INTERNATIONAL STANDARD

ISO/IEC 13239

First edition
1997-06-15

Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures

Technologies de l'information — Télécommunications et échange d'information entre systèmes — Procédures de commande de liaison de données à haut niveau (HDLC)

Reference number
ISO/IEC 13239:1997(E)

Contents

Annexes

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 organizations 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 13239 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

Annexes A to G of this International Standard are for information only.

Introduction

This International Standard is a composition of the following HDLC-related International Standards and Amendments:

- ISO/IEC 3309:1993

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Frame structure

- ISO/IEC 3309:1993/DAM4

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Frame structure — Amendment 4: Optional range of FCS checking

- ISO/IEC 4335:1993

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Elements of procedures

- ISO/IEC 4335:1993/Amd.6:1995

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Elements of procedures — Amendment 6: Extension of HDLC sequence number modulus beyond 128

- ISO/IEC 4335:1993/Amd.7:1995

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Elements of procedures — Amendment 7: Enhanced multi-selective reject option

- ISO/IEC 4335:1993/DAM8

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Elements of procedures — Amendment 8: Unnumbered information frame with header check (UIH) command and response

- ISO/IEC 4335:1993/DAM9

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Elements of procedures — Amendment 9: Span list encoding of the information field in the multi-SREJ frame

- ISO/IEC 7809:1993

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Classes of procedures

- ISO/IEC 7809:1993/Amd.10:1995

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Classes of procedures — Amendment 10: Extension of HDLC sequence number modulus beyond 128

- ISO/IEC 7809:1993/DAM11

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Classes of procedures — Amendment 11: Unnumbered information frame with header check (UIH) command and response

- ISO/IEC 7809:1993/DAM12

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Classes of procedures — Amendment 12: Span list encoding of the information field in the multi-SREJ frame

- ISO/IEC 8885:1993

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — General purpose XID frame information field content and format

- ISO/IEC 8885:1993/Amd.9:1995

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — General purpose XID frame information field content and format — Amendment 9: Extension of HDLC sequence number modulus beyond 128

- ISO/IEC 8885:1993/DAM10

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — General purpose XID frame information field content and format — Amendment 10: Unnumbered information frame with header check (UIH) command and response

- ISO/IEC 8885:1993/DAM11

  Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — General purpose XID frame information field content and format — Amendment 11: Span list encoding of the information field in the multi-SREJ frame

- ISO/IEC 8471:1987

  Information processing systems — Data communication — High-level data link control balanced classes of procedures — Data-link layer address resolution/negotiation in switched environments

High-level data link control (HDLC) procedures are designed to permit synchronous or start/stop, code-transparent data transmission. The normal cycle of the code-transparent data communication between two data stations consists of the transfer of frames containing information from the data source to the data sink acknowledged by a frame in the opposite direction. Generally, until the data station comprising the data source receives an acknowledgement, it holds the original information in memory in case the need should arise for retransmissions.

In those situations that require it, data sequence integrity between the data source and the data sink is effected by means of a numbering scheme, which is cyclic within a specified modulus and measured in terms of frames. An independent numbering scheme is used for each data source/data sink combination on the data link.

The acknowledgement function is accomplished by the data sink informing the data source of the next expected sequence number. This can be done in a separate frame, not containing information, or within the control field of a frame containing information.

HDLC procedures are applicable to unbalanced data links and to balanced data links.

Unbalanced data links

An unbalanced data link involves two or more participating data stations. For control purposes, one data station on the data link assumes responsibility for the organization of data flow and for unrecoverable data link level error conditions. The data station assuming these responsibilities is known as the primary station in unbalanced connection-mode data links and as the control station in unbalanced connectionless-mode data links, and the frames it transmits are referred to as command frames. The other data stations on the data link are known as the secondary stations in unbalanced connection-mode data links and as the tributary stations in unbalanced connectionless-mode data links, and the frames they transmit are referred to as response frames.

For the transfer of data between the primary/control station and the secondary/tributary stations, two cases of data link control are considered (see figures A and B). In the first case, the data station comprising the data source performs a primary/control station data link control function and controls the data station comprising the data sink that is associated with a secondary/tributary station data link control function, by select-type commands.

In the second case, the data station comprising the data sink performs a primary/control station data link control function and controls the data station comprising the data source that is associated with a secondary/tributary station data link control function, by poll-type commands.

The information flows from the data source to the data sink, and the acknowledgements are always transmitted in the opposite direction.

