NBS
RESEARCH
INFORMATION
CENTER

FIPS PUB 100

FEDERAL STANDARD 1041

# FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATION

1983 JULY 6

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

# INTERFACE BETWEEN DATA TERMINAL EQUIPMENT (DTE) AND DATA CIRCUIT-TERMINATING EQUIPMENT (DCE) FOR OPERATION WITH PACKET-SWITCHED DATA COMMUNICATIONS NETWORKS

CATEGORY: HARDWARE STANDARD
SUBCATEGORY: DATA TRANSMISSION

JK
468
.A8A3
#100
1983
C. 2

GENERAL SERVICES ADMINISTRATION

FIPS PUB 100

U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

## Foreword

The Federal Information Processing Standards Publication Series of the National Bureau of Standards is the official publication relating to standards adopted and promulgated under the provisions of Public Law 89-306 (Brooks Act) and under Part 6 of Title 15, Code of Federal Regulations. These legislative and executive mandates have given the Secretary of Commerce important responsibilities for improving the utilization and management of computers and automated data processing in the Federal Government. To carry out the Secretary's responsibilities, the NBS, through its Institute for Computer Sciences and Technology, provides leadership, technical guidance, and coordination of Government efforts in the development of guidelines and standards in these areas.

Comments concerning Federal Information Processing Standards Publications are welcomed and should be addressed to the Director, Institute for Computer Sciences and Technology, National Bureau of Standards, Washington, DC 20234.

James H. Burrows, *Director*
Institute for Computer Sciences and Technology

## Abstract

This joint Federal Information Processing Standard (FIPS) and Federal (Telecommunication) Standard (FED-STD) specifies the means of interfacing automated data processing (ADP) equipment and services, as well as telecommunication system terminal equipment, with packet-switched data communication networks. It is based on Recommendation X.25 which was developed and approved by the International Telegraph and Telephone Consultative Committee (CCITT) of the International Telecommunications Union (ITU). Recommendation X.25 contains a large number of options and implementation alternatives, which if exercised in different ways would impede the interoperability of equipment and services. This joint standard limits these options and alternatives in order to satisfy the vast majority of Federal user requirements for interconnections with packet-switched data communications networks.

Key words: automated data processing; computer networking; data circuit-terminating equipment; data communications; data terminal equipment; Federal Information Processing Standard; packet switching; public data network; Recommendation X.25; telecommunications.

Natl. Bur. Stand. (U.S.) Fed. Info. Process. Stand. Publ. (FIPS PUB) 100; 13 pages (1983)
CODEN:FIPPAT

For sale by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161

**Federal Information Processing Standards Publication 100**

**Federal Standard 1041**

**1983 July 6**

# ANNOUNCING THE JOINT STANDARD FOR

# INTERFACE BETWEEN DATA TERMINAL EQUIPMENT (DTE) AND DATA CIRCUIT-TERMINATING EQUIPMENT (DCE) FOR OPERATION WITH PACKET-SWITCHED DATA COMMUNICATIONS NETWORKS

Federal Information Processing Standards Publications are developed and issued by the National Bureau of Standards pursuant to section 111(f)(2) of the Federal Property and Administrative Services Act of 1949, as amended, Public Law 89-306 (79 Stat. 1127), Executive Order 11717 (38 FR 12315, dated May 11, 1973), and Part 6 of Title 15 Code of Federal Regulations (CFR).

Federal Standards in the "telecommunications" series are developed by the Office of the Manager, National Communications System. These Federal Standards are issued by the General Services Administration pursuant to the Federal Property and Administrative Services Act of 1949, as amended.

**Name of Standard:** Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Operation with Packet-Switched Data Communications Networks.

**Category of Standard:** Hardware, Data Transmission.

**Explanation:** Federal automated data processing equipment, services, and telecommunication equipment using public packet-switched data communications networks (PSDCN) based on the family of CCITT Recommendations derived from X.1 and X.2 shall employ the interface and protocols specified in this joint standard. In addition, designers of these internally operated and maintained Federal networks employing packet-switched technology should consider the use of this interface as appropriate. The joint standard provides:

- A family of physical layer interfaces, from which a particular interface may be selected; and
- A single data link layer control procedure; and
- Packet level procedures for virtual calls and permanent virtual circuits, and an optional datagram operation.

