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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) form the specialized system for worldwide standardization. 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 voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 8208 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

This third edition cancels and replaces the second edition (ISO/IEC 8208:1990), which has been technically revised. It also incorporates amendment 1:1990, amendment 3:1991 and technical corrigendum 1:1992.

Annexes A and B form an integral part of this International Standard. Annexes C and D are for information only.

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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 ITU-T 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, ITU-T Rec. X.200 | ISO/IEC 7498-1.

This International Standard covers DTE operation at the Packet Layer when accessing a public or private packet-switched network conforming to ITU-T 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 ITU-T 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).

To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented. Such a statement is called a Protocol Implementation Conformance Statement (PICS), as defined in ITU-T Rec. X.290 | ISO/IEC 9646-1. Annex B provides the PICS proforma in accordance with the relevant guidance given in ITU-T Rec. X.296 | ISO/IEC 9646-7.

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. The second edition was based on the 1988 CCITT Blue Book text of Recommendation X.25. This third edition is based upon the 1993 version of X.25. Retained within this third edition are the necessary provisions for compatibility with the 1988, 1984 and 1980 versions of X.25. The differences between the first, second and third editions of this International Standard are summarized in annex C.

It should be noted that this International Standard and ITU-T Recommendation X.25 as it applies to DTEs are different in scope. This International Standard contains the specifications that ITU-T 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.

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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 Telecommunication Standardization Bureau of the ITU maintains a register of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1 : 1994, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

CCITT Recommendation X.213 (1992) | ISO/IEC 8348 : 1993, *Information technology — Open Systems Interconnection — Network Service Definition*

ITU-T Recommendation X.273 (1994) | ISO/IEC 11577 : 1995, *Information technology — Open Systems Interconnection — Network layer security protocol*

CCITT Recommendation X.612 (1992) | ISO/IEC 9574 : 1992, *Information technology — Provision of the OSI connection-mode network service by packet-mode terminal equipment connected to an integrated services digital network (ISDN)*

CCITT Recommendation X.613 (1992) | ISO/IEC 10588 : 1993, *Information technology — Use of X.25 Packet Layer Protocol in conjunction with X.21/X.21bis to provide the OSI connection-mode Network Service*

CCITT Recommendation X.614 (1992) | ISO/IEC 10732 : 1993, *Information technology — Use of X.25 Packet Layer Protocol to provide the OSI connection-mode Network Service over the telephone network*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation T.50 (1992), *International Reference Alphabet (IRA)*

  ISO/IEC 646 : 1991, *Information technology — ISO 7-bit coded character set for information interchange*

- CCITT Recommendation X.212 (1988), *Data link service definition for open systems interconnection for CCITT applications*

  ISO/IEC 8886 : 1992, *Information technology — Telecommunications and information exchange between systems — Data link service definition for Open Systems Interconnection*

- ITU-T Recommendation X.223 (1993), *Use of X.25 to provide the OSI connection-mode network service for ITU-T applications*

  ISO/IEC 8878 : 1992, *Information technology — Telecommunications and information exchange between systems — Use of X.25 to provide the OSI Connection-mode Network Service*

- ITU-T Recommendation X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications — General concepts*

  ISO/IEC 9646-1 : 1995, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts*

- ITU-T Recommendation X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications — Implementation Conformance Statements*

  ISO/IEC 9646-7 : 1995, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 7: Implementation Conformance Statements*

2.3 Additional references

CCITT Recommendation D.12 (1988), *Measurement unit for charging by volume in the international packet-switched data communication service*

ITU-T Recommendation X.2 (1993), *International data transmission services and optional user facilities in public data networks and ISDNs*

ITU-T Recommendation X.25 (1993), *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*

ITU-T Recommendation X.29 (1993), *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*

ITU-T Recommendation X.31 (1993), *Support of packet mode terminal equipment by an ISDN*

ITU-T Recommendation X.32 (1993), *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*

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

ITU-T Recommendation X.121 (1993), *International numbering plan for public data networks*

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

CCITT Recommendation X.610 (1992), *Provision and support of the OSI connection-mode network service*

ISO/IEC 7776 : 1994, *Information technology — Telecommunications and information exchange between systems — High-level data link control procedures — Description of the X.25 LAPB-compatible DTE data link procedures*

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

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

ISO/IEC 10039:1991, *Information technology — Open Systems Interconnection — Local area networks — Medium Access Control (MAC) service definition*

ISO/IEC TR 13532:—[1], *Information technology — Telecommunications and information exchange between systems — Protocol combinations to provide and support the OSI network service*

RFC 1166, *Internet numbers*, July 1990.

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.[2] 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 the Data Link Layer 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

1) To be published.

2) 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.

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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);

i) conformance requirements (clause 21);

j) 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 (annex A); and

k) the PICS proforma (annex B).

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 ITU-T X-series recommendations.

e) abbreviations are listed in Annex D.

The Packet Layer procedures in this International Standard are based on an underlying service (for example, that provided by ISO/IEC 7776 or, more generally, the provision of the OSI Data Link Service defined in CCITT Rec. X.212 | 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 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) generally follow the organization of text in Recommendation X.25.

3.1 Compatibility with versions of Recommendation X.25

The Packet Layer procedures and formats specified in this International Standard are compatible with the 1993 version of Recommendation X.25.

NOTE — The TOA/NPI Address Subscription Facility along with associated addressing procedures and formats, introduced into the 1988 version and further elaborated in the 1993 version of Recommendation X.25, is not included in this International Standard since the ITU-T has continued its designation 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.25-1988

For DTEs needing to operate with the 1988 (Blue Book) version of Recommendation X.25, the following 1993 capabilities are not used:

a) *expanded format of the Address Fields; for 1988 operation, only the Address Block with the A-bit = 0 is permitted (see 12.2);*

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b) *Facility Fields in CALL REQUEST, INCOMING CALL, CALL ACCEPTED, CALL CONNECTED, CLEAR REQUEST, CLEAR INDICATION, and CLEAR CONFIRMATION, packets with a length from 109 to 255 octets (see 12.2.2, 12.2.3.1, 12.2.4.1, 12.2.5.2 and 12.2.6.2); for 1988 operation, this field is limited to 109 octets.*

c) *the following optional user facilities*

— *Alternative Addressing related facilities (see 13.28);*

for 1988 operation, these facilities were not defined;

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

— *Throughput Class Negotiation facilities (see 13.13), and*

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

for 1988 operation, the Extended Throughput Class Negotiation Facility and the Inter-network Call Redirection and Deflection (ICRD) control facilities were not defined;

e) *coding of the following CCITT-specified DTE facilities (renamed "ITU-T specified DTE facilities" in the 1993 version of Recommendation X.25) were modified*

— *Minimum Throughput Class Negotiation (see 15.3.2.3);*

for 1988 operation, only the basic format existed; and

f) the throughput classes of 128 000 bit/s and 192 000 bit/s (in the basic format) and throughput classes from 256 000 bit/s up to, and including, 2 048 000 bit/s (in the extended format); for 1988 operation, the largest throughput class is 64 000 bit/s.

It should also be noted that the term "RPOA" meaning Recognized Private Operating Agency used in 1988 and earlier versions of Recommendation X.25 has been replaced by the term "ROA" meaning Recognized Operating Agency in the 1993 version of Recommendation X.25.

3.1.2 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 in addition to those cited in 3.1.1:

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*

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

— *Called Address Extension (see 15.3.2.2);*

for 1984 operation, only BCD encoding of the addresses is permitted; and

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

3.1.3 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 3.1.2:

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 12.2.3.1 and 12.2.4.1); 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 12.2.5.1.1, 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 12.2.5.2); 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 12.2.6.2); 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),*

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— *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 Recommendation X.25 or a packet handler capability in an ISDN operating in accordance with 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 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 1 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.

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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).*

NOTE — This does not apply if the Reference Number Facility is used.

(The 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 one of the Throughput Class Negotiation facilities (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 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 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/IEC TR 13532 and CCITT Recommendation X.610). The Packet Layer protocol supports all the elements of the OSI connection-mode Network Service specified in CCITT Rec. X.213 | ISO/IEC 8348. Mappings to/from the Packet Layer protocol elements and the primitives and parameters of the connection-mode Network

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Service are described in ITU-T Recommendation X.223 and ISO/IEC 8878. Additional provisions applicable in an ISDN environment are described in CCITT Rec. X.612 | ISO/IEC 9574. Additional provisions applicable to a circuit-switched data network environment are described in CCITT Rec. X.613 | ISO/IEC 10588. Additional provisions applicable to the telephone network environment are described in CCITT Rec. X.614 | ISO/IEC 10732.

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.

3.7.1 Normal mechanism for Logical Channel Identifier assignment

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.

3.7.2 Alternative mechanism for Logical Channel Identifier assignment

This alternative mechanism for Logical Channel Identifier assignment only applies in a DTE/DTE environment.

An alternative mechanism for Logical Channel Identifier assignment, which may be used in DTE/DTE environment only, is provided by the Reference Number Optional User Facility. When this mechanism is used, figure 1 does not apply. Instead, one logical channel exists for each Logical Channel Identifier value in the range 1 to 4 095, but only a limited number of values - as determined by the DTE - need be assigned at any given time to Permanent Virtual Circuits and to Virtual Calls established or in the process of being established.

NOTES

1 Under the normal mechanism for Logical Channel Identifier assignment, the assigned logical channel number of a Virtual Call or a Permanent Virtual Circuit is the same in both directions of transmission at an interface. However, the alternative mechanism for Logical Channel Identifier assignment for a Virtual Call or a Permanent Circuit can assign a different number for each direction of transmission at an interface.

2 The alternative mechanism, by allowing a DTE to choose the logical channel identifier values that can appear in received packets, can ease the task of managing logical channels where a DTE can be involved in simultaneous operation over multiple DTE/DTE interfaces, a situation typical in LAN environment (e.g., in figure 2, DTE Z in its communication with DTEs A and B).

See also:

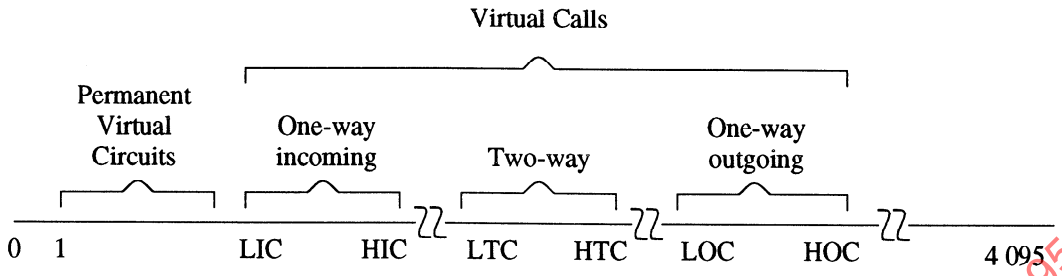
— Optional User Facility for Reference Number (13.29).

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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:



LIC: Lowest Incoming Channel
HIC: Highest Incoming Channel
LTC: Lowest Two-way Channel
HTC: Highest Two-way Channel
LOC: Lowest Outgoing Channel
HOC: Highest Outgoing Channel

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

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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 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

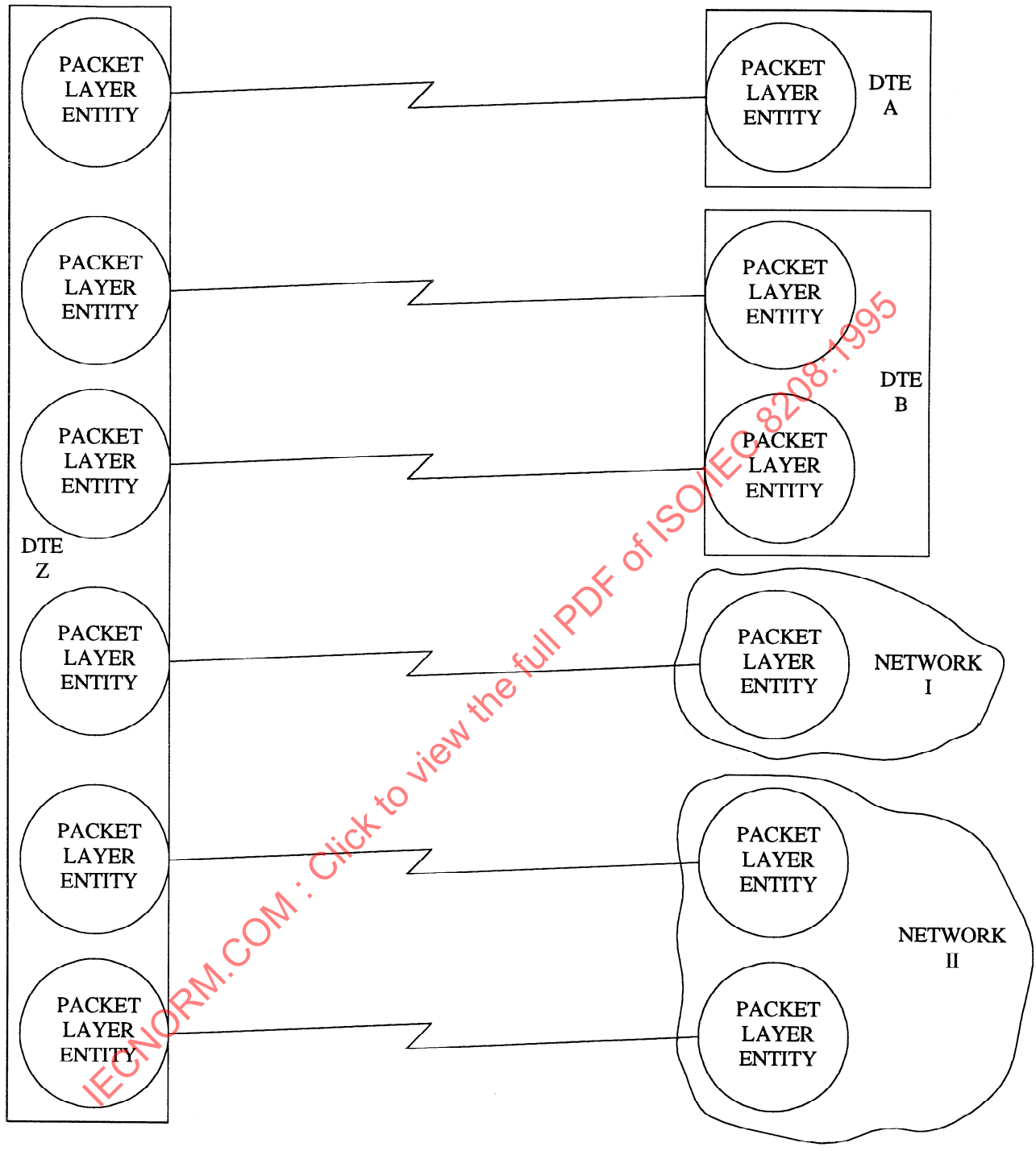


Figure 2 — Packet Layer Entities

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Table 1 — Packet Groupings/Functions

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

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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.

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.

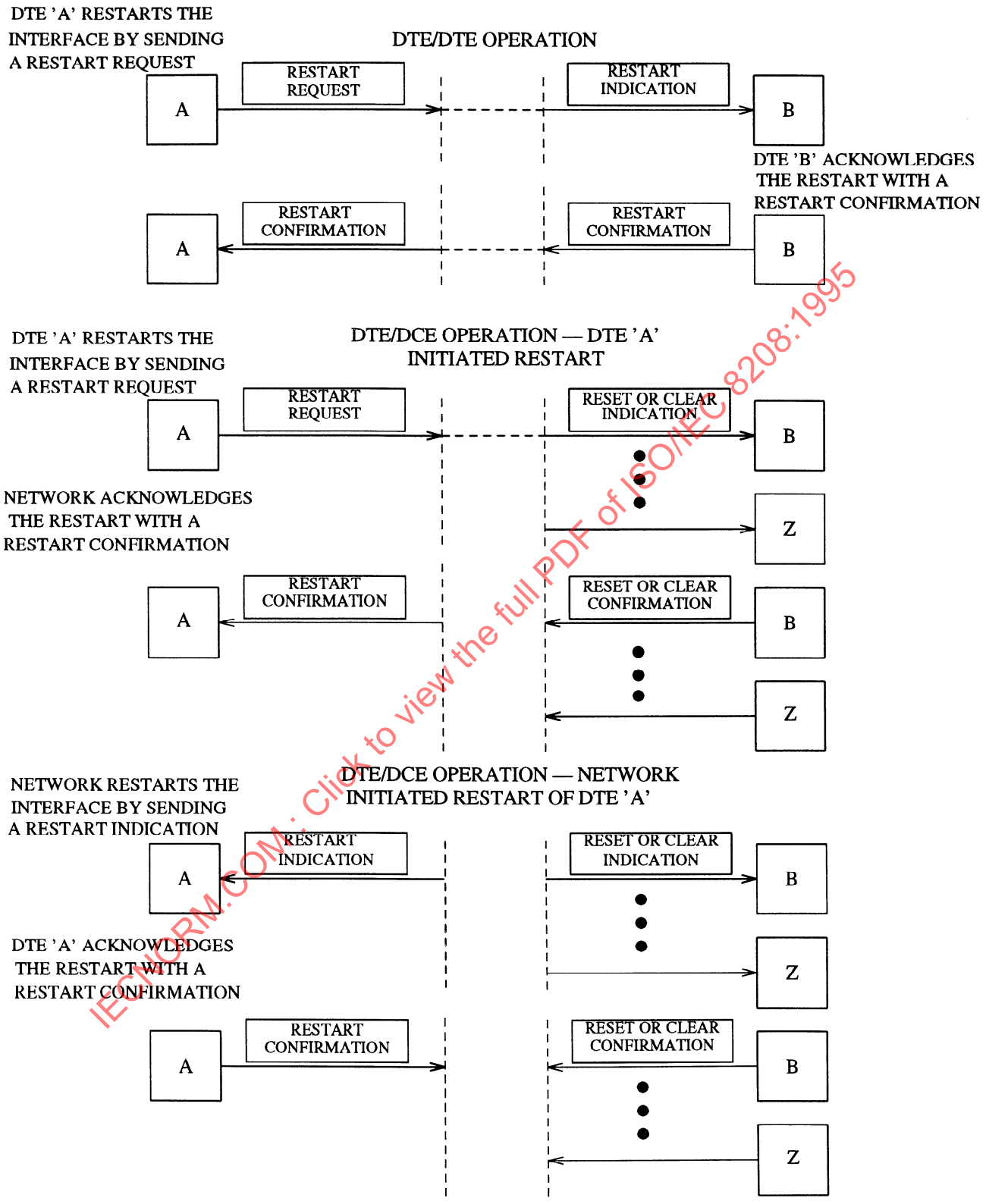
There are three states of a logical channel in relation to the restart procedure. As shown in figure 34, they are the PACKET LAYER READY (r1), DTE RESTART REQUEST (r2), and DXE RESTART INDICATION (r3) states. When entering state r1, *each Virtual Call logical channel is in the READY state (p1), whereas 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 INDICATION, *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



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Figure 3 — Restart Schematic

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 24);

— 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 24);

— 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 25).

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

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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.

NOTES

1 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 described above are not needed. In these cases, the DTE may be initialized to act in the appropriate manner.

2 If a DTE uses the alternative Logical Channel Identifier mechanism (Reference Number Facility) in a DTE/DTE environment, then the procedures described above are not needed.

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);

— Optional User Facility for Reference Number (13.29).

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.) The procedures for selecting a logical channel can be as described here or as described for the Reference Number Facility.

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 35. 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.

See also:

— Optional User Facility for Reference Number (13.29).

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

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.

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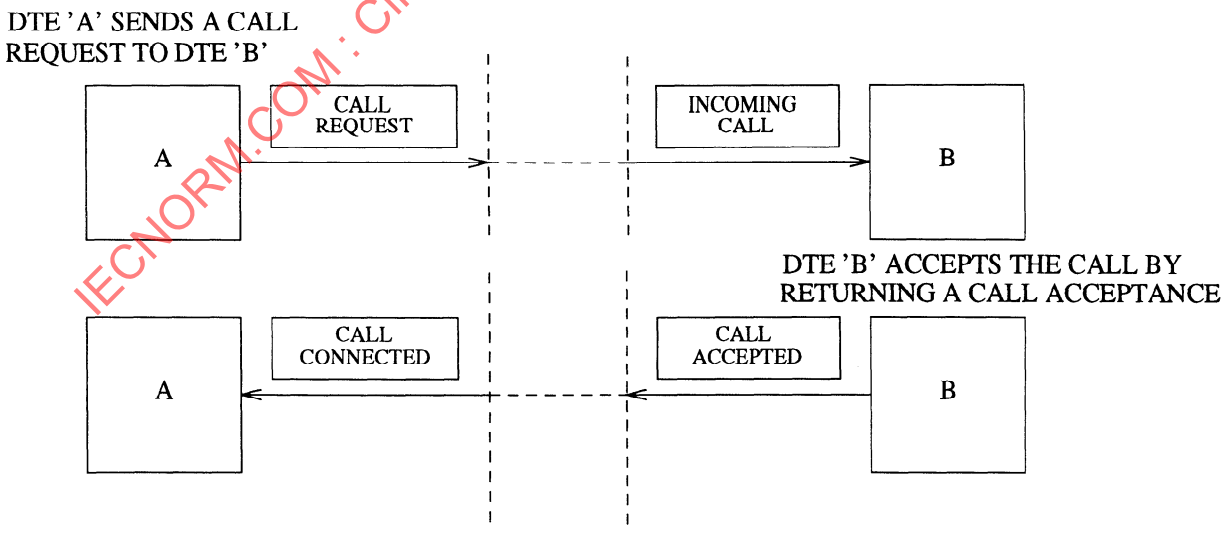
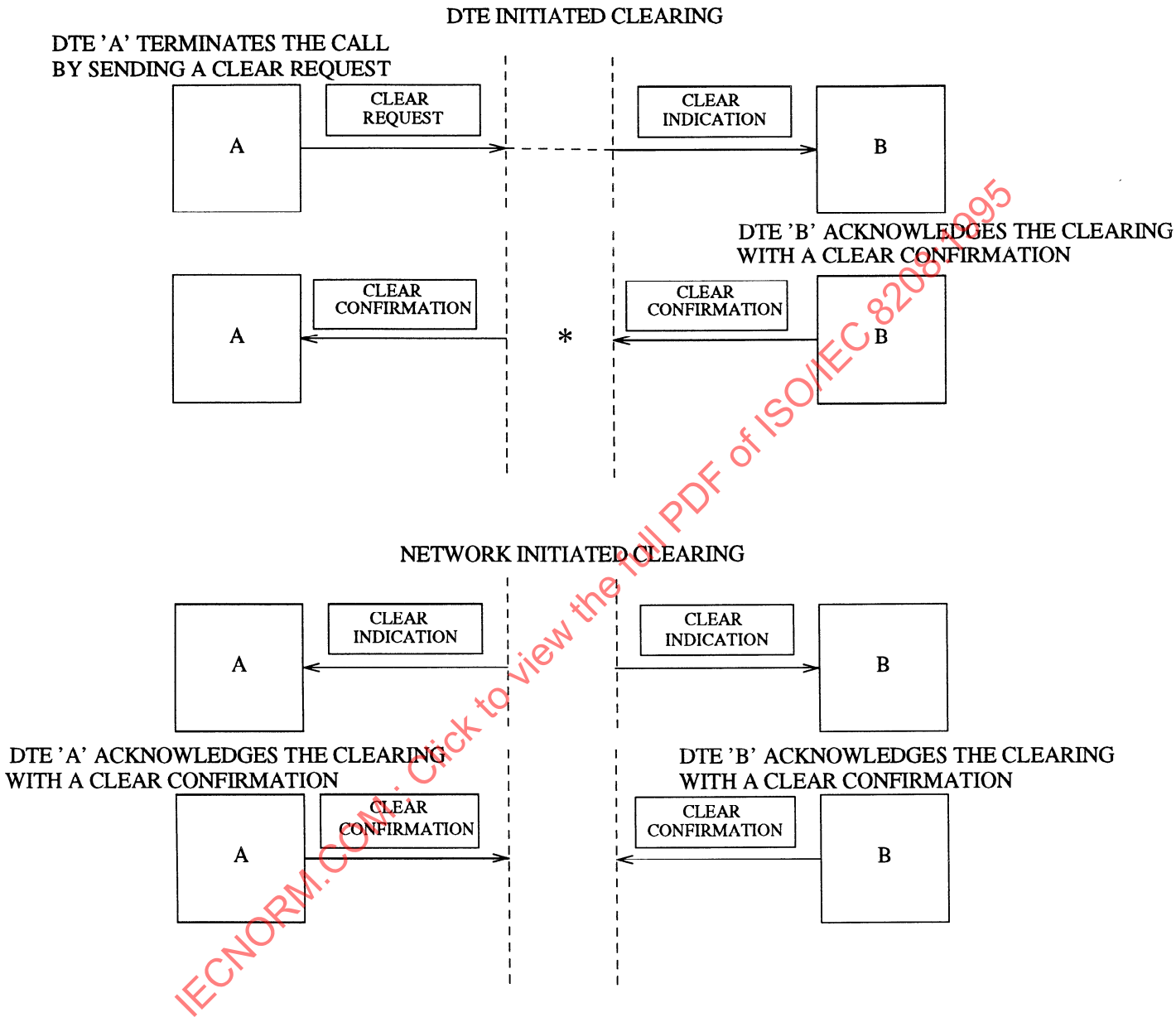


Figure 4 — Call Setup Schematic



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*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

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 (12.2.3 and figure 13);

— 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 (12.2.3 and figure 13);

— 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 (12.2.4 and figure 14);

— 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 (12.2.4 and figure 14);

— 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).

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— 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.*

NOTE — *When using the alternative Logical Channel Identifier assignment mechanism (Reference Number Facility), this subclause does not apply.*

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 (12.2.5 and figure 15);

— 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

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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 (12.2.5 and figure 15);

— Clearing cause (12.2.5);

— 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 (12.2.6 and figure 16).

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 17);

— INTERRUPT packet format (12.3.2 and figure 18);

— 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.

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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:

— Fragmentation and reassembly of messages (6.7);

— Reset procedures (clause 8).

6.5 Complete packet sequence

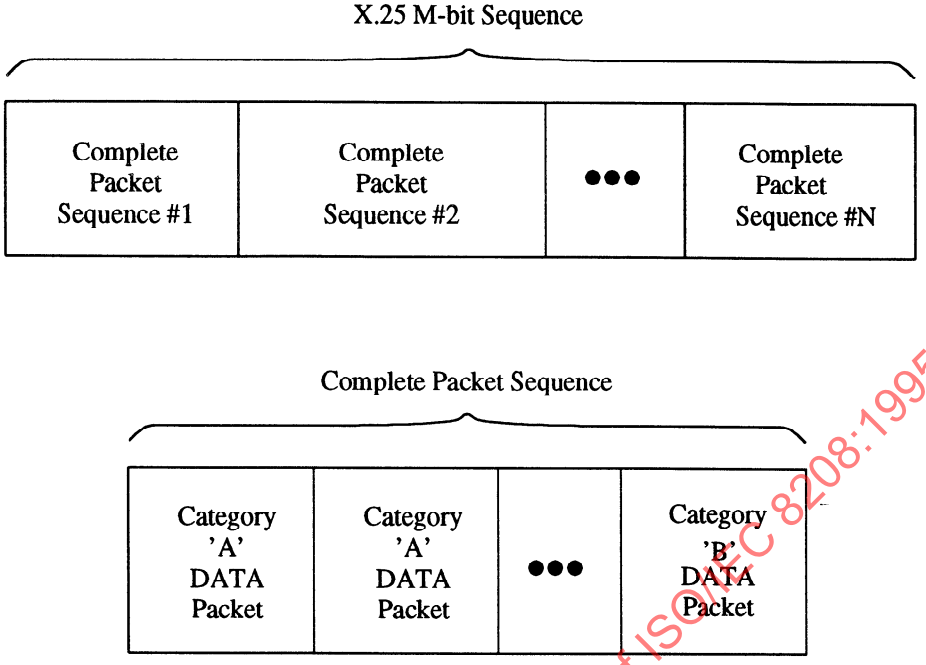
A complete packet sequence is defined as being composed of a single category B packet and all contiguous preceding category A packets (if any). Category A DATA packets have the exact maximum User Data Field length with the M-bit set to 1 and the D-bit set to 0. All other DATA packets are category B packets.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

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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	1 1	<Full Full	Category 'B' DATA packet that marks the end of a CPS but not the end of an MBS
0 0 0 1 1	0 0 1* 0 0	<Full Full <Full <Full Full	Category 'B' DATA packet that simultaneously marks the end of a CPS and an MBS
*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

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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.

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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 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 37. 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.

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 18); 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

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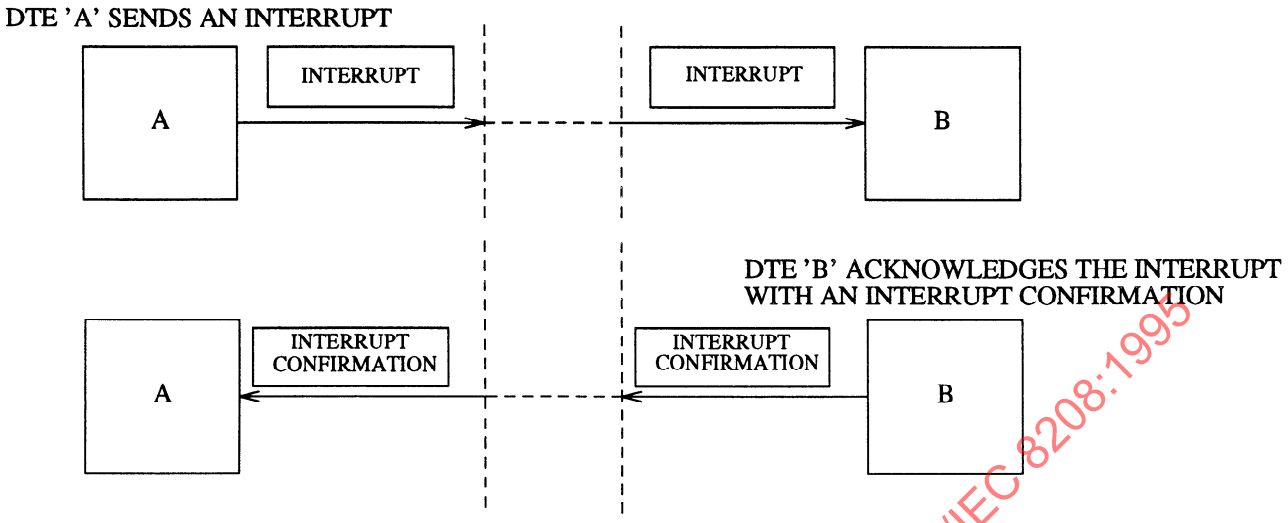


Figure 7 — Interrupt Transfer Schematic

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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 19).

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 38. 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.*

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)."

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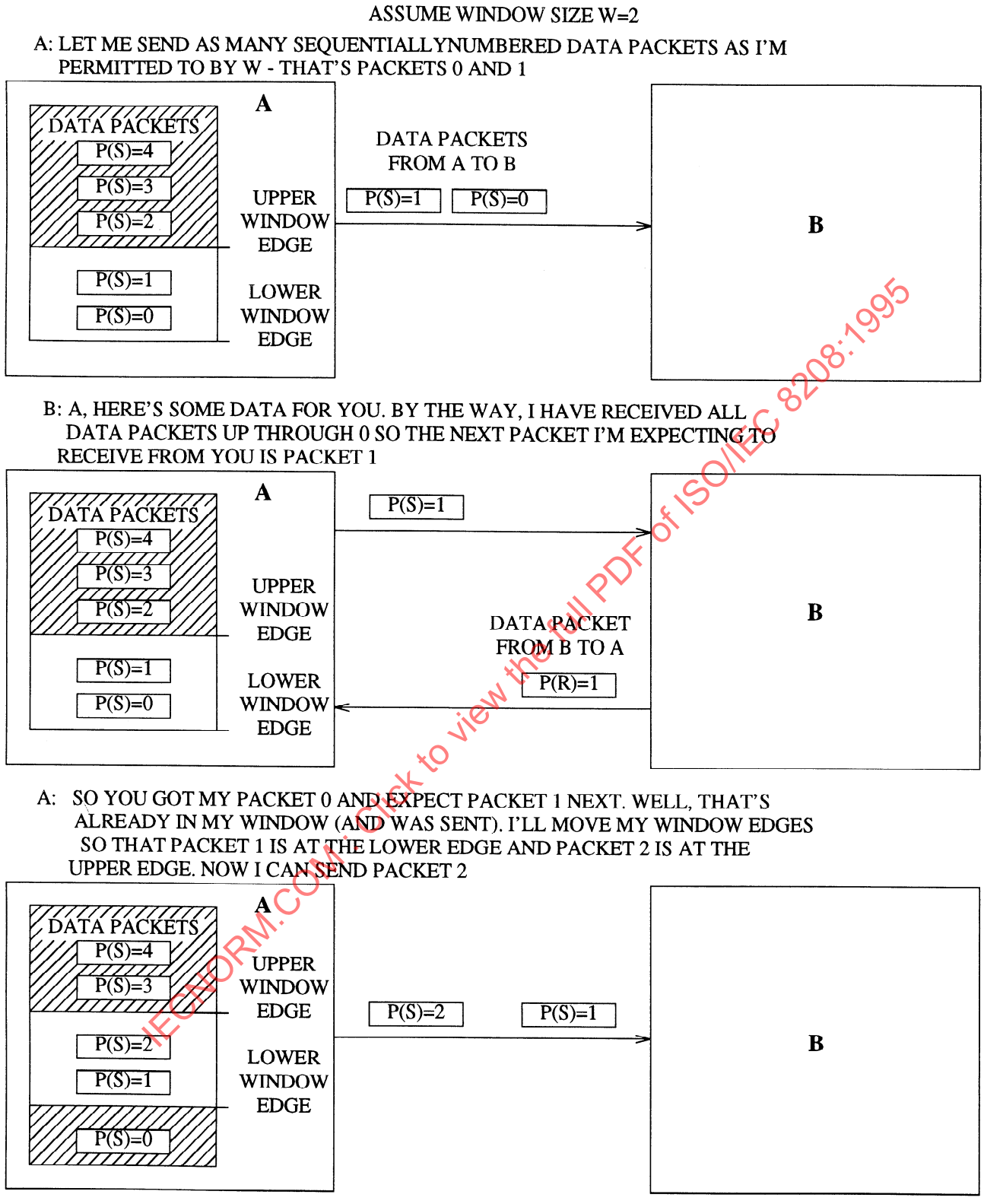


Figure 8 — Flow Control Schematic

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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 20).

