octet of the Facility Parameter Field specify the protection format code as shown below.

Bits 8	7	Protection format code
0	0	Reserved
0	1	Source-address specific
1	0	Destination-address specific
1	1	Globally unique

The remaining six bits of the first octet of the Facility Parameter Field are reserved and set to zero.

The second octet of the Facility Parameter Field specifies the length "n," in octets, of the target (CALL REQUEST packet), available (INCOMING CALL packet), or selected (CALL ACCEPTED and CALL CONNECTED packets) protection level. The actual value is placed in the following "n" octets. Optionally, the "n+3" octet of the Facility Parameter Field specifies the length "m," in octets, of the lowest acceptable protection level in CALL REQUEST and INCOMING CALL packets. The actual value is placed in the following "m" octets. The optional octets are not present in CALL ACCEPTED and CALL CONNECTED packets.

NOTE — The values of "n" and "m" are bounded firstly by the overall length of the Facility Parameter Field, and secondly by each other.

15.3.2.7 Expedited Data Negotiation facility

The coding of the one-octet Facility Parameter Field is:

Bit 1 = 0 for no use of expedited data

Bit 1 = 1 for use of expedited data

NOTE — Bits 8, 7, 6, 5, 4, 3, and 2 may be assigned to other facilities in the future; presently, they are set to 0.

16 Format for Registration Field in registration packets

The formats described in this clause apply only to the Registration Field of Registration packets used in conjunction with the On-line Facility Registration Facility.

See also:

— Optional User Facility for On-line Facility Registration (13.1).

16.1 General

The Registration Field is present in a REGISTRATION REQUEST packet only when there is a request to invoke or revoke an optional user facility. It is present in a

REGISTRATION CONFIRMATION packet to indicate which optional user facilities are available and the values of those optional user facilities currently in effect.

The Registration Field contains one registration element for each registration-facility. The first octet of each registration element is the Registration Code Field and indicates the registration-facility. The remaining octets of a registration element contain the Registration Parameter Field length, when present, and then the Registration Parameter Field.

In order to specify registration parameters consisting of 1, 2, 3, or a variable number of octets, the registration codes are divided into four classes by making use of bits 8 and 7 of the Registration Code Field. The general class coding of the Registration Code Field is shown in table 21. The formats for the four classes of registration elements are shown in figure 30.

Table 21 — General Class Coding for Registration Code Fields

Class	BITS: 8	7	6	5	4	3	2	1	Meaning
A	0	0	X	X	X	X	X	X	single-octet parameter field
B	0	1	X	X	X	X	X	X	double-octet parameter field
C	1	0	X	X	X	X	X	X	triple-octet parameter field
D	1	1	X	X	X	X	X	X	variable-length parameter field

The Registration Code Field is binary-coded and, without extension, provides for a maximum of 64 registration codes for Classes A, B, and C, and 63 registration codes for Class D, giving a total of 255 registration codes.

Registration code 11111111 is reserved for extension of the registration codes. The octet following this octet indicates an extended registration code having the format A, B, C, or D, as defined above. Repetition of registration code 11111111 is permitted, resulting in additional extensions.

A registration code may be assigned to identify a number of specific facilities, each having a bit in the Registration Parameter Field indicating facility requested/facility not requested or indicating facility available/facility not available. In this situation, the Registration Parameter Field is binary-coded, with each bit position relating to a specific facility. A 0 indicates that the facility related to the particular bit is not requested or is not available; a 1 indicates that the facility related to the particular bit is requested or is available. Parameter bit positions not assigned to a specific facility are set to zero. If none of the facilities represented by the registration code are requested or available, then the registration code and its associated Registration Parameter Field need not be present.

For registration codes in class D, the octet following the Registration Code Field indicates the length of the Registration Parameter Field in octets. The Registration Parameter Field length is binary-coded, where bit 1 is the low-order bit of the indicator.

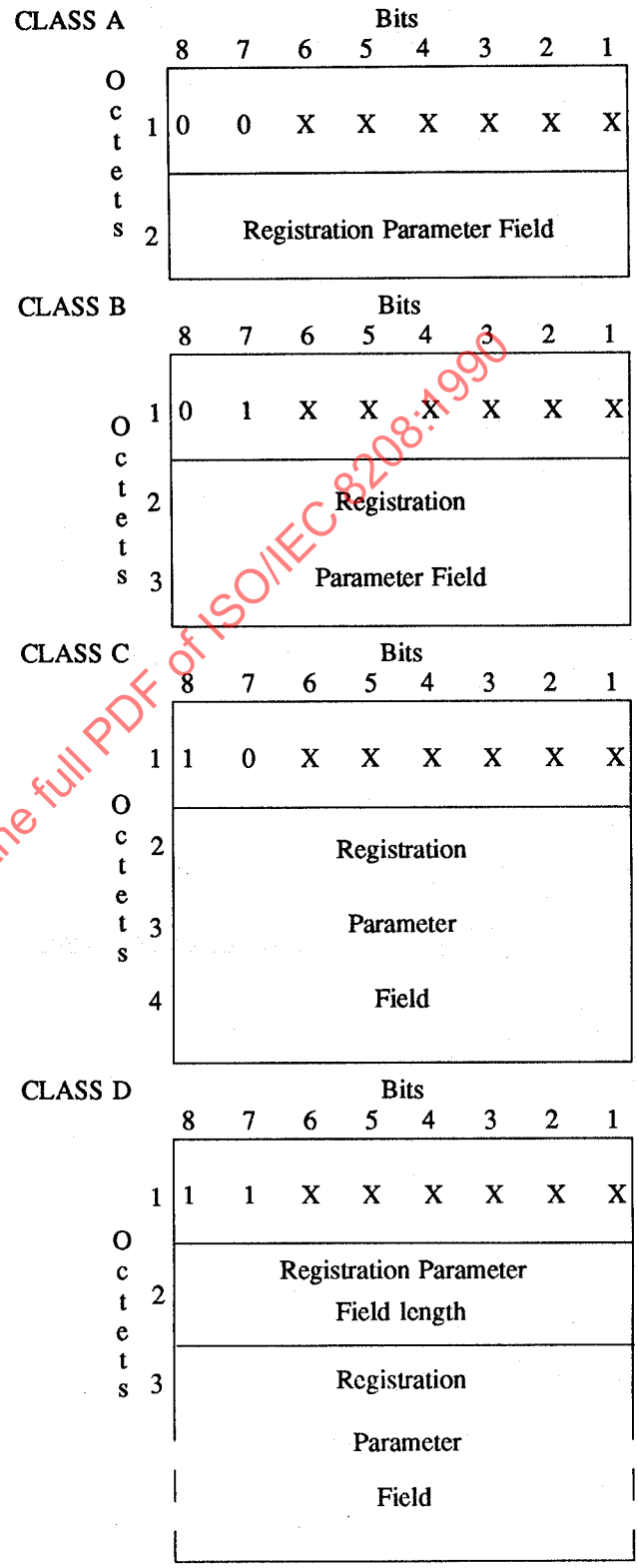


Figure 30 — Generalized Formats of Registration Elements

The coding of the Registration Parameter Field is dependent on the registration-facility being used.