The mandatory interface attributes of this joint standard are summarized as follows:

PHYSICAL LEVEL

| | |
|---|---|
| Transmission rates: | 2.4, 4.8, 9.6 Kbits/s |
| Interface: | one or more of the following: RS-232-C, X.21, RS-449 |

LINK LEVEL:

| | |
|---|---|
| Procedure: | LAPB |
| Parameter K: | 7 |
| Smallest N1: | 164 Octets |

PACKET LEVEL:

| | |
|---|---|
| Services: | Virtual call and permanent virtual circuit |
| Packet types: | All basic plus Diagnostic packets. Packet Reject shall not be used. |
| User data field length: | Octet-aligned |
| Packet sequence numbering: | Modulo 8 |
| D bit procedure: | Supported by all DCEs; DTE need not employ the D bit when sending to the DCE, but no DTE shall reject incoming packet with the D bit set to 1 or 0 as having this bit in error unless it is known by receiver that the sender has no D bit capability. |
| X.25 diagnostic codes: | Use standard codes whenever they apply; non-std codes may be used for events not listed in X.25 within a period of 24 months after the effective date of this standard. |
| Fast Select: | DCEs shall implement fast select; DTE need not employ fast select when sending to DCE, but all DTEs with higher level functionality which allows response to fast select must be able to accept incoming fast select packet. |
| Interrupt packet: | Receipt of a DTE interrupt packet before a previous DTE interrupt packet has been confirmed is an error condition. |
| Duplicated facility codes: | The last appearing facility code should be treated by the DTE as if it were the only appearance of that code. |
| Non-zero cause field of restart request packet: | Discarded |
| Restart request too long in state r1: | Discarded |

This joint standard is intended to enhance interoperability by specifying certain subsets and other constraints on Federal use of CCITT Recommendation X.25.

The Government's intent in employing this joint standard is to reduce the cost of acquiring and using Federal automated data processing equipment, services, and telecommunication equipment with PSDCN. The joint standard is also intended to reduce the cost of acquiring and using Government-owned or leased PSDCN. These goals will be achieved by:

- Increasing the available alternative sources of supply;
- Increasing the reutilization of Government resources; and,
- Assuring the required interoperability.

**Approving Authority:** Secretary of Commerce (Federal Information Processing Standards). Administrator, General Services Administration (Federal Standards).

**Maintenance Agency:** The National Bureau of Standards and the Office of the Manager, National Communications System will jointly maintain this standard coordinating as necessary with the General Services Administration (GSA).

**Cross Index:** The following are related standards upon which this FIPS PUB is based. The inclusion of a particular standard on this list does not necessarily mean that the standard is applicable in all cases to which this FIPS PUB applies.

(a) International Standard 2110-1980: *Data Communication—25-Pin DTE/DCE Interface Connector and Pin Assignments.*

(b) International Telegraph and Telephone Consultative Committee (CCITT) Recommendation V.24 (1980): *List of Definitions for Interchange Circuits Between Data Terminal Equipment and Data Circuit Terminating Equipment.*

(c) CCITT Recommendation V.28 (1980): *Electrical Characteristics for Unbalanced Double-Current Interchange Circuits.*

(d) Electronics Industries Association (EIA) RS-232-C (1969 August): *Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.*

(e) International Standard 4902-1980: *Data Communication—37-Pin and 9-Pin DTE/DCE Interface Connectors and Pin Assignments.*

(f) CCITT Recommendation V.11 (X.27) (1980): *Electrical Characteristics for Balanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communications.*

(g) EIA RS-422-A (1978 June): *Electrical Characteristics of Balanced Voltage Digital Interface Circuits.*

(h) Federal Standard 1020A (1980 January): *Telecommunications: Electrical Characteristics of Balanced Voltage Digital Interface Circuits.*

(i) CCITT Recommendation V.10 (X.26) (1980): *Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communications.*

(j) EIA RS-423-A (1978 June): *Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits.*

(k) Federal Standard 1030A (1980 January): *Telecommunications: Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits.*

(l) CCITT Recommendation X.21bis (1980): *Use on Public Data Networks of Data Terminal Equipment which are Designed for Interfacing to Synchronous V-Series Modems.*

(m) CCITT Recommendation V.54 (1980): *Loop Test Devices for Modems.*

(n) EIA RS-449 (1977 November): *General Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment.*

(o) Federal Standard 1031 (1980 June): *Telecommunications General Purpose 37-Position and 9-Position Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment.* (Implementing instructions in the form of a Federal Property Management Regulation have not yet been issued. The General Services Administration is considering cancelling FED-STD 1031. Furthermore, a Federal Information Processing Standard for ADP applications corresponding to Federal Standard 1031 has not been adopted by the National Bureau of Standards.)