These two cases of data link control may be combined so that the data link becomes capable of two-way alternate communication, or two-way simultaneous communication.

Balanced data links

A balanced data link involves only two participating data stations. For control purposes, each data station assumes responsibility for the organization of its data flow and for unrecoverable data link level error conditions associated with the transmissions that it originates. Each data station is known as a combined station in balanced connection-mode data links and as a peer station in balanced connectionless-mode data links and is capable of transmitting and receiving both command and response frames.

For the transfer of data between combined/peer stations, the data link control functions illustrated in figure C are utilized. The data source in each combined/peer station controls the data sink in the other combined/peer station by the use of select-type commands. The information flows from the data source to the data sink, and the acknowledgements are always transmitted in the opposite direction. The poll-type commands may be used by each combined/peer station to solicit acknowledgements and status responses from the other combined/peer station.

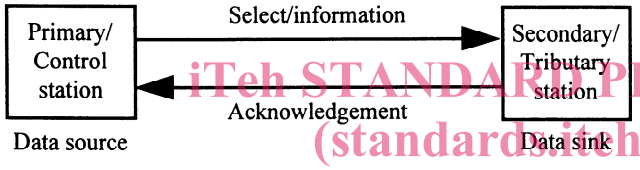

Figure A — Unbalanced data link functions (case 1)

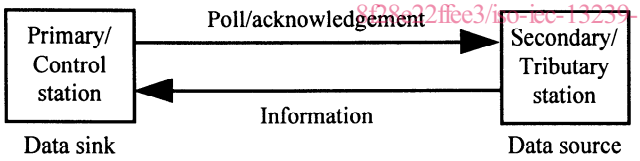

Figure B — Unbalanced data link functions (case 2)

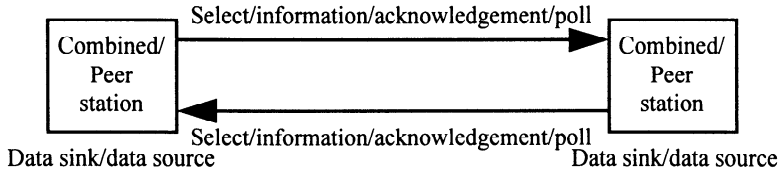

Figure C — Balanced data link functions

HDLC classes of procedures describe methods of data link operation which permit synchronous or start/stop, code-transparent data transmission between data stations in a variety of logical and physical configurations. The classes are defined in a consistent manner within the framework of an overall HDLC architecture. One of the purposes of this International Standard is to maintain maximum compatibility between the basic types of procedures, unbalanced, balanced and connectionless, as this is particularly desirable for data stations with configurable capability, which may have the characteristics of a primary, secondary, combined, control, tributary, or peer station, as required for a specific instance of communication.

Five fundamental classes of procedures (two unbalanced, one balanced, and two connectionless) are defined herein. The unbalanced classes apply to both point-to-point and multipoint configurations (as illustrated in figure D using the primary/secondary nomenclature) over either dedicated or switched data transmission facilities. A characteristic of the unbalanced classes is the existence of a single primary station at one end of the data link plus one or more secondary stations at the other end(s) of the data link. The primary station alone is responsible for data link management, hence the designation "unbalanced" classes of procedures.

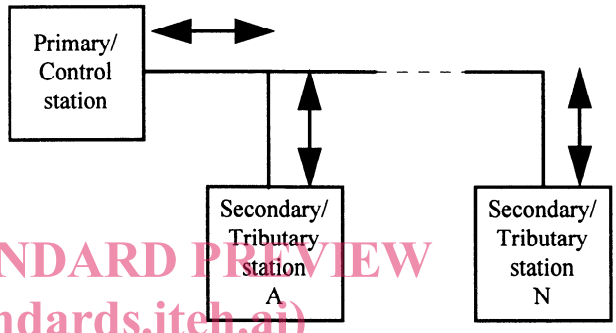

Figure D — Unbalanced data link configuration

The unbalanced connectionless class applies to point-to-point configurations over either dedicated or switched data transmission facilities, or to multipoint configurations over dedicated data transmission facilities (as illustrated in figure D using the control/tributary nomenclature). A characteristic of the unbalanced connectionless class is the existence of a single control station at one end of the data link plus one or more tributary stations at the other end(s) of the data link. The control station is responsible for determining when a tributary station is permitted to send. Neither the control station nor the tributary station(s) support any form of connection establishment/termination procedures, flow control procedures, data transfer acknowledgement procedures, or error recovery procedures, hence the designation «connectionless» class of procedures.