There are two categories of registration-facilities that can be represented in Registration packets:

a) X.25 registration-facilities defined in Section 13.1; and

b) non-X.25 registration-facilities provided by the local network.

A Registration Marker, consisting of two octets, is used to separate X.25 registration-facilities from non-X.25 registration-facilities that may be offered by the local network. X.25 registration-facilities shall precede non-X.25 registration-facilities. A single Registration Marker shall be included whenever registration elements for non-X.25 registration-facilities are present.

The first octet of the Registration Marker is a Registration Code Field and is set to zero. The second octet of the Registration Marker is a Registration Parameter Field and is set to zero.

16.2 Coding of the Registration Field for registration-facilities

The coding of the Registration Code Field and the format of the Registration Parameter Field are the same in the REGISTRATION REQUEST and REGISTRATION CONFIRMATION packets in which they are used.

16.2.1 Coding of the Registration Code Field

Table 22 gives the coding of the Registration Code Field for each registration-facility and indicates the packet types in which they may be present.

16.2.2 Coding of the Registration Parameter Field

The coding of the Registration Parameter Field is dependent upon the specific registration-facility. To facilitate possible latter extensions, DTEs may be tolerant in receiving Registration Parameter Fields containing values which are presently reserved.

16.2.2.1 Non-negotiable facilities values

Each one of the following bits of the one-octet Registration Parameter Field corresponds to one facility which is not available for negotiation but whose value is indicated to the DTE.

Bit 1 Local Charging Prevention Facility

NOTE — Bits 2 through 8 may be assigned to other facilities in the future; presently, they are set to 0.

A bit set to 1 (respectively, 0) in a REGISTRATION CONFIRMATION packet means that the DCE has invoked (respectively, revoked) the corresponding facility.

16.2.2.2 Availability of facilities

Each one of the following bits of the two-octet Registration Parameter Field corresponds to one facility whose availability is indicated to the DTE.

Octet 1

Bit 1 Extended Packet Sequence Numbering Facility
Bit 2 Packet Retransmission Facility
Bit 3 D-bit Modification Facility
Bit 4 Called Line Address Modified Notification Facility[1)]

Bit 5 Charging Information Facility (Per-interface basis)
Bit 6 Charging Information Facility (per Virtual Call basis)[1)]
Bit 7 Reverse Charging Acceptance Facility
Bit 8 Reverse Charging Facility[1)]

Table 22 — Coding of the Registration Code Field

Registration-Facility	May be used in		Registration Code Bits:
	REGISTRATION REQUEST	REGISTRATION CONFIRMATION	8 7 6 5 4 3 2 1
Non-negotiable Facilities Values		X	0 0 0 0 0 1 1 0
Availability of Facilities		X	0 1 0 0 0 1 1 0
Facilities That May Be Negotiated At Any Time	X	X	0 1 0 0 0 1 0 1
Facilities That May Be Negotiated Only When All Logical Channels Used for Virtual Calls are in State p1	X	X	0 0 0 0 0 1 0 1
Nonstandard Default Packet Sizes	X	X	0 1 0 0 0 0 1 0
Nonstandard Default Window Sizes	X	X	0 1 0 0 0 0 1 1
Default Throughput Classes Assignment	X	X	0 0 0 0 0 0 1 0
Logical Channel Types Ranges	X	X	1 1 0 0 1 0 0 0
Marker	X	X	0 0 0 0 0 0 0 0

Octet 2

Bit 1 Default Throughput Classes Assignment Registration-Facility

Bit 2 Nonstandard Default Window Sizes Registration-Facility

Bit 3 Nonstandard Default Packet Sizes Registration-Facility

Bit 4 Logical Channel Types Ranges Registration-Facility

Bit 5 RPOA Selection Facility[1)]

1) A bit set to 1 for the corresponding facility indicates that it is available for use by the DTE; no further negotiation is required for these facilities.

NOTE — Bits 6 through 8 of octet 2 may be assigned to other facilities in the future; presently, they are set to 0.

A bit set to 1 (respectively, 0) in a REGISTRATION CONFIRMATION packet means that the corresponding facility either is available (respectively, not available) for use by the DTE or is available (respectively, not available) for negotiation by the DTE.

16.2.2.3 Facilities that may be negotiated at any time

Each one of the following bits of the two-octet Registration Parameter Field corresponds to one facility that may be negotiated at any time.

Octet 1

Bit 1 Incoming Calls Barred Facility

Bit 2 Outgoing Calls Barred Facility

Bit 3 Fast Select Acceptance Facility

Bit 4 Reverse Charging Acceptance Facility

Bit 5 Flow Control Parameter Negotiation Facility

Bit 6 Throughput Class Negotiation Facility

Bit 7 Charging Information Facility (per-interface basis)

NOTE — Bit 8 of octet 1 and all bits of octet 2 may be assigned to other facilities in the future; presently, they are set to 0.

A bit set to 1 (respectively, 0) in a REGISTRATION REQUEST packet is taken as a request to invoke (respectively, revoke) the corresponding facility.

A bit set to 1 (respectively, 0) in a REGISTRATION CONFIRMATION packet is taken as invocation (respectively, revocation) of the corresponding facility.

16.2.2.4 Facilities that may be negotiated only when all logical channels used for Virtual Calls are in state p1

Each one of the following bits of the one-octet Registration Parameter Field corresponds to one facility that may be negotiated only when all logical channels used for Virtual Calls are in the READY state (p1) and that needs only a single bit to indicate its value.

Bit 1 Extended Packet Sequence Numbering Facility (see note 1)

Bit 2 Packet Retransmission Facility

Bit 3 D-bit Modification Facility

NOTES

1 The exact method for negotiating this facility is for further study by CCITT.

2 Bits 4 through 8 may be assigned to other facilities in the future; presently, they are set to 0.

A bit set to 1 (respectively, 0) in a REGISTRATION REQUEST packet is taken as a request to invoke (respectively, revoke) the corresponding facility.

A bit set to 1 (respectively, 0) in a REGISTRATION CONFIRMATION packet is taken as invocation (respectively, revocation) of the corresponding facility.

16.2.2.5 Nonstandard default packet sizes

The packet size for the direction of data transmission to the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 4, 3, 2, and 1 of the first octet of the two-octet Registration Parameter Field. The packet size for the direction of data transmission from the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 4, 3, 2, and 1 of the second octet. Bits 8, 7, 6, and 5 of each octet are set to zero.

The four bits indicating each packet size are binary-coded and express the logarithm base 2 of the number of octets of the maximum packet size.

Values from 4 to 12, corresponding to packet sizes of 16, 32, 64, 128, 256, 512, 1 024, 2 048, and 4 096, or a subset of these values, may be offered. A packet size of 128 shall always be available.

16.2.2.6 Nonstandard default window sizes

The window size for the direction of data transmission to the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 7 through 1 of the first octet of the two-octet Registration Parameter Field. The window size for the direction of data transmission from the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 7 through 1 of the second octet. Bit 8 of each octet is set to zero.