(p) International Standard 4903-1980: *Data Communication—15-Pin DTE/DCE Interface Connector and Pin Assignments.*

(q) EIA Industrial Electronics Bulletin No. 12 (1977 November): *Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232-C.*

(r) Draft International Standard 2593 (1980): *Data Communication—34-Pin DTE/DCE Interface Connector and Pin Assignments.*

(s) CCITT Recommendation V.35 (1980): *Data Transmission at 48 Kilobits per Second Using 60-108 kHz Group Band Circuits.*

(t) CCITT Recommendation X.21 (1980): *General Purpose Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment for Synchronous Operation on Public Data Networks.*

(u) CCITT Recommendation V.5 (1980): *Standardization of Data-Signalling Rates for Synchronous Data Transmission in the General Switched Telephone Network.*

(v) CCITT Recommendation V.6 (1980): *Standardization of Data-Signalling Rates for Synchronous Data Transmission on Leased Telephone-Type Circuits.*

(w) American National Standard X3.1-1976: *Synchronous Signaling Rates for Data Transmission.*

(x) Federal Information Processing Standard Publication 22-1 (1977 September): *Synchronous Signaling Rates Between Data Terminal and Data Communication Equipment.* (FIPS PUB 22-1 is identified also as FED-STD 1013.)

(y) Federal Standard 1013 (1977 August): *Telecommunications: Synchronous Signaling Rates Between Data Terminal Equipment and Data Circuit-Terminating Equipment Utilizing 4 kHz Circuits.* (FED-STD 1013 is identified also as FIPS PUB 22-1.)

(z) American National Standard X3.36-1975: *Synchronous High-Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment.*

(aa) Federal Information Processing Standards Publication 37 (1975 June): *Synchronous High Speed Data Signaling Rates Between Data Terminal Equipment and Data Communications Equipment.* (FIPS PUB 37 is identified also as FED-STD 1001.)

(ab) Federal Standard 1001 (1975 June): *Telecommunications: Synchronous High-Speed Data Signaling Rates Between Data Terminal Equipment and Data Communications Equipment.* (FED-STD 1001 is identified also as FIPS PUB 37.)

(ac) EIA RS-269-B (1976 January): *Synchronous Signaling Rates for Data Transmission.*

(ad) International Standard 3309-1979: *Data Communication—High-Level Data Link Control Procedures—Frame Structure.*

(ae) International Standard 4335-1979: *Data Communication—High-Level Data Link Control Procedures—Elements of Procedures.*

(af) Addendum 1 to International Standard 4335-1979: *Data Communication—High-Level Data Link Control Procedures—Elements of Procedures.*

(ag) Addendum 2 to International Standard 4335-1979: *Data Communication—High-Level Data Link Control Procedures—Elements of Procedures.*

(ah) International Standard 6256-1980: *Data Communication—High-Level Data Link Control Procedures—Balanced Class of Procedures.*

(ai) American National Standard X3.66-1979: *Advanced Data Communication Control Procedures (ADCCP).*

(aj) Federal Information Processing Standards Publication 71 (1980 May) as revised by the Federal Register notice 47 FR 23798, dated June 1, 1982 and corrected by the notice 47 FR 25397 dated June 11, 1982: *Advanced Data Communication Control Procedures (ADCCP).* (FIPS PUB 71 is technically consistent with FED-STD 1003A.)

(ak) Federal Information Processing Standards Publication 78 (1980 September): *Guideline for Implementing Advanced Data Communication Control Procedures (ADCCP).*

(al) Federal Standard 1003A (1981 August): *Telecommunication: Synchronous Bit-Oriented Data Link Control Procedures.* (FED-STD 1003A is technically consistent with FIPS PUB 71.)

(am) CCITT Recommendation X.25 (1980): *Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode on Public Data Networks.*

(an) Draft Proposed International Standard 7498: *Data Processing—Open Systems Interconnection—Basic Reference Model.*

(ao) CCITT Recommendation X.1 (1980): *International User Classes of Service in Public Data Networks.*

(ap) CCITT Recommendation X.2 (1980): *International User Facilities in Public Data Networks.*

(aq) CCITT Recommendation X.96 (1980): *Call Progress Signals in Public Data Networks.*

**Applicability:** The technical specifications of this joint standard shall be employed in the acquisition, design, and development of all Federal automated data processing equipment, services, and telecommunication equipment and PSDCN whenever an interface based on CCITT Recommendation X.25 (1980), *Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode on Public Networks,* is required. Referred to below as CCITT Recommendation X.25, Recommendation X.25, or X.25.