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 21);

— RECEIVE READY packet (7.1.5);

— Reset procedures (clause 8).

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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 available 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 to maximize the steady state throughput 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 Extended Packet Sequence Numbering (see 13.2), Nonstandard Default Packet Sizes (see 13.9), Nonstandard Default Window Sizes (see 13.10) *and/or the Flow Control Parameter Negotiation (see 13.12)* facilities may be needed to achieve high values of steady state throughput, especially for Virtual Calls or Permanent Virtual Circuits having high transit delay.

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 one of the Throughput Class Negotiation facilities 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 Facilities 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 36. *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.*

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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 22);

— 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 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 22);

— 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:

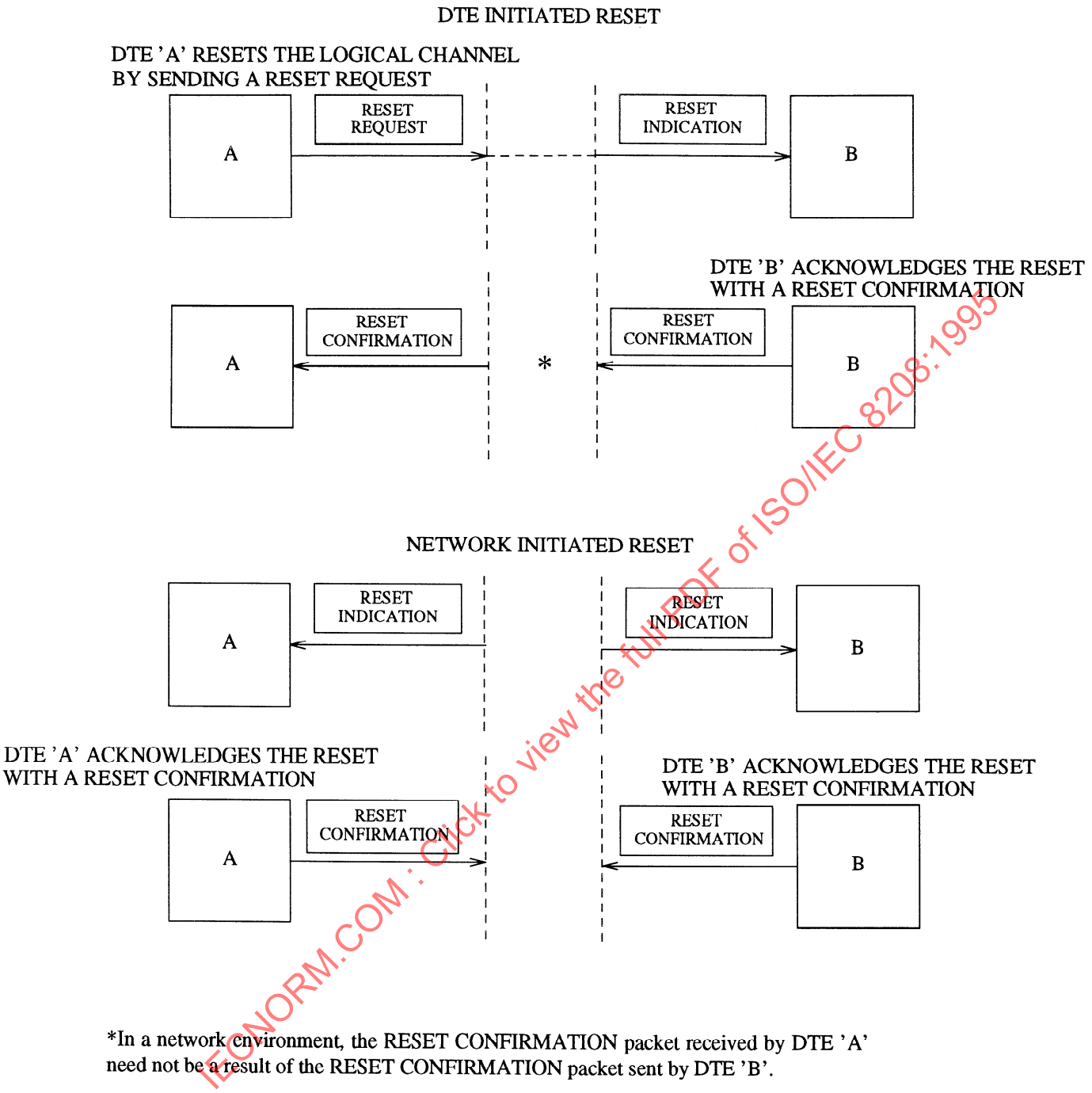
— RESET CONFIRMATION packet format (12.5.2 and figure 23).

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

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*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

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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

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— 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.

See also:

— DIAGNOSTIC packet format (12.7 and figure 26);

— Diagnostic codes (tables 24 and 25);

— Reset procedures (clause 8);

— Clearing procedures (5.5);

— Restart procedures (clause 4).

11.2 Nonreceipt of window-rotation information

The procedures described in this subclause may optionally be implemented by a DTE to recover from nonreceipt of window-rotation information (i.e., nonreceipt of a P(R) to rotate the window after transmission of DATA packets). It is strongly recommended that a higher layer protocol be used to effect such recovery rather than these procedures.

Nonreceipt of window-rotation information, from the viewpoint of the DTE transmitting the DATA packets, can occur because of situations such as:

a) loss of transmitted DATA packets, up to an entire window's worth of DATA packets (in the event that such a loss occurs, the transmitting DTE will not receive packets that rotate the window);

b) loss of a packet containing a P(R) that rotates the window (packets used for conveying a P(R) are the RR, RNR, DATA, and REJECT (if subscribed to) packets);

c) less than a full window's worth of DATA packets with the D-bit set to 0 was transmitted (the DXE, under normal circumstances, is only required to effect window rotation to meet the throughput class and to acknowledge DATA packets with the D-bit set to 1); and

d) the DXE is effecting flow control by allowing the window to close (i.e., without sending an RNR packet) when receiving DATA packets with the D-bit set to 0 because of a temporary lack of resources or other reasons.

Failure to receive window-rotation information, depending on the reason, can lead to a condition in which the transmitting DTE is "flow-control inhibited" at the Packet Layer. If the window has closed, then the transmitting DTE may not transmit any more DATA packets because of the flow-control mechanisms defined in 7.1. The DTE remains flow-control inhibited until its transmission window is rotated and it is not explicitly flow controlled by an RNR packet. Of particular concern are items (a) and (b) above, since the DTE can remain flow-control inhibited indefinitely. This condition is referred to as "flow-control lockout."

See also:

— Window description (7.1.2);

— Flow control principles (7.1.3).

11.2.1 Optional procedures at the transmitting DTE

To effect recovery from nonreceipt of window-rotation information, a DTE may start a Window Rotation Timer (T25) when a DATA packet is transmitted across the DTE/DXE interface. When a P(R) is received that rotates the window, the timer is restarted if there are any previously-transmitted DATA packets still in the window or if additional DATA packets are then transmitted; otherwise, the timer is cancelled. If a P(R) that rotates the window is not received before expiration of T25, then

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the transmitting DTE should:

a) reset the logical channel; or

b) retransmit all previously-transmitted DATA packets in the window, and restart the timer. If the number of retransmissions exceeds a maximum number R25, then the DTE should reset the logical channel.

NOTES

1 This retransmission of DATA packets has nothing to do with the Packet Retransmission Optional User Facility or the use of REJECT packets.

2 A DTE (except if it is operating with one of the alternative procedures described in item (b) or (c) of 11.3) and a DCE will consider receipt of a DATA packet with a P(S) that is out of sequence or outside the window as a procedure error and will reset the logical channel.

When resetting the logical channel as in (a) or (b) above, the DTE indicates the cause as "DTE Originated" with the diagnostic "Timer Expired Or Retransmission Count Surpassed For DATA Packet Transmission."

NOTE 3 — A DCE or DTE receiving DATA packets is not obligated to rotate the window in such a timely fashion so as to prevent the transmitting DTE's T25 timer from expiring (for example, see items (c) and (d) of 11.2). Therefore, the procedure outlined above should be used with caution.

See also:

— Window Rotation Timer (T25) (table 26);

— Data Packet Retransmission Count (R25) (table 27);

— Reset procedures (clause 8).

11.2.2 Optional procedures at the receiving DTE

To decrease the probability of a lost window-rotation indication packet, the DTE may send a RR, RNR, DATA, or REJECT (if subscribed to) packet every T24 time units (i.e., at the expiration of the Window Status Transmission Timer) while the logical channel is in the FLOW CONTROL READY state (d1). If T24 time units have elapsed since the last transmission of a window-rotation indication packet, then either an RR or an RNR packet is sent. The packet that is sent should reflect the current condition of the DTE that transmits it. Thus, if the DTE is unable to accept more DATA packets, then an RNR packet is transmitted; otherwise, an RR packet is transmitted. These packets contain a P(R) corresponding to the most recently-received correct DATA packet. This P(R) then becomes the lower window edge at the transmitting DTE.

The above procedure does not preclude the use of additional algorithms for rotation of the window. This procedure merely attempts to ensure that once a decision is made to rotate the window, the transmission of that decision will be effected even if the original packet is lost.

NOTE — *In a DTE/DCE environment, use of the above procedure at one DTE/DCE interface may not have any effect on the other DTE/DCE interface.*

See also:

— Window Status Transmission Timer (T24) (table 26).

11.3 Receipt of erroneous DATA packets

The normal operation of data transfer requires that DATA packets be received in sequence, be no larger than the maximum-allowed packet size for the current data transfer operation, and contain an integral number of octets in the User Data Field. Receipt of a DATA packet with a nonconsecutive P(S) value (i.e., P(S) ≠ last P(S) + 1, modulo 8, or modulo 128 when extended), with a User Data Field length greater than the allowed maximum, or with a User Data Field not octet aligned is considered an error.

Three alternatives are available to a DTE for recovering from the errors described above. They are:

a) ignore the erroneous DATA packet and reset the logical channel with a cause indicating "DTE Originated" and one of the following diagnostics as appropriate:

— Invalid P(S),

— Packet Too Long, or

— Nonoctet Aligned Data Field;

b) ignore the erroneous DATA packet and transmit a REJECT packet with a P(R) equal to the P(S) expected in the next in-sequence DATA packet.

This alternative may be used only if agreement has been reached on the use of the Packet Retransmission Facility with the interfacing DXE. *Furthermore, in a DTE/DCE environment, packet retransmission by a DCE as a result of receiving a REJECT packet only carries local significance. That is, a DCE will respond to the REJECT packet by retransmitting the requested DATA packet across the local interface (a DCE does not transmit a REJECT packet to the remote DTE).*

c) ignore the erroneous DATA packet and all subsequent DATA packets until the correct DATA packet is received. This procedure depends on the source DTE retransmitting all DATA packets still in the window after its timer T25 has expired up to a maximum of R25 retransmissions. (After this, the source DTE should reset the logical channel with a cause indicating "DTE Originated" and the diagnostic "Timer Expired Or Retransmission Count Surpassed For DATA Packet Transmission.")

In a DTE/DCE environment, the DCE will reset the logical channel if it receives a duplicate DATA packet. This alternative requires that both DTEs have agreed to this method for recovering from erroneous DATA packets.

The standard mode of recovery requires that the logical channel be reset.

See also:

— Reset procedures (clause 8);

— Optional User Facility for Packet Retransmission (13.4);

— Window Rotation Timer (T25) (11.2.1 and table 26);

— Data Packet Retransmission Count (R25) (11.2.1 and table 27);

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— Flow control principles (7.1.3).

12 Packet formats

The information contained in this clause includes:

a) general packet-format information (12.1);

b) formats of the call setup and call clearing packets (12.2);

c) formats of the DATA and interrupt packets (12.3);

d) formats of the flow control packets (12.4);

e) formats of the reset packets (12.5);

f) formats of the restart packets (12.6);

g) format of the DIAGNOSTIC packet (12.7);

h) format of the REJECT packet (12.8); and

i) formats of the registration packets (12.9).

12.1 General

A packet always consists of at least three octets. These three octets contain the General Format Identifier Field, the Logical Channel Identifier Field, and the Packet Type Identifier Field. Depending on the particular packet type, other fields may also be defined. Figure 10 shows the generalized packet format.

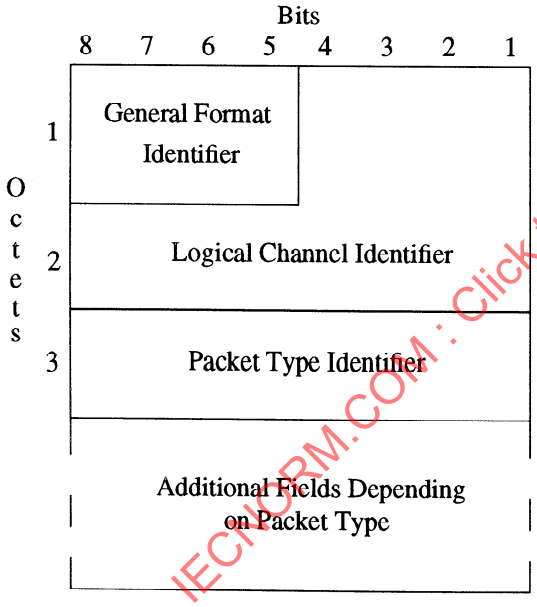


Figure 10 — General Packet Format

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 A-bit in call set-up and call clearing packets,* or as 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.

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 ITU-T. 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).

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Table 3 — General Format Identifier

		OCTET 1 BITS: 8 7 6 5
Sequence numbering scheme modulo 8	Call Setup and DATA packets	X X 0 1
	Call Clearing packets	X 0 0 1
	Flow Control, Interrupt, REJECT, Reset, Restart, Registration, and DIAGNOSTIC packets	0 0 0 1
Sequence numbering scheme modulo 128	Call Setup and DATA packets	X X 1 0
	Call Clearing packets	X 0 1 0
	Flow Control, Interrupt, REJECT, Reset, Restart, Registration, and DIAGNOSTIC packets	0 0 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.

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12.1.1 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.

12.1.2 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 (12.2.3);

b) CALL ACCEPTED and CALL CONNECTED (12.2.4);

c) CLEAR REQUEST and CLEAR INDICATION (12.2.5); and

d) CLEAR CONFIRMATION (12.2.6).

Each of these packets includes an Address Block which is described in 12.2.1.

The packet and Facility Field length restrictions are described in 12.2.2.

See also:

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

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

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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.

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12.2.1 Address block description

Call setup and call clearing packets contain an Address Block. This Address Block has two possible formats as determined by the value of the A-bit in the General Format Identifier. The format where the A-bit is set to 0 can accommodate addresses conforming to the formats described in Recommendations X.121 whose length (including possible prefixes and/or escape codes) is not greater than 15 digits. The format where the A-bit is set to 1 can carry an alternative address in the called DTE Address Field of the CALL REQUEST packet (see 13.28 for more details on alternative addressing). The address format where the A-bit is set to 1 contains, in addition to the address itself, fields to specify the Type Of Address (TOA) and the Numbering Plan Identification (NPI).

NOTES

1 An alternative address is one that does not conform to the formats specified in Recommendation X.121.

2 Other possible uses of the A-bit = 1 Address Block format are for further study in ITU-T.

3 Pending further study in ITU-T, the calling DTE Address Field cannot be used in CALL REQUEST packets when the A-bit = 1.

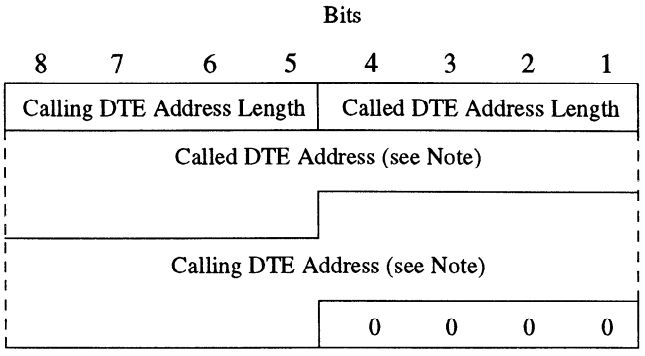
4 Pending further study in ITU-T, all other call setup packets and all call clearing packets use only the A-bit = 0 Address Block format.

The A-bit = 0 Address Block format is supported by all networks and DTEs. The A-bit = 1 Address Block format may be supported by some networks and by some DTEs. DTEs and networks supporting the A-bit = 1 Address Block format shall also support the A-bit = 0 Address Block format.

When transmitting a CALL REQUEST packet, the DTE may use either the A-bit = 0 Address Block format or the A-bit = 1 Address Block format. However, the DTE may use the A-bit = 1 Address Block format only if it is not possible to use the A-bit = 0 Address Block format and if the A-bit = 1 Address Block format is supported by the DXE.

12.2.1.1 Format of the Address Block when the A-bit = 0

Figure 11 illustrates the format of the Address Block when the A-bit is set to 0.



NOTE — 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 — Format of the Address Block when the A-bit = 0

12.2.1.1.1 Calling and Called DTE address length fields

These fields are each four bits long and consist 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.

12.2.1.1.2 Calling and Called DTE 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 with bit 5 or 1 being the low order bit of the digit. Starting from the high-order digit, an 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.

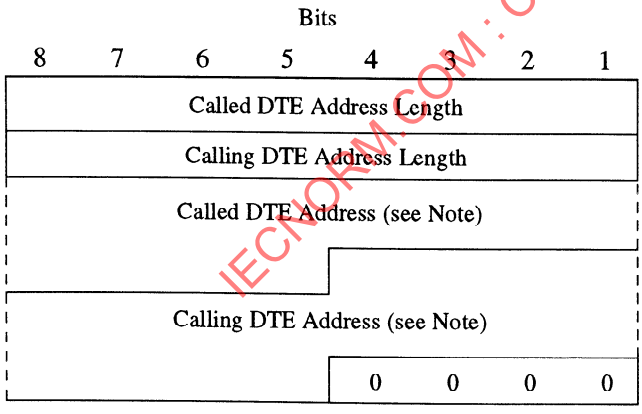
When present, the Calling DTE Address Field starts on the first semi-octet following the end of the Called DTE Address Field, when present. Consequently, when the number of digits of the Called DTE Address Field is odd, the beginning of the Calling DTE Address Field, when present, is not octet aligned.

When the total number of digits in the Called DTE Address Field plus Calling DTE Address Field 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 ITU-T.

12.2.1.2 Format of the Address Block when the A-bit = 1

Figure 12 illustrates the format of the Address Block when the A-bit is set to 1.



NOTE — The figure is drawn assuming the number of semi-octets present in the Called DTE Address Field is odd and the number of semi-octets present in the Calling DTE Address Field is even.

Figure 12 — Format of the Address Block when the A-bit = 1

12.2.1.2.1 Calling and Called DTE address length fields

These fields are each one octet long and consist of field length indicators for the Calling and Called DTE Address fields. The first Address Field Length octet indicates the length of the Called DTE Address Field in semi-octets. The second Address Field Length octet indicates the length of the Calling DTE Address Field in semi-octets. Each address-length indicator is binary-coded, where 1 is the low-order bit of the indicator.

12.2.1.2.2 Calling and Called DTE address fields

These fields respectively consist of the Called DTE Address Field when present and the Calling DTE Address Field when present. Each DTE Address Field, when present, has three subfields: Type Of Address (TOA) subfield, Numbering Plan Identification (NPI) subfield and the Address Digits subfield. The first two subfields are at the beginning of each Address Field and are binary coded.

The coding of the Type Of Address subfield is given in table 5.

Table 5 — Coding of the Type Of Address subfield

Bits: 8	7	6	5	Type Of Address
0	1	0	1	Alternative address
other values				Reserved

The coding of the Numbering Plan Identification subfield is dependent upon the value specified in the Type Of Address subfield. When the Type Of Address subfield indicates an alternative address, the Numbering Plan Identification subfield identifies the coding of the address in accordance with table 6.

12.2.2 Packet and Facility Field length restrictions

The maximum length of call setup and call clearing packets is 259 octets. Each field, except the Facility Field, has a specified maximum as given in the following subclauses. The Facility Field may vary in size up to a value so as to make the packet 259 octets in length.

If any of the field-specific maxima is exceeded or if the maximum packet length is exceeded, the call is cleared as specified in table 33.

NOTE — Although a CALL REQUEST or a CLEAR REQUEST packet does not exceed 259 octets when transmitted across the local DTE/DCE interface, it still may not be compatible in size with all interfaces in route to the remote DTE. This is especially true if, for example, facilities are added to the packet or if the remote DTE's Data Link Layer frame size does not support this length of packet. In such cases, the call is cleared by the network.

12.2.3 CALL REQUEST and INCOMING CALL packets

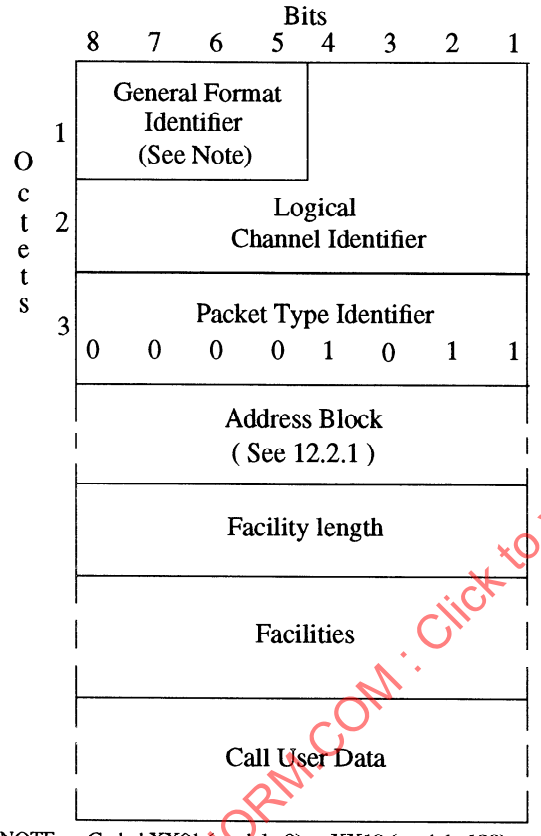
Figure 13 illustrates the format of CALL REQUEST and INCOMING CALL packets.

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.

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Table 6 — Coding of the Numbering Plan Identification subfield when the Type Of Address subfield specifies alternative address

Bits: 4	3	2	1	Alternative Address Coding
0	0	0	0	Character string coded in accordance with Recommendation T.50 | ISO/IEC 646
0	0	0	1	OSI NSAP address coded in accordance with Recommendation X.213 | ISO/IEC 8348
0	0	1	0	Medium Access Control (MAC) address coded in accordance with ISO/IEC 10039
0	0	1	1	Internet address coded in accordance with RFC 1166
other values				Reserved



NOTE — Coded XX01 (modulo 8) or XX10 (modulo 128).

Figure 13 — CALL REQUEST and INCOMING CALL Packet Format

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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. However, bits 8 and 7 of octet 1 (part of the General Format Identifier) are set as noted below.

12.2.3.1.1 General Format Identifier

Bit 8 of the General Format Identifier (octet 1) is set to 0 or 1 according to the Address Block format used as described in 12.2.1. Presently, only the A-bit = 0 format can be used in an INCOMING CALL packet.

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).

12.2.3.1.2 Address Block

The Address Block is described in 12.2.1.

Either the A-bit = 0 Address Block format or, if transmitting an alternative address in the Address Field, the A-bit = 1 Address Block format can be used in a CALL REQUEST packet.

Presently, only the A-bit = 0 Address Block format can be used in an INCOMING CALL packet.

12.2.3.1.3 Facility Length field

The octet following the Address Block 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.

12.2.3.1.4 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 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 255 octets and is also limited by the global maximum length of the packet (see 12.2.2).

See also:

— Coding of the Facility Field (clause 15).

12.2.3.1.5 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 Recommendation X.244).

12.2.3.2 Extended format

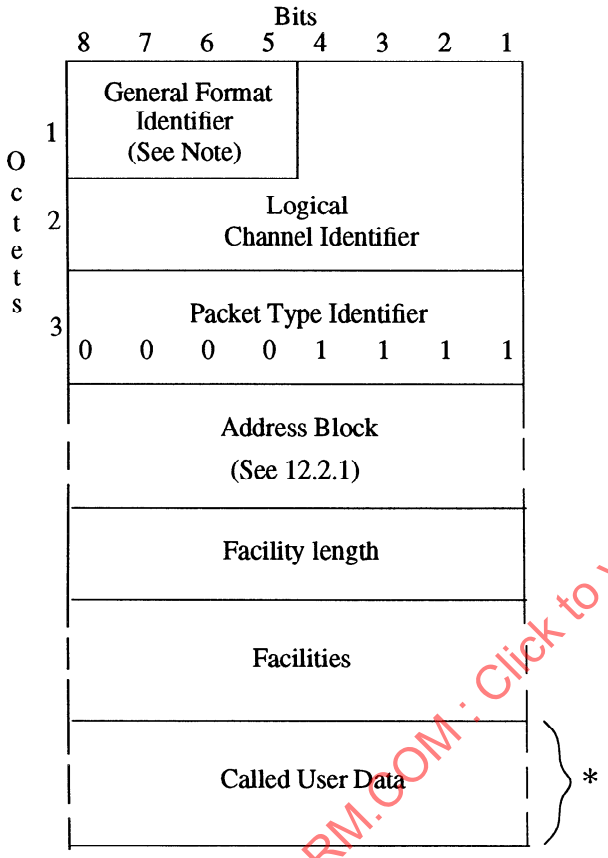
The extended format may be used only in conjunction with the Fast Select Facility. The extended format is identical to the basic format except that the Call User Data Field has a maximum length of 128 octets.

See also:

— Fast Select (13.16).

12.2.4 CALL ACCEPTED and CALL CONNECTED packets

Figure 14 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.*



NOTE — Coded XX01 (modulo 8) or XX10 (modulo 128).

*Used only in the extended format (see 12.2.4.2).

Figure 14 — CALL ACCEPTED and CALL CONNECTED Packet Format

12.2.4.1 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, bits 8 and 7 of octet 1 (part of the General Format Identifier) are set as noted below.

12.2.4.1.1 General Format Identifier

Bit 8 of the General Format Identifier (octet 1) is set to 0 or 1 according to the Address Block format used as described in 12.2.1. Presently, only the A-bit = 0 format can be used for the CALL CONNECTED or CALL ACCEPTED packets.

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).

12.2.4.1.2 Address Block

The Address Block for A-bit = 0 is described in 12.2.1.1.

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

12.2.4.1.3 Facility Length field

The octet following the Address Block 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.

12.2.4.1.4 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 255 octets and is also limited by he global maximum length of the packet (see 12.2.2).

See also:

— Coding of the Facility Field (clause 15).

12.2.4.2 Extended format

The extended format may be used only in conjunction with the Fast Select Facility. 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 Recommendation X.244).

See also:

— Fast Select (13.16).

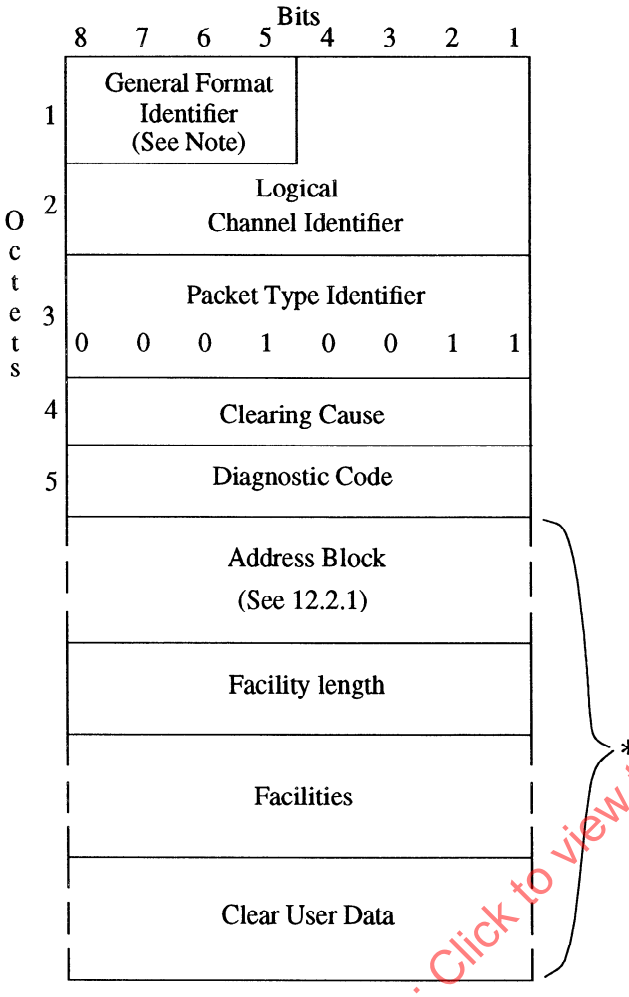
12.2.5 CLEAR REQUEST and CLEAR INDICATION packets

Figure 15 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

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DTE/DTE environment, the CLEAR INDICATION packet received by a DTE is the same as the CLEAR REQUEST packet sent by the other DTE.



NOTE — Coded X001 (modulo 8) or X010 (modulo 128).
*Used only in the extended format (see 12.2.5.2).

Figure 15 — CLEAR REQUEST and CLEAR INDICATION Packet Format

12.2.5.1 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.

Bit 8 of the General Format Identifier is set to 0.

12.2.5.1.1 Clearing Cause field

Octet 4 is the Clearing Cause Field and contains the reason for the clearing of the call.

The Clearing Cause Field in a CLEAR REQUEST shall be set to "DTE Originated" by a DTE.

The coding of the Clearing Cause Field in a CLEAR INDICATION packet is given in table 7 (clearing causes are defined in Recommendation X.96). *In a DTE/DCE environment, a DTE, in order to allow for possible later extensions to table 7, shall be able to accept any value in the Clearing Cause Field in a CLEAR INDICATION packet.*

In a DTE/DTE environment, a DTE may either handle a clearing cause other than "DTE Originated" as it does in a DTE/DCE environment (i.e., process the packet normally) or treat it as an error. In the latter case, the Packet Layer transmits a CLEAR REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Improper Cause Code From DTE."

12.2.5.1.2 Diagnostic Code field

Octet 5 is the Diagnostic Code Field and contains additional information on the reason for the clearing of the call. The coding of the Diagnostic Code Field is dependent on the clearing cause as given in table 24.

In a CLEAR REQUEST packet, the Diagnostic Code Field is required, even if it indicates no additional information.

In a CLEAR INDICATION packet, if the Clearing Cause Field indicates "DTE Originated," the Diagnostic Code Field has been passed unchanged from the remote DTE as a result of its having initiated a clearing procedure *or, in a DTE/DCE environment, a restarting procedure. In a CLEAR INDICATION packet, if the Clearing Cause Field does not indicate "DTE Originated," the Diagnostic Code Field is network generated.*

NOTE — The contents of the Diagnostic Code Field do not alter the meaning of the Clearing Cause Field. A DTE is not required to undertake any action on the contents of the Diagnostic Code Field. The Clearing Cause Field has to be accepted even if the Diagnostic Code Field contains an unspecified code combination.