The seven bits indicating each window size are binary-coded and express the size of the window. A value of zero is not allowed.

Window sizes of 8 to 127 are valid only when the Extended Packet Sequence Numbering Facility is being used.

The range of values allowed for normal numbering and for extended numbering is interface-dependent. A window size of 2 shall always be available.

16.2.2.7 Default throughput classes assignment

The throughput class for the direction of data transmission from the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 8, 7, 6, and 5 of the one-octet Registration Parameter Field. The throughput class for the direction of data transmission to the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 4, 3, 2, and 1.

The four bits indicating each throughput class are binary-coded and correspond to throughput classes as indicated in table 23.

Table 23 — Coding of Throughput Classes

bits: 8	7	6	5	Throughput Class (bits/s)
or bits: 4	3	2	1	
0	0	0	0	Reserved
0	0	0	1	Reserved
0	0	1	0	Reserved
0	0	1	1	75
0	1	0	0	150
0	1	0	1	300
0	1	1	0	600
0	1	1	1	1 200
1	0	0	0	2 400
1	0	0	1	4 800
1	0	1	0	9 600
1	0	1	1	19 200
1	1	0	0	48 000
1	1	0	1	64 000
1	1	1	0	Reserved
1	1	1	1	Reserved

16.2.2.8 Logical channel types ranges

The octet following the Registration Code Field indicates the length of the Registration Parameter Field in octets and shall indicate 14 octets. The Registration Parameter Field then consists of the following 14 octets.

Bits 4, 3, 2, and 1 of octets 1, 3, 5, 7, 9, and 11 of the Registration Parameter Field contain the high-order bits for parameters LIC, HIC, LTC, HTC, LOC, and HOC, respectively (see figure 1). Bits 8, 7, 6, and 5 of these octets are set to zero.

Octets 2, 4, 6, 8, 10, and 12 of the Registration Parameter Field contain the low-order bits for parameters LIC, HIC, LTC, HTC, LOC, and HOC, respectively. Bit 1 of these octets is the low-order bit.

When there are no one-way incoming logical channels, LIC and HIC are equal to zero. When there are no two-way logical channels, LTC and HTC are equal to zero. When there are no one-way outgoing logical channels, LOC and HOC are equal to zero.

Bits 4, 3, 2, and 1 of octet 13 of the Registration Parameter Field contain the high-order bits of the total number of logical channels to be used for Virtual Calls. Bits 8, 7, 6, and 5 of octet 13 are set to zero. Octet 14 of the Registration Parameter Field contains the low-order bits of the total number of logical channels to be used for Virtual Calls.

NOTES

1 The inequalities of figure 1 apply to nonzero values of LIC, HIC, LTC, HTC, LOC, and HOC.

2 The total number of logical channels to be used for Virtual Calls is indicated in octets 13 and 14. It is equal to the sum of the number of one-way incoming logical channels, two-way logical channels, and one-way outgoing logical channels.

17 Diagnostic codes

The coding of the Diagnostic Code Field in CLEAR REQUEST, CLEAR INDICATION, RESET REQUEST, RESET INDICATION, RESTART REQUEST, RESTART INDICATION, REGISTRATION CONFIRMATION, and DIAGNOSTIC packets is dependent upon the originator of the packet as given in tables 24 and 25.

Table 24 — Coding of the Diagnostic Code Field as a Function of Packet Type and Cause Code

PACKET TYPE	CAUSE CODE BITS 8 7 6 5 4 3 2 1	PACKET ORIGINATED BY	DIAGNOSTIC CODE
CLEAR REQUEST, CLEAR INDICATION, RESET REQUEST, RESET INDICATION	0 0 0 0 0 0 0 0	DTE	Specified in table 25 (Notes 1, 2)
	1 0 0 0 0 0 0 0	DTE	DTE-specific diagnostics
	0 [at least one 1]	Public packet switched network	Specified in Annex E of CCITT Recommendation X.25 (Notes 1, 3)
	1 [at least one 1]	Private packet switched network	Specified in table 25 (Notes 1, 2, 4)
RESTART REQUEST, RESTART INDICATION	0 0 0 0 0 0 0 0	DTE	Specified in table 25 (Notes 1, 2)
	1 0 0 0 0 0 0 0	DTE	DTE-specific diagnostics
	0 [at least one 1]	Local network (public or private)	Public Network: Specified in Annex E of CCITT Recommendation X.25 (Notes 1, 3)
			Private Network: Specified in table 25 (Notes 1, 2, 4)
DIAGNOSTIC, REGISTRATION CONFIRMATION	(Note 5)	DTE (Note 6)	Specified in table 25 (Notes 1, 2)
		Local network (public or private)	Public Network: Specified in Annex E of CCITT Recommendation X.25 (Notes 1, 3)
			Private Network: Specified in table 25 (Notes 1, 2, 4)

NOTES

1 The diagnostic codes 0 through 127 contained in Annex E of CCITT Recommendation X.25 and in table 25 are identical; these codes are standardized by CCITT and may be used in packets originated by either a DCE or a DTE.

2 The diagnostic codes 128 through 255 contained in table 25 are standardized by ISO/IEC.

3 The diagnostic codes 128 through 255 contained in Annex E of CCITT Recommendation X.25 are reserved for network-specific diagnostics.

4 A private packet switched network may use network-specific diagnostics codes 128 through 175.

5 The Cause Field does not exist in DIAGNOSTIC packets and is not partitioned in REGISTRATION CONFIRMATION packets.

6 DTE-to-DTE environment only.

Table 25 (1 of 5) — Diagnostic Codes

DIAGNOSTIC	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 1)
No Additional Information	0 0 0 0 0 0 0 0	0	D,Rr,C,Re,Rg
invalid P(S)	0 0 0 0 0 0 0 1	1	Re
invalid P(R)	0 0 0 0 0 0 1 0	2	Re
	. . . . .		
	0 0 0 0 1 1 1 1	15	
Packet Type Invalid	0 0 0 1 0 0 0 0	16	Rr,C,Re
for state r1	0 0 0 1 0 0 0 1	17	Rr,C,Re
for state r2	0 0 0 1 0 0 1 0	18	Rr,C,Re
for state r3	0 0 0 1 0 0 1 1	19	Rr,C,Re
for state p1	0 0 0 1 0 1 0 0	20	C
for state p2	0 0 0 1 0 1 0 1	21	C
for state p3	0 0 0 1 0 1 1 0	22	C
for state p4	0 0 0 1 0 1 1 1	23	C
for state p5	0 0 0 1 1 0 0 0	24	C
for state p6	0 0 0 1 1 0 0 1	25	C
for state p7	0 0 0 1 1 0 1 0	26	C
for state d1	0 0 0 1 1 0 1 1	27	Re
for state d2	0 0 0 1 1 1 0 0	28	Re
for state d3	0 0 0 1 1 1 0 1	29	Re
	. . . . .		
	0 0 0 1 1 1 1 1	31	
Packet Not Allowed	0 0 1 0 0 0 0 0	32	D,Rr,C,Re
unidentifiable packet	0 0 1 0 0 0 0 1	33	Rr,C,Re
call on one-way logical channel	0 0 1 0 0 0 1 0	34	C
invalid packet type on a Permanent Virtual Circuit	0 0 1 0 0 0 1 1	35	Re
packet on an unassigned logical channel	0 0 1 0 0 1 0 0	36	D
REJECT not subscribed to	0 0 1 0 0 1 0 1	37	Re
packet too short	0 0 1 0 0 1 1 0	38	D,Rr,C,Re,Rg
packet too long	0 0 1 0 0 1 1 1	39	D,Rr,C,Re,Rg
invalid General Format Identifier	0 0 1 0 1 0 0 0	40	D
Restart or Registration packet with nonzero Logical Channel Identifier	0 0 1 0 1 0 0 1	41	Re,C,Re
Packet type not compatible with facility	0 0 1 0 1 0 1 0	42	C
unauthorized INTERRUPT CONFIRMATION	0 0 1 0 1 0 1 1	43	Re
unauthorized INTERRUPT	0 0 1 0 1 1 0 0	44	Re
unauthorized REJECT	0 0 1 0 1 1 0 1	45	Re
	. . . . .		
	0 0 1 0 1 1 1 1	47	