**Implementation:** The provisions of this joint standard are effective July 6, 1983. Any applicable equipment or service ordered on or after the effective date, or procurement action for which solicitation documents have not been issued by that date, must conform to the provisions of this standard unless a waiver has been granted in accordance with the procedures described below.

This joint standard shall be reviewed by the Institute for Computer Sciences and Technology, National Bureau of Standards and the Office of the Manager, National Communications System, within five years after its effective date. This review shall take into account technological trends and other factors to determine if the joint standard should be affirmed, revised, or withdrawn.

**Specifications:** This joint standard adopts a subset, identified below, of the International Telegraph and Telephone Consultative Committee's Recommendation X.25.

(a) At the physical level, the provisions of Section 1 of CCITT Recommendation X.25 shall be used. As a minimum, networks shall support dedicated circuit access; other types of access (e.g., through the general switched telephone network) may also be offered.

CCITT Recommendation X.1 standardizes data signalling rates of 2.4, 4.8, 9.6, and 48 kbits/s for packet mode interfaces. At a minimum, networks shall support the synchronous data signalling rates of 2.4, 4.8, and 9.6 kbits/s full duplex; other speeds (e.g., 19.2 kbits/s) may also be offered. The 48 kbits/s rate need not be supported in those locations where it is not available; 56 kbits/s is recommended in its place (see American National Standard X3.36-1975 and related documents referenced above). The term "user class of service" used in X.25 refers to the data signalling rate of DTE/DCE interface.

In accordance with CCITT Recommendation X.25, networks shall provide one or more of the following interface options:

i. CCITT Recommendation X.21;

ii. EIA RS-232-C, which is essentially equivalent to one of the options in CCITT Recommendation X.21bis;

iii. CCITT Recommendation X.21bis option that is equivalent to RS-449 using only the EIA RS-423A unbalanced electrical characteristics.

Interworking between EIA RS-232-C on one side of the interface and RS-449 on the other side is permitted in accordance with EIA Industrial Electronics Bulletin Number 12. Where interworking with RS-232-C equipment is not required, the provisions described below employing RS-449 with the RS-422A electrical characteristics may optionally be employed at signalling rates below 48 kbit/s.

Networks which support 48 or 56 kbits/s data signalling rates shall provide one or more of the following interface options:

i. CCITT Recommendation X.21;

ii. CCITT Recommendation X.21bis option that specifies CCITT Recommendation V.35; or

iii. CCITT Recommendation X.21bis option that specifies CCITT Recommendation V.36 which is equivalent to EIA RS-449.

NOTE: Current study in national and international standards groups may result in the development of additional physical interfaces. Each such physical interface will be evaluated for inclusion in this joint standard. If there are significant savings, one physical interface may be selected as the future mandatory physical interface.

NOTE: DTE purchasers and designers should determine which physical interface(s) is provided by the associated DCE(s).

(b) Only the LAPB link level procedures shall be used.

NOTE: These procedures are a subset of those described in FIPS PUB 71 and Federal Standard 1003A and correspond to FIPS PUB 78 recommended class B. This subset is identified as follows:

i. Link configuration: two combined stations on a point-to-point link.

ii. Class of procedures: balanced asynchronous (BA) with options two and eight. The RSET command shall not be used. (RSET is found in option 11 of the FIPS PUB 71. RSET is part of the basic repertoire in Federal Standard 1003A; option 11 of Federal Standard 1003A deletes the RSET command. Note that RSET is *not* part of CCITT Recommendation X.25.)

iii. Two-way simultaneous operation shall be employed.

iv. The smallest N1, (the maximum number of bits in an information frame excluding flags and zero bit insertion for transparency), which shall be supported shall be 1064 octets (the maximum length of

fast select call setup packet). If a DTE neither transmits, nor receives for processing by higher level functionality fast select packets, an N1 as small as 135 octets may be supported by the DTE.

v. The address of the combined station provided by the network shall be 10000000; the address of the other combined station shall be 11000000; where the left-hand bit is the least significant bit (bit number 1) and shall be transmitted first. This convention is consistent with the provisions of FIPS 71 and Federal Standard 1003A.

vi. The FCS shall be a 16-bit sequence as indicated in Section 2.2.7. DTE/DCE may also employ the 32-bit FCS as indicated in FIPS PUB 71 (revised) and FED-STD 1003A. DTE/DCE equipment using the 32-bit FCS shall be able to also operate with the 16-bit FCS. The smallest N1 shall be 166 octets when the 32-bit FCS is used. If a DTE neither transmits, nor receives for processing by higher level functionality fast select packets, an N1 as small as 137 octets may be supported by the DTE when the 32-bit FCS is used.