12.2.5.2 Extended format

The extended format is used only when the DTE or DXE needs to use the Address Fields, the Facility Field, and/or the Clear User Data Field. The Address and Facility Fields are used in a CLEAR REQUEST or CLEAR INDICATION packet in response to an INCOMING CALL or CALL REQUEST packet, respectively, when the Called Line Address Modified Notification Facility (see 13.26) is present. The Facility Field is used when the Charging Information Facility (see 13.22), Reference Number Facility (13.29) or the Facility Marker (15.1) is present. The Clear User Data Field is used in conjunction with the Fast Select Facility (13.16) and the Call Deflection Selection Facility (13.25.2.2).

The description in 12.2.5.1 applies to the extended format and, in addition, the fields defined in 12.2.5.2.1 through 12.2.5.2.4 follow the Diagnostic Code Field.

Bit 8 of the General Format Identifier (octet 1) is set to 0 or 1 according to the Address Block format as described in 12.2.1. Presently, only the A-bit = 0 format can be used.

12.2.5.2.1 Address Block

The Address Block for A-bit = 0 is described in 12.2.1.1.

12.2.5.2.2 Facility Length field

The octet following the Address Block 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.

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Table 7 — Coding of the Clearing Cause Field in CLEAR INDICATION Packets

CLEARING CAUSE	OCTET 4 BITS: 8 7 6 5 4 3 2 1	NOTES
DTE Originated	0 0 0 0 0 0 0 0	1
DTE Originated	1 0 0 0 0 0 0 0	2
Number Busy	X 0 0 0 0 0 0 1	3, 4
Out of Order	X 0 0 0 1 0 0 1	3, 4
Remote Procedure Error	X 0 0 1 0 0 0 1	3, 4
Reverse Charging Acccptance Not Subscribed	X 0 0 1 1 0 0 1	3, 4, 5
Incompatible Destination	X 0 1 0 0 0 0 1	3, 4
Fast Select Acceptance Not Subscribed	X 0 1 0 1 0 0 1	3, 4, 5
Ship Absent	X 0 1 1 1 0 0 1	3, 4, 6
Invalid Facility Request	X 0 0 0 0 0 1 1	3, 4
Access Barred	X 0 0 0 1 0 1 1	3, 4
Local Procedure Error	X 0 0 1 0 0 1 1	3, 4
Network Congestion	X 0 0 0 0 1 0 1	3, 4
Not Obtainable	X 0 0 0 1 1 0 1	3, 4
ROA Out of Order	X 0 0 1 0 1 0 1	3, 4, 5
Gateway-detected Procedure Error	1 1 0 0 0 0 0 1	3
Gateway Congestion	1 1 0 0 0 0 1 1	3

NOTES

1 Used when the Diagnostic Code Field is coded in accordance with table 25.

2 Used when the Diagnostic Code Field is not coded in accordance with table 25.

3 These clearing causes apply only to a DTE/DCE environment.

4 The bit indicated as "X" set to 0 indicates a clearing cause generated by a public data network and set to 1 indicates a clearing cause generated by a private network.

5 May be received only if the corresponding optional user facility is used.

6 Used in conjunction with maritime mobile service.

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12.2.5.2.3 Facility field

The Facility Field is present only when the DTE or DXE is using an optional user facility requiring some indication in the CLEAR REQUEST or CLEAR INDICATION 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 255 octets and is also limited by the global maximum length of the packet (see 12.2.2).

See also:

— Coding of the Facility Field (clause 15).

12.2.5.2.4 Clear User Data field

Following the Facility Field, the Clear 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 cleared between two packet-mode DTEs, networks do not act on any part of the Clear User Data Field (see Recommendation X.244).

12.2.6 CLEAR CONFIRMATION packet

Figure 16 illustrates the format of the CLEAR CONFIRMATION packet transmitted by a DTE as well as the format of the CLEAR CONFIRMATION packet received by a DTE.

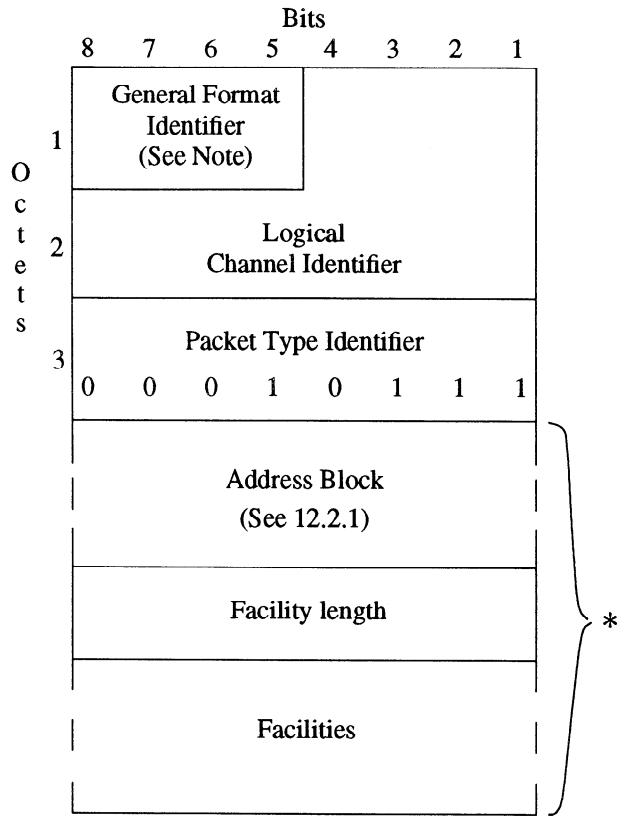
12.2.6.1 Basic format

This packet contains three octets. These 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.

Bit 8 of the General Format Identifier is set to 0.

12.2.6.2 Extended format

The extended format is used for CLEAR CONFIRMATION packets issued by a DCE only in conjunction with the Charging Information Facility (see 13.22). The extended format is used for CLEAR CONFIRMATION packets issued by a DTE only in conjunction with the Reference Number Facility (see 13.29) or



NOTE — Coded X001 (modulo 8) or X010 (modulo 128).

*Used only in the extended format (see 12.2.6.2).

Figure 16 — CLEAR CONFIRMATION Packet Format

where the Facility Marker (15.1) is needed. The description in 12.2.6.1 applies to the extended format and, in addition, the fields defined in 12.2.6.2.1 through 12.2.6.2.3 follow octet 3.

Bit 8 of the General Format Identifier (octet 1) is set to 0 or 1 according to the Address Block format used as described in 12.2.1. Presently, only the A-bit = 0 format can be used for the CLEAR CONFIRMATION packet.

12.2.6.2.1 Address Block

The Address Block for A-bit = 0 is described in 12.2.1.1.

Presently, the Address Length Fields are coded with all zeros. The Address Fields are not present.

12.2.6.2.2 Facility Length field

The octet following the Address Block 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.

12.2.6.2.3 Facility field

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 255 octets and is also limited by the global maximum length of the packet (see 12.2.2).

See also:

— Coding of the Facility Field (clause 15).

12.3 DATA and interrupt packets

The following packets are used for transmitting data or are used with the interrupt procedure:

a) DATA (12.3.1);

b) INTERRUPT (12.3.2); and

c) INTERRUPT CONFIRMATION (12.3.3).

12.3.1 DATA packet

Figure 17 illustrates the format of the DATA packet transmitted by a DTE as well as the format of the DATA packet received by a DTE.

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. In addition, bits 8 and 7 of octet 1 (part of the General Format Identifier) are used as noted below. When packet sequence numbering is performed modulo 8, bits 8 through 2 of octet 3 (part of the Packet Type Identifier) are used as noted below.

12.3.1.1 QUALIFIER bit

Bit 8 of octet 1 is the Qualifier bit (Q-bit).

12.3.1.2 DELIVERY CONFIRMATION bit

Bit 7 of octet 1 is the Delivery Confirmation bit (D-bit).

12.3.1.3 Packet Receive Sequence Number

Bits 8, 7, and 6 of octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the packet receive sequence number P(R). P(R) is binary-coded, where bit 6, or bit 2 when extended, is the low-order bit.

12.3.1.4 More Data bit

Bit 5 of octet 3, or bit 1 of octet 4 when extended, is the More Data bit (M-bit).

12.3.1.5 Packet Send Sequence Number

Bits 4, 3, and 2 of octet 3, or bits 8 through 2 of octet 3 when extended, are used for indicating the packet send sequence number P(S). P(S) is binary-coded, where bit 2 is the low-order bit.

12.3.1.6 User Data field

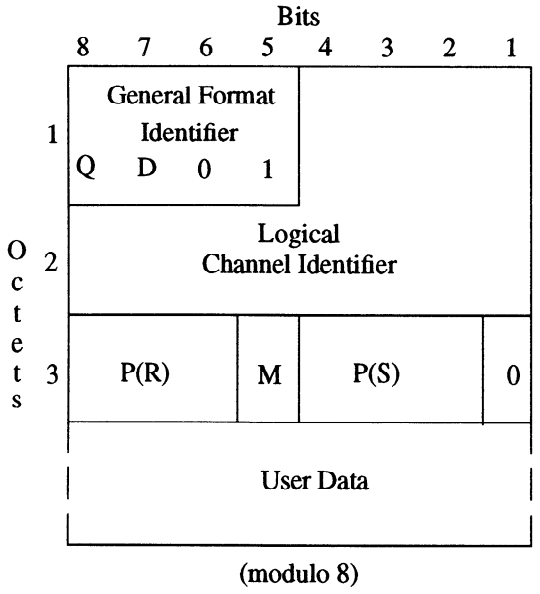
Octets following octet 3, or octet 4 when extended, contain user data. This field shall contain an integral number of octets, as indicated in 12.1. The maximum length of this field is described in 6.2.

12.3.2 INTERRUPT packet

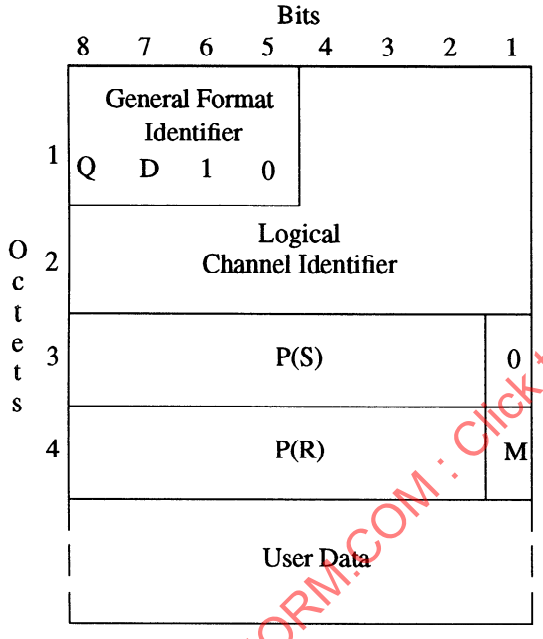
Figure 18 illustrates the format of the INTERRUPT packet transmitted by a DTE as well as the format of the INTERRUPT packet received by a DTE.

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.

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(modulo 8)



(when extended to Modulo 128)

D = DELIVERY CONFIRMATION bit
M = MORE DATA bit
Q = QUALIFIER bit

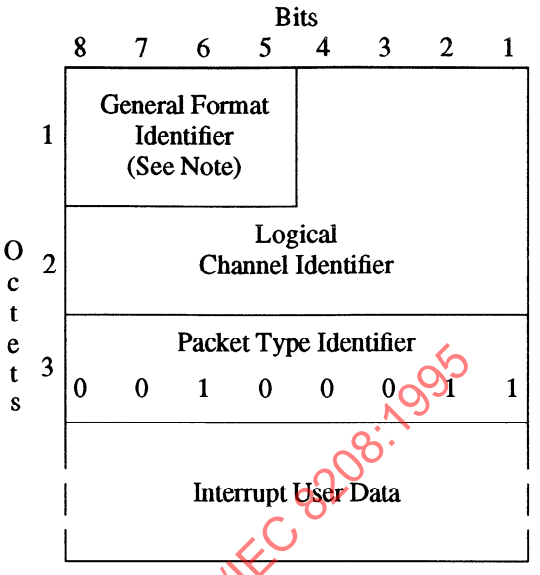
Figure 17 — DATA Packet Format

Interrupt User Data:

Octet 4 and any following octets contain the interrupt user data. This field contains from 1 to 32 octets and shall contain an integral number of octets, as indicated in 12.1.

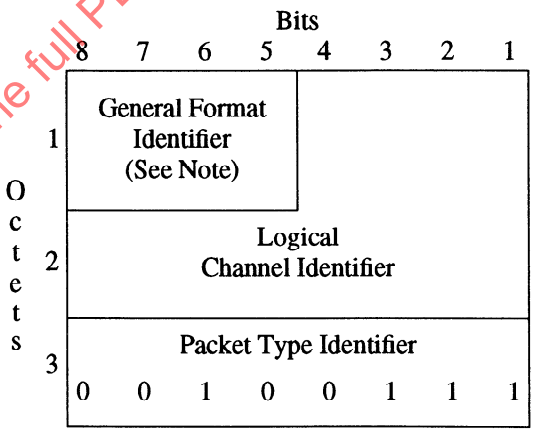
12.3.3 INTERRUPT CONFIRMATION packet

Figure 19 illustrates the format of the INTERRUPT CONFIRMATION packet transmitted by a DTE as well as the format of the INTERRUPT CONFIRMATION packet received by a DTE. This packet contains three octets. These 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 18 — INTERRUPT Packet Format



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

Figure 19 — INTERRUPT CONFIRMATION Packet Format

12.4 Flow control packets

The following packets are used to control the flow of DATA packets (the DATA and REJECT packets, described in 12.3.1 and 12.8, respectively, are also used to control the flow of DATA packets):

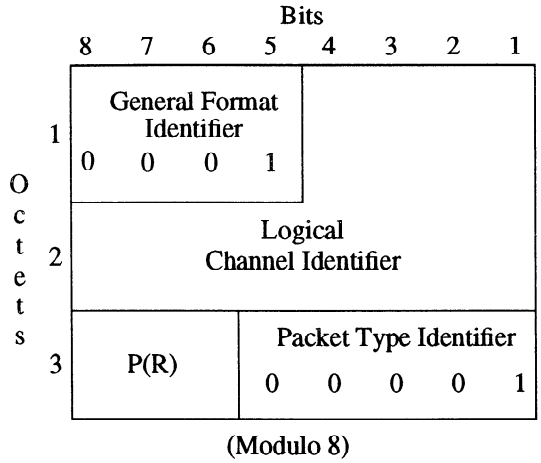
a) RECEIVE READY (12.4.1); and

b) RECEIVE NOT READY (12.4.2).

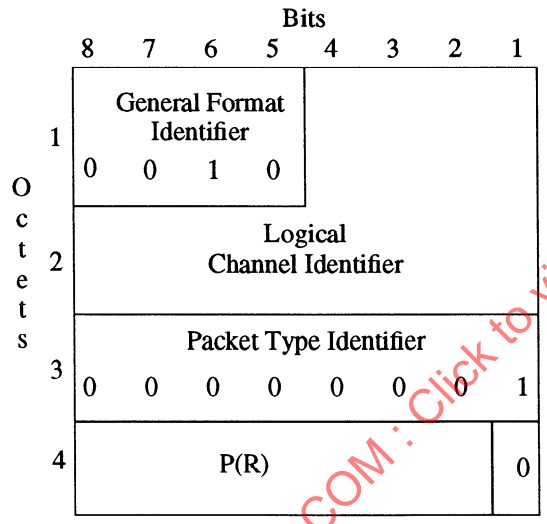
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12.4.1 RECEIVE READY packet

Figure 20 illustrates the format of the RECEIVE READY packet transmitted by a DTE as well as the format of the RECEIVE READY packet received by a DTE.



(Modulo 8)



(when extended to Modulo 128)

Figure 20 — RECEIVE READY Packet Format

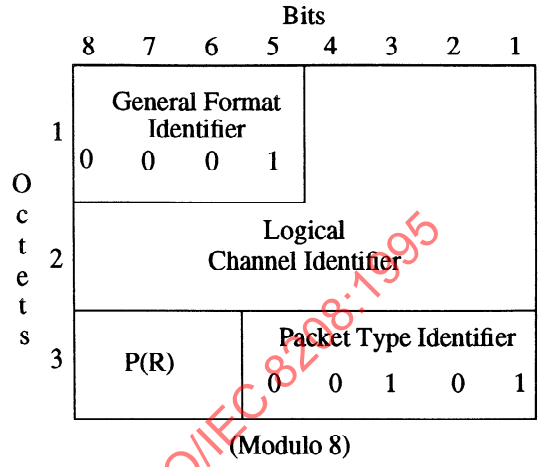
This packet contains three or four octets, depending on whether extended sequence numbering is used. The first three octets consist of the General Format Identifier, the Logical Channel Identifier, and the Packet Type Identifier Fields, as described in 12.1.1 through 12.1.3. However, when packet sequence numbering is performed modulo 8, bits 8, 7, and 6 of octet 3 (part of the Packet Type Identifier) are used as noted below.

Packet Receive Sequence Number:

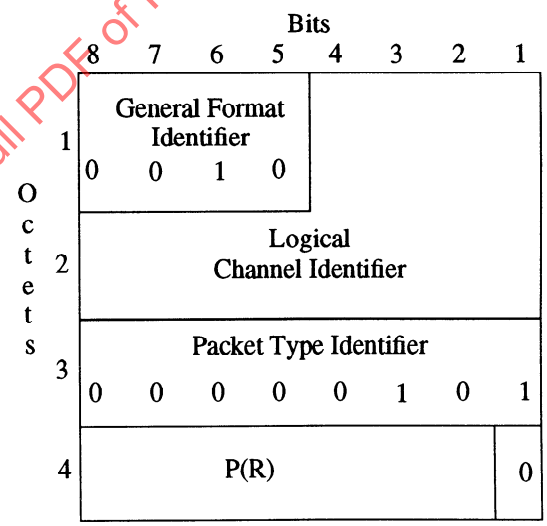
Bits 8, 7, and 6 of octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the packet receive sequence number P(R). P(R) is binary-coded, where bit 6, or bit 2 when extended, is the low-order bit.

12.4.2 RECEIVE NOT READY packet

Figure 21 illustrates the format of the RECEIVE NOT READY packet transmitted by a DTE as well as the format of the RECEIVE NOT READY packet received by a DTE.



(Modulo 8)



(when extended to Modulo 128)

Figure 21 — RECEIVE NOT READY Packet Format

This packet contains three or four octets, depending on whether extended sequence numbering is used. 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, when packet sequence numbering is performed modulo 8, bits 8, 7, and 6 of octet 3 (part of the Packet Type Identifier) are used as noted below.

Packet Receive Sequence Number:

Bits 8, 7, and 6 of octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the packet receive sequence number P(R). P(R) is binary-coded, where bit 6, or bit 2 when extended, is the low-order bit.

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12.5 Reset packets

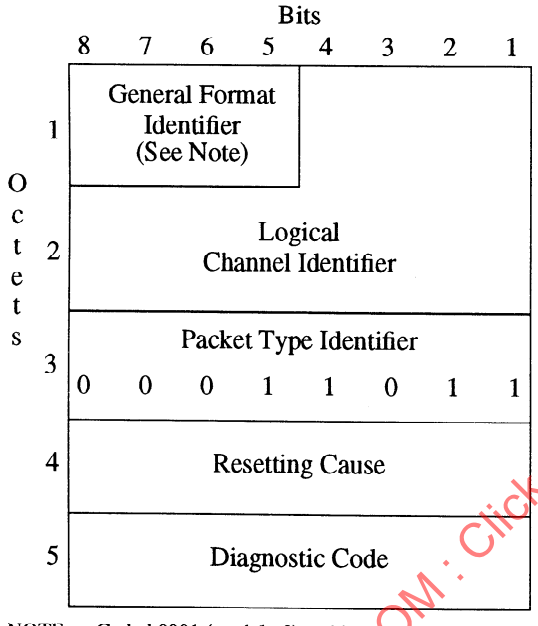
The following packets are used to (re)initialize the flow of DATA, INTERRUPT and flow control packets:

a) RESET REQUEST and RESET INDICATION (12.5.1); and

b) RESET CONFIRMATION (12.5.2).

12.5.1 RESET REQUEST and RESET INDICATION packets

Figure 22 illustrates the format of RESET REQUEST and RESET INDICATION packets. *In a DTE/DCE environment, the RESET REQUEST packet and RESET INDICATION packet are two different "physical" packets because of the intervening network. However, in a DTE/DTE environment, the RESET INDICATION packet received by a DTE is the same as the RESET REQUEST packet sent by the other DTE.*



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

Figure 22 — RESET REQUEST and RESET INDICATION Packet 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.

12.5.1.1 Resetting Cause field

Octet 4 is the Resetting Cause Field and contains the reason for the reset.

The Resetting Cause Field in a RESET REQUEST packet shall be set to "DTE Originated" by a DTE. The coding of the Resetting Cause Field in a RESET INDICATION packet is given in table 8 (resetting causes are defined in Recommendation X.96). *In a DTE/DCE environment, a DTE, in order to allow for possible later extensions to table 8, shall be able to accept any value in the Resetting Cause Field in a RESET INDICATION packet. In a DTE/DTE environment, a DTE may either handle a resetting cause other than "DTE Originated" as it does in a DTE/DCE environment (i.e., process the packet normally) or treat it as an error. In the latter case, the Packet Layer transmits a RESET REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Improper Cause Code From DTE."*

12.5.1.2 Diagnostic Code field

Octet 5 is the Diagnostic Code Field and contains additional information on the reason for the reset. The coding of the Diagnostic Code Field is dependent on the resetting cause as given in table 24.

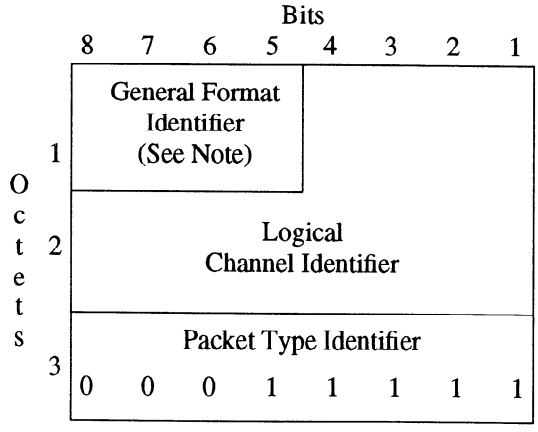
In a RESET REQUEST packet, the Diagnostic Code Field is required, even if it indicates no additional information.

In a RESET INDICATION packet, if the Resetting Cause Field indicates "DTE Originated," the Diagnostic Code Field has been passed unchanged from the remote DTE as a result of its having initiated a resetting procedure *or, in a DTE/DCE environment, a restarting procedure. In a RESET INDICATION packet, if the Resetting Cause Field does not indicate "DTE Originated," the Diagnostic Code Field is network generated.*

NOTE — The contents of the Diagnostic Code Field do not alter the meaning of the Resetting Cause Field. A DTE is not required to undertake any action on the contents of the Diagnostic Code Field. The Resetting Cause Field has to be accepted even if the Diagnostic Code Field contains an unspecified code combination.

12.5.2 RESET CONFIRMATION packet

Figure 23 illustrates the format of the RESET CONFIRMATION packet transmitted by a DTE as well as the format of the RESET CONFIRMATION packet received by a DTE. This packet contains three octets. These 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 23 — RESET CONFIRMATION Packet

12.6 Restart packets

The following packets are used to (re)initialize the DTE/DXE Packet Layer interface:

a) RESTART REQUEST and RESTART INDICATION (12.6.1); and

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Table 8 — Coding of the Resetting Cause Field in RESET INDICATION Packets

RESETTING CAUSE	OCTET 4 BITS: 8 7 6 5 4 3 2 1	NOTES
DTE Originated	0 0 0 0 0 0 0 0	1
DTE Originated	1 0 0 0 0 0 0 0	2
Out of Order	X 0 0 0 0 0 0 1	3, 4, 5
Remote Procedure Error	X 0 0 0 0 0 1 1	3, 4
Local Procedure Error	X 0 0 0 0 1 0 1	3, 4
Network Congestion	X 0 0 0 0 1 1 1	3, 4
Remote DTE Operational	X 0 0 0 1 0 0 1	3, 4, 5
Network Operational	X 0 0 0 1 1 1 1	3, 4, 5
Incompatible Destination	X 0 0 1 0 0 0 1	3, 4
Network Out of Order	X 0 0 1 1 1 0 1	3, 4, 5
Gateway-detected Procedure Error	1 1 0 0 0 0 0 1	3
Gateway Congestion	1 1 0 0 0 0 1 1	3
Gateway Operational	1 1 0 0 0 1 1 1	3, 5

NOTES

1 Used when the Diagnostic Code Field is coded in accordance with table 25.

2 Used when the Diagnostic Code Field is not coded in accordance with table 25.

3 These resetting causes apply only to a DTE/DCE environment.

4 The bit indicated as "X" set to 0 indicates a resetting cause generated by a public data network and set to 1 indicates a resetting cause generated by a private network.

5 Applicable to Permanent Virtual Circuits only.

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b) RESTART CONFIRMATION (12.6.2).

12.6.1 RESTART REQUEST and RESTART INDICATION packets

Figure 24 illustrates the format of RESTART REQUEST and RESTART INDICATION packets.

In a DTE/DCE environment, the RESTART REQUEST packet and RESTART INDICATION packet apply only at a local DTE/DCE interface. However, in a DTE/DTE environment, the RESTART INDICATION packet received by a DTE is the same as the RESTART REQUEST packet sent by the other DTE.

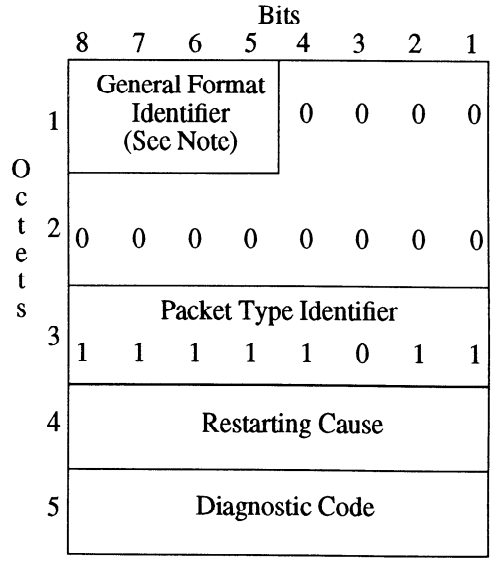
The first three octets consist of the General Format Identifier, the Logical Channel Identifier, and the Packet Type Identifier Fields, as described in 12.1.1 through 12.1.3. However, the Logical Channel Identifier Field is coded as all zeros.

12.6.1.1 Restarting Cause field

Octet 4 is the Restarting Cause Field and contains the reason for the restart.

The Restarting Cause Field in a RESTART REQUEST packet shall be set to "DTE Originated" by a DTE.

The coding of the Restarting Cause Field in a RESTART INDICATION packet is given in table 9 (restarting causes are defined in Recommendation X.96). *In a DTE/DCE environment, a DTE, in order to allow for possible later extensions to table 9, shall be able to accept any value in the Restarting Cause Field in a RESTART INDICATION packet. In a DTE/DTE environment, a DTE may either handle a restarting cause other than "DTE Originated" as it does in a DTE/DCE environment (i.e., process*



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

Figure 24 — RESTART REQUEST and RESTART INDICATION Packet Format

Table 9 — Coding of the Restarting Cause Field in RESTART INDICATION Packets

RESTARTING CAUSE	OCTET 4 BITS: 8 7 6 5 4 3 2 1	NOTES
DTE Originated	0 0 0 0 0 0 0 0	1, 2
DTE Originated	1 0 0 0 0 0 0 0	1, 3
Local Procedure Error	0 0 0 0 0 0 0 1	4
Network Congestion	0 0 0 0 0 0 1 1	4
Network Operational	0 0 0 0 0 1 1 1	4
Registration/Cancellation Confirmed	0 1 1 1 1 1 1 1	4, 5

NOTES

1 These restarting causes apply only to a DTE/DTE environment.

2 Used when the Diagnostic Code Field is coded in accordance with table 25.

3 Used when the Diagnostic Code Field is not coded in accordance with table 25.

4 These restarting causes apply only to a DTE/DCE environment.

5 May be received only if the On-line Facility Registration Facility (see 13.1) is used.

the packet normally) or treat it as an error. In the latter case, the Packet Layer transmits a RESTART REQUEST packet with a cause indicating "DTE Originated" and the diagnostic "Improper Cause Code From DTE."

12.6.1.2 Diagnostic Code field

Octet 5 is the Diagnostic Code Field and contains additional information on the reason for the restart. The coding of the Diagnostic Code Field is dependent on the restarting cause as given in table 24.

In a RESTART REQUEST packet, the Diagnostic Code Field is required, even if it indicates no additional information.

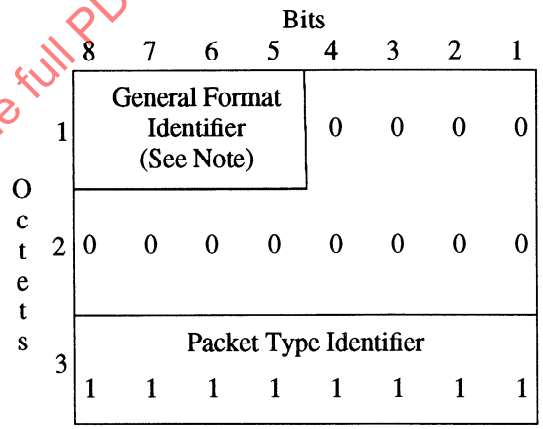
In network applications, the Diagnostic Code in a RESTART REQUEST packet is passed to the corresponding DTEs as the Diagnostic Code of a RESET INDICATION packet for Permanent Virtual Circuits or as the Diagnostic Code of a CLEAR INDICATION packet for Virtual Calls.

NOTE — The contents of the Diagnostic Code Field do not alter the meaning of the Restarting Cause Field. A DTE is not required to undertake any action on the contents of the Diagnostic Code Field. The Restarting Cause Field has to be accepted even if the Diagnostic Code Field contains an unspecified code combination.

12.6.2 RESTART CONFIRMATION packet

Figure 25 illustrates the format of the RESTART CONFIRMATION packet transmitted by a DTE as well as the format of the RESTART CONFIRMATION packet received by a DTE.

This packet contains three octets. These 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, the Logical Channel Identifier Field is coded as all zeros.



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

Figure 25 — RESTART CONFIRMATION Packet Format

12.7 DIAGNOSTIC packet

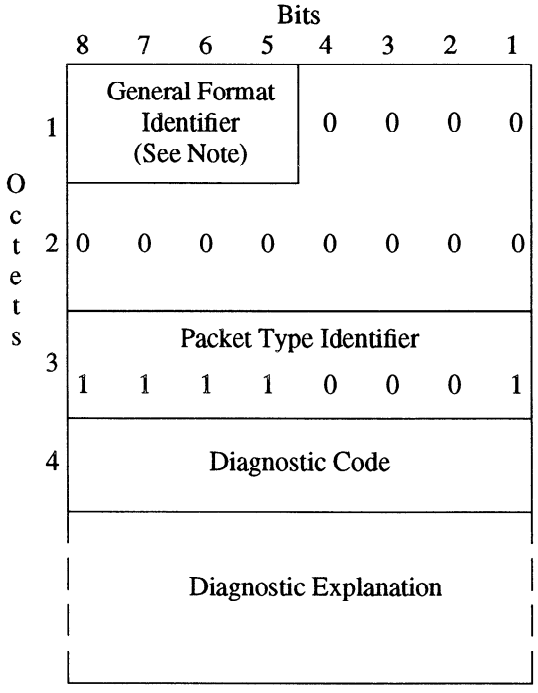
Figure 26 illustrates the format of the DIAGNOSTIC packet.

All DTEs shall be capable of receiving a DIAGNOSTIC packet. *The DIAGNOSTIC packet may be used in a DTE/DCE environment, and then only to be sent by a DCE to a DTE.*

The DIAGNOSTIC packet may be originated by a DTE only in a DTE/DTE environment provided its generation can be suppressed when connected to a network.

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, the Logical Channel Identifier Field is coded as all zeros.

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

Figure 26 — DIAGNOSTIC Packet Format

12.7.1 Diagnostic Code field

Octet 4 is the Diagnostic Code Field and contains information on the error condition which resulted in the transmission of the DIAGNOSTIC packet. The coding of the Diagnostic Code Field is given in table 24.

12.7.2 Diagnostic Explanation field

When the DIAGNOSTIC packet is issued as a result of the reception of an erroneous packet (i.e., a packet with one of the conditions listed in tables 31 or 32), this field contains the first three octets of header information from the erroneous packet. If the erroneous packet contains less than three octets, then this field contains *only integral octets, if any, that were received by a DTE in a DTE/DTE environment or whatever bits were received by a DCE in a DTE/DCE environment.*

When the DIAGNOSTIC packet is issued as a result of a time-out, the Diagnostic Explanation Field contains 2 octets coded as follows.

a) Bits 8, 7, 6, and 5 of the first octet contain the General Format Identifier for the interface.

b) Bits 4 through 1 of the first octet and bits 8 through 1 of the second octet are all 0 for expiration of the restart timer *(T10 for DTE/DCE environment)* and give the number of the logical channel on which the time-out occurred for expiration of the reset timer *(T12 for DTE/DCE environment)* or the clear timer *(T13 for DTE/DCE environment).*

12.8 REJECT packet

Figure 27 illustrates the format of the REJECT packet used in conjunction with the Packet Retransmission Facility (see 13.4).