Table 25 (2 of 5) — Diagnostic Codes

DIAGNOSTIC	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 1)
Timer Expired	0 0 1 1 0 0 0 0	48	D,Rr,C,Re
for INCOMING CALL (or for DTE timer expired for CALL REQUEST)	0 0 1 1 0 0 0 1	49	C
for CLEAR INDICATION (or for DTE timer expired or retransmission count surpassed for CLEAR REQUEST)	0 0 1 1 0 0 1 0	50	D,C
for RESET INDICATION (or for DTE timer expired or retransmission count surpassed for RESET REQUEST)	0 0 1 1 0 0 1 1	51	D,C,Re
for RESTART INDICATION (or for DTE timer expired or retransmission count surpassed for RESTART REQUEST)	0 0 1 1 0 1 0 0	52	D,Rr,C,Re
for call deflection	0 0 1 1 0 1 0 1	53	C
	. . . .		
	0 0 1 1 1 1 1 1	63	
Call Setup, Call Clearing, or Registration Problem	0 1 0 0 0 0 0 0	64	C,Rg
facility/registration code not allowed	0 1 0 0 0 0 0 1	65	C,Rg
facility parameter not allowed	0 1 0 0 0 0 1 0	66	C,Rg
invalid called DTE address	0 1 0 0 0 0 1 1	67	C
invalid calling DTE address	0 1 0 0 0 1 0 0	68	C
invalid facility/registration length	0 1 0 0 0 1 0 1	69	C,Rg
incoming call barred	0 1 0 0 0 1 1 0	70	C
no logical channel available	0 1 0 0 0 1 1 1	71	C
call collision	0 1 0 0 1 0 0 0	72	C
duplicate facility requested	0 1 0 0 1 0 0 1	73	C,Rg
nonzero address length	0 1 0 0 1 0 1 0	74	C,Rg
nonzero facility length	0 1 0 0 1 0 1 1	75	C
facility not provided when expected	0 1 0 0 1 1 0 0	76	C,Rg
invalid CCITT-specified DTE facility	0 1 0 0 1 1 0 1	77	C
maximum number of call redirections or call deflections exceeded	0 1 0 0 1 1 1 0	78	C
	. . . .		
	0 1 0 0 1 1 1 1	79	

Table 25 (3 of 5) — Diagnostic Codes

DIAGNOSTIC	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 1)
Miscellaneous	0 1 0 1 0 0 0 0	80	Rr,C,Re
improper cause code from DTE	0 1 0 1 0 0 0 1	81	D,Rr,C,Re
nonoctet aligned	0 1 0 1 0 0 1 0	82	D,Rr,C,Re
inconsistent Q-bit settings	0 1 0 1 0 0 1 1	83	Re
NUI problem	0 1 0 1 0 1 0 0	84	C
	. . . . .		
	0 1 0 1 1 1 1 1	95	
Not assigned	0 1 1 0 0 0 0 0	96	
	. . . . .		
	0 1 1 0 1 1 1 1	111	
International Problem	0 1 1 1 0 0 0 0	112	Rr,C,Re
remote network problem	0 1 1 1 0 0 0 1	113	C,Re
international protocol problem	0 1 1 1 0 0 1 0	114	C,Re
international link out of order	0 1 1 1 0 0 1 1	115	C,Re
international link busy	0 1 1 1 0 1 0 0	116	C
transit network facility problem	0 1 1 1 0 1 0 1	117	C
remote network facility problem	0 1 1 1 0 1 1 0	118	C
international routing problem	0 1 1 1 0 1 1 1	119	C
temporary routing problem	0 1 1 1 1 0 0 0	120	C
unknown called DNIC	0 1 1 1 1 0 0 1	121	C
maintenance action (Note 5)	0 1 1 1 1 0 1 0	122	Rr,C,Re
	. . . . .		
	0 1 1 1 1 1 1 1	127	
Reserved for DTE-defined Diagnostic Information	1 0 0 0 0 0 0 0	128	
	. . . . .		
	1 0 0 0 1 1 1 1	143	
Timer Expired or Retransmission Count Surpassed	1 0 0 1 0 0 0 0	144	Re
for INTERRUPT	1 0 0 1 0 0 0 1	145	Re
for DATA packet transmission	1 0 0 1 0 0 1 0	146	Re
for REJECT	1 0 0 1 0 0 1 1	147	Re
	. . . . .		
	1 0 0 1 1 1 1 1	159	

Table 25 (4 of 5) — Diagnostic Codes

DIAGNOSTIC	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 1)
DTE-Specific Signals	1 0 1 0 0 0 0 0	160	Rr,C,Re
DTE operational	1 0 1 0 0 0 0 1	161	Rr,Re
DTE not operational	1 0 1 0 0 0 1 0	162	Rr,C,Re
DTE resource constraint	1 0 1 0 0 0 1 1	163	Rr,C,Re
Fast Select not subscribed	1 0 1 0 0 1 0 0	164	C
invalid partially full DATA packet	1 0 1 0 0 1 0 1	165	Re
D-bit procedure not supported	1 0 1 0 0 1 1 0	166	C,Re
Registration/Cancellation confirmed	1 0 1 0 0 1 1 1	167	Rg
	. . . . .		
	1 0 1 0 1 1 1 1	175	
Not Assigned	1 0 1 1 0 0 0 0	176	
	. . . . .		
	1 1 0 1 1 1 1 1	223	
OSI Network Service Problem	1 1 1 0 0 0 0 0	224	C,Re
disconnection (transient condition)	1 1 1 0 0 0 0 1	225	C
disconnection (permanent condition)	1 1 1 0 0 0 1 0	226	C
connection rejection — reason unspecified (transient condition)	1 1 1 0 0 0 1 1	227	C
connection rejection — reason unspecified (permanent condition)	1 1 1 0 0 1 0 0	228	C
connection rejection — quality of service not available (transient condition)	1 1 1 0 0 1 0 1	229	C
connection rejection — quality of service not available (permanent condition)	1 1 1 0 0 1 1 0	230	C
connection rejection — NSAP unreachable (transient condition)	1 1 1 0 0 1 1 1	231	C
connection rejection — NSAP unreachable (permanent condition)	1 1 1 0 1 0 0 0	232	C
reset — reason unspecified	1 1 1 0 1 0 0 1	233	Re
reset — congestion	1 1 1 0 1 0 1 0	234	Re
connection rejection — NSAP address unknown (permanent condition)	1 1 1 0 1 0 1 1	235	C
	. . . . .		
	1 1 1 0 1 1 1 1	239	