NOTE: FIPS PUB 78 provides a detailed discussion of the relative merits of the 16-bit and 32-bit FCS.

vii. The frame reject information field shall be padded with 4 zero bits in bit positions 21 through 24 of the information field to provide a length of three octets.

viii. It is required that all implementations be capable of operating with K=7; optionally, values of 1 to 6 are permissible with modulo 8 operation and values 1 to 127 are permissible with modulo 128 operation.

NOTE: DTE purchasers and designers should determine that values of k other than 7 are supported by the associated DCE(s).

(c) The user data field of packets shall be an integral number of octets. If a packet is received which shows a user data field not equal to an integral number of octets, the receiving DTE/DCE shall follow the packet level procedures for processing a packet type which is too long. A new diagnostic code, "non-octet aligned packet," consistent with the *Data Communications—X.25 Packet Layer Specification for Data Terminal Equipment,* ISO DP 8208, November 8, 1982, is recommended as #82.

(d) The reject packet shall not be used.

(e) All DCE restart confirmation, DCE reset confirmation, and DCE clear confirmation packets shall be interpreted by the DTE as having local significance only.

(f) The D-bit shall be implemented by all networks. DTE's need not employ the D-bit procedures when transmitting to the network, but no DTE shall reject incoming packets with the D-bit set to 1 or 0 as having this bit in error unless the receiving DTE knows the remote DTE has not implemented the D-bit procedure; in this case, the receipt of a D-bit set to 1 may be treated by the receiving DTE as an error condition.

(g) The selection of logical channel number for new virtual calls shall follow the procedures suggested in Section 4.1.2 Note 2, Annex A Note 5, and Annex A Note 6, of the CCITT Recommendation X.25.

(h) It is required that all implementations be capable of operating with packet sequence numbering modulo 8; optionally, implementations of packet sequence numbering modulo 128 are also permitted.

NOTE: DTE purchasers and designers should determine if the associated DCE(s) support packet sequence numbering modulo 128.

(i) All DTE's and DCE's shall follow the flow control principles outlined in the first two sentences of the first paragraph of Section 4.4.1.3 of CCITT Recommendation X.25.

(j) The alternative procedure for passing packets containing a P(S) that is out of sequence but within the window as described in the third paragraph of Section 4.4.1.3 of CCITT Recommendation X.25 shall not be used.

(k) The second sentence of Section 4.4.1.4 Note 2 shall not apply. This sentence permits networks to defer updating the window for data packets with D=0, and sent within the window but before a data packet with D=1, until the network receives a corresponding P(R) for the packet with D=1.

(l) The resetting cause field of a reset request packet shall be set to zero. If a reset request is received with a non-zero resetting cause field, the packet shall be discarded. The network shall then initiate the resetting procedure with the resetting cause field indicating local/remote procedure error.

(m) The clearing cause field of a clear request packet shall be set to zero. If a clear request packet is received with a non-zero clearing cause field, the packet shall be discarded. The network shall then initiate the clearing procedure with the clearing cause field indicating local/remote procedure error.

(n) The restarting cause field of a restart request packet shall be set to zero. If a restart request packet is received with a non-zero restart cause field, the restart request packet shall be discarded without further action. Optionally, the DCE may generate a diagnostic packet with a recommended diagnostic code #81 (improper cause code from DTE), which is consistent with the *Data Communication—X.25 Packet Layer Specification for Data Terminal Equipment,* ISO DP 8208, November 8, 1982.

(o) A diagnostic code shall be provided in all clear request, reset request, and restart request packets in accordance with the codes listed in Annex E of CCITT Recommendation X.25 whenever they apply; non-assigned codings in X.25 may be used for events not listed in X.25 within the period of 24 months after the effective date of this standard. Prior to the end of this 24 month period, this standard will be reviewed by NBS to determine whether the standard should be revised to incorporate a different table. After this revision, codes not specifically listed shall not be used.

(p) A generic diagnostic code shall not be used when a more specific diagnostic code is known to be applicable.

(q) The network diagnostic codes shall be used in accordance with the codes listed in Annex E of CCITT Recommendation X.25 whenever they apply; non-assigned codings in X.25 may be used for events not listed in X.25 within the period of 24 months after the effective date of this standard. Prior to the end of this 24 month period, this standard will be reviewed by NBS to determine whether the standard should be revised to incorporate a different table. After this revision, network diagnostic codes not specifically listed shall not be used.