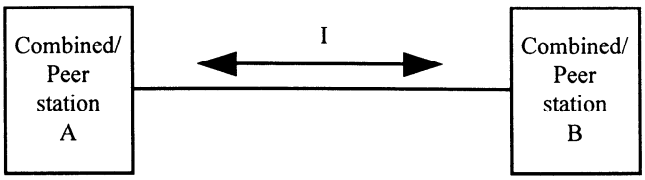

Figure E — Balanced data link configuration

The balanced class applies to point-to-point configurations (as illustrated in figure E using the combined nomenclature) over either dedicated or switched data transmission facilities. A characteristic of the balanced class is the existence of two data stations, called combined stations, on a logical data link, that may share equally in the responsibility for data link management, hence the designation "balanced" class of procedures.

The balanced connectionless class applies to point-to-point configurations over either dedicated or switched data transmission facilities (as illustrated in figure E using the peer nomenclature). A characteristic of the balanced connectionless class is the existence of two data stations, called peer stations, on a data link, that are each independently in control of when they can send. Neither peer station supports any form of connection establishment/termination procedures, flow control procedures, data transfer acknowledgement procedures, or error recovery procedures, hence the designation "connectionless" class of procedures.

For each class of procedures, a method of operation is specified in terms of the capabilities of the basic repertoire of commands and responses that are found in that class.

A variety of optional functions are also listed. Procedural descriptions for the use of the optional functions are defined.

It is recognized that it is possible to construct symmetrical configurations for operation on a single data circuit from the unbalanced classes of procedures which are defined in this International Standard. For example, the combination of two unbalanced procedures (with I frame flow as commands only) in opposite directions would create a symmetrical point-to-point configuration (as illustrated in figure F).

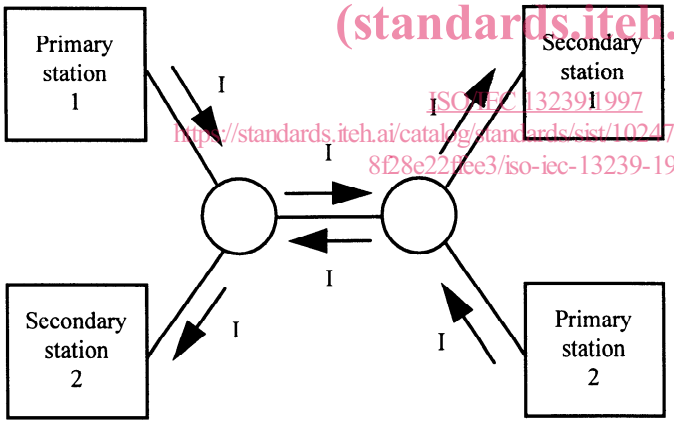

Figure F — Symmetrical data link configuration

These HDLC procedures define the exchange identification (XID) command/response frame as an optional function for exchange of data link information (identification, parameters, functional capability, etc.). The content and format for a general purpose XID frame information field is defined.

These HDLC procedures also specify the parameters and procedures which may be employed by two data stations to mutually determine the data link layer addresses to be used prior to logical data link establishment.

Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures

1 Scope

This International Standard specifies the frame structure, the elements of procedures, the classes of procedures, the content and format of the general purpose Exchange Identification (XID) frame, and a means for resolution/negotiation of a data link layer address in switched environments for data communication systems using bit-oriented high-level data link control (HDLC) procedures.

NOTE — The use of the phrase «bit-oriented», referring to the HDLC control procedures, pertains to the allocation of a non-integral number of bits to various subfields used for HDLC control purposes. However, the frame as an entirety may be constructed from octet-oriented units (e.g., start-stop mode) for transmission purposes.

The frame structure portion defines the relative positions of the various components of the basic frame and the bit combination for the frame delimiting sequence (flag). The mechanisms used to achieve bit pattern independence (transparency) within the frame are also defined. In addition, two frame checking sequences (FCS) are specified; the rules for address field extension are defined; and the addressing conventions available are described.

The elements of procedures portion specifies elements of data link control procedures for synchronous or start/stop, code-transparent data transmission using independent frame numbering in both directions.

These HDLC elements of procedures are defined specifically in terms of the actions that occur on receipt of commands at a secondary station, a tributary station, a peer station, or a combined station.

This International Standard is intended to cover a wide range of applications; for example one-way, two-way alternate or two-way simultaneous data communication between data stations which are usually buffered, including operations on different types of data circuits; for example multipoint/point-to-point, duplex/half-duplex, switched/non-switched, synchronous/start-stop, etc.