Table 25 (5 of 5) — Diagnostic Codes

DIAGNOSTIC	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 1)
Higher Layer Initiated	1 1 1 1 0 0 0 0	240	Rr,C,Re
disconnection—normal	1 1 1 1 0 0 0 1	241	C
disconnection—abnormal	1 1 1 1 0 0 1 0	242	C
disconnection—incompatible information in user data	1 1 1 1 0 0 1 1	243	C
connection rejection — reason unspecified (transient condition)	1 1 1 1 0 1 0 0	244	C
connection rejection — reason unspecified (permanent condition)	1 1 1 1 0 1 0 1	245	C
connection rejection — quality of service not available (transient condition)	1 1 1 1 0 1 1 0	246	C
connection rejection — quality of service not available (permanent condition)	1 1 1 1 0 1 1 1	247	C
connection rejection — incompatible information in user data	1 1 1 1 1 0 0 0	248	C
connection rejection — unrecognizable protocol identifier in user data	1 1 1 1 1 0 0 1	249	C
reset—user resynchronization	1 1 1 1 1 0 1 0	250	Re
	. . . . .		
	1 1 1 1 1 1 1 1	255	

NOTES

1 A given diagnostic need not apply to all packet types. The packet type(s) to which each diagnostic may apply is shown (D=DIAGNOSTIC; Rr=RESTART REQUEST and RESTART INDICATION; C=CLEAR REQUEST and CLEAR INDICATION; Re=RESET REQUEST and RESET INDICATION; Rg=REGISTRATION CONFIRMATION). Since a DTE is permitted to use a "stronger" error action (i.e., restarting the Packet Layer instead of clearing a Virtual Call, and restarting the Packet Layer or clearing a Virtual Call instead of resetting):

a) the applicable packets for diagnostic codes 0-223, when transmitted by a DTE, also include C=RESTART REQUEST, Re=CLEAR REQUEST (Virtual Call only) and RESTART REQUEST;

b) hence, the applicable packets for diagnostic codes 0-223, when received by a DTE, also include C=RESTART INDICATION (DTE/DTE environment only), Re=CLEAR INDICATION (Virtual Call only) and RESTART INDICATION (DTE/DTE environment only).

2 Not all diagnostics need be implemented but those used are as coded in the table. The first diagnostic in each grouping is a generic diagnostic and can be used in place of the more specific diagnostics within the grouping. The decimal 0 diagnostic code can be used in situations where no additional information is available (e.g., where the more specific diagnostics are not implemented).

3 Diagnostics 224 through 255 support the OSI Network Service Definition.

4 In certain situations, multiple diagnostic codes may apply. For example, if a timer has expired and a (RESTART, CLEAR, or RESET) REQUEST packet is to be retransmitted, then the DTE may use the diagnostic code associated with the original error or the corresponding "timer expired" diagnostic code.

5 This diagnostic may also apply to a maintenance action within a national network.

18 Timers and retransmission counts

Table 26 lists the timer parameters and table 27 lists the retransmission-count parameters. Values for these parameters may be chosen independently of the specific values chosen by the interfacing DXE. They may take into account whether the Packet Layer entity interfaces with a network (and, therefore, the characteristics of the network) or with a Packet Layer entity of another DTE, the nature of the traffic flowing over the interface, and other appropriate considerations. The values chosen may apply in common to all logical channels in the Packet Layer entity.

Table 28 lists the timers a DTE should take into consideration when responding to packets from a DXE.

Table 26 (1 of 2) — DTE Timer Parameters

Timer	Default Time-Limit Value (Note 2)	Started When (Note 3)	Normally Terminated When (Notes 3, 4)	Action When Timer Expires (Notes 3, 5)
T20 (Restart Request Response Timer)	180 s	DTE transmits a RESTART REQUEST packet (r2)	DTE receives a: • RESTART CONFIRMATION packet (r1), or • RESTART INDICATION packet (r1)	DTE retransmits the RESTART REQUEST packet and restarts T20 up to a maximum of R20 times
T21 (Call Request Response Timer)	200 s	DTE transmits a CALL REQUEST packet (p2)	DTE receives a: • CALL CONNECTED packet (p4), or • INCOMING CALL packet (p5) (Note 6), or • CLEAR INDICATION packet (p7); or DTE sends a CLEAR REQUEST packet (p6)	DTE transmits a CLEAR REQUEST packet (p6)
T22 (Reset Request Response Timer)	180 s	DTE transmits a RESET REQUEST packet (d2)	DTE receives a: • RESET CONFIRMATION packet (d1), or • RESET INDICATION packet (d1)	DTE retransmits the RESET REQUEST packet and restarts T22 up to a maximum of R22 times
T23 (Clear Request Response Timer)	180 s	DTE transmits a CLEAR REQUEST packet (p6)	DTE receives a: • CLEAR CONFIRMATION packet (p1), or • CLEAR INDICATION packet (p1)	DTE retransmits the CLEAR REQUEST packet and restarts T23 up to a maximum of R23 times
T24 (Window Status Transmission Timer) (Note 7)	60 s	DTE transmits a packet with a P(R), i.e., a RR, RNR, DATA, or REJECT packet		DTE transmits a RR or RNR packet (or a DATA or REJECT packet if available for transmission) reflecting the current window condition and restarts T24
T25 (Window Rotation Timer) (Notes 7, 8)	200 s	DTE transmits a DATA packet or DTE's window is rotated but there are still outstanding DATA packets	There are no outstanding DATA packets in the window	DTE retransmits all DATA packets in the window and restarts T25 up to a maximum of R25 times (Note 9)

Table 26 (2 of 2) — DTE Timer Parameters

Timer	Default Time-Limit Value (Note 2)	Started When (Note 3)	Normally Terminated When (Notes 3, 4)	Action When Timer Expires (Notes 3,5)
T26 (Interrupt Response Timer)	180 s	DTE transmits an INTERRUPT packet (i2)	DTE receives an INTERRUPT CONFIRMATION packet (i1)	DTE transmits a RESET REQUEST packet (d2)
T27 (Reject Response Timer) (Notes 7, 8)	60 s	DTE transmits a REJECT packet	DTE receives the first retransmitted DATA packet	DTE transmits the REJECT packet and restarts T27 up to a maximum of R27 times (Note 9)
T28 (Registration Request Response Timer) (Notes 7, 8)	300 s	DTE transmits a REGISTRATION REQUEST packet	DTE receives a REGISTRATION CONFIRMATION packet	DTE retransmits the REGISTRATION REQUEST packet and restarts T28 up to a maximum of R28 times

NOTES

1 The DTE should take into consideration the timers started by the DXE when the DXE transmits a packet. These considerations are shown in table 28.