(r) The network shall consider the receipt of a DTE interrupt packet before a previous DTE interrupt packet has been confirmed as an error, and shall execute the error procedure described in Annex C, Table C-4/X.25 and the corresponding note 2.

(s) The timeouts and time limits specified in Annex D shall be observed by all DTE and DCE equipment. T21 shall not be less than the value given in table D-2/X.25. The preferred actions listed in table D-2/X.25 shall be followed.

(t) When the link level procedures enter the logically disconnected state, the associated packet level procedures shall clear all virtual calls and reset all permanent virtual circuits and datagram logical channels. When the link level procedures reenter the information transfer state, the associated packet level procedures shall execute the restart procedure. The terms "logically disconnected state" and "information transfer state" are used as defined in American National Standard X3.66-1979 (referenced above). Link level procedures enter the logically disconnected state when a DISC command is sent and a UA response is received, for example. The link level procedure shall also be considered to be in the logically disconnected state after N2 (re)transmissions of SABM or DISC, where N2 is as defined in CCITT Recommendation X.25. The logically disconnected state is not assumed after N2 (re)transmissions of other types of frames.

(u) If a restart request packet is received in state r1 which exceeds the maximum permitted length, the DCE shall discard the restart request packet without further action. Optionally, the DCE may generate a diagnostic packet with diagnostic code #39 (packet too long).

(v) In the event that a facility code appears more than once in a facility field, the receiving DTE detecting this condition should treat the last appearance of the particular code as if it were the only appearance of that code.

(w) All networks shall supply diagnostic packets when their use is suggested in CCITT Recommendation X.25. No DTE shall reject diagnostic packets as errors.

(x) In Section 6.1.1, the second paragraph, the last phrase, "and is set to 0 in all other packets", shall be interpreted that the Qualifier bit is set to 0 in all other packets except data packets. For the case of data packets, the Qualifier bit is set to 0 or 1 as indicated in Section 4.3.6 of CCITT Recommendation X.25.

(y) The list of user facilities for packet-switched data networks, extracted from CCITT Recommendation X.2, is given below. These facilities are described in Section 7 of CCITT Recommendation X.25. The following further constraints apply:

i. Networks shall provide the facilities designated as essential "E" below.

ii. Networks shall also implement the Fast Select and Fast Select Acceptance facilities to facilitate more efficient operation in conveying higher layer protocol information or user data during call establishment. DTE's need not employ fast select packets when transmitting to the network, but all DTE's associated with the higher level functionality which allows response to a fast select packet must be able to accept incoming fast select packets.

iii. The packet retransmission facility shall not be used.

iv. All DTE's which employ any of the facilities labelled as additional "A" below (except Fast Select and Fast Select Acceptance) shall also be capable of operating without employing any A facilities (except Fast Select and Fast Select Acceptance).

v. The throughput class value of 48,000 bits/s may be interpreted as 56,000 bits/s in those locations where 56,000 bits/s access is used.

*Facilities of packet-switched data networks:*

| *User Facility* | VC | PVC | DG* |
|---|---|---|---|
| Optional user facilities assigned for an agreed contractual period: | | | |
| Extended packet sequence numbering (modulo) | A | A | A* |
| Non-standard default window sizes | A | A | A* |
| Non-standard default packet sizes 16, 32, 64, 256, 512, 1024 | A | A | - |
| Default throughput class assignment | A | A | A* |
| Flow control parameter negotiation | E | - | - |
| Throughput class negotation | E | - | - |
| Packet retransmission | A*** | A*** | A*** |
| Incoming calls barred | E | - | E* |
| Outgoing calls barred | E | - | E* |
| One-way logical channel outgoing | E | - | A* |
| One-way logical channel incoming | A | - | A* |
| Closed user group | E | - | E* |
| Closed user group with outgoing access | A | - | A* |
| Closed user group with incoming access | A | - | A* |
| Incoming calls barred within a closed user group | A | - | A* |
| Outgoing calls barred within a closed user group | A | - | A* |
| Bilateral closed user group | A | - | A* |
| Bilateral closed user group with outgoing access | A | - | A* |
| Reverse charging acceptance | A | - | A* |
| Fast select acceptance | A** | - | - |
| Datagram queue length selection* | - | - | A* |
| Datagram service signal logical channel* | - | - | A* |
| Datagram non-delivery indication* | - | - | E* |
| Datagram delivery confirmation* | - | - | E* |
| D-bit modification | A | A | - |
| *Optional user facilities requested by the DTE on a per call basis* | | | |
| Closed user group selection | E | - | E* |
| Bilateral closed user group selection | A | - | A* |
| Reverse charging | A | - | A* |
| RPOA selection | A | - | A* |
| Flow control parameter negotiation | E | - | - |
| Fast select | A** | - | - |
| Throughput class negotiation | E | - | - |
| Abbreviated address calling | FS | - | A* |
| Datagram non-delivery indication | - | - | E* |
| Datagram delivery confirmation | - | - | E* |