The defined elements of procedures are to be considered as a common basis for establishing different types of data link control procedures. This International Standard does not define any single system and should not be regarded as a specification for a data communication system. Not all of the commands or responses are required for any particular system implementation.

The classes of procedures portion describes the HDLC unbalanced classes of procedures, the HDLC balanced class of procedures, and the HDLC connectionless classes of procedures for synchronous or start/stop data transmission.

For the unbalanced classes, the data link consists of a primary station plus one or more secondary stations and operates in either the normal response mode or the asynchronous response mode in a point-to-point or multipoint configuration. For the balanced class, the data link consists of two combined stations and operates in the asynchronous balanced mode in a point-to-point configuration. For the unbalanced connectionless class, the data link consists of a control station plus one or more tributary stations and operates in the unbalanced connectionless-mode in a point-to-point or multipoint configuration. For the balanced connectionless class, the data link consists of two peer stations and operates in the balanced connectionless-mode in a point-to-point configuration. In each class, a basic repertoire of commands and responses is defined, but the capability of the data link may be modified by the use of optional functions.

Balanced operation is intended for use in circumstances which require equal control at either end of the data link. Operational requirements are covered in accordance with the overall HDLC architecture.

The content and format of the Exchange Identification (XID) frame portion builds on the fact that the principal use of the XID frame is to exchange data link information between two or more HDLC stations. For the purpose of this International Standard, data link information shall include any and all essential operational characteristics such as identification, authentication and/or selection of optional functions and facilities concerning each station. This International Standard defines a single-exchange negotiation procedure for establishing operational characteristics when either one or more stations are capable of providing multiple selections.

This International Standard provides a means for exchanging the necessary information to establish, at a minimum, a data link connection between two correspondents wishing to communicate. It describes a general purpose XID frame information field content and format for that purpose.

It defines encoding for information related to the basic HDLC standards only. Mechanisms are provided to permit the general purpose XID frame information field to be used to negotiate private parameters in a single XID exchange simultaneously with negotiation of the defined basic parameters.

This International Standard does not limit or restrict the use of the XID frame information field from defining other standard formats for use in specific applications.

The following are examples of potential uses of the XID command/response frame interchange:

a) Identification of the calling and called stations when using circuit switched networks (including switched network backup applications).

b) Identification of stations operating on non-switched networks requiring identification at start-up.

c) The XID command frame with an individual, group or all-station address may be used to solicit XID response frame(s) from other station(s) on the data link, prior to or following data link establishment.

d) Negotiation of the Frame Check Sequence (FCS) to be used for subsequent information interchange, by stations that support both 16-bit FCS and 32-bit FCS capabilities.

e) Convey higher layer information that may be required prior to data link establishment.

f) Transmission of an XID response frame at any respond opportunity to request an XID exchange to modify some of the operational parameters (for example, window size) following data link establishment.

g) Negotiation of the number of protected bits in the frame when an Unnumbered Information with Header check (UIH) frame is used.

The means for resolution/negotiation of a data link layer address in switched environments portion is applicable to data stations employing HDLC balanced classes of procedures which provide the XID command/response capability with the two specific parameter fields, identified below. It is used to select a pair of operational link addresses when preassigned, system designated addresses are not known on an a priori basis, e.g., switched circuited data links. Additional XID frame functions (including the exchange of operational parameters, command/response support, higher layer information, etc.) may be accomplished in conjunction with data link layer address determination or following address determination, with additional XID frame exchanges.

NOTE — Address resolution procedures for situations where the remote DTE does not support XID frames, the "all-station" address, or complete address support capabilities as defined in clause 8 below are not within the scope of this International Standard.

2 Normative references

The following standards contains 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 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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO/IEC 2382-9:1995, *Information technology — Vocabulary —Part 9: Data communication.*

ISO 7478:1987, *Information processing systems — Data communication — Multilink procedures.*

ISO/IEC 7498-1:1994, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model.*

ISO/IEC 7776:1995, *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 TR 10171:1994, *Information technology — Telecommunications and information exchange between systems — List of standard data link layer protocols that utilize high-level data link control (HDLC) classes of procedures and list of standardized XID format identifiers and private parameter set of identification values.*

3 Definitions, acronyms and abbreviations

3.1 Definitions

The following definitions are to be used throughout this International Standard.