2 The time-limit values shown are only defaults. The actual values chosen may depend on a number of factors, including whether the DTE is operating in a DTE/DTE environment, the need to detect problems quickly, etc. However, the values chosen must preserve the relationship between the time-limit values shown in order to ensure proper operation.

3 If the state of the logical channel changes as a result of the action shown, then the new state is indicated for states other than the Flow Control states. For the Flow Control states, the state may or may not change as a result of the action.

4 The receipt or sending of a packet belonging to a state of higher priority (as defined in clause 19) will normally also cause the timer to terminate. For example, the receipt of a RESTART INDICATION packet after having transmitted a RESET REQUEST packet will normally also cause timer T22 to terminate.

5 When (re)transmitting a RESTART REQUEST, CLEAR REQUEST, or RESET REQUEST packet, the DTE should indicate the cause as "DTE Originated." The diagnostic when T21 or T26 expires should indicate expiration of the corresponding timer. The diagnostic when any other timer expires may indicate expiration of the corresponding timer or the original error.

6 In a DTE/DTE environment, the DTE which maintains its role as a DTE for the purpose of resolving call collision should not terminate timer T21 upon receipt of an INCOMING CALL packet.

7 T24, T25, T27, and T28 are needed only if the associated procedures (described in 11.2.2, 11.2.1, 13.4, and 13.1, respectively) are used.

8 Although the DTE starts this timer when transmitting the corresponding packet, a DXE is not obliged to respond to this packet in such a timely fashion so as to prevent the transmitting DTE's timer from expiring. Therefore, such a timer should be used with caution.

9 It is permissible to transmit a RESET REQUEST packet when this timer expires (i.e., R25 and R27 are set to 0).

Table 27 — DTE Retransmission Count Parameters

Retransmission Count	Description	Default Value (Notes 1, 2)	Action When Retransmission Count Surpassed (Note 3)
R20 (Restart Request Retransmission Count)	Number of times a RESTART REQUEST packet is retransmitted requesting restarting of the Packet Layer entity	1	Notify the appropriate entity
R22 (Reset Request Retransmission Count)	Number of times a RESET REQUEST packet is retransmitted requesting resetting of the logical channel	1	For a Virtual Call, transmit a CLEAR REQUEST packet (p6) (Note 4); for a Permanent Virtual Circuit, notify the appropriate entity
R23 (Clear Request Retransmission Count	Number of times a CLEAR REQUEST packet is retransmitted requesting clearing of the Virtual Call	1	Notify the appropriate entity
R25 (Data Packet Retransmission Count) (Note 5)	Number of times DATA packets are retransmitted	0	Transmit a RESET REQUEST packet (d2) (Note 4)
R27 (Reject Retransmission Count) (Note 5)	Number of times a REJECT packet is retransmitted requesting retransmission of the same DATA packet (i.e., same P(R) value)	0	Transmit a RESET REQUEST packet (d2) (Note 4)
R28 (Registration Request Retransmission Count) (Note 5)	Number of times a REGISTRATION REQUEST packet is retransmitted	1	Notify the appropriate entity

NOTES

1 It is permissible to implement only the procedures associated with the default values.

2 With a default value of 1, the associated procedure is performed twice: once for the original transmission and once for a retransmission. To ensure proper operation because of the possibility of collisions, R20, R22, and R23 should never be set to 0.

3 If the state of the logical channel changes as a result of the action shown, then the new state is indicated.

4 When the DTE transmits a CLEAR REQUEST or RESET REQUEST packet, the cause indicates "DTE Originated" and the diagnostic indicates that the corresponding timer expired or retransmission count was surpassed.

5 R25, R27, and R28 are needed only if the associated procedures (described in 11.2.1, 13.4, and 13.1, respectively) are used.

Table 28 — Timers a DTE Should Take Into Consideration When Responding to Packets from a DXE

Packet From DXE	DTE/DCE Environment		DTE/DTE Environment
	Network Timer	Remote DTE Timer	Remote DTE Timer
RESTART INDICATION	T10 (60 s) started when DCE sends a RESTART INDICATION packet		T20 (180 s default) started when remote DTE sends a RESTART REQUEST packet
INCOMING CALL	T11 (180 s) started when DCE sends an INCOMING CALL packet	T21 (200 s default) started when remote DTE sends a CALL REQUEST packet	T21 (200 s default) started when remote DTE sends a CALL REQUEST packet
RESET INDICATION	T12 (60 s) started when DCE sends a RESET INDICATAION packet	(Note)	T22 (180 s default) started when remote DTE sends a RESET REQUEST packet
CLEAR INDICATION	T13 (60 s) started when DCE sends a CLEAR INDICATION packet	(Note)	T23 (180 s default) started when remote DTE sends a CLEAR REQUEST packet
DATA		T25 (200 s default) started when remote DTE sends a DATA packet	T25 (200 s default) started when remote DTE sends a DATA packet
INTERRUPT		T26 (180 s default) started when remote DTE sends an INTERRUPT packet	T26 (180 s default) started when remote DTE sends an INTERRUPT packet
REJECT			T27 (180 s default) started when remote DTE sends a REJECT packet
REGISTRATION			T28 (300 s default) started when remote DTE sends a REGISTRATION REQUEST packet

NOTE — Within those networks where the associated CONFIRMATION packet has end-to-end significance, a DTE receiving this packet should also consider the remote DTE's corresponding timer.

19 State diagrams

The state diagrams contained in this clause are provided to further supplement the procedural definition of the Packet Layer. The state diagrams give the transitions of the Packet Layer under normal operation. Table 29 provides an index to the figures containing the state diagrams.