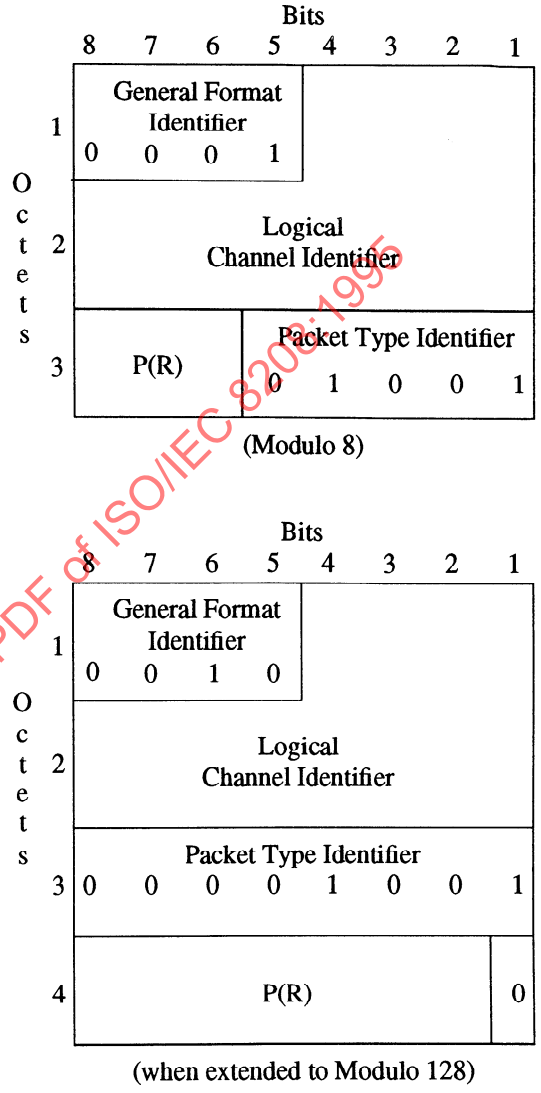


Figure 27 — REJECT Packet Format

This packet contains three or four octets, depending on whether extended sequence numbering is used. 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 when packet sequence numbering is performed modulo 8, bits 8, 7, and 6 of octet 3 (part of the Packet Type Identifier) are used as noted below.

Packet Receive Sequence Number:

Bits 8, 7, and 6 of octet 3, or bits 8 through 2 of octet 4 when extended, are used for indicating the packet receive sequence number P(R). P(R) is binary-coded, where bit 6, or bit 2 when extended, is the low-order bit.

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12.9 Registration packets

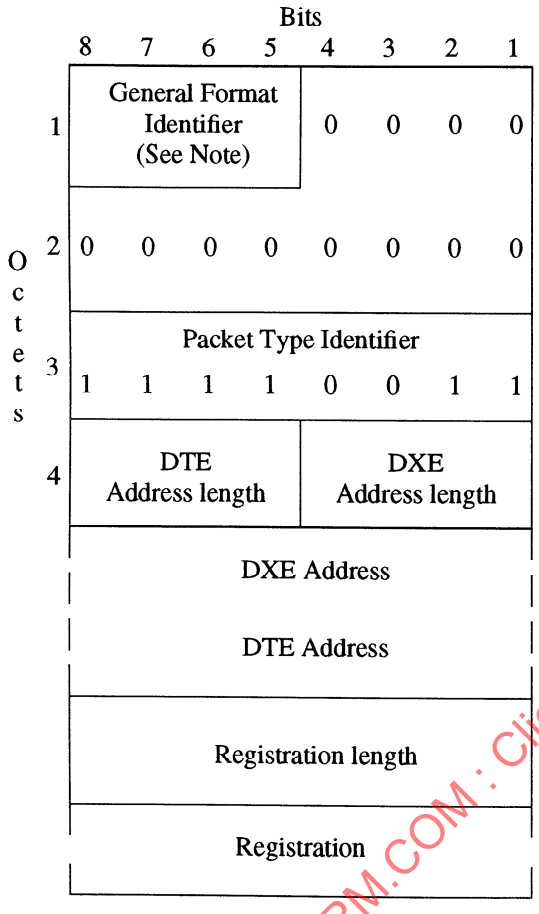
The following packets are used in conjunction with the On-line Facility Registration Facility (see 13.1):

a) REGISTRATION REQUEST (12.9.1); and

b) REGISTRATION CONFIRMATION (12.9.2).

12.9.1 REGISTRATION REQUEST packet

Figure 28 illustrates the format of the REGISTRATION REQUEST packet.



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

Figure 28 — REGISTRATION REQUEST Packet 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, the Logical Channel Identifier Field is coded as all zeros.

12.9.1.1 Address Length fields

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

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

12.9.1.2 Address fields

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

12.9.1.3 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.

12.9.1.4 Registration field

The Registration Field is present only when a change in agreement is desired for one or more optional user facilities.

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).

12.9.2 REGISTRATION CONFIRMATION packet

Figure 29 illustrates the format of the REGISTRATION CONFIRMATION packet.

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, the Logical Channel Identifier Field is coded as all zeros.

12.9.2.1 Cause field

Octet 4 is the Cause Field and contains the cause of any failure in negotiation of facilities or an indication that the Registration Field was acceptable.

The coding of the Cause Field in a REGISTRATION CONFIRMATION packet is given in table 10.

12.9.2.2 Diagnostic Code field

Octet 5 is the Diagnostic Code Field and contains additional information on the reason for failure of facilities negotiation.

The coding of the Diagnostic Code Field is given in table 24. The bits of the Diagnostic Code Field are all set to 0 when negotiation is successful or when no additional information is supplied.

12.9.2.3 Address Length fields

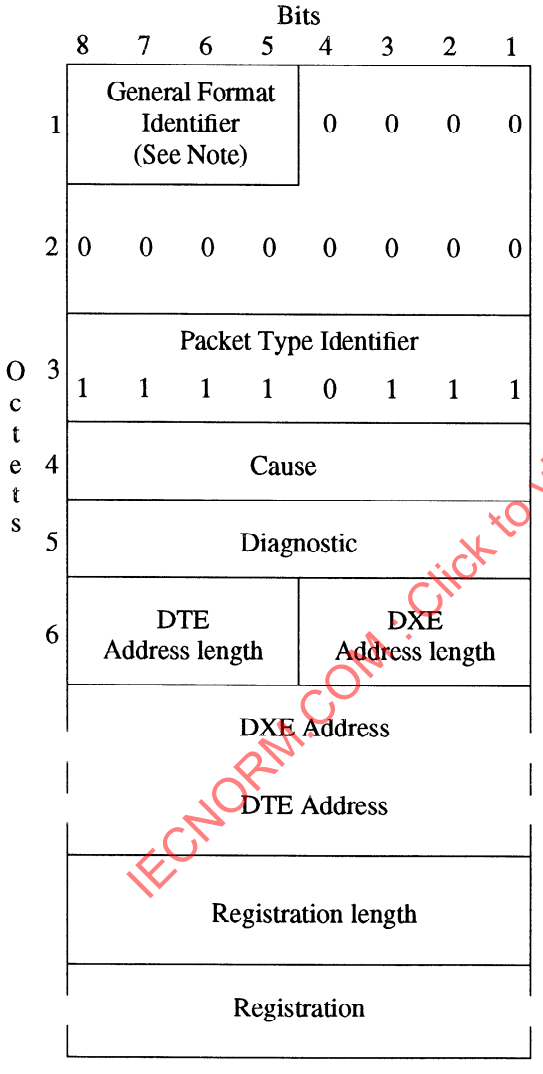
Octet 6 consists of field-length indicators for the addresses of the DTE and the interfacing DXE. Bits 8, 7, 6, and 5 indicate the length, in semi-octets, of the address of the DTE receiving the REGISTRATION CONFIRMATION packet. Bits 4, 3, 2, and 1 indicate the length, in semi-octets, of the address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

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

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Table 10 — 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



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

Figure 29 — REGISTRATION CONFIRMATION Packet Format

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 11 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 at any time 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 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

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Table 11 (1 of 2) — Packet Layer Optional User Facilities

Optional User Facility	See Clause	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	13.1	A	A	Yes	No	Yes[2]
Extended Packet Sequence Numbering	13.2	A	A	Yes	No	Yes
D-bit Modification	13.3	A	A	Yes	No	No
Packet Retransmission	13.4	A	A	Yes	No	Yes[2]
Incoming Calls Barred	13.5	E	—	Yes	No	No[3]
Outgoing Calls Barred	13.6	E	—	Yes	No	No[3]
One-way Logical Channel Outgoing	13.7	E	—	Yes	No	Yes
One-way Logical Channel Incoming	13.8	A	—	Yes	No	Yes
Nonstandard Default Packet Sizes	13.9	A	A	Yes	No	Yes
Nonstandard Default Window Sizes	13.10	A	A	Yes	No	Yes
Default Throughput Classes Assignment	13.11	A	A	Yes	No	Yes
Flow Control Parameter Negotiation	13.12	E	—	Yes	Yes[4]	Yes
Throughput Class Negotiation related facilities	13.13					
—Basic Throughput Class Negotiation	13.13	E	—	Yes	Yes[4]	Yes
—Extended Throughput Class Negotiation	13.13	A	—	Yes	Yes[4]	Yes
Closed User Group related facilities	13.14					
—Closed User Group	13.14.1	E	—	Yes	No	No
—Closed User Group With Outgoing Access	13.14.2	A	—	Yes	No	No
—Closed User Group With Incoming Access	13.14.3	A	—	Yes	No	No
—Incoming Calls Barred Within a Closed User Group	13.14.4	A	—	Yes	No	No
—Outgoing Calls Barred Within a Closed User Group	13.14.5	A	—	Yes	No	No
—Closed User Group Selection	13.14.6	E	—	No	Yes[4]	No
—Closed User Group With Outgoing Access Selection	13.14.7	A	—	No	Yes[4]	No
Bilateral Closed User Group related facilities	13.15					
—Bilateral Closed User Group	13.15.1	A	—	Yes	No	No
—Bilateral Closed User Group With Outgoing Access	13.15.2	A	—	Yes	No	No
—Bilateral Closed User Group Selection	13.15.3	A	—	No	Yes[4]	No
Fast Select	13.16	E	—	No	Yes	Yes[5]
Fast Select Acceptance	13.17	E	—	Yes	No	No[3]
Reverse Charging	13.18	A	—	No	Yes	No
Reverse Charging Acceptance	13.19	A	—	Yes	No	No
Local Charging Prevention	13.20	A	—	Yes	No	No

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Table 11 (2 of 2) — Packet Layer Optional User Facilities

Optional User Facility	See Clause	Classification[1]: VC*	Classification[1]: PVC*	Agree For Period Of Time?	Applies Per Call?	Applies To DTE/DTE Operation? (Note 6)
Network User Identification (NUI) related facilities	13.21					
—NUI Subscription	13.21.1	A	—	Yes	No	No
—NUI Override	13.21.2	A	—	Yes	No	No
—NUI Selection	13.21.3	A	—	No	Yes[4]	No
Charging Information	13.22	A	—	Yes	Yes	No
ROA related facilities	13.23					
—ROA Subscription	13.23.1	A	—	Yes	No	No
—ROA Selection	13.23.2	A	—	No	Yes	No
Hunt Group	13.24	A	—	Yes	No	No
Call Redirection and Call Deflection related facilities	13.25					
—Call Redirection	13.25.1	A	—	Yes	No	No
—Call Deflection Subscription	13.25.2.1	A	—	Yes	No	No
—Call Deflection Selection	13.25.2.2	A	—	No	Yes[4]	No
—Call Redirection or Call Deflection Notification	13.25.3	A	—	No	Yes	No
—ICRD Prevention Subscription	13.25.4.1	A	—	Yes	No	No
—ICRD Status Selection	13.25.4.2	A	—	No	Yes	No
Called Line Address Modified Notification	13.26	E	—	No	Yes	No
Transit Delay Selection And Indication	13.27	E	—	No	Yes	No
Alternative Addressing related facilities	13.28	A				
—Global Alternative Address Registration	13.28.1.1	A	—	Yes	No	No
—Interface Specific Alternative Address Registration	13.28.1.2	A	—	Yes	No	No
—Alternative Address Usage Subscription	13.28.2	A	—	Yes	No	No
Reference Number[7]	13.29			Yes	Yes[4]	Yes

*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 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.

7 This facility, which does not appear in Recommendation X.2, applies only to DTE/DTE operation. It is applicable for both Virtual Calls and Permanent Virtual Circuits.

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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 28);

— 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 29);

— 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

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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 29);

— 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 12 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)
   — Hunt Group (13.24),
   — Alternate addressing related facilities (13.28), and
   — Reference Number (13.29);

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 for which the applicability of the registration procedure is for further study by ITU-T:
   — ROA Subscription (13.23.1),
   — Call Redirection (13.25.1),
   — Call Deflection related facilities (13.25.2), and
   — Call Redirection or Call Deflection Notification (13.25.3).

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Table 12 (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	—	—	—	—
	ROA Subscription	—	—	—	—
	Hunt Group	—	—	—	—
	Call Redirection and Call Deflection related facilities	—	—	—	—
	Transit Delay Selection and Indication	—	—	—	—
	Alternate Addressing related facilities	—	—	—	—
	Reference Number	—	—	—	—
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
	ROA 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
	Basic Throughput Class Negotiation[6]	c	c	—	Yes
	Fast Select Acceptance	c	c	—	Yes

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Table 12 (2 of 2) — Classification of Optional User Facilities for Registration

Class And Characteristics Of Optional User Facilities[1] (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)	Extended Packet Sequence Numbering	d[5]	d	b	Yes
	D-bit Modification	d[5]	d	b	No
	Packet Retransmission	d[5]	d	b	Yes
	Nonstandard Default Packet Sizes	e	e	b	Yes
	Nonstandard Default Window Sizes	f	f	b	Yes
	Default Throughput Classes Assignment	g	g	b	Yes
	Extended Throughput Class Negotiation[6]	c	c	—	Yes
	Reverse Charging Acceptance	c	c	b	No
	Charging Information (per interface basis)	c	c	b	No
	Logical Channel Ranges[2]	h[5]	h	b	Yes

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

NOTES

1 The categorization of facilities as Essential or Additional is given in table 11.

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.

6 A DTE can only subscribe to one of these facilities at a time.

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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) ROA 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) Basic 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 the Basic Throughput Class Negotiation Facility is 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 nine Class 5 optional user facilities:

a) Extended Packet Sequence Numbering (the exact method for negotiating this facility is being studied by ITU-T) (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) Extended Throughput Class Negotiation (13.13) - Class 5.1;

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

i) 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

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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 12. The appropriate registration-facilities, as indicated in table 12, 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 12) 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 12) 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

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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 27);
— 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.

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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 facilities. 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 Facilities 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.

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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 13. 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 14.

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

Table 13 — 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) = 1	W(indicated) ≥ W(requested) ≥ 2 W(requested) = 1 or 2
P(indicated) ≥ 128 P(indicated) < 128	P(indicated) ≥ P(requested) ≥ 128 P(indicated) ≤ P(requested) ≤ 128

Table 14 — 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) = 1	W(requested) ≥ W(indicated) ≥ 2 W(indicated) = 1 or 2
P(requested) ≥ 128 P(requested) < 128	P(requested) ≥ P(indicated) ≥ 128 P(requested) ≤ P(indicated) ≤ 128

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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);

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

13.13 Throughput Class Negotiation Facilities

These optional user facilities apply only to the Virtual Call service.

Basic Throughput Class Negotiation and Extended Throughput Class Negotiation are optional user facilities. Only one of these facilities may be agreed to for a period of time by the DTE and DXE for Virtual Calls. If subscribed to, the facility permits negotiation on a per Virtual Call basis of the throughput classes. When the Basic Throughput Class Negotiation Facility has been subscribed to, the DTE may explicitly negotiate throughput classes up to 192 000 bit/s. When the Extended Throughput Class Negotiation Facility has been subscribed to, the DTE may explicitly negotiate throughput class values higher than 192 000 bit/s. The throughput classes are considered independently for each direction of data transmission.

NOTE 1 For an interim period, some networks may allow subscription of default throughput classes higher than 192 000 bit/s when the Basic Throughput Class Negotiation Facility is also subscribed. In this case, the meaning of the value corresponding to 192 000 bit/s in the parameter field of the Basic Throughput Class Negotiation Facility in INCOMING CALL and CALL CONNECTED packets is changed to "192 000 bit/s or higher".

When the calling DTE has subscribed to one of the throughput class negotiation facilities, 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 one of the throughput class negotiation facilities, 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 one of the throughput class negotiation facilities 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 one of the throughput class negotiation facilities, 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 one of the throughput class negotiation facilities, 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 one of the throughput class negotiation facilities, 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

2 Since both the Flow Control Parameter Negotiation Facility and either the Basic or Extended Throughput Class Negotiation Facility can be applied to a single call, the achievable throughput will depend on how the D-bit is manipulated.

3 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.

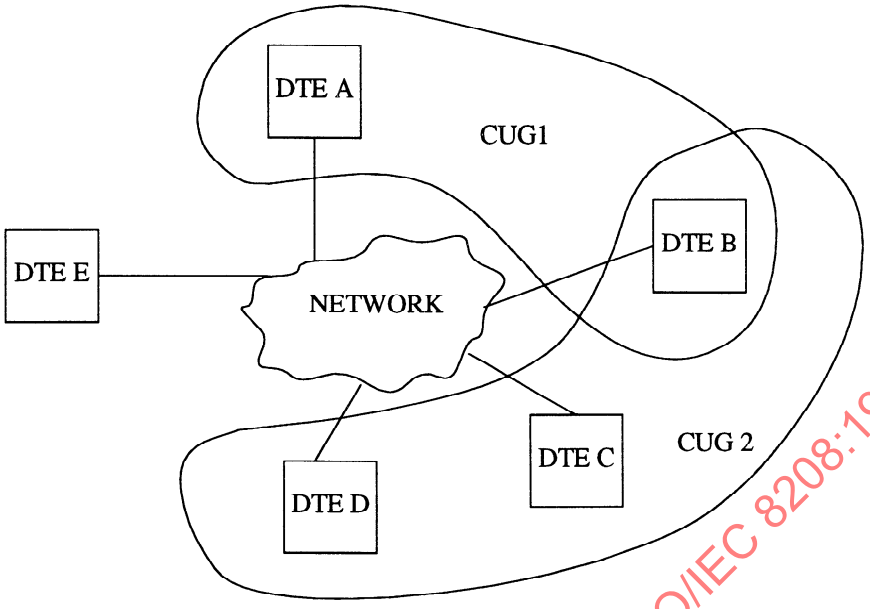
4 Basic Throughput Class Negotiation and Extended Throughput Class Negotiation facilities should never be present simultaneously at the DTE/DXE interface.

See also:

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

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

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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

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Figure 30 — Allowable Connections in Hypothetical Closed User Group Environment

— 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 30 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.

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.

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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 15 and 16, 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.

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.

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Table 15 — 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="4">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 with outgoing access (see Note 3)</td><td rowspan="2">Preferential or only CUG with 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 with 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.

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Table 16 — 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="5">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 or CUG specified with incoming access (see Note 4)</td><td rowspan="2">One of the following:
- Preferential or only CUG
- Preferential or only CUG with incoming access (see Note 5)
- Incoming access</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 rowspan="2">Not applicable</td></tr>
<tr><td>CUG/IA without preferential</td><td rowspan="2">CUG specified with incoming access (see Note 4)</td></tr>
<tr><td>CUG/IA/OA without Preferential</td><td rowspan="2">Incoming Access</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.

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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 15 and 16, 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 15 and 16, 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

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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.

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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 17. 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

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Table 17 — 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 related facilities (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
ROA Subscription	Yes
Hunt Group	No
Call Redirection	No
Call Deflection Subscription	No
ICRD Prevention Subscription	No
Alternative Address Registration related facilities	No
Alternative Address Usage Subscription	No

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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 ROA related facilities

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

The set of ROA optional user facilities provides for the calling DTE's designation of a sequence of one or more ROA transit network(s) within the originating country through which the call is to be routed when more than one ROA 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 ROA in the originating country.

In the absence of both the ROA Subscription Facility and the ROA Selection Facility, no user designation of ROA transit networks is in effect.

13.23.1 ROA Subscription

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

ROA 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 ROA Selection Facility) to all Virtual Calls where more than one ROA transit network exists at a sequence of one or more gateways. The ROA Subscription Facility provides a sequence of ROA transit networks through which calls are to be routed.

See also:

— Optional User Facility for ROA Selection (13.23.2).

13.23.2 ROA Selection

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

ROA 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 ROA 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 ROA transit network exists at a sequence of one or more gateways. The ROA Selection Facility provides a sequence of ROA 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 ROA transit networks that may have been specified by the ROA Subscription Facility.

If the DTE selects only one ROA transit network, either the basic or extended format of the ROA Selection Facility may be used. If the DTE selects more than one ROA transit network, the extended format of the ROA 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 ROA Subscription (13.23.1);

— Coding of the ROA 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).

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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 "alternate 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.

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 alternate 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 alternate 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.

In addition, some networks may allow a DTE to indicate 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 CALL REQUEST packet.

For cases where call deflection and redirection takes place between networks, Inter-network Call Redirection and Deflection (ICRD) control facilities are offered.

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 alternate 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 alternate 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 alternate 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 (or an alternate DTE in the case of prior call redirection or call deflection) 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

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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 alternate DTE address to which the call is to be deflected. When requested for a given Virtual Call, the network deflects the call to the alternate 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 ITU-T specified DTE facilities and user data to be sent to the alternate DTE. The ITU-T specified DTE facilities and user data in the CLEAR REQUEST packet need not be dependent on the contents of the original INCOMING CALL packet. 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 ITU-T specified DTE facilities are included in the CLEAR REQUEST packet, then there will be none in the INCOMING CALL packet to the alternate 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 alternate DTE.

The X.25 facilities that are present in the INCOMING CALL packet transmitted to the alternate 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 alternate 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 alternate 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 alternate DTE that the call has been redirected or deflected, why the call was redirected or deflected, and the address of the originally-called DTE.

When more than one address applies to a DTE/DCE interface, the Call Redirection or Call Deflection Notification Facility may also be used by the originally-called DTE (which may be a packet switched private data network) in a CALL REQUEST packet to inform the alternate DTE that the call has been redirected or deflected. When this facility is received from the originally-called DTE (private network) the DCE will clear the call if the address contained in this facility is not one of those applying to the interface.

NOTE — This last possibility may not be supported by all networks supporting the Call Redirection or Call Deflection Notification Facility.

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.

e) redirection or deflection in the calling DTE (which is supposed to be a packet switched private data network).

Some networks may also use the following reason in network-dependent cases:

f) 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).

13.25.4 Inter-network Call Redirection and Deflection (ICRD) control facilities

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

When the originally-called DTE and the alternate DTE are on different packet-switched public data networks (PSPDNs), the call redirection or call deflection is considered to be inter-network. Because the tariff between the calling DTE and the alternate DTE may be more expensive than that between the calling DTE and the originally-called DTE, optional user facilities are defined to prevent the inter-network call redirection and deflection (ICRD) from taking place in all cases of ICRD except for one. The exception case is when the calling DTE and the alternate DTE are served by the same PSPDN.

When a PSPDN supports ICRD, it will allow ICRD to take place unless the DTE subscribes to ICRD Prevention Subscription Facility or uses the per-call ICRD Status Selection Facility to signal that ICRD should be prevented for the call. If a PSPDN does not support ICRD, ICRD is prevented by default and neither of the following two facilities are applicable.

13.25.4.1 ICRD Prevention Subscription

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

ICRD Prevention Subscription is an optional user facility agreed to for a period of time by the DTE and DCE. This facility, if subscribed to, will prevent calls originated by the subscribed DTE from undergoing ICRD except in the case where the alternate DTE is served by the same PSPDN as that of the subscribed DTE. This facility may be overridden by the ICRD Status Selection Facility.

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13.25.4.2 ICRD Status Selection

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

ICRD Status Selection is an optional user facility which may be used on a per Virtual Call basis. This facility may be requested by a calling DTE.

The ICRD Status Selection Facility may be used by the calling DTE in the CALL REQUEST packet to indicate whether ICRD should be allowed or prevented. If the ICRD Status Selection Facility indicates that ICRD allowance is requested, ICRD should be allowed by the PSPDN for the call whether or not ICRD Prevention Subscription Facility is subscribed by the DTE. Likewise, if the ICRD Status Selection Facility indicates that ICRD is prevented, ICRD should be prevented by the PSPDN for the call even if ICRD Prevention Subscription Facility is not subscribed by the DTE.

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 by the calling DTE 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 called 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);

d) 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).

13.28 Alternative Addressing Related Facilities

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

The set of alternative addressing related facilities enables the registration of alternative addresses with the network and enables a calling DTE to use an alternative address to identify the called DTE in order to establish a Virtual Call. An alternative address

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is defined as one that does not conform to the formats defined in Recommendation X.121. In particular the following alternative addresses may be supported:

a) character string coded in accordance with CCITT Rec. T.50 | ISO/IEC 646;

b) OSI NSAP address coded in accordance with CCITT Rec. X.213 | ISO/IEC 8348;

c) Medium Access Control (MAC) address coded in accordance with ISO/IEC 10039; and

d) Internet address coded in accordance with RFC 1166.

When receiving a CALL REQUEST packet containing an alternative address, the DCE will translate the alternative address to the format defined in Recommendations X.121 as the basis on which to route the call. The translation of the address will depend on the rules determined at subscription time. A single alternative address could map to several X.121 addresses dependent on parameters such as time of day, etc. A single X.121 address could be reached by multiple alternative addresses.

When establishing a Virtual Call, an alternative address can only be present in the CALL REQUEST packet. The use of addresses in all other packets is unchanged by using an alternative address in the CALL REQUEST packet. When an alternative address is used in a CALL REQUEST packet, the called DTE address of the INCOMING CALL and CALL ACCEPTED packets will conform to the format specified in Recommendations X.121. However, it is a network option that the called DTE address of the CALL CONNECTED packet can either conform to the format specified in Recommendations X.121 or be absent.

13.28.1 Alternative Address Registration Related Facilities

The set of alternative address registration related facilities, when subscribed to, enables users to register an alternative address. There are two facilities for registering an alternative address. Depending on which facility is subscribed to, the alternative address either will have global significance or will be interface specific.

13.28.1.1 Global Alternative Address Registration

Global Alternative Address Registration is an optional user facility agreed for a period of time. Any DTE (both inside and outside of a specific network) can register alternative address translations with a network. All such alternative addresses would require uniqueness within the network of registration and, thus, have network-wide (global) significance.

NOTE — It is envisaged that network-wide translations will be registered for the benefit of any calling DTE. In this case, the translation of the alternative address would be independent of the calling DTE. Organizations wishing the calling DTEs of a specific network to use the alternative address of a DTE rather than its X.121 number will need to register such alternative addresses with the specific network.

13.28.1.2 Interface Specific Alternative Address Registration

Interface Specific Alternative Address Registration is an optional user facility agreed for a period of time. When subscribed to, alternative address translations that are specific to a DTE/DCE interface may be registered, for use by the DTE when making a call. In such cases, the rules for translations of the interface specific alternative addresses are given at registration time. The Alternative Address Usage Subscription Facility must also be subscribed to. When an interface specific alternative address is the same as a global alternative address, the interface specific alternative address takes precedence and the translation will be according to the rules defined for the specific DTE/DCE interface.

13.28.2 Alternative Address Usage Subscription

Alternative Address Usage Subscription is an optional user facility which, when subscribed to by a DTE, allows the DTE to use an alternative address in the CALL REQUEST packet. The decision to use an alternative address is made on a per Virtual Call basis.

When the Alternative Address Usage Subscription Facility has been subscribed to, the DTE may identify a called DTE by using an alternative address in the CALL REQUEST packet. In such cases the network would perform an analysis of the alternative address and derive an address conforming to the formats described in Recommendations X.121 as the basis on which to route the call.

Networks may support all or a sub-set of the formats listed in 13.28. The formats supported will be made known to subscribing DTEs. Which set is supported will determine how the alternative address may be carried in the CALL REQUEST packet.

Two network options are allowed for use by DTEs. The first option permits a DTE to use the Address Block to carry any of the alternative address formats. The second option allows the DTE to use the Called Address Extension Facility to carry an OSI NSAP address (i.e., an address conforming to CCITT Rec. X.213 | ISO/IEC 8348) as an alternative address. Either or both of these options can be supported by a network.

13.28.2.1 Use of the Address Block to carry an alternative address

If the first network option of the Alternative Address Usage Subscription Facility applies to the DTE/DCE interface, then the alternative address is carried in the Called Address Field of the CALL REQUEST packet using the A-bit = 1 Address Block format.

NOTE — One of the cases where this network option applies is where the alternative address is an OSI NSAP address, but the network does not support the analysis and translation of the OSI NSAP address carried in the Called Address Extension Facility. In this case, the NSAP address used as an alternative address is carried in the Called DTE Address Field of the CALL REQUEST packet (see 12.2.1.2). However, in such cases when this format is used and the called OSI NSAP address is also required by the called DTE, then the called OSI NSAP address must also be included in the Called Address Extension Facility by the calling DTE.

See also:

— Address Block description (12.2.1).

13.28.2.2 Use of the Called Address Extension Facility to carry an alternative address

If the second network option of the Alternative Address Usage Subscription Facility applies to the DTE/DCE interface, then the alternative address is carried in the Called Address Extension Facility of the CALL REQUEST packet.

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The fact that the Called Address Extension Facility is being used to carry an alternative address is indicated by the Called DTE Address Length Field in the Address Block of the CALL REQUEST packet being set to zero.

NOTE — The preferred method for using the Called Address Extension Facility is described above. However, some networks may allow the use of the Called Address Extension Facility to carry an alternative address without having the Called DTE Address Length Field set to zero. In this case, the translation will apply for every CALL REQUEST packet.

The OSI NSAP address carried in the Called Address Extension Facility is passed unchanged by the network.

13.29 Reference Number

This optional user facility applies only in a DTE/DTE environment.

Reference Number is an optional user facility which may be agreed to for a period of time. It applies to a Packet Layer entity. It is used as an alternative mechanism for Logical Channel Identifier assignment. It should be noted that the normal mode of operation of a DTE does not make use of this facility.

13.29.1 General description

For each Virtual Call or Permanent Virtual Circuit, a pair of reference numbers (a Source reference number and a Destination reference number) is assigned to identify the Virtual Call or the Permanent Virtual Circuit. Reference numbers are in the range from 1 through 4 095, inclusive (0 shall not be assigned as a reference number).

For a Permanent Virtual Circuit, the reference numbers are chosen independently by the DTEs. Each DTE is informed of the remote DTE's choice as part of the agreement to operate the Permanent Virtual Circuit.

For Virtual Calls, these reference numbers are assigned by the two DTEs using the Reference Number Facility during call setup. The Source reference number is chosen by the calling DTE when transmitting a CALL REQUEST packet. The Destination reference number is chosen by the called DTE when transmitting a CALL ACCEPTED packet. If the called DTE does not accept the call, no Destination reference number is chosen.

The Logical Channel Identifier contained in subsequent packets transmitted on a Virtual Call or a Permanent Virtual Circuit by a DTE is equal to the reference number value chosen by the remote DTE.

In RESTART, DIAGNOSTIC and REGISTRATION packets, the Logical Channel Identifier Field is coded with all zeros.

See also:

— Coding of Reference Number Facility (15.2.1 and 15.2.2.14);

— Logical Channels (3.7).

13.29.2 Negotiating Reference Numbers for a Virtual Call

13.29.2.1 Virtual Call Setup

When originating a Virtual Call, the calling DTE sets the Logical Channel Identifier Field to zero in the CALL REQUEST packet and specifies the Source reference number (chosen by the calling DTE) in the Reference Number Facility.

A DTE receiving an INCOMING CALL packet containing the Reference Number Facility indicates its acceptance by sending a CALL ACCEPTED packet across the interface. This packet contains the Source reference number (assigned by the calling DTE) coded in the Logical Channel Identifier Field and the Destination reference number (chosen by the called DTE) coded in the Reference Number Facility. See figure 31a.

If a DTE sends a CALL REQUEST packet, or a CLEAR REQUEST packet abandoning a call, to a DTE which does not support the Reference Number Facility, one of the following situations will result:

a) a DIAGNOSTIC packet is returned with the Diagnostic code = 36; or

b) no packet is returned.

When a) applies, the logical channel indicated in the original CALL REQUEST packet's Reference Number Facility may be returned immediately to state p1, and re-used as necessary.

When b) applies, however, the logical channel indicated in the original CALL REQUEST packet's Reference Number Facility remains assigned to the original call setup attempt, according to the procedures specified in 5.2.1 and, following expiry of timer T21, 5.4 and 5.5.1. Assuming no response is received to the CLEAR REQUEST packets transmitted on T21 and T23 expiry, the logical channel may be returned to the p1 state, ready for subsequent re-use, on expiry of the retransmission count R23.