NOTE: Detailed explanations of these facilities are provided in CCITT Recommendation X.25.

LEGEND:

E = An essential user facility to be offered by all networks.
A = An additional user facility which may be offered by certain networks.
FS = Further study is required. This standard will be modified when this study is complete.
- = Not applicable.
DG = Applicable when the datagram service is being used.*
VC = Applicable when the virtual call service is being used.
PVC = Applicable when the permanent virtual circuit service is being used.

* - The datagram service and its related facilities *may* be used *only* when:
- there is to be a one-way transfer of information which does not require recovery at the network layer; and,
- a response to this transfer of information is not required at the network layer.

NOTES: 1. At the present time, the transfer of datagram packets across international borders through public packet-switching networks is not permitted.
2. DCE's are not required to provide datagram service. DTE's are not required to generate or accept datagrams and datagram-related packets.

** - Fast select shall be provided by all DCE's. All DTE's associated with the higher level functionality which allows response to a fast select packet must be capable of accepting incoming fast select packets, but need not generate fast select packets.

*** - The packet retransmission facilities shall not be used.

(z) The list of the applicable call progress signals, extracted from CCITT Recommendation X.96, is given below. These signal definitions apply to the cause codes specified in CCITT Recommendation X.25. The related circumstances giving rise to each call progress signal is also defined in table 1 below. The significance of categories indicates broadly the type of action expected of the DTE receiving the signal:

| *Category* | *Significance* |
|---|---|
| A | Requested action confirmed by network. |
| B | Call cleared because the procedure is complete. |
| C1 and C2 | Call cleared. The calling DTE should call again soon: the next attempt may be successful. However, after a number of unsuccessful call attempts with the same response, the cause could be assumed to be in Category D1 or D2. The interval between successive attempts and the number of maximum attempts will depend on a number of circumstances including:<br><br>- nature of the call progress signal<br>- users' traffic pattern<br>- tariffs<br>- possible regulations by the network provider.<br>OR<br>Reset. The DTE may continue to transmit data recognizing that data loss may have occurred. |
| D1 and D2 | Call cleared. The calling DTE should take other action to clarify when the call attempt might be successful.<br>OR<br>Reset (for permanent virtual circuit only).<br>The DTE should cease data transmission and take other action as appropriate. |
| C1 and D1 | Due to subscriber condition. |
| C2 and D2 | Due to network condition. |

The sequence of call progress signals in table 1 implies, for Categories C and D, the order of call set-up processing by the network. In general, the DTE can assume, on receiving a call progress signal, that no condition higher up in the table is present. Network congestion is an exception to this general rule. The actual coding of call progress signals does not necessarily reflect this sequence.

Users and DTE manufacturers are warned to make due allowance to possible later extensions to this table by providing appropriate fall-back routines for unexpected signals.

Table 1

| *Call Progress Signal* | *Definition* | *Category* |
|---|---|---|
| Delivery confirmation | The datagram has been accepted by the destination DTE. | A |
| Local procedure error | A procedure error caused by the DTE is detected by the DCE at the local DTE/DCE interface. | C1 |
| Network congestion | A condition exists in the network such as:<br>1) temporary network congestion<br>2) temporary fault condition within the network, including procedure error within a network or an international link. | C2 |
| Invalid facility request | A facility requested by the calling DTE is detected as invalid by the DCE at the local DTE/DCE interface.<br>Possible reasons include:<br>- request for a facility which has not been subscribed to by the DTE;<br>- request for a facility which is not available in the local network;<br>- request for a facility which has not been recognized as valid by the local DCE. | D1 or D2 |
| RPOA out of order | The RPOA nominated by the calling DTE is unable to forward the call. | D2 |
| Not obtainable | The called DTE address is out of the numbering plan or not assigned to any DTE. | D1 |
| Access barred | The calling DTE is not permitted the connection to the called DTE.<br>Possible reasons include:<br>- unauthorized access between the calling DTE and the called DTE;<br>- incompatible closed user group. | D1 |
| Reverse charging acceptance not subscribed | The called DTE has not subscribed to the reverse charging acceptance facility. | D1 |
| Fast select acceptance not subscribed | The called DTE has not subscribed to the fast select acceptance facility. | D1 |
| Incompatible destination | The remote DTE/DCE interface or the transit network does not support a function or facility requested (e.g., the datagram service). | D1 |
| Out of order | The remote number is out of order.<br>Possible reasons include:<br>- DTE is Uncontrolled Not Ready;<br>DCE Power Off;<br>- Network fault in the local loop;<br>X.25 Level 1 not functioning;<br>X.25 Level 2 not in operation. | D1 or D2 |