Table 29 — Packet Layer State Diagrams

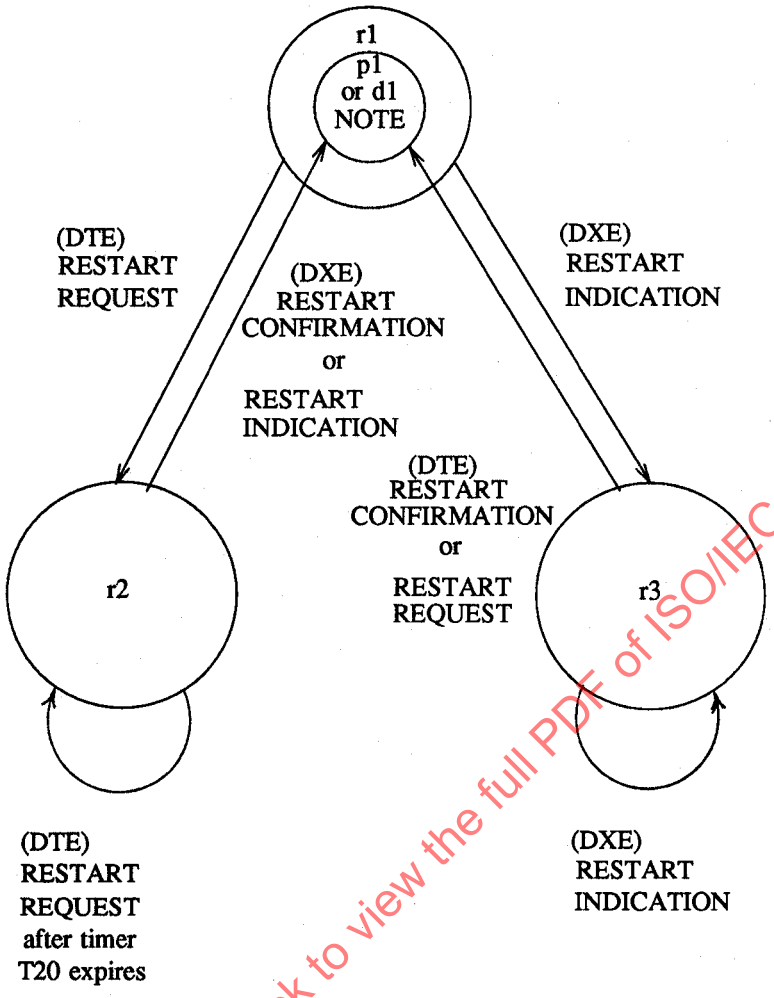
Figure	Applicable States
31	Restart States (r1, r2, and r3)
32	Call Setup and Call Clearing States (p1, p2, p3, p4, p5, p6, and p7)
33	Data Transfer States (d1, d2, and d3)
34	Interrupt States (i1, i2, j1, and j2)
35	Flow Control States (f1, f2, g1, and g2)

In the state diagrams, each state is represented by a circle containing the state designation. Each state transition is represented by an arrow. The responsibility for the transition (DTE or DXE) and the packet that has been transferred is indicated beside that arrow.

For the sake of clarity, the normal procedure at the DTE/DXE interface is described in a number of small state diagrams. In order to describe the normal procedure fully, it is necessary to allocate a priority to the different figures and to relate a higher-order diagram to a lower one. This has been done as described below.

a) The figures are arranged in order of priority with figure 31 (Restart) having the highest priority, then followed by figure 32 (Call Setup and Call Clearing), and then by figure 33 (Reset). Of equal priority and following figure 33 are figure 34 (Interrupt) and figure 35 (Flow Control). Priority means that when a packet belonging to a higher-order diagram is transmitted, that diagram is applicable and the lower-order one is not.

b) The relation with a state in a lower-order diagram is given by including that state inside a circle in the higher-order diagram.



NOTE: p1 FOR VIRTUAL CALL LOGICAL CHANNELS, OR
d1 FOR PERMANENT VIRTUAL CIRCUIT LOGICAL CHANNELS

STATES:
- d1: FLOW CONTROL READY
- p1: READY
- r1: PACKET LAYER READY
- r2: DTE RESTART REQUEST
- r3: DXE RESTART INDICATION

Figure 31 — State Diagram for the Transfer of Restart Packets

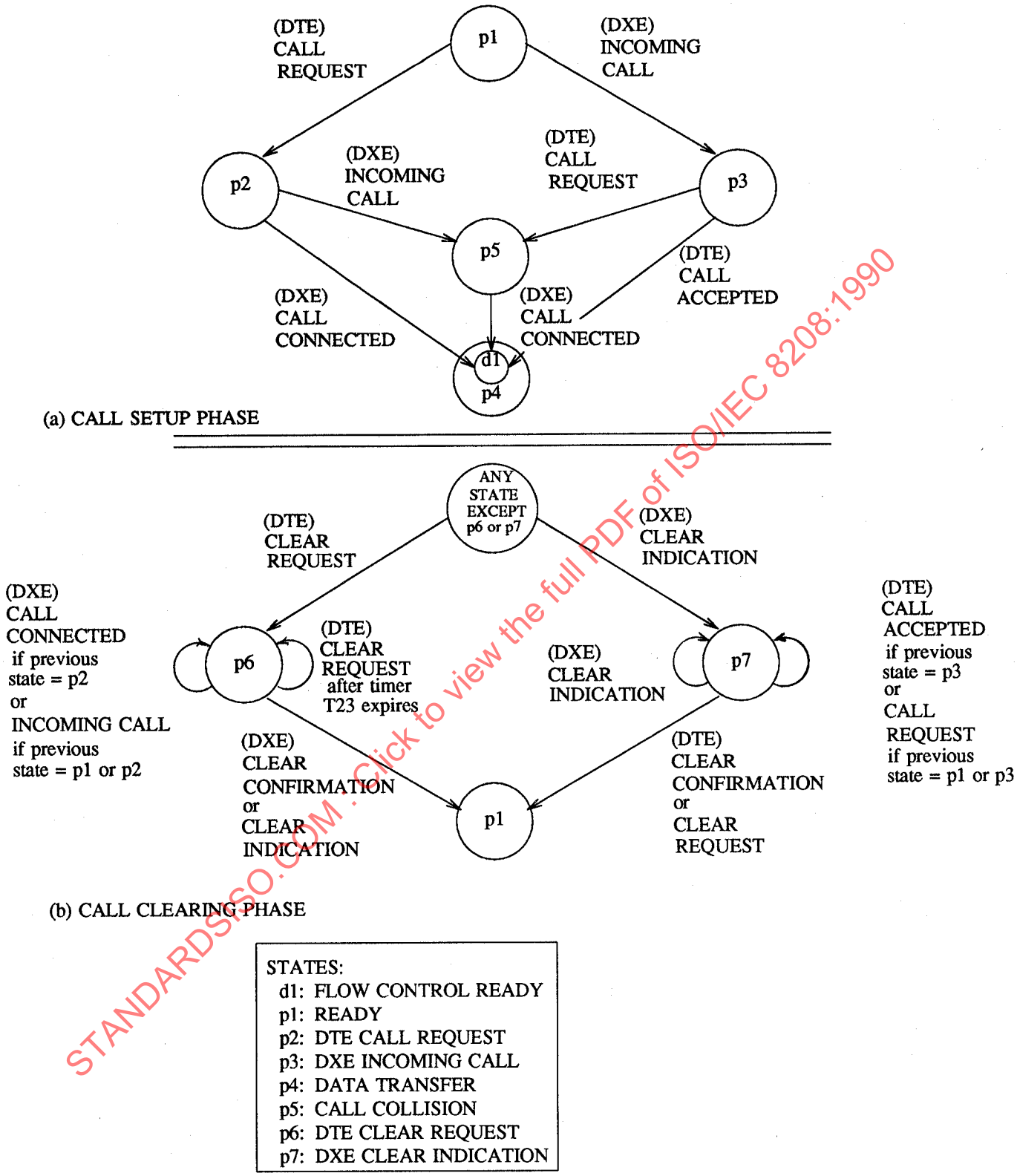


Figure 32 — State Diagram for the Transfer of Call Setup and Call Clearing Packets within the Packet Layer Ready State (r1)