In both situations, the requesting DTE may change its mode of operation and process all subsequent Virtual Calls without using the Reference Number Facility.

13.29.2.2 Rejecting a Call

If the called DTE wishes to reject an incoming call that uses the Reference Number Facility, it sends a CLEAR REQUEST packet with a Logical Channel Identifier set to the value received in the Reference Number Facility of the INCOMING CALL packet. The Reference Number Facility is not used in the CLEAR REQUEST packet. See figure 31b.

13.29.2.3 Abandoning a Call

If the calling DTE, having sent a CALL REQUEST packet, does not wish to proceed with the Virtual Call, then it sends a CLEAR REQUEST packet with a Logical Channel Identifier set to zero and with the Reference Number Facility set to the value chosen in the CALL REQUEST packet. See figure 31c.

NOTE — In figure 31c, it is assumed that the called DTE supports the Reference Number Facility.

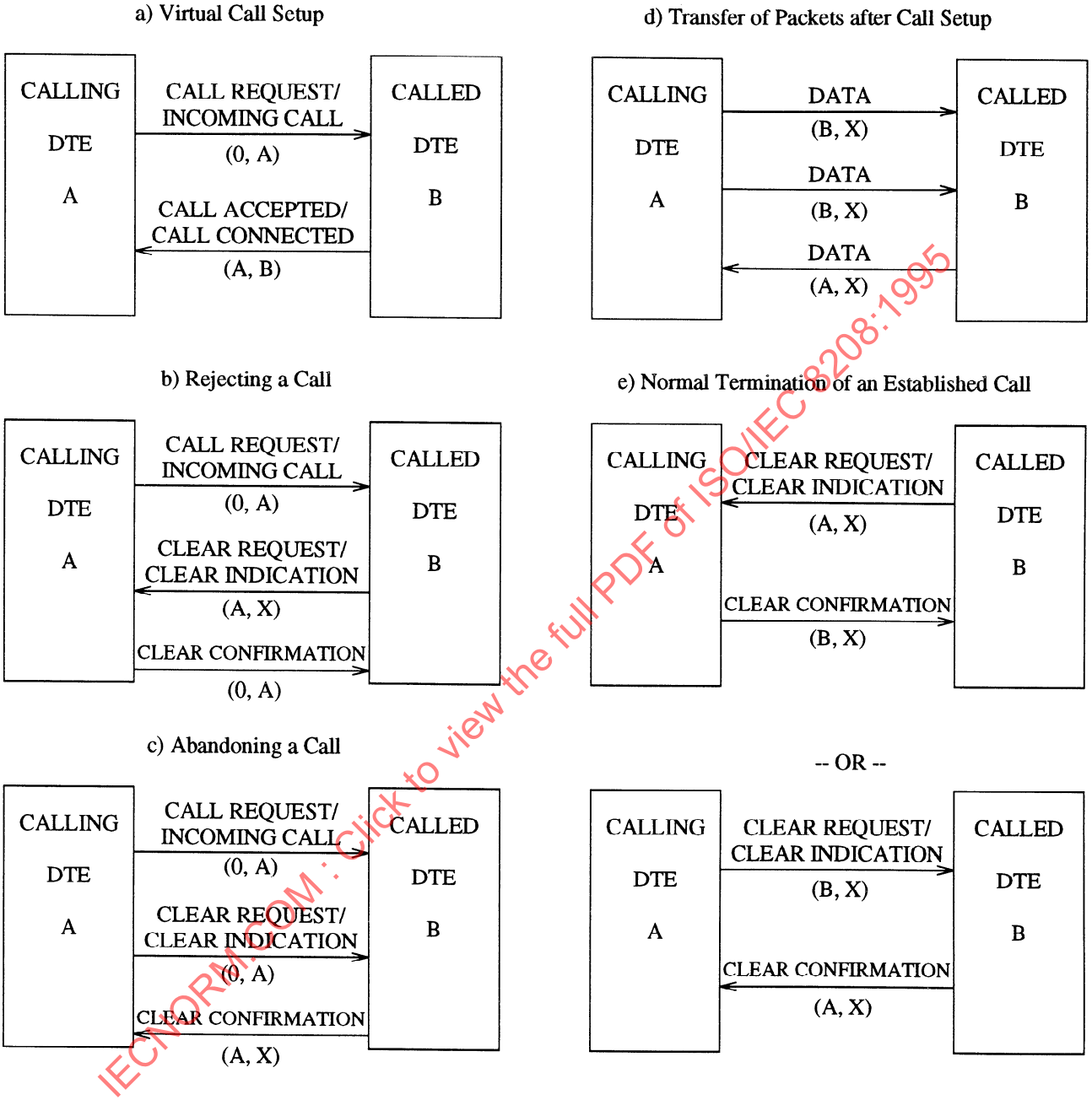
13.29.3 Use of Reference Numbers after Assignment

All DATA, interrupt, flow control and reset packets transmitted on a Virtual Call or Permanent Virtual Circuit, *and all call clearing packets transmitted after Virtual Call setup,* contain the reference number chosen by the remote DTE as the Logical Channel Identifier. See figures 31d and 31e.

13.29.4 Exception conditions resulting from erroneous usage of reference numbers

A DIAGNOSTIC packet is sent back with Diagnostic Code 36 when one of the following conditions applies:

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NOTE — The two symbols between parentheses indicate, respectively, the value of the Logical Channel Identifier Field and the value of the Facility Parameter Field of the Reference Number Facility. Absence of the Reference Number Facility is indicated by the symbol "X".

Figure 31 — Reference Number Facility schematics

a) an expected Reference Number Facility is missing in a received packet, or

b) an INCOMING CALL packet is received with a non-zero Logical Channel Number.

14 Procedures for optional ITU-T specified DTE facilities

The optional ITU-T 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. They can also be used for other purposes. These facilities follow the ITU-T 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.

These ITU-T specified DTE facilities are categorized according to their usage:

a) Addressing related facilities:
   - — Calling Address Extension (14.1);
   - — Called Address Extension (14.2).

b) Quality of Service related facilities:
   - — Minimum Throughput Class Negotiation (14.3);
   - — End-to-End Transit Delay Negotiation (14.4);
   - — Priority (14.5);
   - — Protection (14.6).

c) Feature related facilities:
   - — Expedited Data Negotiation (14.7).

14.1 Calling Address Extension

Calling Address Extension is an optional ITU-T 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 ITU-T 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 ITU-T 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.

The calling DTE should use the extended format only when it indicates a specific minimum throughput class value greater than 192 000 bits/s.

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 ITU-T 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.

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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 ITU-T 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 ITU-T specified DTE facility which may be used for a given Virtual Call. The Protection facility is used to convey security information including level of protection, authentication information and key information.

When this ITU-T specified DTE facility is used to convey level of protection information, 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 (or other) 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 (or other) entity which will return selected values. These selected values are indicated by the called DTE in the CALL ACCEPTED packet (or CLEAR REQUEST packet in the case of immediate clearing), conveyed transparently to the calling DTE in the CALL CONNECTED packet (or CLEAR INDICATION packet), and passed to a higher layer (or other) entity in the calling DTE.

When this ITU-T specified DTE facility is used to convey authentication and key information, operation is as specified in ITU-T Rec. X.273 | ISO/IEC 11577.

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 ITU-T 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 ITU-T 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 ITU-T 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.

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NOTES

1 A DTE should not repeat a facility code (codes 00000000 and 11111111 are exceptions). When a facility code appears more than once, a DTE may either use the last one or treat the situation as an error. If the DTE chooses to treat this situation as an error, then it transmits a CLEAR REQUEST packet across the DTE/DXE interface with a cause indicating "DTE Originated" and the diagnostic "Duplicate Facility Requested"

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 18. The general formats for the four classes of facility elements are shown in figure 32.

Table 18 — 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.

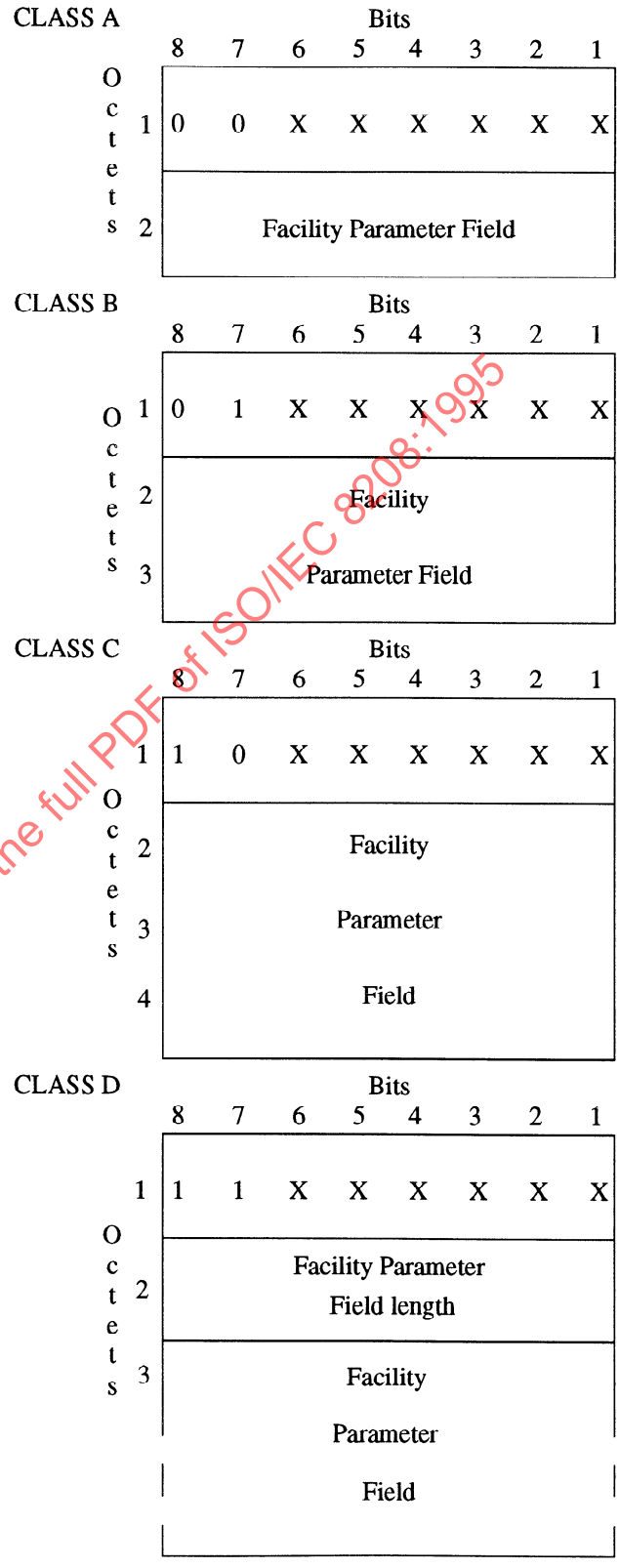


Figure 32 — Generalized Formats of Facility Elements

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There are four categories of facilities:

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 inter-network Virtual Calls); and

d) ITU-T 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 ITU-T 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 intra-network call or non-X.25 facilities supported by the network of the calling DTE in the case of an inter-network 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 inter-network call
0 0 0 0 1 1 1 1	ITU-T 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 19 gives the coding of the Facility Code Field for each optional user facility and indicates the packet types in which they may be present.

To facilitate possible later extensions, DTEs may be tolerant in receiving Facility Code Fields containing values which do not have a corresponding subscription-time facility to protect the DTE from receiving them. (Such a subscription-time facility would be introduced if the new per-call facility would adversely affect the operation at the DTE/DCE interface). DTEs can then discard any unrecognized facility codes instead of clearing the call.

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 of the two-octet Facility Parameter Field. The packet size for the direction of data transmission from the calling DTE 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 contiguous subset of these values, may be offered. A packet size of 128 shall always be available.

15.2.2.1.2 Window Sizes

The window size for the direction of data transmission from the called DTE is indicated in bits 7 through 1 of the first octet of the two-octet Facility Parameter Field. The window size for the direction of data transmission from the calling DTE 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 has been subscribed to.

The window sizes available for normal numbering and for extended numbering form a contiguous set of values. A window size of 2 shall always be available.

15.2.2.2 Throughput Class Negotiation facilities

15.2.2.2.1 Basic Throughput Class Negotiation facility

The throughput class for the direction of data transmission from the called DTE is indicated in bits 8, 7, 6, and 5 of the one-octet Facility Parameter Field. The 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 20a.

15.2.2.2.2 Extended Throughput Class Negotiation facility

The throughput class for the direction of data transmission from the calling DTE is indicated in bits 6 to 1 of the first octet of the two-octet Facility Parameter Field. The throughput class for the direction of data transmission from the called DTE is indicated in bits 6 to 1 of the second octet. Bits 8 and 7 of each octet shall be set to zero and are reserved for future allocation.

The bits indicating each throughput class are binary coded and correspond to throughput classes as indicated in table 20b.

15.2.2.3 Closed User Group Selection facility

15.2.2.3.1 Basic format

The index to the closed user group selected for the Virtual Call, which is contained in the one-octet Facility Parameter Field, is in the form of two decimal digits. Each digit is coded in a semi-

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Table 19 (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
Basic Throughput Class Negotiation	X (Note 1)	X (Note 1)	X (Note 1)	X (Note 1)				0 0 0 0 0 0 1 0
Extended Throughput Class Negotiation	X (Note 1)	X (Note 1)	X (Note 1)	X (Note 1)				0 1 0 0 1 1 0 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 2)
Reverse Charging	X	X						
ICRD Status Selection	X							
NUI Selection	X		X (Note 3)					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
ROA 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 (Note 5)	X						1 1 0 0 0 0 1 1

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Table 19 (2 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
Called Line Address Modified Notification			X (Note 6)	X	X (Notes 4,6)	X		0	0	0	0	1	0	0	0
Transit Delay Selection And Indication	X	X		X				0	1	0	0	1	0	0	1
Reference Number	X	X	X	X	X	X	X	0	1	1	0	0	0	0	0
Marker	X	X	X	X	X	X	X	0	0	0	0	0	0	0	0

NOTES

1 Basic Throughput Class Negotiation and Extended Throughput Class Negotiation cannot be simultaneously present in the same packet.

2 This facility code and associated facility parameter will be present in the INCOMING CALL packet if either or both of the Reverse Charging Facility (if Reverse Charging Acceptance is subscribed to) and Fast Select Facility (if Fast Select Acceptance is subscribed to) is indicated. They may, but need not, be present if neither the Reverse Charging Acceptance Facility nor the Fast Select Acceptance Facility is subscribed to.

3 Only if the NUI Subscription Facility has been subscribed to.

4 The DTE is not allowed to use both Call Deflection Selection and Called Line Address Modified Notification Facilities in the same CLEAR REQUEST packet.

5 Only when the reason "Calling DTE originated" is used in the parameter field.

6 Only when the reason "Called DTE Originated" is used in the parameter field.

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Table 20a — Coding of Basic 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	128 000
1	1	1	1	192 000 *

* See Note 1 in 13.13.

octet in binary-coded decimal, where bit 5 is the low-order bit of the first digit and bit 1 is the low-order bit of the second digit. Indexes to the same closed user group at different DTE/DCE interfaces may be different.

15.2.2.3.2 Extended format

The index to the closed user group selected for the Virtual Call, which is contained in the two-octet Facility Parameter Field, 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.

Indexes to the same closed user group at different DTE/DCE interfaces may be different.

15.2.2.4 Closed User Group With Outgoing Access Selection facility

15.2.2.4.1 Basic format

The index to the closed user group selected for the Virtual Call, which is contained in the one-octet Facility Parameter Field, is in the form of two decimal digits. Each digit is coded in a semi-octet in binary-coded decimal, where bit 5 is the low-order bit of the first digit and bit 1 is the low-order bit of the second digit.

Indexes to the same closed user group at different DTE/DCE interfaces may be different.

Table 20b — Coding of Extended Throughput Classes

Bits: 8	7	6	5	4	3	2	1	Throughput Class (bit/s)
0	0	0	0	0	0	0	0	Reserved
0	0	0	0	0	0	0	1	Reserved
0	0	0	0	0	0	1	0	Reserved
0	0	0	0	0	0	1	1	75
0	0	0	0	0	1	0	0	150
0	0	0	0	0	1	0	1	300
0	0	0	0	0	1	1	0	600
0	0	0	0	0	1	1	1	1 200
0	0	0	0	1	0	0	0	2 400
0	0	0	0	1	0	0	1	4 800
0	0	0	0	1	0	1	0	9 600
0	0	0	0	1	0	1	1	19 200
0	0	0	0	1	1	0	0	48 000
0	0	0	0	1	1	0	1	64 000
0	0	0	0	1	1	1	0	128 000
0	0	0	0	1	1	1	1	192 000
0	0	0	1	0	0	0	0	256 000
0	0	0	1	0	0	0	1	320 000
0	0	0	1	0	0	1	0	384 000
0	0	0	1	0	0	1	1	448 000
0	0	0	1	0	1	0	0	512 000
0	0	0	1	0	1	0	1	576 000
0	0	0	1	0	1	1	0	640 000
0	0	0	1	0	1	1	1	704 000
0	0	0	1	1	0	0	0	768 000
0	0	0	1	1	0	0	1	832 000
0	0	0	1	1	0	1	0	896 000
0	0	0	1	1	0	1	1	960 000
0	0	0	1	1	1	0	0	1 024 000
0	0	0	1	1	1	0	1	1 088 000
0	0	0	1	1	1	1	0	1 152 000
0	0	0	1	1	1	1	1	1 216 000
0	0	1	0	0	0	0	0	1 280 000
0	0	1	0	0	0	0	1	1 344 000
0	0	1	0	0	0	1	0	1 408 000
0	0	1	0	0	0	1	1	1 472 000
0	0	1	0	0	1	0	0	1 536 000
0	0	1	0	0	1	0	1	1 600 000
0	0	1	0	0	1	1	0	1 664 000
0	0	1	0	0	1	1	1	1 728 000
0	0	1	0	1	0	0	0	1 792 000
0	0	1	0	1	0	0	1	1 856 000
0	0	1	0	1	0	1	0	1 920 000
0	0	1	0	1	0	1	1	1 984 000
0	0	1	0	1	1	0	0	2 048 000
					Other values			Reserved

15.2.2.4.2 Extended format

The index to the closed user group selected for the Virtual Call, which is contained in the two-octet Facility Parameter Field, 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.

Indexes to the same closed user group at different DTE/DCE interfaces may be different.

15.2.2.5 Bilateral Closed User Group Selection facility

The index to the bilateral closed user group selected for the Virtual Call, which is contained in the two-octet Facility Parameter Field, 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.

Indexes to the same bilateral closed user group at different DTE/DCE interfaces may be different.

15.2.2.6 Reverse Charging, Fast Select and ICRD Status facilities

The coding of the one-octet Facility Parameter Field is:

Bit 1 = 0 for Reverse Charging not requested

Bit 1 = 1 for Reverse Charging requested

Bit 5 = 0 and Bit 6 = 0 for ICRD Status Selection not requested (i.e., if the network supports ICRD, then ICRD is allowed unless ICRD Prevention Subscription Facility is subscribed)

Bit 5 = 0 and Bit 6 = 1 for ICRD prevention requested

Bit 5 = 1 and Bit 6 = 0 for ICRD allowance requested

Bit 5 = 1 and Bit 6 = 1 not allowed

Bit 8 = 0 and bit 7 = 0 or 1 for Fast Select not requested (see text below)

Bit 8 = 1 and bit 7 = 0 for Fast Select requested with no restriction on response

Bit 8 = 1 and bit 7 = 1 for Fast Select requested with restriction on response

NOTES

1 Bits 5 and 6 are set to 0 in INCOMING CALL packets and have no meaning.

2 Bits 4, 3, and 2 may be assigned to other facilities in the future; presently, they are set to 0.

In a CALL REQUEST packet, a DTE shall set bit 8 equal to 0 and bit 7 equal to 0 for Fast Select not requested. In an INCOMING CALL packet, however, a DTE shall interpret bit 8 set to 0 and bit 7 set to 0 or 1 as Fast Select not requested.

15.2.2.7 NUI Selection facility

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. The Facility Parameter Field follows the length and contains the network user identifier in a format determined by the network Administration (e.g., see Appendix VI of Recommendation X.25).

15.2.2.8 Charging Information facilities

15.2.2.8.1 Requesting Service

The coding of the one-octet Facility Parameter Field is:

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Bit 1 = 0 for charging information not requested

Bit 1 = 1 for charging information requested

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.

15.2.2.8.2 Indicating Monetary Unit

The octet following the Facility Code Field indicates the length of the Facility Parameter Field in octets. The Facility Parameter Field follows the length and indicates the charging. The coding of the Facility Parameter Field is for further study by ITU-T.

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 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 ROA 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 ROA 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 ROA transit networks selected. The Facility Parameter Field follows the length and indicates the DNIC for each ROA 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.

ROA 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 alternate DTE).

The first octet of the Facility Parameter Field indicates the reason for 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 or Call deflection by gateway as a result of call deflection by the originally-called DTE[1)]
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 private network gateway to the public network that presented the incoming call deflects the call so that the private network is no longer involved with the call (see annex A).

NOTE — If bits 8 and 7 are not set to 1 by the called DTE, they are assumed to have this value by the DCE. The network performing the call deflection uses these codes to set the value conveyed to the DTE to which the call is deflected (via the Call Redirection or Call Deflection Notification facility) and to the calling DTE (via the Called Line Address Modified Notification facility) (see annex A).

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The second octet of the Facility Parameter Field indicates the number of digits in the alternate 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 alternate 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 alternate 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[1)]
0 0 0 0 0 1 1 1	Call distribution within a hunt group[2)]
0 0 0 0 1 0 0 1	Call redirection due to originally-called DTE out of order[1)]
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 0	Call deflection by the originally-called DTE[3)]
1 0 0 0 0 0 0 1	Call redirection due to originally-called DTE busy[3)]
1 0 0 0 1 0 0 1	Call redirection due to originally-called DTE out of order[3)]
1 0 0 0 1 1 1 1	Call redirection due to prior request from originally-called DTE for systematic call redirection[3)]
1 1 0 0 0 0 0 0	Call deflection by the originally-called DTE[4)] or Call deflection by gateway as a result of call deflection by the originally-called DTE[4),5)]
1 1 0 0 0 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE busy[4),5)]
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[4),5)]
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[4),5)]

1) Applies where the call redirection takes place in a public network.

2) This value may be used by some public networks for network-dependent reasons.

3) Applies where the call redirection or deflection takes place within a private network and the private network continues to be involved with the call (see annex A).

4) These codes are those set by the DTE or private network in the Call Deflection Selection Facility (see 15.2.2.10).

5) Applies where call redirection or deflection takes place within a private network and the private network deflects the call back to the public network that presented the incoming call so that the private network is no longer involved with the call (see annex A).

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
0 0 0 0 0 0 0 1	Call redirection due to originally-called DTE busy[1)]
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[1)]
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 0	Call deflection by the originally-called DTE[2)]
1 0 0 0 0 0 0 1	Call redirection due to originally-called DTE busy[2)]
1 0 0 0 0 1 1 1	Call distribution within a hunt group[2)]
1 0 0 0 1 0 0 1	Call redirection due to originally-called DTE out of order[2)]

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1 0 0 0 1 1 1 1	Call redirection due to prior request from originally-called DTE for systematic call redirection[2)]
1 1 0 0 0 0 0 0	Call deflection by the originally-called DTE[3)] or Call deflection by gateway as a result of call deflection by the originally-called DTE[3),4)]
1 1 0 0 0 0 0 1	Call deflection by gateway as a result of call redirection due to originally-called DTE busy[3),4)]
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[3),4)]
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[3),4)]

1) Applies where the call redirection or distribution takes place in a public network.

2) Applies where the call redirection, deflection or distribution takes place within the private network and the private network continues to be involved with the call (see annex A).

3) These codes are those set by the DTE or private network in the Call Deflection Selection Facility (see 15.2.2.10).

4) Applies where the originally-called DTE is on a private network and the private network deflects the call back to the public network that presented the incoming call so that the private network is no longer involved with the call (see annex A).

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.

15.2.2.14 Reference Number facility

The Facility Parameter Field contains two octets.

The reference number is a number from 1 to 4 095 and is encoded in 12 bits. The reference number 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. Bits 8 through 5 of octet 1 are set to 0.

15.3 Coding of the Facility Field for ITU-T 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 21 gives the coding of the Facility Code Field for each ITU-T specified DTE Facility and indicates the packet types in which they may be present. These facilities are conveyed after the ITU-T 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 ITU-T 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	7	Use of Calling Address Extension
0	0	To carry a calling address assigned according to CCITT Rec. X.213 | ISO/IEC 8348
0	1	Reserved
1	0	Other (to carry a calling address not assigned according to CCITT Rec. X.213 | ISO/IEC 8348)
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 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 used to encode the calling OSI NSAP address using the preferred binary encoding (PBE) defined in CCITT Rec. X.213 | ISO/IEC 8348. 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) follows the IDP and is coded 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

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Table 21 — Coding of the Facility Code Field

Use	Facility	Packet types in which the facility may be present						Facility Code Bits:
		CALL REQUEST	INCOMING CALL	CALL ACCEPTED	CALL CON-NECTED	CLEAR REQUEST (see Note 1)	CLEAR INDICA-TION (see Note 1)	8 7 6 5 4 3 2 1
Addressing	Calling Address Extension	X	X			X (See Note 2)		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
Quality of Service	Minimum Throughput Class: — basic format	X	X			X (See Note 2)		0 0 0 0 1 0 1 0
	— extended format	X	X			X (See Note 2)		0 0 0 0 1 1 0 1
	End-to-End Transit Delay Negotiation	X	X	X	X	X (See Note 2)		1 1 0 0 1 0 1 0
	Priority	X	X	X	X	X (See Note 2)		1 1 0 1 0 0 1 0
	Protection	X	X	X	X	X (See Note 3)	X (see Note 3)	1 1 0 1 0 0 1 1
Feature	Expedited Data Negotiation	X	X	X	X	X (See Note 2)		0 0 0 0 1 0 1 1

NOTES

1 Only when issued in direct response to an incoming call (i.e., no CALL ACCEPTED packet was transmitted).

2 Only when the Call Deflection Selection Facility is used.

3 Presently Recommendation X.25 restricts the use of the Protection Facility in clearing packets to only the CLEAR REQUEST packet in the case where Call Deflection Selection is used. The more general capability denoted by the X in the table will be included in the next revision of Recommendation X.25.

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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 CCITT Rec. X.213 | ISO/IEC 8348.
0	1	Reserved
1	0	Other (to carry a called address not assigned according to CCITT Rec. X.213 | ISO/IEC 8348)
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 used to encode the called OSI NSAP address using the preferred binary encoding (PBE) defined in CCITT Rec. X.213 | ISO/IEC 8348. 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) follows the IDP and is coded 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

15.3.2.3.1 Basic format

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 20a.

15.3.2.3.2 Extended format

The two-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 calling DTE is indicated in bits 6 to 1 of the first octet. The minimum throughput class for the direction of data transmission from the called DTE is indicated in bits 6 to 1 of the second octet. Bits 8 and 7 of each octet shall be set to zero and are reserved for future allocation.

The bits indicating each throughput class are binary-coded and correspond to throughput classes as indicated in table 20b.

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.

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		Protection format code
8	7	
0	0	Reserved
0	1	Source-address specific
1	0	Destination-address specific
1	1	Globally unique

When bits 8 and 7 are not both set to one, the remaining six bits of the first octet of the Facility Parameter Field are reserved and set to zero.

When bits 8 and 7 are both set to one, the remaining six bits of the first octet of the Facility Parameter Field are used as shown below.

Bits						Protection Facility Information
6	5	4	3	2	1	
0	0	0	0	0	0	Level of protection information
0	0	0	0	0	1	Authentication and key information
other values						Reserved

When conveying level of protection information, the second octet of the Facility Parameter Field specifies the length "n," in octets, of the target protection level (CALL REQUEST packet), available protection level (INCOMING CALL packet), or selected protection level (CALL ACCEPTED and CALL CONNECTED packets, or CLEAR REQUEST and CLEAR INDICATION packets issued in direct response to the incoming call). 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, CALL

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CONNECTED, CLEAR REQUEST and CLEAR INDICATION 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.

When conveying authentication and key information, the second and following octets of the Facility Parameter Field are coded as given in 9.5 of ITU-T Rec. X.273 | ISO/IEC 11577.

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 22. The formats for the four classes of registration elements are shown in figure 33.

Table 22 — 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.

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 23 gives the coding of the Registration Code Field for each registration-facility and indicates the packet types in which they may be present.

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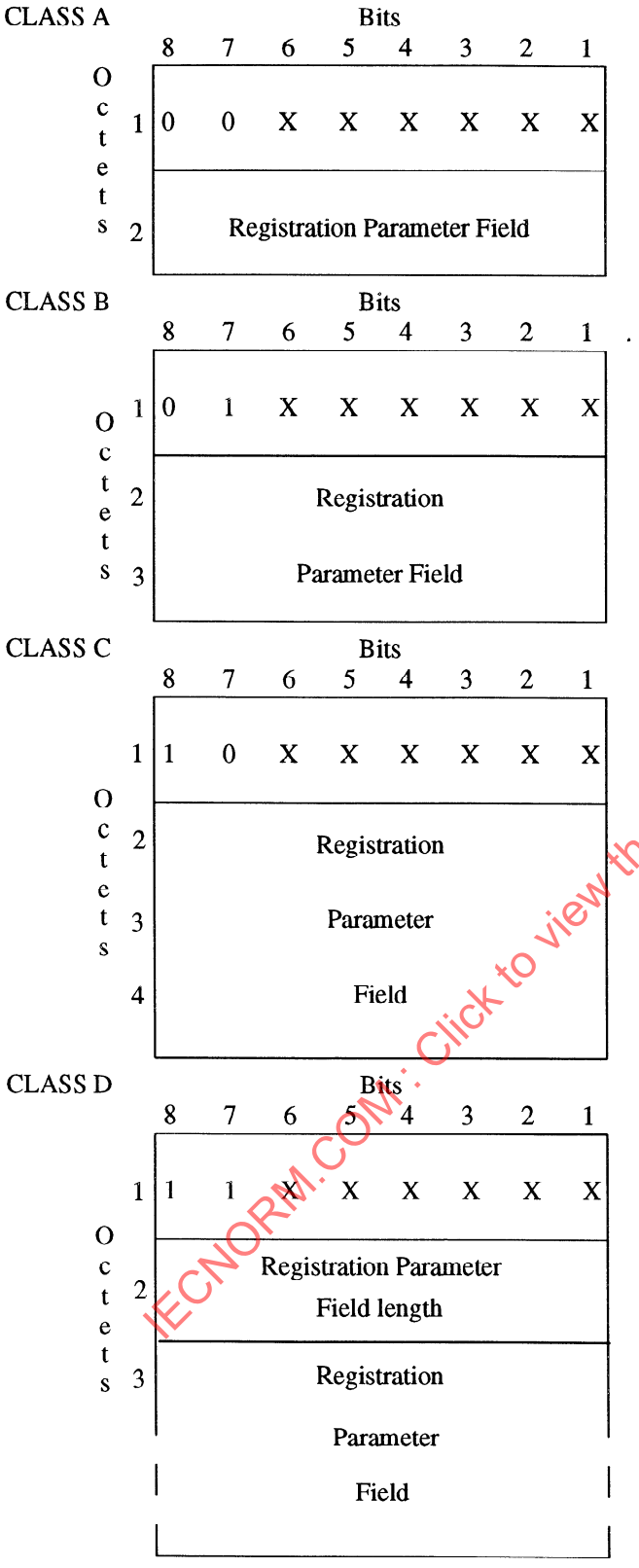


Figure 33 — Generalized Formats of Registration Elements

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)]

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 ROA Selection Facility[1)]

Bit 6 Extended Throughput Class Negotiation Facility

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 7 and 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.

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Table 23 — 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: — basic format	X	X	0 0 0 0 0 0 1 0
— extended format	X	X	0 1 0 0 1 1 0 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

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 Basic Throughput Class Negotiation Facility

Bit 7 Charging Information Facility (per-interface basis)

Octet 2

Bit 8 Extended Throughput Class Negotiation Facility

NOTE — Bit 8 of octet 1 and bits 1 through 7 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.

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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

16.2.2.7.1 Basic format

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 20a.

16.2.2.7.2 Extended format

The throughput class for the direction of data transmission to the DTE issuing the REGISTRATION REQUEST is indicated in bits 6 to 1 of the first octet of the two-octet Registration Parameter Field. The throughput class for the direction of data transmission from the DTE issuing the REGISTRATION REQUEST packet is indicated in bits 6 to 1 of the second octet. Bits 8 and 7 of each octet shall be set to zero.

The bits indicating each throughput class are binary-coded and correspond to throughput classes as indicated in table 20b.

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.