Table 1 (Continued)

| *Call Progress Signal* | *Definition* | *Category* |
|---|---|---|
| Number busy | The called DTE is detected by the DCE as engaged on other call(s), and therefore as not being able to accept the incoming call. (In the case of the datagram service, the queue at the destination DCE is full.) | C1 |
| Remote procedure error | A procedure error caused by the remote DTE is detected by the DCE at the remote DTE/DCE interface. | D1 |
| Network operational | Network is ready to resume normal operation after a temporary failure or congestion. | C1 |
| Remote DTE operational | Remote DTE/DCE interface is ready to resume normal operation after a temporary failure or out of order condition (e.g., restart at the remote DTE/DCE interface. Loss of data may have occurred. | C1 or D1 |
| DTE originated | The remote DTE has initiated a clear, reset, or restart procedure. | B or D1 |

**Waivers:** Waiver of this standard is required when an interface based on CCITT Recommendation X.25 (1980) is to be employed and has either one of the following conditions: 1) The interface has options that are not permitted by this standard; 2) The interface does not implement all options mandated by this standard.

Heads of agencies desiring a waiver from the requirements stated in this standard, so as to acquire applicable equipment or service not conforming to this standard, shall submit a request for waiver to the Administrator, General Services Administration, for review and approval. Approval will be granted if, in the judgment of the Administrator after consultation with the Assistant Secretary of Commerce for Productivity, Technology and Innovation, based on all available information including that provided in the waiver requests, a major adverse economic or operational impact would occur through conformance with this standard.

A request for waiver shall include a justification for the waiver, including a description and discussion of the adverse economic or operational impact that would result from conforming to this standard as compared to the alternative for which the waiver is requested. ICST and NCS will provide technical assistance, as required, to GSA.

**Where to Obtain Copies:** Copies of this publication are for sale by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161. When ordering, refer to Federal Information Processing Standards Publication 100 (FIPS-PUB-100)/Federal Standard 1041 (FED-STD 1041), and title. When microfiche is desired, this should be specified. Payment may be made by check, money order, purchase order, credit card, or deposit account.

The CCITT X.25 specifications upon which this publication is based may also be obtained from NTIS. Specify PB82-187766; the cost is $50; telephone (703) 487-4650.

# NBS TECHNICAL PUBLICATIONS

## PERIODICALS

**JOURNAL OF RESEARCH**—The Journal of Research of the National Bureau of Standards reports NBS research and development in those disciplines of the physical and engineering sciences in which the Bureau is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Bureau's technical and scientific programs. As a special service to subscribers each issue contains complete citations to all recent Bureau publications in both NBS and non-NBS media. Issued six times a year. Annual subscription: domestic $18; foreign $22.50. Single copy, $5.50 domestic; $6.90 foreign.

## NONPERIODICALS

**Monographs**—Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

**Handbooks**—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

**Special Publications**—Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

**Applied Mathematics Series**—Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

**National Standard Reference Data Series**—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS under the authority of the National Standard Data Act (Public Law 90-396).

NOTE: The principal publication outlet for the foregoing data is the Journal of Physical and Chemical Reference Data (JPCRD) published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

**Building Science Series**—Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

**Technical Notes**—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

**Voluntary Product Standards**—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NBS administers this program as a supplement to the activities of the private sector standardizing organizations.

**Consumer Information Series**—Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

*Order the* **above** *NBS publications from: Superintendent of Documents, Government Printing Office, Washington, DC 20402.*

*Order the* **following** *NBS publications—FIPS and NBSIR's—from the National Technical Information Service, Springfield, VA 22161.*

**Federal Information Processing Standards Publications (FIPS PUB)**—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

**NBS Interagency Reports (NBSIR)**—A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service, Springfield, VA 22161, in paper copy or microfiche form.