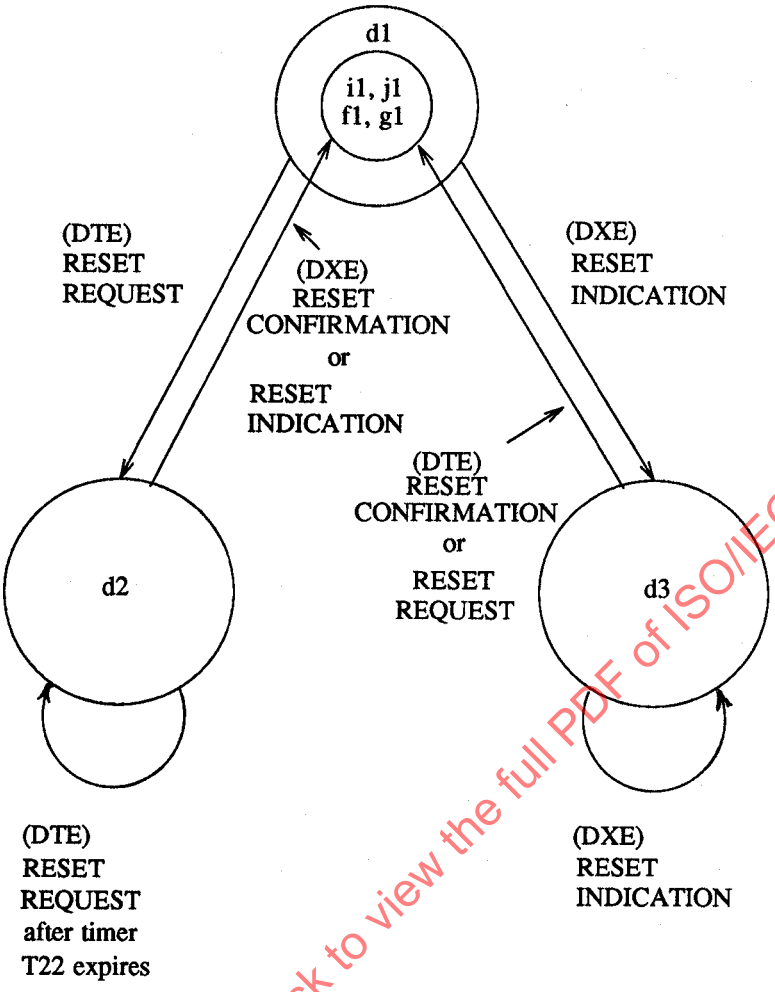
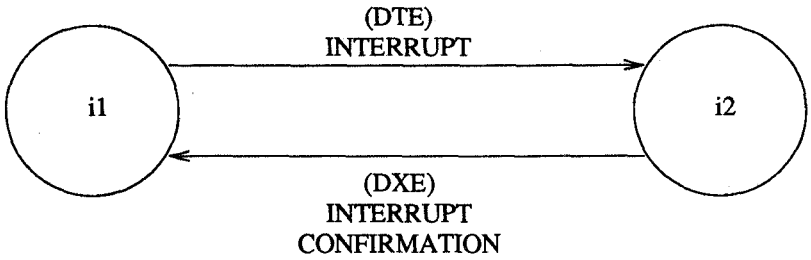
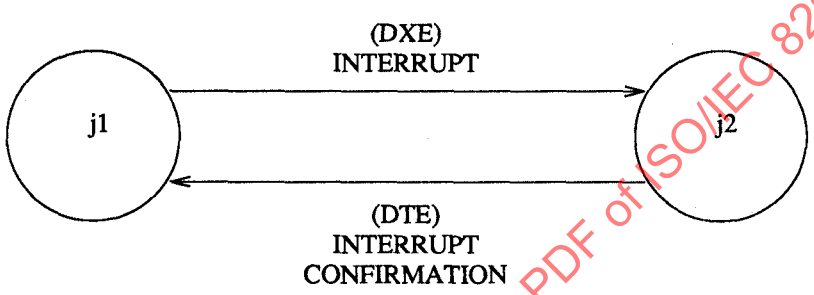


Figure 33 — State Diagram for the Transfer of Reset Packets within the Data Transfer State (p4)



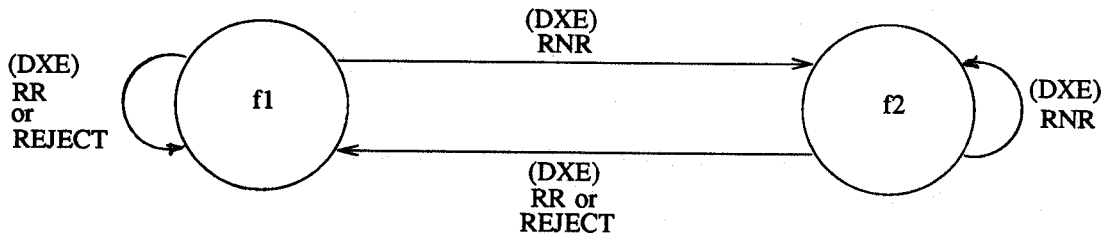
(a) INTERRUPT TRANSFER FROM DTE TO DXE



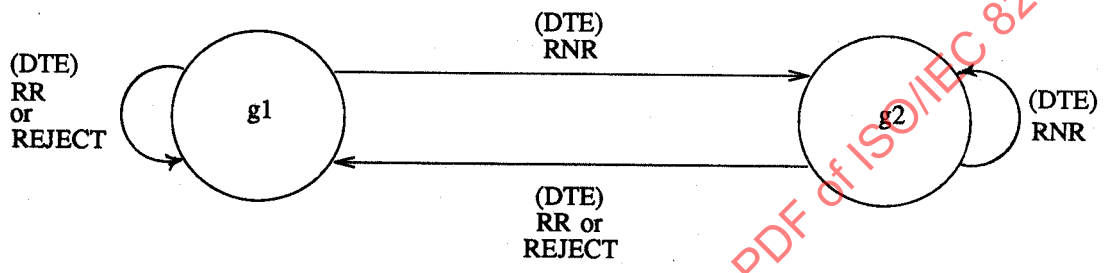
(b) INTERRUPT TRANSFER FROM DXE TO DTE

STATES:
i1: DTE INTERRUPT READY
i2: DTE INTERRUPT SENT
j1: DXE INTERRUPT READY
j2: DXE INTERRUPT SENT

Figure 34 — State Diagram for the Transfer of Interrupt Packets within the Flow Control Ready State (d1)



(a) FLOW CONTROL FROM DXE TO DTE
(DATA TRANSFER FROM DTE TO DXE)



(b) FLOW CONTROL FROM DTE TO DXE
(DATA TRANSFER FROM DXE TO DTE)

STATES:
f1: DXE RECEIVE READY
f2: DXE RECEIVE NOT READY
g1: DTE RECEIVE READY
g2: DTE RECEIVE NOT READY

Figure 35 — State Diagram for the Transfer of Flow Control Packets within the Flow Control Ready State (d1)