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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 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 packet switched network: Specified in Annex E of Recommendation X.25 (Notes 1, 3)
										Private packet switched 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 packet switched network: Specified in Annex E of Recommendation X.25 (Notes 1, 3)
										Private packet switched network: Specified in table 25 (Notes 1, 2, 4)

NOTES

1 The diagnostic codes 0 through 127 contained in Annex E of Recommendation X.25 and in table 25 are identical; these codes are standardized by ITU-T 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 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.

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Table 25 (1 of 5) — Diagnostic Codes

DIAGNOSTIC (Notes 1, 2)	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 3)
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	

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Table 25 (2 of 5) — Diagnostic Codes

DIAGNOSTIC (Notes 1, 2)	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 3)
Timer Expired for INCOMING CALL (or for DTE timer expired for CALL REQUEST)	0 0 1 1 0 0 0 0 0 0 1 1 0 0 0 1	48 49	D,Rr,C,Re 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 . . . . . . 0 0 1 1 1 1 1 1	53 63	C
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 ITU-T 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 . . . . . . 0 1 0 0 1 1 1 1	78 79	C

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Table 25 (3 of 5) — Diagnostic Codes

DIAGNOSTIC (Notes 1, 2)	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE	APPLICABLE PACKETS (Note 3)
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
ICRD problem	0 1 0 1 0 1 0 1	85	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	

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Table 25 (4 of 5) — Diagnostic Codes

DIAGNOSTIC (Notes 1, 2)	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE (Note 4)	APPLICABLE PACKETS (Note 3)
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	

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Table 25 (5 of 5) — Diagnostic Codes

DIAGNOSTIC (Notes 1, 2)	BITS: 8 7 6 5 4 3 2 1	DECIMAL VALUE (Note 4)	APPLICABLE PACKETS (Note 3)
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	

1 Not all diagnostics need be implemented but those used are as coded in the table. The first diagnostic in each grouping of 16 diagnostic codes is a generic diagnostic for the group and can be used in place of the more specific diagnostics within the group. Also, 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).

2 In certain situations, more than one specific diagnostic code may apply, as specified by the procedures in this International Standard. 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.

3 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,* or either restarting the Packet Layer *or clearing the Virtual Call* instead of resetting):

a) the applicable packets for diagnostic codes 0-223, when transmitted by a DTE, also include: for *C: RESTART REQUEST;* for 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: *for C: RESTART INDICATION (DTE/DTE environment only); for Re: CLEAR INDICATION (Virtual Call only) and RESTART INDICATION (DTE/DTE environment only).*

4 Diagnostics 224 through 255 support the OSI Network Service.

5 This diagnostic may also apply to a maintenance action within a national network.

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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 Trans-mission 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)

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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 DCE for the purpose of resolving call collision shall terminate timer T21 upon receipt of an INCOMING CALL packet and 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. In a DTE/DCE environment, the DTE may either terminate or preferably 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).

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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.

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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 INDICATION 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.

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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
34	Restart States (r1, r2, and r3)
35	Call Setup and Call Clearing States (p1, p2, p3, p4, p5, p6, and p7)
36	Data Transfer States (d1, d2, and d3)
37	Interrupt States (i1, i2, j1, and j2)
38	Flow Control States (f1, f2, g1, and g2)

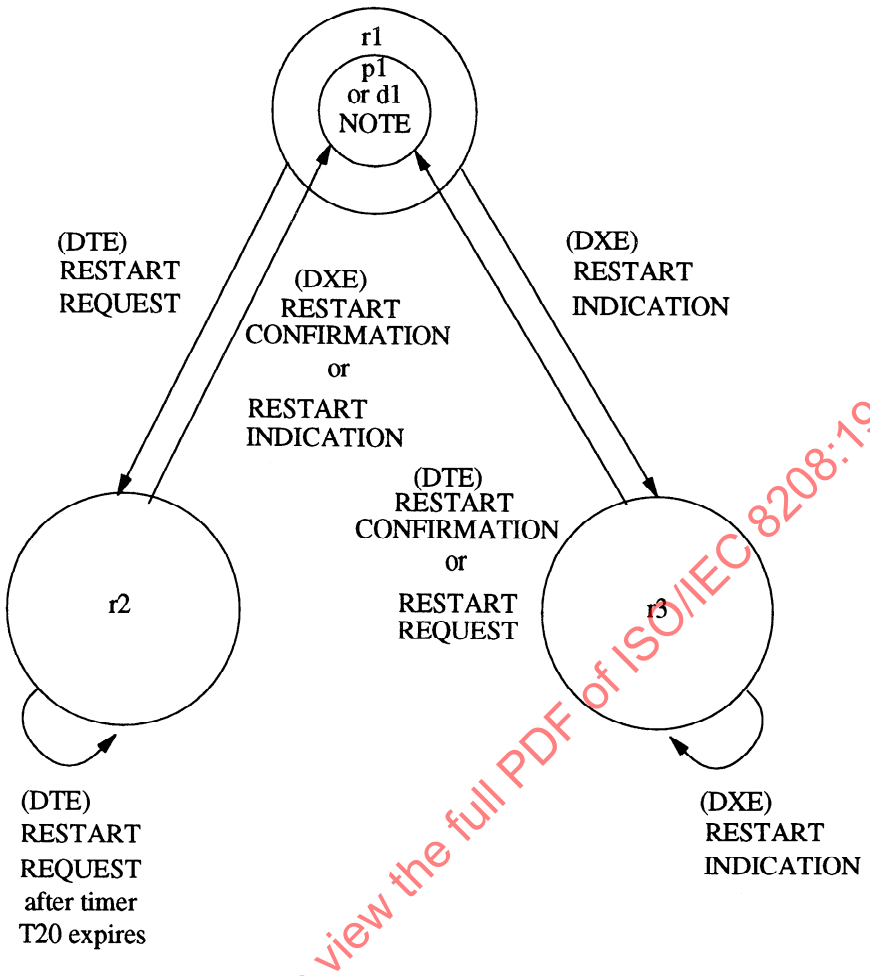
In the state diagrams, each state is represented by a circle containing the state designation. Each state transition is represented by an arrow. The responsibility for the transition (DTE or DXE) and the packet that has been transferred is indicated beside that arrow.

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 34 (Restart) having the highest priority, then followed by figure 35 (Call Setup and Call Clearing) and then by figure 36 (Reset). Of equal priority and following figure 36 are figure 37 (Interrupt) and figure 38 (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.

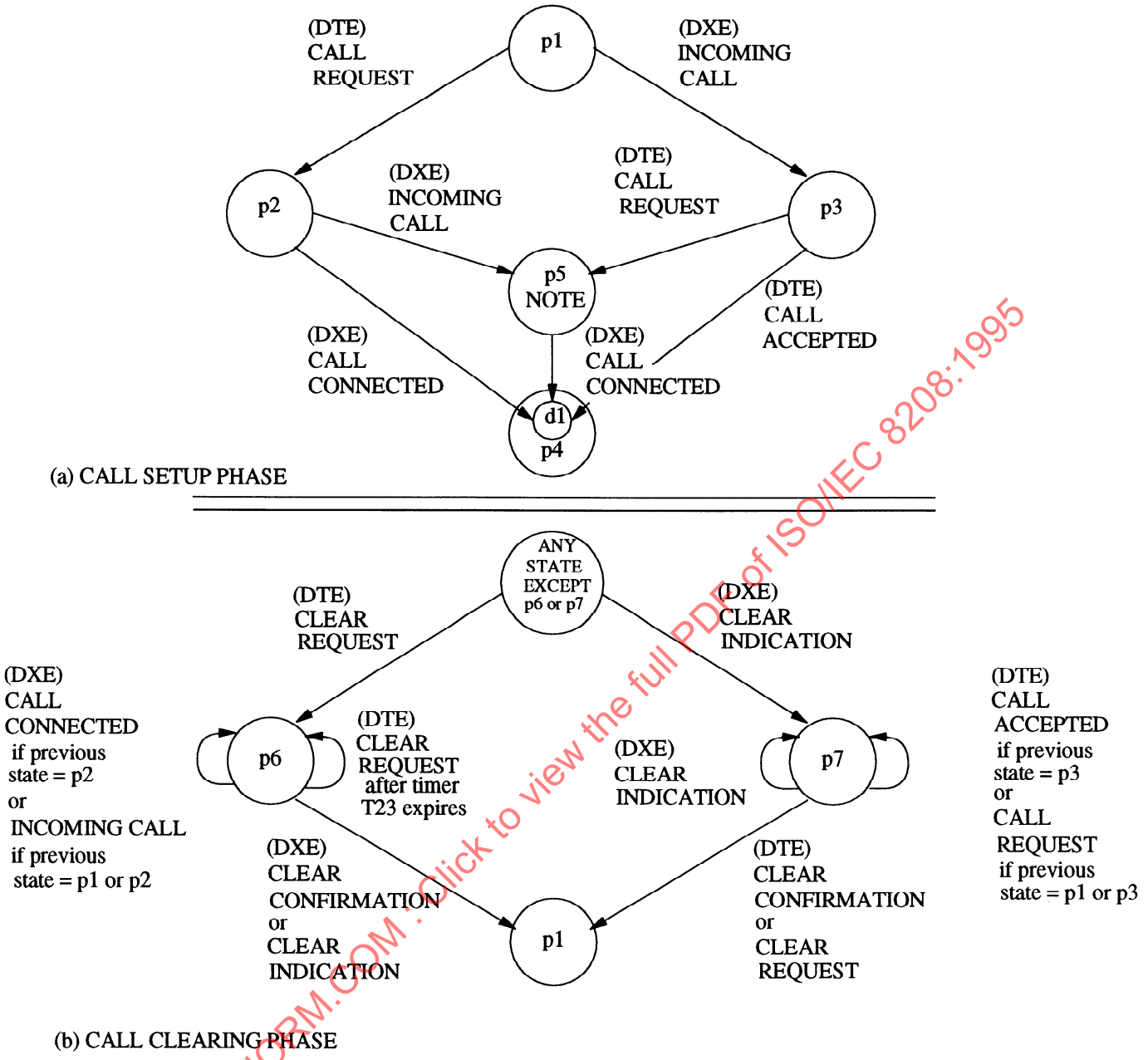
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NOTE — p1 for Virtual Call logical channels, or d1 for Permanent Virtual Circuit logical channels

Figure 34 — State Diagram for the Transfer of Restart Packets

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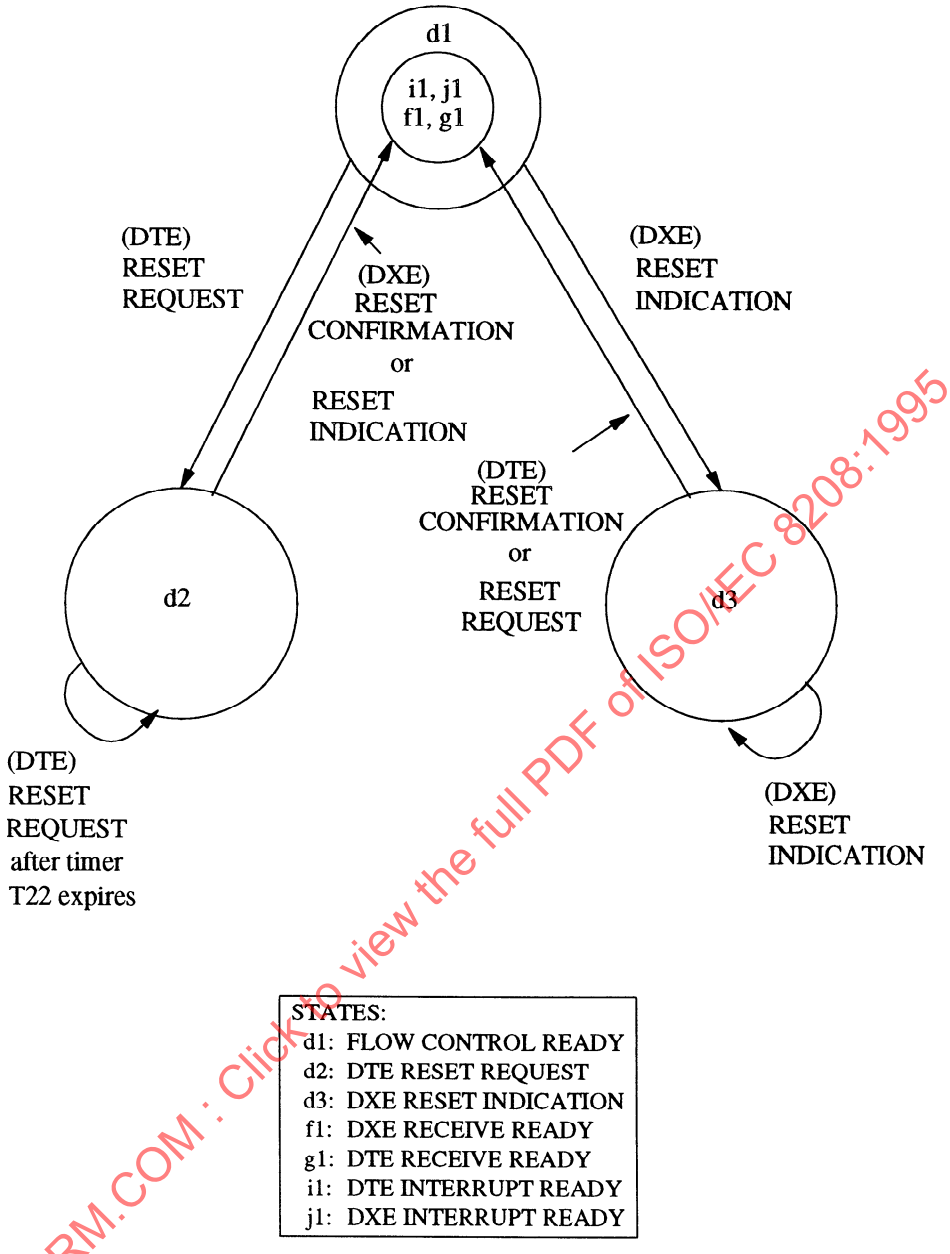


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STATES:
- d1: FLOW CONTROL READY
- p1: READY
- p2: DTE CALL REQUEST
- p3: DXE INCOMING CALL
- p4: DATA TRANSFER
- p5: CALL COLLISION (see Note)
- p6: DTE CLEAR REQUEST
- p7: DXE CLEAR INDICATION

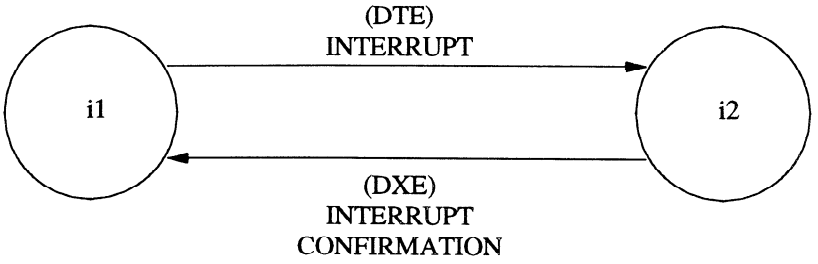
NOTE — State P5 is not applicable when using the Reference Number Facility.

Figure 35 — State Diagram for the Transfer of Call Setup and Call Clearing Packets within the Packet Layer Ready State (r1)

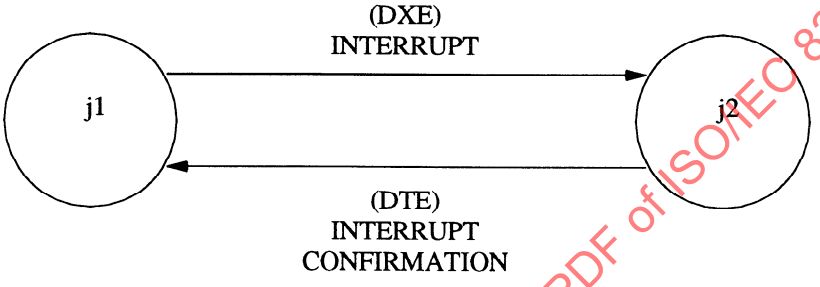


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Figure 36 — State Diagram for the Transfer of Reset Packets within the Data Transfer State (p4)



(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 37 — State Diagram for the Transfer of Interrupt Packets within the Flow Control Ready State (d1)

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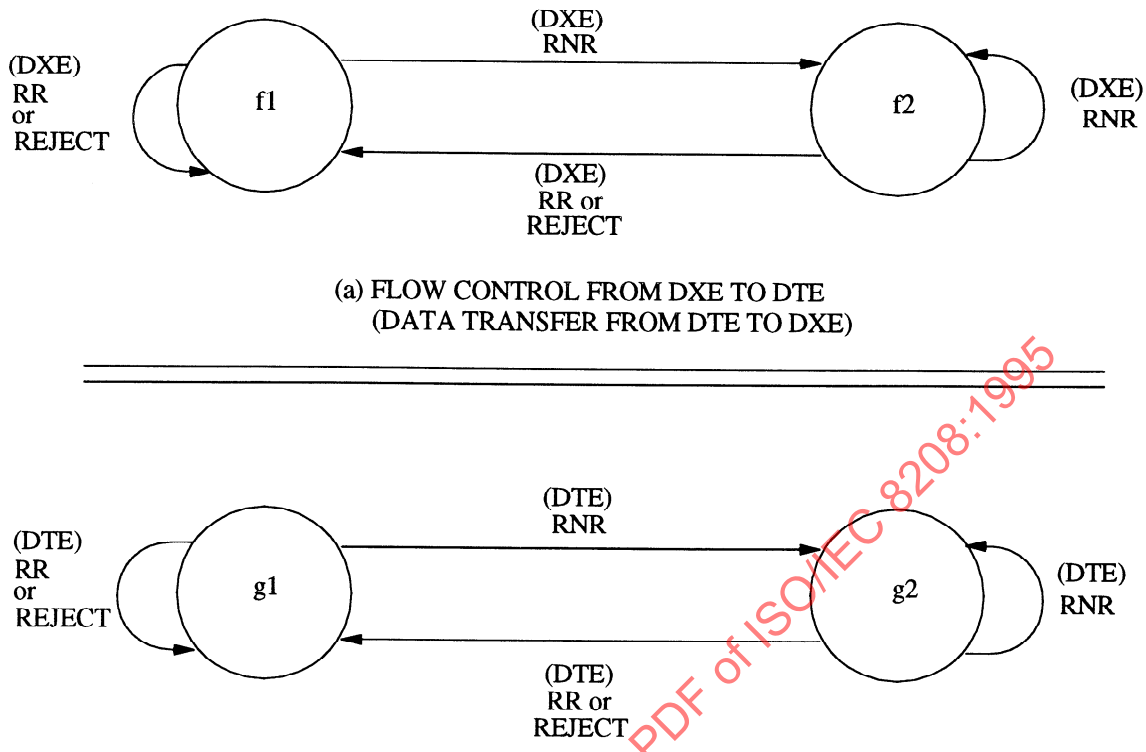


Figure 38 — State Diagram for the Transfer of Flow Control Packets within the Flow Control Ready State (d1)

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20 State tables

The state tables contained in this clause are provided to further supplement the procedural definition of the Packet Layer. The state tables give the actions taken by a DTE on the receipt of any packet in any state of Packet Layer operation.

Table 30 provides an index to the state tables.

Table 30 — Packet Layer State Tables

Table	Applicable States
31	Any State
32	Restart States (r1, r2, and r3)
33	Call Setup and Call Clearing States (p1, p2, p3, p4, p5, p6, and p7)
34	Data Transfer States (d1, d2, and d3)
35	Interrupt States (i1, i2, j1, and j2) (see Note)
36	Flow Control States (f1, f2, g1, and g2) (see Note)

NOTE — The Interrupt States and the Flow Control States are independent of one another and exist in parallel. That is, a logical channel is simultaneously in one of the two "i" states, one of the two "j" states, one of the two "f" states, and one of the two "g" states when the interface is in state d1.

The following conventions are used in the state tables:

a) A=action taken, which could be:

- NORMAL, as defined in the referenced clause(s),
- DISCARD the received packet and take no subsequent action as a result of receiving that packet,
- DIAG, which includes discarding the received packet; the DTE should also send a DIAGNOSTIC packet if implemented and if operating in a DTE/DTE environment (otherwise no subsequent action is taken as a result of receiving that packet), or
- ERROR, as defined in note 1 following the table (it is assumed that a DTE stops the normal processing of packet when an error is encountered; however, the order of packet decoding and checking is not standardized);

b) S=new state, if any, after taking the action noted above; and

c) D=the diagnostic code contained in the Diagnostic Code Field of the appropriate packet (DIAGNOSTIC, RESTART REQUEST, CLEAR REQUEST, or RESET REQUEST) issued upon detection of the indicated error (see note 2 of table 25).

NOTE — In some DTE implementations, certain states (e.g., r3, p7, d3, and j2) may be transient (i.e., the Packet Layer entering one of these states as a result of an incoming packet will leave the state by generating the appropriate response packet before processing any subsequent incoming packet). The reactions to incoming packets given in these Packet Layer state tables do not apply to states that are implemented as transient since such events cannot occur.

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Table 31 — Packet Layer State Table - Any State

ACTIONS TAKEN BY THE DTE UPON RECEIPT OF PACKETS IN ANY STATE OF THE PACKET LAYER DTE/DXE INTERFACE AS PERCEIVED BY THE DTE

Packet Received From the DXE:	Any State
Any packet less than 2 octets in length (including a valid Data Link Layer I frame containing no packet)	A = DIAG D = 38
Any packet with an invalid General Format Identifier (see 12.1.1)	A = DIAG D = 40
Any packet with an unassigned Logical Channel Identifier (see figure 1)	A = DIAG D = 36
Any packet with a valid General Format Identifier and either an assigned Logical Channel Identifier or a Logical Channel Identifier of 0.	See table 32

Table 32 (1 of 2) — Packet Layer State Table - Restart States

ACTIONS TAKEN BY THE DTE UPON RECEIPT OF PACKETS
IN RESTART-RELATED STATES OF THE PACKET LAYER DTE/DXE INTERFACE
AS PERCEIVED BY THE DTE

Packet Received From the DXE	Restart States		
	PACKET LAYER READY (r1)	DTE RESTART REQUEST (r2)	DXE RESTART INDICATION (r3)
Packet having a Packet Type Identifier which is shorter than 1 octet and having a Logical Channel Identifier of 0	A = DIAG D = 38	A = DISCARD	A = ERROR S = r2 D = 38
Packet having a Packet Type Identifier which is shorter than 1 octet and having an assigned Logical Channel Identifier	See table 33	A = DISCARD	A = ERROR S = r2 D = 38
Packet having a Packet Type Identifier which is undefined or not supported by the DTE (Note 2) and having a Logical Channel Identifier of 0	A = DIAG D = 33	A = DISCARD	A = ERROR S = r2 D = 33
Packet having a Packet Type Identifier which is undefined or not supported by the DTE (Note 2) and having an assigned Logical Channel Identifier	See table 33	A = DISCARD	A = ERROR S = r2 D = 33
RESTART INDICATION, RESTART CONFIRMATION, or Registration (if supported) packet with a Logical Channel Identifier unequal to 0 (Note 2)	See table 33	A = DISCARD	A = ERROR S = r2 D = 41
RESTART INDICATION or RESTART CONFIRMATION packet with a format error (Note 5)	A = DIAG D = 38, 39, 81, or 82	A = ERROR D = 38, 39, 81, or 82	A = DISCARD
RESTART INDICATION packet	A = NORMAL (4.2) S = r3	A = NORMAL (4.3) S = p1 or d1 (Note 4)	A = DISCARD
RESTART CONFIRMATION packet	A = ERROR S = r2 D = 17	A = NORMAL (4.4) S = p1 or d1 (Note 4)	A = ERROR S = r2 D = 19
REGISTRATION REQUEST or REGISTRATION CONFIRMATION packet with a format error (Note 9)	A = DIAG D = 38, 39, 81, or 82	A = ERROR D = 38, 39, 81, or 82	A = ERROR S = r2 D = 38, 39,
REGISTRATION REQUEST or REGISTRATION CONFIRMATION packet (Notes 7, 8)	A = NORMAL (13.1)	A = NORMAL (13.1)	A = NORMAL (13.1)
DIAGNOSTIC packet with a format error (including a Logical Channel Identifier unequal to 0) (Note 6)	A = DISCARD	A = DISCARD	A = DISCARD
DIAGNOSTIC packet	A = NORMAL (11.1)	A = NORMAL (11.1)	A = NORMAL (11.1)

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Table 32 (2 of 2) — Packet Layer State Table - Restart States

Packet Received From the DXE	Restart States		
	PACKET LAYER READY (r1)	DTE RESTART REQUEST (r2)	DXE RESTART INDICATION (r3)
Packet, other than a (a) Restart, (b) Registration (if supported), (c) DIAGNOSTIC, or (d) INCOMING CALL, CLEAR INDICATION (abandoning a call) or CALL CONFIRMATION (confirming rejection of a call) [when Reference Number mechanism is being used in a DTE/DTE environment] is supported by the DTE and having a Logical Channel Identifier of 0 (Notes 2, 3)	A = DIAG D = 36	A = DIAG D = 36	A = DIAG D = 36
Call Setup, Call Clearing, DATA, Interrupt, Flow Control, or Reset packet	See table 33	A = DISCARD	A = ERROR S = r2 D = 19

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a restarting procedure by transmitting a RESTART REQUEST packet across the DTE/DXE interface and starting timer T20. The Restarting Cause Field of the RESTART REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE RESTART REQUEST state (r2).

2 REJECT or Registration packets are not supported when the DTE is not capable of using the Packet Retransmission Facility or the On-line Facility Registration Facility, respectively. If the DTE is capable of using the On-line Facility Registration Facility but is capable of acting only as an initiator or only as a responder for the registration procedure, then a REGISTRATION REQUEST packet or a REGISTRATION CONFIRMATION packet, respectively, is not supported.

3 If the REGISTRATION REQUEST packet or REGISTRATION CONFIRMATION packet is not supported (see note 2 above), then the packet is treated as "Any packet with a Logical Channel Identifier of 0" and the corresponding action invoked.

4 State p1 for each Virtual Call logical channel and state d1 for each Permanent Virtual Circuit logical channel.

5 Formats for Restart packets are described in 12.6.

6 Format for the DIAGNOSTIC packet is described in 12.7.

7 Processing of Registration packets is as indicated except if any of the following conditions has occurred:

a) In cases where the DTE only acts as an initiator for the registration procedure, a received REGISTRATION REQUEST packet is treated as a packet not supported.

b) In cases where the DTE only acts as a responder for the registration procedure, a received REGISTRATION CONFIRMATION packet is treated as a packet not supported.

c) In cases where the DTE can act as a responder for the registration procedure, a DTE receiving a REGISTRATION REQUEST packet when use of the registration procedure has not been agreed to transmits a REGISTRATION CONFIRMATION packet with the cause "Local Procedure Error", diagnostic #42, and no Registration Field. Otherwise, the REGISTRATION REQUEST packet is processed as indicated.

d) In cases where the DTE can act as an initiator for the registration procedure, a DTE receiving a REGISTRATION CONFIRMATION packet when an unconfirmed REGISTRATION REQUEST packet is not outstanding (including the case where use of the registration procedure has not been agreed to) discards the packet. Otherwise, the REGISTRATION CONFIRMATION packet is processed as indicated.

8 A REGISTRATION REQUEST packet may be received, in a DTE/DTE environment only, if the agreement to use the On-line Facility Registration Facility includes the DTE responding to registration-procedure initiation.

When receiving a REGISTRATION REQUEST packet modifying one or more of the facilities that can take effect only when all logical channels used for Virtual Calls are in state p1 and it is possible to make the modification, the DTE invokes the ERROR procedure (with a cause indicating "DTE Originated" and the diagnostic "Registration/Cancellation Confirmed") if there is one or more logical channels assigned to Permanent Virtual Circuits. This action ensures that the Permanent Virtual Circuits are reset so that all of the negotiated facilities can properly take effect.

9 Formats for Registration packets are described in 12.9 and 16.

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Table 33 (1 of 2) — Packet Layer State Table - Call Setup and Call Clearing States

ACTIONS TAKEN BY THE DTE UPON RECEIPT OF PACKETS ON A LOGICAL CHANNEL ASSIGNED TO VIRTUAL CALL SERVICE IN CALL SETUP AND CALL CLEARING RELATED STATES OF THE PACKET LAYER DTE/DXE INTERFACE AS PERCEIVED BY THE DTE

Packet Received From the DXE	Call Setup and Call Clearing States (Within State r1)						
	READY (p1)	**DTE CALL REQUEST (p2) (Note 2)**	**DXE INCOMING CALL (p3) (Note 3)**	**DATA TRANSFER (p4)**	**CALL COLLISION (p5) (Notes 2, 3, 11)**	**DTE CLEAR REQUEST (p6)**	**DXE CLEAR INDICATION (p7)**
Packet having a Packet Type Identifier which is shorter than 1 octet	A = ERROR S = p6 D = 38	A = ERROR S = p6 D = 38	A = ERROR S = p6 D = 38	See table 34	A = ERROR S = p6 D = 38	A = DISCARD	A = ERROR S = p6 D = 38
Packet having a Packet Type Identifier which is undefined or not supported by the DTE (Note 4)	A = ERROR S = p6 D = 33	A = ERROR S = p6 D = 33	A = ERROR S = p6 D = 33	See table 34	A = ERROR S = p6 D = 33	A = DISCARD	A = ERROR S = p6 D = 33
RESTART INDICATION, RESTART CONFIRMATION or Registration (if supported) packet with a Logical Channel Identifier unequal to 0 (Note 4)	A = ERROR S = p6 D = 41	A = ERROR S = p6 D = 41	A = ERROR S = p6 D = 41	See table 34	A = ERROR S = p6 D = 41	A = DISCARD	A = ERROR S = p6 D = 41
INCOMING CALL packet	A = NORMAL (5.2.2) S = p3 (Notes 5, 6)	A = NORMAL (5.2.5) S = p5 (Notes 6, 7)	A = ERROR S = p6 D = 22	A = ERROR S = p6 D = 23 (Note 8)	A = ERROR S = p6 D = 24	A = DISCARD	A = ERROR S = p6 D = 26
CALL CONNECTED packet (Note 5)	A = ERROR S = p6 D = 20	A = NORMAL (5.2.4) S = p4 or A = ERROR S = p6 D = 21 or 42 (Note 9)	A = ERROR S = p6 D = 22	A = ERROR S = p6 D = 23 (Note 8)	A = NORMAL (5.2.5) S = p4 or A = ERROR S = p6 D = 24 or 42 (Notes 9, 10)	A = DISCARD	A = ERROR S = p6 D = 26
CLEAR INDICATION packet (Note 5)	A = NORMAL (5.5.2) S = p7	A = NORMAL (5.5.2) S = p7	A = NORMAL (5.5.2) S = p7	A = NORMAL (5.5.2) S = p7 (Note 8)	A = NORMAL (5.5.2) S = p7	A = NORMAL (5.5.2) S = p7	A = DISCARD
CLEAR CONFIRMATION packet (Note 5)	A = ERROR S = p6 D = 20	A = ERROR S = p6 D = 21	A = ERROR S = p6 D = 22	A = ERROR S = p6 D = 23 (Note 8)	A = ERROR S = p6 D = 24	A = NORMAL (5.5.4) S = p1	A = ERROR S = p6 D = 26
DATA, Interrupt, Flow Control, or Reset packet	A = ERROR S = p6 D = 20	A = ERROR S = p6 D = 21	A = ERROR S = p6 D = 22	See table 34	A = ERROR S = p6 D = 24	A = DISCARD	A = ERROR S = p6 D = 26

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Table 33 (2 of 2) — Packet Layer State Table - Call Setup and Call Clearing States

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a clearing procedure by transmitting a CLEAR REQUEST packet across the DTE/DXE interface for the logical channel specified in the received packet and starting timer T23. The Clearing Cause Field of the CLEAR REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE CLEAR REQUEST state (p6).

2 This state does not exist in the case of an incoming one-way logical channel as perceived by the DTE or if the Outgoing Calls Barred Facility is subscribed to.

3 This state does not exist in the case of an outgoing one-way logical channel as perceived by the DTE or if the Incoming Calls Barred Facility is subscribed to.

4 REJECT or Registration packets are not supported when the DTE is not capable of using the Packet Retransmission Facility or the On-line Facility Registration Facility, respectively. If the DTE is capable of using the On-line Facility Registration Facility but is capable of acting only as an initiator or only as a responder for the registration procedure, then a REGISTRATION REQUEST packet or a REGISTRATION CONFIRMATION packet, respectively, is not supported.

5 If the packet is acceptable to the state of the logical channel (i.e., A = NORMAL) but contains a format error or is otherwise unacceptable, then the DTE will invoke the ERROR procedure (diagnostic codes that may apply include 38, 39, 42, 64, 65, 66, 67, 68, 69, 74, 75, 76, 77, 81, 82, and 164). Formats for Call Setup and Call Clearing packets are described in 12.2; formats for facility information are described in clause 15. In addition to being properly formatted, address information must contain the correct number of digits and specify a valid address. A facility code that is not supported or that does not apply in a DTE/DTE environment may be ignored or treated as an error. If the DTE chooses to treat this situation as an error, then it invokes the ERROR procedure (with D = 65).

6 In the case of an outgoing one-way logical channel as perceived by the DTE, the DTE will invoke the ERROR procedure (with D = 34).

7 If the INCOMING CALL packet contains a format error or is otherwise unacceptable, then

a) in a DTE/DTE environment, if the DTE is acting as a DCE for the purpose of resolving call collisions (see 5.2.5) it shall act as in Note 5;

b) otherwise, the DTE may invoke the ERROR procedure (diagnostic codes that may apply include 38, 39, 42, 64, 65, 66, 67, 68, 69, 73, 74, 75, 76, 77, 82, 163 and 164).

Formats for call setup packets are described in 12.2 and formats for facility information are described in clause 15. In addition to being properly formatted, address information must contain the correct number of digits and specify a valid address. A facility code that is not supported or that does not apply in a DTE/DTE environment may be ignored or treated as unacceptable; in the latter case, diagnostic code 65 applies if the DTE invokes the error procedure.

8 In the case of a Permanent Virtual Circuit, the packet is invalid and table 34 applies.

9 The use by the calling DTE of the Fast Select Facility with a restriction on the response prohibits the DXE from sending a CALL CONNECTED packet.

10 In a DTE/DTE environment, the DTE that acts as a DCE for purposes of resolving call collisions (see 5.2.5) will invoke the ERROR procedure (with D = 24).

11 State p5 is not applicable when using the Reference Number Facility.

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Table 34 (1 of 2) — Packet Layer State Table - Reset States

ACTIONS TAKEN BY THE DTE UPON RECEIPT OF PACKETS ON AN ASSIGNED LOGICAL CHANNEL IN RESET-RELATED STATES OF THE PACKET LAYER DTE/DXE INTERFACE AS PERCEIVED BY THE DTE

Packet Received From the DXE	Reset States (Within State p4)		
	FLOW CONTROL READY (d1)	DTE RESET REQUEST (d2)	DXE RESET INDICATION (d3)
Packet having a Packet Type Identifier which is shorter than 1 octet	A = ERROR S = d2 D = 38	A = DISCARD	A = ERROR S = d2 D = 38
Packet having a Packet Type Identifier which is undefined or not supported by the DTE (Note 2)	A = ERROR S = d2 D = 33	A = DISCARD	A = ERROR S = d2 D = 33
RESTART INDICATION, RESTART CONFIRMATION, or Registration (if supported) packet with a Logical Channel identifier unequal to 0	A = ERROR S = d2 D = 41	A = DISCARD	A = ERROR S = d2 D = 41
RESET INDICATION packet (Note 3)	A = NORMAL (8.2) S = d3	A = NORMAL (8.3) S = d1	A = DISCARD
RESET CONFIRMATION packet (Note 3)	A = ERROR S = d2 D = 27	A = NORMAL (8.4) S = d1	A = ERROR S = d2 D = 29
Invalid packet type on a Permanent Virtual Circuit logical channel	A = ERROR S = d2 D = 35	A = DISCARD	A = ERROR S = d2 D = 35
REJECT packet supported but not subscribed to	A = ERROR S = d2 D = 37	A = DISCARD	A = ERROR S = d2 D = 37
Interrupt packet	See table 35	A = DISCARD	A = ERROR S = d2 D = 29
DATA or Flow Control packet	See table 36	A = DISCARD	A = ERROR S = d2 D = 29

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Table 34 (2 of 2) — Packet Layer State Table - Reset States

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a resetting procedure by transmitting a RESET REQUEST packet across the DTE/DXE interface for the logical channel specified in the received packet and starting timer T22. The Resetting Cause Field of the RESET REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE RESET REQUEST state (d2).

2 REJECT or Registration packets are not supported when the DTE is not capable of using the Packet Retransmission Facility or the On-line Facility Registration Facility, respectively. If the DTE is capable of using the On-line Facility Registration Facility but is capable of acting only as an initiator or only as a responder for the registration procedure, then a REGISTRATION REQUEST packet or a REGISTRATION CONFIRMATION packet, respectively, is not supported.

3 If the packet is acceptable to the state of the logical channel (i.e., A = NORMAL) but contains a format error, then the DTE will invoke the ERROR procedure (diagnostic codes that may apply include 38, 39, 81, and 82). Formats for Reset packets are described in 12.5.

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Table 35 — Packet Layer State Table - Interrupt States

ACTIONS TAKEN BY THE DTE UPON RECEIPT OF PACKETS ON AN ASSIGNED LOGICAL CHANNEL IN INTERRUPT-RELATED STATES OF THE PACKET LAYER DTE/DXE INTERFACE AS PERCEIVED BY THE DTE

Packet Received From the DXE	DTE-to-DXE Interrupt Transfer States (Within State d1)	
	DTE INTERRUPT READY (i1)	DTE INTERRUPT SENT (i2)
INTERRUPT CONFIRMATION packet (Note 2)	A = ERROR S = d2 D = 43	A = NORMAL (6.8.3) S = i1

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a resetting procedure by transmitting a RESET REQUEST packet across the DTE/DXE interface for the logical channel specified in the received packet and starting timer T22. The Resetting Cause Field of the RESET REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE RESET REQUEST state (d2).

2 If the packet is acceptable to the state of the logical channel (i.e., A = NORMAL) but contains a format error, then the DTE will invoke the ERROR procedure (diagnostic codes that may apply include 38, 39, and 82). The format for the INTERRUPT CONFIRMATION packet is described in 12.3.3.

Packet Received From the DXE	DXE-to-DTE Interrupt Transfer States (Within State d1)	
	DXE INTERRUPT READY (j1)	DXE INTERRUPT SENT (j2)
INTERRUPT packet (Note 2)	A = NORMAL (6.8.2) S = j2	A = ERROR S = d2 D = 44

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a resetting procedure by transmitting a RESET REQUEST packet across the DTE/DXE interface for the logical channel specified in the received packet and starting timer T22. The Resetting Cause Field of the RESET REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE RESET REQUEST state (d2).

2 If the packet is acceptable to the state of the logical channel (i.e., A = NORMAL) but contains a format error, then the DTE will invoke the ERROR procedure (diagnostic codes that may apply include 38, 39, and 82). The format for the INTERRUPT packet is described in 12.3.2.

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Table 36 (1 of 2) — Packet Layer State Table - Flow Control States

ACTIONS TAKEN BY THE DTE UPON RECEIPT OF PACKETS ON AN ASSIGNED LOGICAL CHANNEL IN FLOW CONTROL-RELATED STATES OF THE PACKET LAYER DTE/DXE INTERFACE AS PERCEIVED BY THE DTE

Packet Received From the DXE	DXE-to-DTE Flow Control Transfer States (DTE-to-DXE Data Transfer) (Within State d1)	
	DXE RECEIVE READY (f1)	**DXE RECEIVE NOT READY (f2)**
RR, RNR, or REJECT (if subscribed to) packet with less than 4 octets when using modulo 128 numbering	A = ERROR S = d2 D = 38 or A = DISCARD	A = ERROR S = d2 D = 38 or A = DISCARD
RR, RNR, or REJECT (if subscribed to) packet with an invalid P(R)	A = ERROR S = d2 D = 2	A = ERROR S = d2 D = 2
RR packet with a valid P(R) (Note 2)	A = NORMAL (7.1.5)	A = NORMAL (7.1.5) S = f1
RNR packet with a valid P(R) (Note 2)	A = NORMAL (7.1.6) S = f2	A = NORMAL (7.1.6)
REJECT packet (if subscribed to) with a valid P(R) (Notes 2, 3)	A = NORMAL (13.4.2)	A = NORMAL (13.4.2) S = f1

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a resetting procedure by transmitting a RESET REQUEST packet across the DTE/DXE interface for the logical channel specified in the received packet and starting timer T22. The Resetting Cause Field of the RESET REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE RESET REQUEST state (d2).

Invoking the ERROR procedure, as described above, clears any receive-not-ready condition that may exist.

2 For RR, RNR, or REJECT packets, the presence of one or more octets beyond the third octet when modulo 8 numbering is used (or the fourth octet when modulo 128 numbering is used) is considered an error. Although a valid P(R) may be accepted to update the status of outstanding DATA packets, the ERROR procedure, as described in note 1, should be invoked (with D = 39). Alternatively, the packet may be ignored.

3 Receipt of a second REJECT packet before transfer of the DATA packet with the P(S) equal to the P(R) indicated in the previous REJECT packet is an error. In this case, the ERROR procedure, as described in note 1, is invoked (with D = 45).

4 In addition to the state transitions resulting from the receipt of packets, there may be certain internal stimuli that will cause state transitions and the transmission of packets (e.g., local receive-not-ready condition detected/cleared resulting in transmission of a RNR/RR packet).

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Table 36 (2 of 2) — Packet Layer State Table - Flow Control States

Packet Received From the DXE	DTE-to-DXE Flow Control Transfer States (DXE-to-DTE Data Transfer) (Within State d1)	
	DTE RECEIVE READY (g1)	DTE RECEIVE NOT READY (g2)
DATA packet with less than 4 octets when using modulo 128 numbering	A = ERROR S = d2 D = 38	A = ERROR S = d2 D = 38 or A = DISCARD (Note 6)
DATA packet with an invalid P(R)	A = ERROR S = d2 D = 2	A = ERROR S = d2 D = 2
DATA packet with a valid P(R) but with an invalid P(S) or a User Data Field with improper format	A = ERROR S = d2 D = See Note 4 or A = DISCARD (Note 3)	A = ERROR S = d2 D = See Note 2 or A = DISCARD (Notes 5, 6)
DATA packet with a valid P(R) but with the D-bit set to 1 when the D-bit procedure is not supported, or the M-bit set to 1 and the D-Bit set to 0 when the User Data Field is partially full, or the Q-bit not set to the same value in all DATA packets of a complete packet sequence	A = ERROR S = d2 D = See Note 4	A = ERROR S = d2 D = See Note 4 or A = DISCARD (Notes 5, 6)
DATA packet with a valid P(R), a valid P(S), and a User Data Field with proper format	A = NORMAL (6.7, 7.1.3)	A = DISCARD (Notes 5, 7)

NOTES

1 The ERROR procedure involves discarding the received packet and initiating a resetting procedure by transmitting a RESET REQUEST packet across the DTE/DXE interface for the logical channel specified in the received packet and starting timer T22. The Resetting Cause Field of the RESET REQUEST packet should be coded "DTE Originated" and the Diagnostic Code Field should be coded as indicated. At this time, the logical channel is in the DTE RESET REQUEST state (d2).

Invoking the ERROR procedure, as described above, clears any receive-not-ready condition that may exist.

2 The diagnostic code depends on the condition detected: D = 1 for an invalid P(S), D = 39 if the User Data Field is greater than the maximum allowed on the logical channel, and D = 82 if the User Data Field is not octet aligned.

3 Recovery mechanism (b) or (c) described in 11.3 may be invoked to recover from the receipt of an invalid P(S) or an invalid User Data Field.

4 The diagnostic code depends on the condition detected: D = 166 if the D-bit is set to 1 where the D-bit procedure is not supported, D = 165 if the M-bit is set to 1 and the D-bit is set to 0 when the User Data Field is partially full, and D = 83 if the Q-bit is not set to the same value in all DATA packets of a complete packet sequence.

5 Although a receive-not-ready condition exists at the DTE, the P(R) information contained in the header of a DATA packet should be processed.

6 The DTE may define an internal mechanism to indicate that DATA packets have been discarded during a receive-not-ready condition. In this case, when the receive-not-ready condition clears, one of the recovery mechanisms described in 11.3 should be invoked.

7 If possible, the DTE should process these packets normally. On the other hand, the DTE may define an internal mechanism to indicate that valid DATA packets have been discarded during a receive-not-ready condition. In this case, when the receive-not-ready condition clears, appropriate recovery procedures (such as resetting the logical channel), described in 11.3, should be invoked.

8 In addition to the state transitions resulting from the receipt of packets, there may be certain internal stimuli that will cause state transitions and the transmission of packets (e.g., local receive-not-ready condition detected/cleared resulting in transmission of a RNR/RR packet).

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21 Conformance

21.1 Static conformance

NOTE — Many DTE capabilities are optional. Designers of DTEs should be aware that use by a DTE of certain options to the exclusion of others may adversely affect the DTE's general interconnection capabilities, since complementary options may not be supported by the DXE (for example, the use of only modulo 128 packet sequencing, or use of only Fast Select in call setup).

21.1.1 General requirements

A DTE that claims conformance to this International Standard shall implement:

a) either Permanent Virtual Circuit Service or Virtual Call Service (and may support both);

b) operation in either a DTE/DCE or DTE/DTE environment (and may support both);

c) operation[1)] with the role as DTE or DCE either

1) initialized to DTE, or
2) initialized to DCE, or
3) dynamically selected according to the procedures in 4.5

(and may support more than one of these methods of role selection);

d) either modulo 8 packet sequencing or modulo 128 packet sequencing (and may support both);

e) the functions specified in table 37 as Mandatory, or as Conditional when the relevant conditions apply, according to the procedures specified in the clauses to which the table items refer;

f) the timers and retransmission counters specified in table 38 as Mandatory, or as Conditional when the relevant conditions apply;

g) the mapping onto the Data Link Layer as specified in clause 3, third items (a) to (c); 3.3 first item (d); clause 10; and 12.1 (Data Link Layer Information Fields, Data Link Service data units).

Such a DTE shall not implement the functions specified in table 37 as Prohibited when the relevant conditions apply.

21.1.2 Options

A DTE that claims conformance to this International Standard is not required to:

a) send DIAGNOSTIC packets (3.3, second item (d); 11.1);

b) support any optional user facilities (clause 13);

c) support any optional ITU-T specified DTE facilities (clause 14);

d) transmit a specific value of the Q-bit in DATA packets (6.6);

e) support either the use of the D-bit, or the optional mechanism for negotiating D-bit usage (6.3);

f) transmit specific diagnostic code values when originating clearing, resetting or restarting (12.2.5.1, 12.5.1, 12.6.1 and tables 24 and 25);

g) implement transient states r3, p3, p7, d3, j2;

h) transmit RECEIVE NOT READY packets (7.1.6);

i) implement any of the optional procedures relating to non-receipt of window rotation information (11.2.1, 11.2.2);

k) implement either of the non-standard alternative modes of recovery from receipt of out of sequence DATA packets (11.3 (b) and (c));

l) support Interrupt data transfer (6.8);

m) support transfer of user data in call setup and clearing packets (5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.5.1, 5.5.2);

n) support DATA packet transfer (clause 6);

p) support DATA packets with the M-bit set to 1 (6.4, 6.7);

q) transmit updated window rotation information (7.1.3);

r) transmit RECEIVE READY packets (7.1.5)

In items b), c), e), l), m), n) and p), support refers to transmission and reception, independently.

NOTE — Non-support by a DTE of any of items (l) to (r), and to a lesser extent of item (d), would normally be appropriate only for an unusual and highly application-specific implementation; these items, although strictly optional, are generally expected to be part of the normal functionality of a DTE.

21.2 Protocol Implementation Conformance Statement

The supplier of a protocol implementation which is claimed to conform to this International Standard shall complete a copy of the PICS proforma provided in annex B, including the information necessary to identify fully both the supplier and the implementation.

21.3 Dynamic conformance

A DTE for which conformance to this International Standard is claimed shall exhibit external behaviour consistent with having implemented, for each function that the PICS states to be supported,

a) the corresponding Packet Layer procedures and
b) the encoding of any transmitted packets

as specified in the clauses to which the PICS proforma entry for the function refers, and using the Data Link Layer as specified in 3.3, clause 10, and 12.1.

1) This does not apply when the Reference Number Facility is used in a DTE/DTE environment.

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Table 37 (1 of 2) — DTE capabilities for static conformance

Item no.	DTE capability [Clauses specifying the corresponding procedures]	Service: PVC	VC
1	Restarting the packet layer:		
1a	- as initiator [4, 4.1, 4.3, 4.4]	M	M
1b	- as responder [4, 4.2, 4.3, 4.4]	M	M
2	Support of DIAGNOSTIC packet:		
2a	- receipt [11.1]	M	M
2b	- sending [11.1]	/DCE: X /DTE: O	/DCE: X /DTE: O
3	Virtual Call setup:		[M]
3a	- initiating an outgoing VC, with subsequent acceptance or rejection [5, 5.2.1, 5.2.4, 5.2.5, 5.5.2, 5.5.4] (Note 1)	-	O
	Receiving an incoming VC and responding by:		
3b	- acceptance [5, 5.2.2, 5.2.3, 5.2.5] (Note 1)	-	O
3c	- rejection [5, 5.2.2, 5.2.5, 5.3, 5.5, 5.5.1, 5.5.3, 5.5.4] (Notes 1, 2)	-	O
4	Aborting an outgoing VC attempt, by clearing [5.4, 5.5, 5.5.1, 5.5.3, 5.5.4] (Note 3)	-	O
5	Clearing an established VC (Note 3)		
5a	- as initiator [5.5, 5.5.1, 5.5.3, 5.5.4]	-	O
5b	- as responder [5.5, 5.5.2, 5.5.4]	-	O
6	Response to errors and unsupported packets on an assigned logical channel - expiry of T21 [5.2.1, 5.4] or R22 [8.1] - received packets causing the ERROR procedure in Call Setup and Call Clearing states [table 33] - received CLEAR INDICATION if clearing as responder is not supported (item 5b) - received RESET INDICATION if resetting as responder is not supported (item 8b) by:	-	[M]
6a	- initiating clearing		O
6b	- initiating restarting (Notes 4, 5, 6, 7)		O
6c	- other		X
7	Response to other errors and to receipt of other unsupported packets, or fields of packets, on an assigned logical channel, by:	[M]	[M]
7a	- initiating clearing [6.3, 6.4, 6.6, 6.8.1, 6.8.2,	-	O
7b	- initiating restarting 7.1.3, 7.1.4, 8.2, 11.2.1,	O	O
7c	- initiating resetting 13.4.1, tables 34, 35, 36]	O	O
7d	- other (Notes 5, 6, 7, 8)	X	X
8	Resetting a logical channel:		
8a	- as initiator [8, 8.1, 8.3, 8.4] (Note 9)	O	O
8b	- as responder [8, 8.2, 8.3, 8.4] (Note 10)	O	O

Where:

M =	Mandatory
[M] =	at least one of the items in this group shall be supported
O =	Optional
- =	not applicable to the PVC service
X =	Prohibited
/DCE: =	specification for operation in a DTE/DCE environment
/DTE: =	specification for operation in a DTE/DTE environment

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Table 37 (2 of 2) — DTE capabilities for static conformance

NOTES

1 The reference to 5.2.5 (call collision) applies only if two-way logical channels are supported and the Reference Number Facility is not used.

2 Rejection because of errors is covered by item 6.

3 *Although many implementations that support VCs will be designed to implement call clearing as a matter of course, clearing is classed as optional because implementations are free to initiate a restart at any time; some implementations, therefore, may exercise this freedom in situations where call clearing would otherwise apply.*

4 This item does not include unrecognized or unsupported facility codes within a Facilities Field (15.1).

5 Where optional capabilities are specified for these items, the DTE may choose any permitted option on each occasion that an error, etc., occurs, independently of the options chosen on other occasions or for other errors, etc.

6 Packets with LCI = 0 are excluded, since that is not an assigned logical channel (figure 1).

7 The clauses and tables listed are those specifying the occurrence of errors: items 5, 8 and 9 cover the error procedures themselves.

8 Although many implementations will be designed to reset on the errors covered by item 7, resetting is classed as optional in item 7 because implementations are free to initiate a restart, *or to initiate clearing of a virtual call,* at any time; some implementations, therefore, may exercise this freedom in situations where resetting would otherwise apply.

9 Initiation of resetting is optional: a) because of the considerations in Note 8 with respect to events internal to the packet layer; and b) because initiation of resetting on request from the higher-layer entity is intrinsically optional, in that an implementation could be designed for use specifically by a higher-layer entity that in turn is designed never to request resetting.

10 Although many implementations will be designed to reset a logical channel by responding to a reset, response to resetting is classified as optional because implementations are free to initiate restarting, *or to initiate clearing of a virtual call,* at any time; some implementations, therefore, may exercise this freedom in situations where resetting would otherwise apply.

Table 38 - Static conformance: required timers and retransmission counters

T20	Restart Request Response Timer	and	R20	Restart Request Retransmission Counter	M
T21	Call Request Response Timer				C.1
T22	Reset Request Response Timer	and	R22	Reset Request Retransmission Counter	C.2
T23	Clear Request Response Timer	and	R23	Clear Request Retransmission Counter	C.3
T24	Window Status Transmission Timer				C.4
T25	Window Rotation Timer	and	R25	Data Packet Retransmission Counter	C.5
T26	Interrupt Response Timer				C.6
T27	Reject Response Timer	and	R27	Reject Retransmission Counter	C.7
T28	Registration Request Response Timer	and	R28	Registration Request Retransmission Counter	C.8

Where:

M =	Mandatory
C.n =	Conditional, as follows:
C.1 =	*required if the DTE initiates Virtual Calls*
C.2 =	required if the DTE initiates resetting
C.3 =	*required if the DTE implements the Virtual Call service and initiates clearing*
C.4 =	required if the DTE implements the optional procedure for window status transmission, specified in 11.2.2
C.5 =	required if the DTE implements either of the optional procedures relating to the receipt of window rotation information, specified in 11.2.1
C.6 =	required if the DTE supports sending of Interrupt data
C.7 =	required if the DTE supports the optional user facility for Packet Retransmission
C.8 =	required if the DTE supports the optional user facility for On-line Facility Registration

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Annex A
(normative)

Private networks

This International Standard specifies the procedures and formats at the Packet Layer for DTE's operating in conformance with Recommendation X.25. It covers direct DTE-to-DTE operation and DTE operation for access to a packet-switched public data network (PSPDN) or to a packet-switched private data network (PSPvtDN) conforming to Recommendation X.25. This annex applies this International Standard to two additional cases:

a) for a private network (PvtN) that connects to a PSPDN using X.25; and

b) for a PvtN that offers to DTEs an X.25 packet-switched interface (i.e., a PSPvtDN).

NOTES

1 The distinction between public and private X.25 packet-switched networks is mostly a matter of ownership and accessibility. Functionally, they may appear identical to a DTE. However, a PSPvtDN uses the procedures in this International Standard, as modified by this annex, to connect to a PSPDN whereas two PSPDNs connect to each other using the procedures in CCITT Recommendation X.75.

2 A PSPvtDN, for the purposes of this annex, is defined as offering an X.25 packet-switched network interface when, for example, it provides cause-code information as shown in tables 7, 8, and 9 and it offers at least those optional user facilities noted as Essential in table 11. This is to distinguish a PSPvtDN from equipment that performs a concentration or protocol-conversion function, for example, on behalf of other equipment but offers only a DTE interface.

3 A special case of a PSPvtDN is an X.25 interworking unit (IWU) (see ISO/IEC TR 10029).

Figure A.1 depicts the interfaces described in this annex and contrasts them to other possible interfaces. Interfaces C (PvtN-to-PSPDN interface), E (DTE-to-PSPvtDN interface), F (IWU-to-PSPDN interface) and G (DTE-to-IWU interface) are referenced in this annex as appropriate.

A.1 Connection of private networks to PSPDNs

Connection of a PvtN to a PSPDN may be accomplished using X.25. That is, the DCE within the PSPDN (i.e., a PSPDN-DCE) conforms to Recommendation X.25 while the PvtN acts as a DTE in conformance with this International Standard. Factors to be considered for this interface (interfaces C and F in figure A.1) include:

a) addressing of DTEs on the PvtN: alternatives include sharing of the address space available to PSPDNs, if permitted, and use of the Address Extension Facilities described in 14.1 and 14.2;

b) allocation of PSPDN charges to DTEs on the PvtN: the Charging Information Facility (see 13.22), if available, may be used by the PvtN to ascertain PSPDN charges for Virtual Calls; and

c) reliability of PvtN-to-PSPDN access: use of the Hunt Group Facility (see 13.24) or the Layer 2 Multilink Procedures can increase the reliability from that obtained with a single access line between the PvtN and the PSPDN.

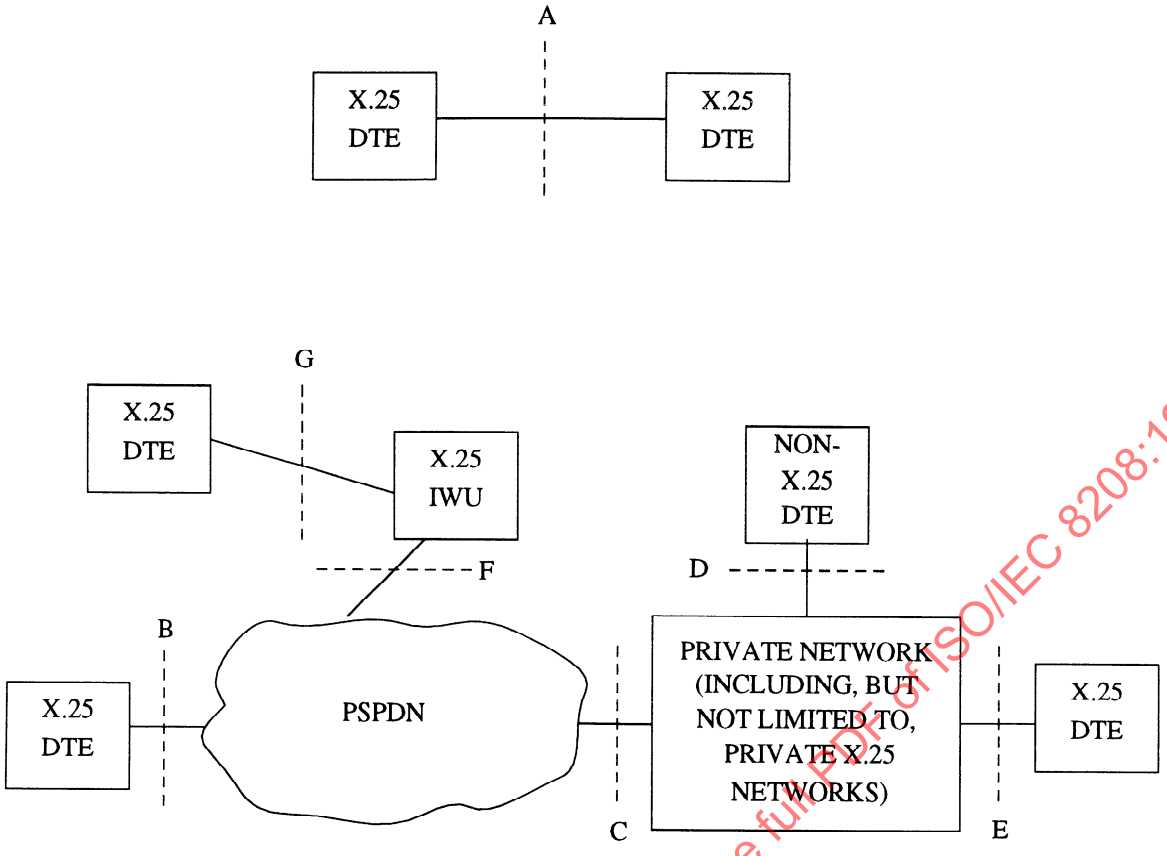
To report status information about the PvtN, "private-network" reason/cause codes are used in the corresponding packets originated by the PvtN and transmitted to the PSPDN, that is:

a) when transmitting a CALL REQUEST packet to the PSPDN resulting from a Call Redirection or Call Deflection within the PvtN into the PSPDN, the PvtN uses the same reason codes in the Call Redirection or Call Deflection Notification (see 13.25.3) Facility Parameter Field in its CALL REQUEST packet as used by a PSPDN in the same facility in an INCOMING CALL packet but with bit 8 set to 1;

b) when clearing or resetting a logical channel, the PvtN uses the same cause codes in its CLEAR REQUEST or RESET REQUEST packet, respectively, as used by a PSPDN (these codes are defined in tables 7 and 8, respectively) but with bit 8 set to 1; and

c) when restarting interface C or F, the PvtN uses the restart cause codes in table A.1.

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INTERFACES

A: X.25 DTE-to-X.25 DTE interface as governed by this International Standard (DTE/DTE environment)

B: X.25 DTE-to-PSPDN DCE interface as governed by this International Standard and by Recommendation X.25 (DTE/DCE environment)

C: Private Network-to-PSPDN DCE interface as governed by this International Standard as modified by this annex and by Recommendation X.25 (DTE/DCE environment)

D: Non-X.25 DTE-to-Private Network interface as governed by other applicable standards

E: X.25 DTE-to-Private Network DCE interface as governed by this International Standard as modified by this annex (DTE/DCE environment)

F: X.25 interworking unit (IWU)-to-PSPDN DCE interface as governed by this International Standard and augmented by ISO/IEC TR 10029, and by Recommendation X.25 (DTE/DCE environment).

G: X.25 DTE-to-X.25 DTE interface as governed by this International Standard and augmented by ISO/IEC TR 10029 (DTE/DTE environment).

NOTE — An X.25 DTE may provide concentration or protocol-conversion functions, for example, on behalf of other DTEs.

Figure A.1 — Classification of Interfaces Involving X.25 DTEs

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Table A.1 — Coding of the Restarting Cause Field in RESTART REQUEST Packets Transmitted by a PvtN Across the PvtN-DTE/PSPDN-DCE Interface

RESTARTING CAUSE	OCTET 4 BITS: 8 7 6 5 4 3 2 1
Gateway-detected Procedure Error	1 1 0 0 0 0 0 1
Gateway Congestion	1 1 0 0 0 0 1 1
Gateway Operational	1 1 0 0 0 1 1 1

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Additional actions for a PvtN pertain to the receipt of certain optional user facilities from a PSPDN, as specified below.

a) A PvtN may clear a Virtual Call when the throughput value for either direction of data transmission indicated in one of the Throughput Class Negotiation facilities (see 13.13) is less than the minimum-acceptable value specified by the calling DTE. These minimum-acceptable values, when present, are specified in the Minimum Throughput Class Negotiation Facility (see 14.3).

b) The transit-delay values, as provided in the Transit Delay Selection and Indication Facility (see 13.27) and the End-to-End Transit Delay Negotiation Facility (see 14.4), reflect the transit delay introduced by the PvtN (see annex G of ISO/IEC 8878). If the total delay then exceeds the maximum-acceptable transit-delay value, if specified by the calling DTE in the End-to-End Transit Delay Negotiation Facility, then the PvtN may clear the Virtual Call.

A.2 X.25 DTE operation with private networks

The operation of an X.25 DTE/DCE interface in PSPvtDNs (interface E in figure A.1) is governed by this International Standard and by Recommendation X.25. The operation of an X.25 DTE/DTE interface in PSPvtDNs (interface G in figure A.1) is governed by this International Standard. If communication with DTEs reachable through a PSPDN is also desired, then several additional factors need to be considered as specified below.

a) To allow DTEs to distinguish between actions (clear, reset, or restart) originated by a PSPDN from those originated by a PSPvtDN, "private-network" cause codes are used at interface E or G. That is, when clearing or resetting a logical channel, the PSPvtDN uses the same cause codes in its CLEAR INDICATION and RESET INDICATION packets, respectively, as used by a PSPDN (these codes are defined in tables 7 and 8, respectively) but with bit 8 set to 1. When restarting interface E or G, the PSPvtDN uses the same cause codes in its RESTART INDICATION packet as used by a PSPDN (as defined in table 9).

b) To allow DTEs to distinguish between problems at interface C or F and similar problems at other interfaces, the PSPvtDN translates the cause code in a RESTART INDICATION packet received from the PSPDN to the cause code indicated in table A.2 for the resulting CLEAR INDICATION packet (Virtual Call) or RESET INDICATION packet (Permanent Virtual Circuit) transmitted to the DTE at interface E or G.

Table A.2 — Translation of Restarting Cause Codes in a RESTART INDICATION Packet Received from a PSPDN

Restarting Cause Code Received From PSPDN Octet 4 bits:								Resulting Cause Code Transmitted to DTE on PSPvtDN Clearing Cause Code Octet 4 bits:								Resetting Cause Code Octet 4 bits:							
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	0	0	0	0	0	1
0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1
0	0	0	0	0	1	1	1	Not Applicable								1	1	0	0	0	1	1	1
0	1	1	1	1	1	1	1	Not Applicable								1	1	0	0	0	1	1	1

c) The subscription and/or use of certain optional user facilities at interface E or G requires, for the most part, the subscription and/or use of the same facilities at interface C or F to the PSPDN. Some considerations and exceptions include the following:

— To support closed user groups (CUGs) involving DTEs both inside and outside the PSPvtDN, the PSPvtDN must subscribe to the appropriate CUG-related facilities (see 13.14) at its interface to the PSPDN. This subscription depends on the CUG-related subscriptions of DTEs in the PSPvtDN. Table A.3 shows, for each CUG-related subscription that a DTE can make to the PSPvtDN, the CUG-related subscriptions that a PSPvtDN can make to the PSPDN to support its DTEs (i.e., an "X" indicates that the PSPvtDN-to-PSPDN subscription in the column can support the DTE-to-PSPvtDN subscription in the row).

— Subscription to the Fast Select Acceptance Facility (see 13.17) and/or the Reverse Charging Acceptance Facility (see 13.19) by DTEs on the PSPvtDN requires the PSPvtDN to subscribe to these facilities at the interface to the PSPDN to be able to receive calls requesting the Fast Select Facility (see 13.16) and/or the Reverse Charging Facility (see 13.18), respectively. However, there may be adverse charging implications for calls presented to the PSPvtDN that are destined to DTEs on the PSPvtDN that do not subscribe to the corresponding Acceptance Facility.

— Any charging information (see 13.22) for a particular Virtual Call accumulated by the PSPvtDN for provision to a DTE may need to be modified to reflect PSPDN charges, if available.

— For DTEs on the PSPvtDN, use of the Hunt Group Facility (see 13.24), the Call Redirection Facility (see 13.25.1), or the Call Deflection Selection Facility (see 13.25.2.2), resulting in a modification to the called DTE address, requires the PSPvtDN to use the Called Line Address Modified Notification Facility (see 13.26) at its interface to the PSPDN with bit 8 of the Modification Reason Code set to 1. This facility is used in the CALL ACCEPTED or CLEAR REQUEST packet sent by the PSPvtDN to the PSPDN.

— For DTE's on a private network which subscribe to the ICRD Prevention Subscription Facility (see 13.25.4.1), the gateway must then at least use the ICRD Status Selection Facility (see 13.25.4.2).

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Table A.3 — PSPvtDN's CUG-Related Subscription to PSPDN to Support DTEs on PSPvtDN

CUG-Related Subscriptions of DTEs on PSPvtDN (see Note 1)	PSPvtDN's CUG-Related Subscription To PSPDN (see Note 1)							
	With Preferential				Without Preferential (see Note 2)			
	CUG	CUG/ IA	CUG/ OA	CUG/ IA/OA	CUG/ IA	CUG/ OA	CUG/ IA/OA	no CUG
CUG with preferential (see Note 2)	X	X			X	X	X	
CUG/IA with preferential		X			X		X	
CUG/OA with preferential			X	X		X	X	
CUG/IA/OA with preferential				X			X	
CUG/IA without preferential					X		X	
CUG/OA without preferential						X	X	
CUG/IA/OA without preferential							X	
no CUG							X	X

CUG = Closed User Group IA = Incoming Access OA = Outgoing Access

NOTES

1 A PSPDN or a PSPvtDN need not offer all the CUG-related subscriptions shown.

2 Subscription to the CUG Facility without preferential is not allowed.

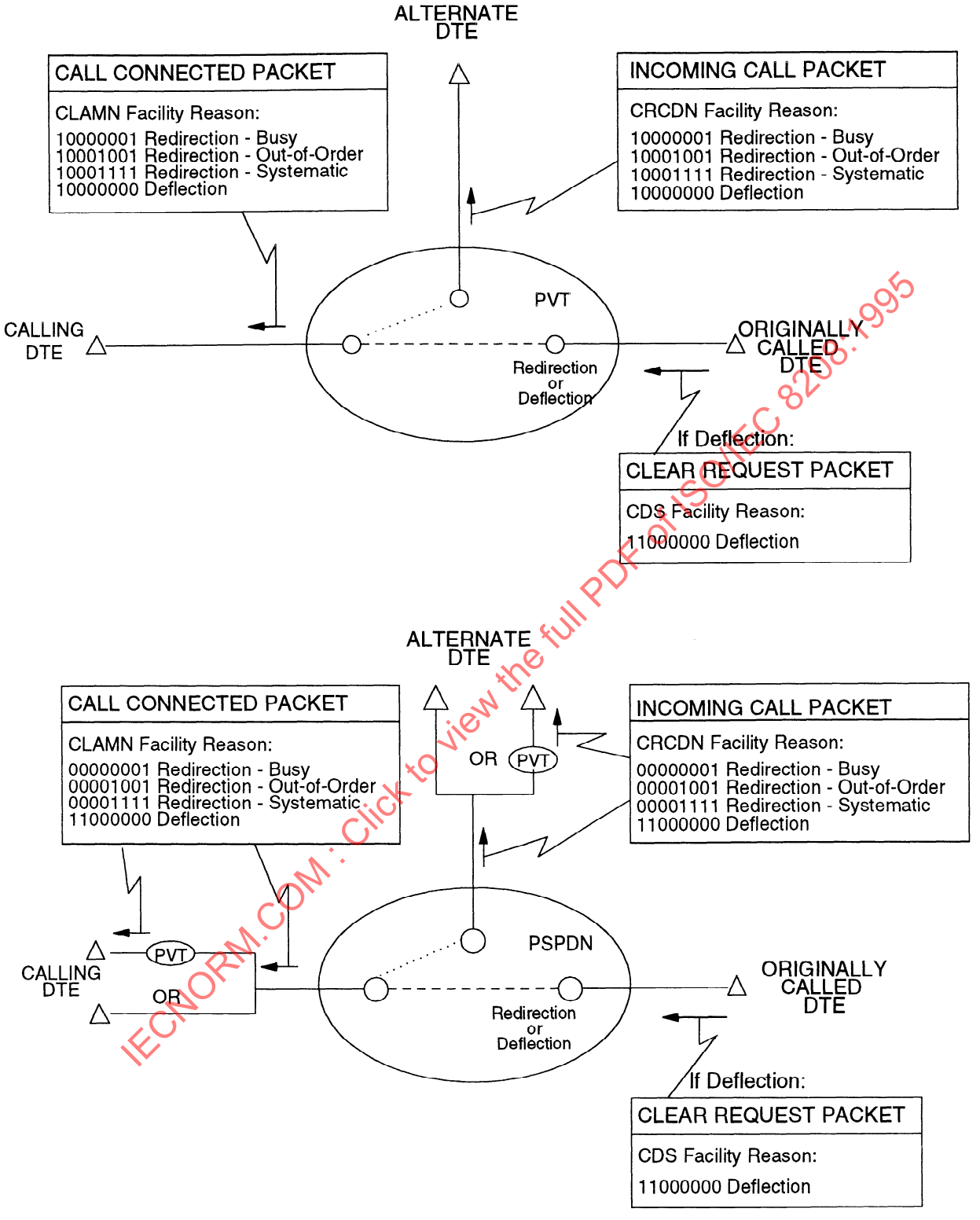
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A.3 Call Redirection, Call Deflection and Hunt Group operation

Figure A.2 depicts the operation of call redirection and call deflection in various configurations of public and private packet switched networks. Figure A.3 provides a similiar depiction for the operation of a hunt group. In both figures, emphasis is given to the Facility Reason Codes conveyed in call set up and clearing packets.

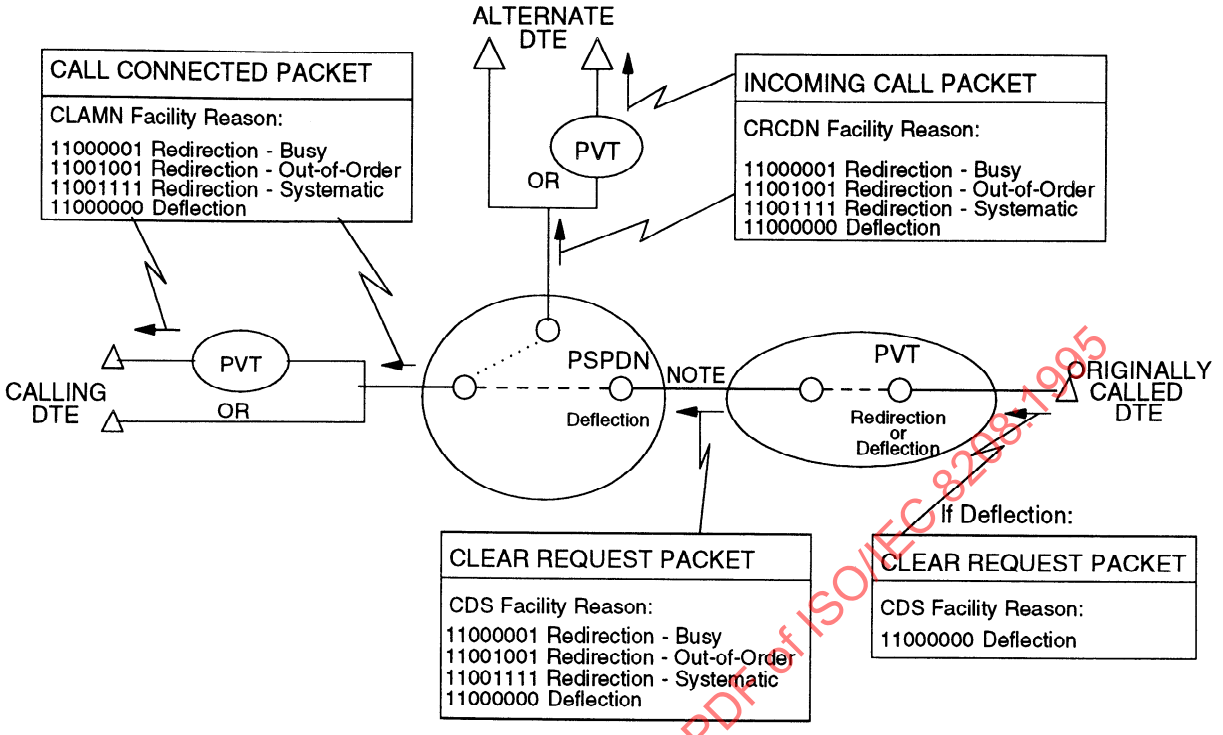
The following legend applies to both figures:

CDS — Call Deflection Selection
CLAMN — Called Line Address Modified Notification
CRCDN — Call Redirection or Call Deflection Notification
PSPDN — one or more packet switched public data networks
PVT — packet switched private data network
- - - - - relation between calling DTE and originally called DTE
· · · · relation between calling DTE and alternate DTE

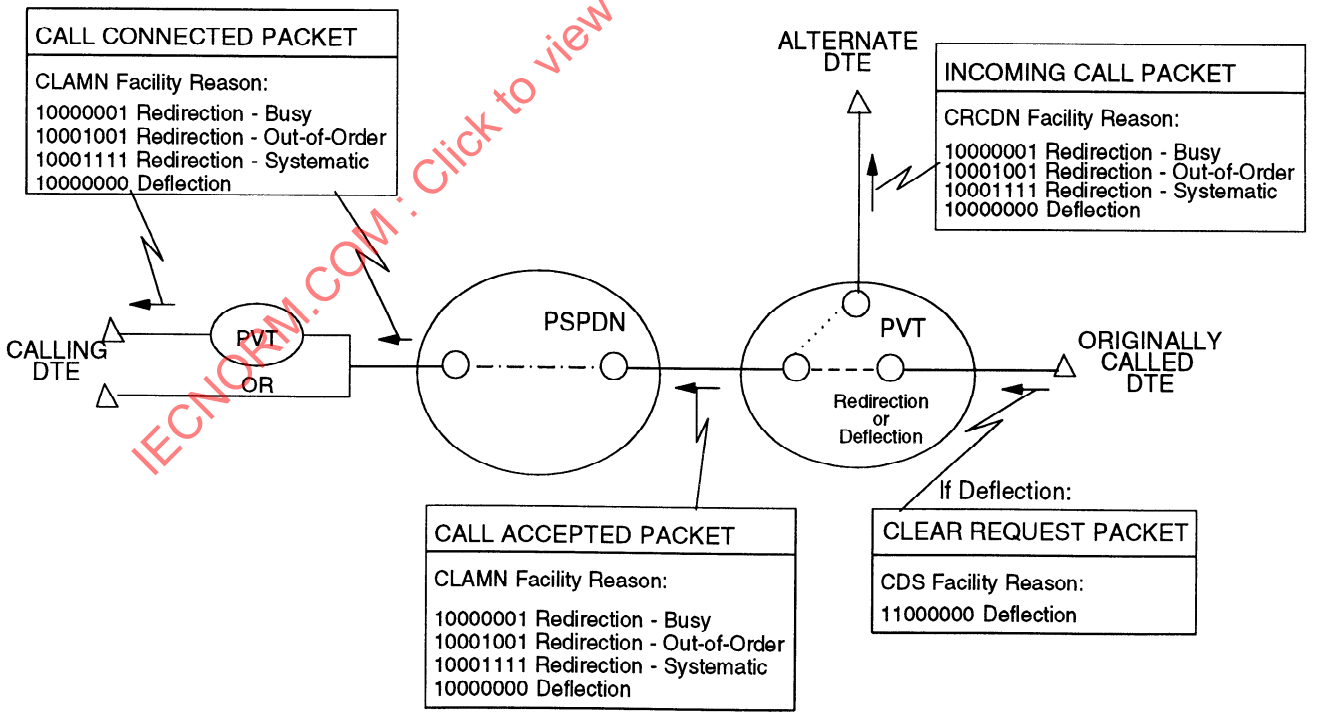


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Figure A.2 (1 of 3) — Call Redirection and Call Deflection operation

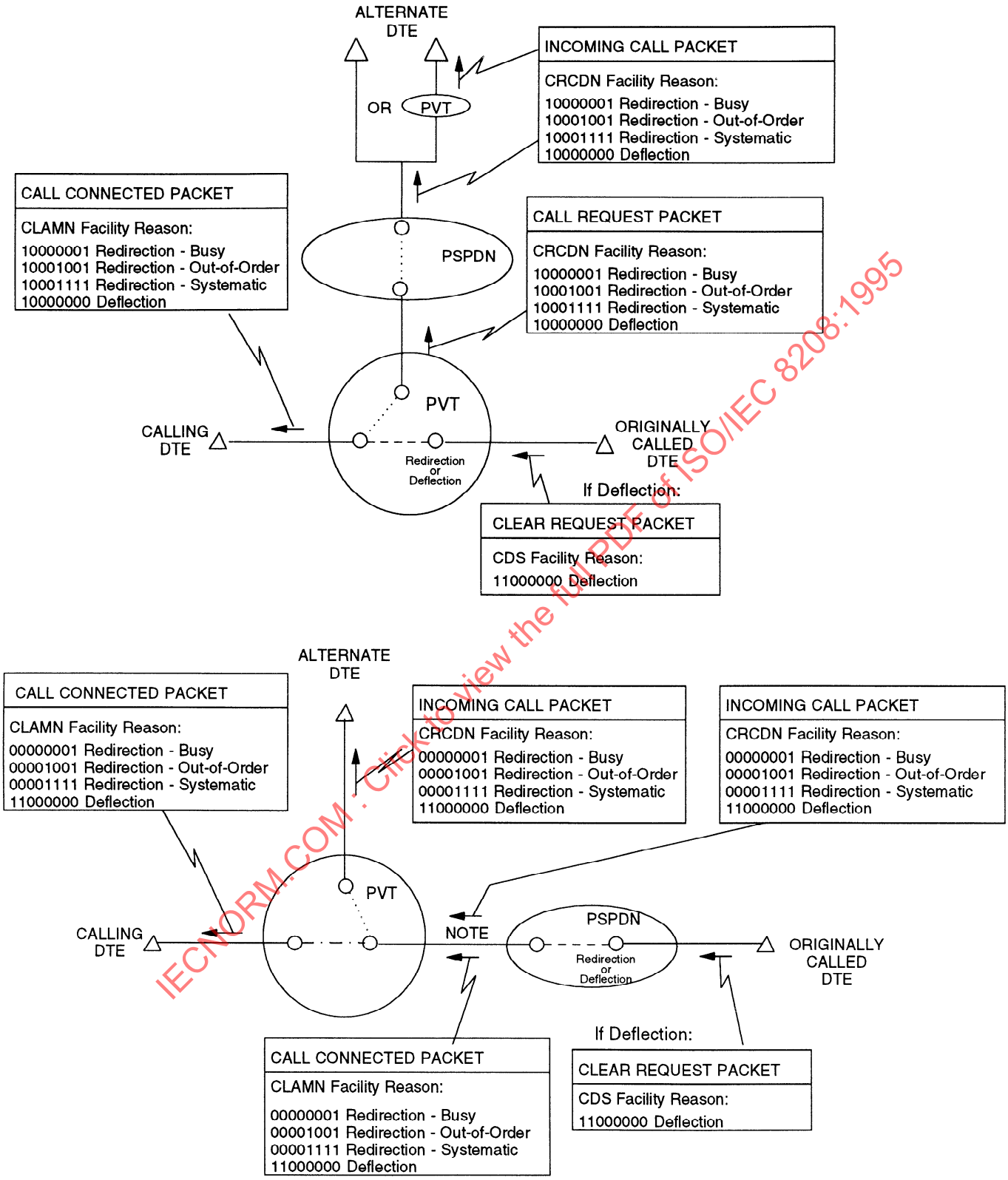


NOTE — Private network deflects call back to PSPDN and is no longer involved in the call



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Figure A.2 (2 of 3) — Call Redirection and Call Deflection operation



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NOTE — Two logical channels are used at this interface and the PSPDN remains involved throughout the call

Figure A.2 (3 of 3) — Call Redirection and Call Deflection operation

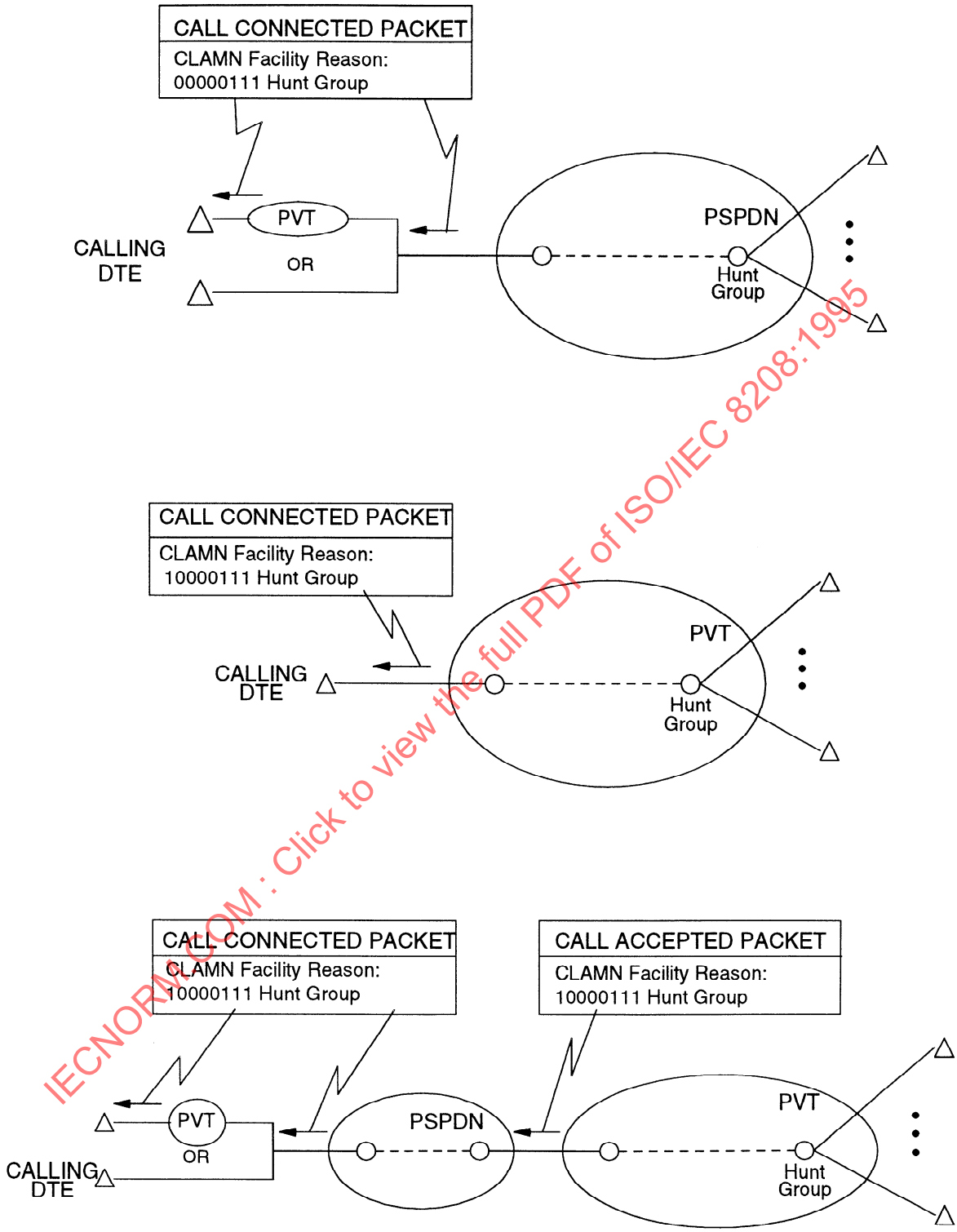


Figure A.3 — Hunt Group operation

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Annex B *
(normative)

PICS Proforma

B.1 Introduction

The supplier of a protocol implementation which is claimed to conform to ISO/IEC 8208 : 1995 shall complete the following Protocol Implementation Conformance Statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. The PICS can have a number of uses, including use:

— by the protocol implementor, as a check-list to reduce the risk of failure to conform to the standard through oversight;

— by the supplier and acquirer – or potential acquirer – of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma;

— by the user – or potential user – of the implementation, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICSs);

— by a protocol tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

B.2 Abbreviations and special symbols

B.2.1 Status symbols

M	mandatory
O	optional
O.*n*	optional, but support of at least one of the group of options labelled by the same numeral *n* is required
X	prohibited
pred:	conditional-item symbol, including predicate identification: see B.3.4
¬	logical negation, applied to a conditional item's predicate

B.2.2 General abbreviations

LC	logical channel
N/A	not applicable
PICS	Protocol Implementation Conformance Statement
PVC	Permanent Virtual Circuit

B.2.3 Item references

PICS items dealing with related functions are identified by item references sharing the same initial letter or letter-pair (in capitals). There follow two lists of those initials, first in the order in which the items occur in the PICS proforma, and then in alphabetical order.

B.2.3.1 In order of occurrence

V	permanent Virtual circuit or Virtual call service
E	Environment: DTE/DCE or DTE/DTE; X.25 1993, 1988, 1984 or 1980
M	Modulo 8 or Modulo 128 packet sequence numbers
RN	Reference Number optional user facility
L	Link layer interactions
P	general Packet formatting
Z	packet layer functions independent of logical channels (packets with LC identifier Zero)
S	call Setup
SP	call Setup Packets
SA	call Setup with Alternative addressing
DN	D-bit Negotiation
C	call Clearing
CP	call Clearing Packets
RS	ReSetting of logical channels
W	error procedures (response to Wrong behaviour)
I	Interrupt transfer
DS	Data packet Sending
DR	Data packet Receiving
DC	Delivery Confirmation
Y	cause and diagnostic code values (whY resets, etc., initiated)
O	Observability of transient states
B	X.25 interworking: Backward compatibility
N	X.25 Network differences from ISO/IEC 8208
FS	Facilities Sent during call setup and clearing
FR	Facilities Received during call setup and clearing
GS	reGistration facilities Sent
GR	reGistration facilities Received
V	parameter Values and ranges
T	Timers
R	Retransmission counts
LC	Logical Channel ranges
A	Additional information (see B.3.1)
X	eXception information (see B.3.1)

*) **Copyright release for PICS proformas**

Users of this International Standard may freely reproduce the PICS proforma in this annex so that it can be used for the intended purpose and may further publish the completed PICS.

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B.2.3.2 In alphabetical order

A	Additional information
B	X.25 interworking: Backwards compatibility
C	call Clearing
CP	call Clearing Packets
DC	Delivery Confirmation
DN	D-bit Negotiation
DR	Data packet Receiving
DS	Data packet Sending
E	Environment: DTE/DCE or DTE/DTE; X.25 1993, 1988, 1984 or 1980
FR	Facilities Received during call setup and clearing
FS	Facilities Sent during call setup and clearing
GR	reGistration facilities Received
GS	reGistration facilities Sent
I	Interrupt transfer
L	Link layer interactions
LC	Logical Channel ranges
M	Modulo 8 or Modulo 128 packet sequence numbers
N	X.25 Network differences from ISO/IEC 8208
O	Observability of transient states
P	general Packet formatting
R	Retransmission counts
RN	Reference Number optional user facility
RS	ReSetting of logical channels
S	call Setup
SA	call Setup with Alternative addressing
SP	call Setup Packets
T	Timers
V	permanent Virtual circuit or Virtual call service
V*n*	parameter Values and ranges
W	error procedures (response to Wrong behaviour)
X	eXception information
Y	cause and diagnostic code values (whY resets, etc., initiated)
Z	packet layer functions independent of logical channels (packets with LC identifier Zero)

B.3 Instructions for completing the PICS proforma

B.3.1 General structure of the PICS proforma

The first part of the PICS proforma – Identification, B.4 – is to be completed as indicated with the information necessary to identify fully both the supplier and the implementation.

The main part of the PICS proforma is a fixed-format questionnaire divided into six major subclauses; these can be divided into further subclauses each containing a group of individual items. Answers to the questionnaire items are to be provided in the rightmost column, either by simply marking an answer to indicate a restricted choice (usually Yes or No), or by entering a value or a set or range of values. Note that there are some items where two or more choices from a set of possible answers can apply: all relevant choices are to be marked.

Each item is identified by an item reference in the first column; the second column contains the question to be answered; the third column contains the reference or references to the material that specifies the item in the main body of ISO/IEC 8208 : 1995. The remaining columns record the status of the item – whether support is mandatory, optional, prohibited or conditional – and provide the space for the answers: see also B.3.4 below. (Status is sometimes indicated by other means than a separate Status column: for example, where the same status applies to a whole group of items, as in B.8.1.)

A supplier may also provide, or can be required to provide, further information, categorized as either Additional Information or Exception Information. When present, each kind of further information is to be provided in a further subclause of items labelled A*i* or X*i* respectively for cross-referencing purposes, where *i* is any unambiguous identification for the item (e.g., simply a numeral): there are no other restrictions on its format and presentation.

A completed PICS proforma, including any Additional Information and Exception Information, is the Protocol Implementation Conformance Statement for the implementation in question.

NOTE — Where an implementation is capable of being configured in more than one way according, for example, to the items in B.5, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, in case that makes for easier and clearer presentation of the information.

B.3.2 Additional Information

Items of Additional Information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and a PICS can be considered complete without any such information. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations; or a brief rationale – based perhaps upon specific application needs – for the exclusion of features which, although optional, are nonetheless commonly present in implementations of the X.25 packet layer protocol.

References to items of Additional Information may be entered next to any answer in the questionnaire, and may be included in items of Exception Information.

B.3.3 Exception Information

It may occasionally happen that a supplier will wish to answer an item with mandatory or prohibited status (after any conditions have been applied) in a way that conflicts with the indicated requirement. No pre-printed answer will be found in the Support column for this: instead, the supplier shall write the missing answer into the Support column, together with an X*i* reference to an item of Exception Information, and shall provide the appropriate rationale in the Exception item itself.

An implementation for which an Exception item is required in this way does not conform to ISO/IEC 8208 : 1995.

NOTE — A possible reason for the situation described above is that a defect in this International Standard has been reported, a correction for which is expected to change the requirement not met by the implementation.

B.3.4 Conditional status

B.3.4.1 Conditional items

The PICS proforma contains a number of conditional items. These are items for which the status – mandatory, optional or prohibited – that applies is dependent upon whether or not certain other items are supported.

In many cases, whether or not the item applies at all is conditional in this way, as well as the status when the item does apply.

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Where a group of items is subject to the same condition for applicability, a separate preliminary question about the condition appears at the head of the group, with an instruction to skip to a later point in the questionnaire if the "Not Applicable" answer is selected. Otherwise, individual conditional items are indicated by one or more conditional symbols (on separate lines) in the Status column.

A conditional symbol is of the form "***pred:*** *S*" where ***pred*** is a predicate as described in B.3.4.2 below, and *S* is one of the status symbols M, O, O.n or X.

If the value of the predicate in any line of a conditional item is true (see B.3.4.2), the conditional item is applicable, and its status is that indicated by the status symbol following the predicate: the answer column is to be marked in the usual way. If the value of a predicate is false, the Not Applicable (N/A) answer is to be marked in the relevant line. (Each line in a multi-line conditional item should be marked: at most one line will require an answer other than N/A.)

B.3.4.2 Predicates

A predicate is one of the following:

a) an item-reference for an item in the PICS proforma: the value of the predicate is true if the item is marked as supported, and is false otherwise; or

b) a predicate name, for a predicate defined elsewhere in the PICS proforma: see below; or

c) the logical negation symbol "¬" prefixed to an item-reference or predicate name: the value of the predicate is true if the value of the predicate obtained by omitting the "¬" symbol is false, and vice versa.

The definition for a predicate name is a boolean expression constructed by combining simple predicates, as at (a) or (b) above, using the boolean operators AND, OR and NOT, and parentheses, in the usual way. The value of such a predicate is true if the boolean expression evaluates to true when the item-references are interpreted as at (a) above.

Each item whose reference is used in a predicate or predicate definition is indicated by an asterisk in the Item column.

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B.4 Identification

B.4.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification – e.g., name(s) and version(s) of machines and /or operating systems; system names	

NOTES

1 Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification.

2 The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).

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B.4.2 Protocol summary

Identification of protocol specification	ISO/IEC 8208 : 1995
Identification of amendments and corrigenda to this PICS proforma which have been completed as part of this PICS	ISO/IEC 8208 : 1995/ Amd. : Corr. : Amd. : Corr. : Amd. : Corr. : Amd. : Corr. :
Have any Exception items been required (see B.3.3)? (The answer Yes means that the implementation does not conform to ISO/IEC 8208 : 1995)	No ☐ Yes ☐

Date of Statement	

B.5 General DTE Characteristics

Item	Protocol Feature	References	Status	Support		
	Service supported:					
* Vs	— Virtual Call		O.1		Yes ☐	No ☐
* Vp	— Permanent Virtual Circuit		O.1		Yes ☐	No ☐
	What environments are supported?	3, 3.2				
Ec/3	— DTE/DCE (1993)		O.2		Yes ☐	No ☐
* Ec/8	— DTE/DCE (1988)		O.2		Yes ☐	No ☐
* Ec/4	— DTE/DCE (1984)		O.2		Yes ☐	No ☐
* Ec/0	— DTE/DCE (1980)		O.2		Yes ☐	No ☐
Et/t	— DTE/DTE in fixed role as DTE		O.2		Yes ☐	No ☐
Et/c	— DTE/DTE in fixed role as DCE		Vs: O.2	N/A ☐	Yes ☐	No ☐
Et/d	— DTE/DTE with dynamic role selection	4.5	Vs: O.2	N/A ☐	Yes ☐	No ☐
	What packet sequence numbering is supported?					
* M8	— Modulo 8	13.2, 12.1.1, table 3	O.3		Yes ☐	No ☐
* M128	— Modulo 128 (extended)	13.2, 12.1.1, table 3	O.3		Yes ☐	No ☐
	Is the Reference Number optional user facility supported, for the alternative Logical Channel Identifier assignment mechanism:	13.29, 13.29.1, 13.29.2, 13.29.3, 13.29.4, figure 31,				
RNa	— without reversion to use of logical channel ranges?	13.29.2.1	Et: O	N/A ☐	Yes ☐	No ☐
			¬Et: X	N/A ☐	No ☐	
RNb	— with possible reversion of operating mode to use logical channel ranges?	13.29.2.1	Et: O	N/A ☐	Yes ☐	No ☐
			¬Et: X	N/A ☐	No ☐	

Predicate definitions and usage:

Et = Et/t OR Et/c OR Et/d — is used in items RNa, RNb, Z2s, Z4r, DS6, DS7b

Ec = Ec/3 OR Ec/8 OR Ec/4 OR Ec/0 — is used in items Y2b, Y4b, Y6b, GS3id, GS3ig, GS4ic

RN = RNa OR RNb — is used in items CP2e (predicate C1rn), CP4e (predicate C2rnci), FS14, FR14

Vs is used in items Et/c, Et/d, O2, O3, LC8; and in B.6.4, B.6.6, B.7.1, B.7.2, B.8.1, B.9.1.1, B.9.1.2, B.9.2.1, B.9.2.2, B.10.1, B.10.2
Vp is used in item LC7; and in B.6.6, B.10.2
Ec/8 is used in B.7.2.3
Ec/4 is used in B.7.2.2, B.7.2.3
Ec/0 is used in B.7.2.1, B.7.2.2, B.7.2.3
M8 and M128 are used in items V2s, V2r, V10s, V10r, V15s, V15r

B.6 Procedures, packet types and packet formats

B.6.1 Data Link layer interactions

Item	Protocol Feature	References	Status	Support	
	Is restarting of the packet layer initiated:				
L1a	— on completion of Data Link layer initialization?	3.10	M	Yes ☐	
L1b	— on recovery from failure of the Data Link layer?	10	M	Yes ☐	
* L2	Can packets consisting of a non-integral number of octets be received from the Data Link layer?	12.1	O	Yes ☐	No ☐

Predicate usage: L2 is used in item P1

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