3.1.1 abort:

A function invoked by a sending primary, secondary, combined, control, tributary or peer station causing the recipient to discard (and ignore) all bit sequences transmitted by the sender since the preceding flag sequence.

3.1.2 accept:

The condition assumed by a data station (primary, secondary, combined, control, tributary or peer station) upon accepting a correctly received frame for processing.

3.1.3 address field (A):

The sequence of eight (or any multiple of eight, if extended) bits immediately following the opening flag sequence of a frame identifying the secondary/combined or tributary/peer station sending (or designated to receive) the frame.

3.1.4 address field extension:

Enlarging the address field to include more addressing information.

3.1.5 address resolution/negotiation:

Procedure for exchanging/determining the data link layer identity of each data link layer entity.

3.1.6 basic status:

A secondary/combined or tributary/peer station's capability to send or receive a frame containing an information field.

3.1.7 centralized control:

A control in which all the primary or control station functions of the data link are centralized in one data station.

3.1.8 combined station:

That part of a data station that supports the combined station control functions of the data link.

NOTE — The combined station generates commands and responses for transmission and interprets received commands and responses. Specific responsibilities assigned to a combined station include:

a) initialization of control signal interchange;

b) organization of data flow;

c) interpretation of received commands and generation of appropriate responses; and

d) actions regarding error control and error recovery functions at the data link layer.

3.1.9 command:

In data communication, an instruction represented in the control field of a frame and transmitted by the primary/combined/control/peer station. It causes the addressed secondary/combined/tributary/peer station to execute a specific data link control function.

3.1.10 command frame:

a) All frames transmitted by a primary/control station.

b) Those frames transmitted by a combined/peer station that contain the address of the other combined/peer station.

3.1.11 contention mode:

A mode of transmission in which a transmitter can send on its own initiative.

3.1.12 control escape (CE):

The unique sequence of eight bits (10111110) employed to indicate the following octet has been modified according to the transparency algorithm for start/stop transmission environments.

3.1.13 control field (C):

The sequence of eight (or 16/32/64, if extended) bits immediately following the address field of a frame.

NOTE — The content of the control field is interpreted by:

a) the receiving secondary/combined/tributary/peer station, designated by the address field, as a command instructing the performance of some specific function; and

b) the receiving primary/combined/control/peer station as a response from the secondary/combined/tributary/peer station, designated by the address field, to one or more commands.

3.1.14 control field extension:

Enlarging the control field to include additional control information.

3.1.15 control station:

The data station that supports the control station control functions of the data link.

NOTE — The control station generates command for transmission and interprets received responses. Specific responsibilities assigned to the control station include:

a) initialization of control signal interchange, and

b) organization of data flow.

3.1.16 data communication:

See ISO/IEC 2382-9, term 09.01.03.

3.1.17 data link:

See ISO/IEC 2382-9, term 09.04.08.

3.1.18 data link connection:

See ISO/IEC 7498-1 : 1994.

3.1.19 data link layer:

The conceptual layer of control or processing logic existing in the hierarchical structure of a data station (primary, secondary, combined, control, tributary or peer station) that is responsible for maintaining control of the data link.

NOTE — The data link layer functions provide an interface between the data station higher layer logic and the data link. These functions include:

a) transparency;

b) address/control field interpretation;

c) command/response generation, transmission and interpretation; and

d) frame check sequence computation and interpretation.

3.1.20 data transmission:

See ISO/IEC 2382-9, term 09.01.02.

3.1.21 duplex transmission:

See ISO/IEC 2382-9, term 09.03.01.

3.1.22 exception condition:

The condition assumed by a secondary/combined station upon receipt of a frame which it cannot execute due either to a transmission error or to an internal processing malfunction.

3.1.23 flag sequence (F):

The unique sequence of eight bits (01111110) employed to delimit the opening and closing of a frame.

3.1.24 format identifier:

Designator of one of 128 different standardized formats or one of 128 user-defined formats of the Exchange Identification (XID) frame information field.

3.1.25 frame:

The sequence of address, control, information, and FCS fields, bracketed by opening and closing flag sequences.

NOTE — A valid frame is at least 32 bits in length and contains an address field, a control field and a frame check sequence. A frame may or may not include an information field.

3.1.26 frame check sequence (FCS):

The field immediately preceding the closing flag sequence of a frame, containing the bit sequence that provides for the detection of transmission errors by the receiver.

3.1.27 group identifier:

Classifier of data link layer characteristics or parameters by function (for example, address resolution, parameter negotiation, user data).

3.1.28 half-duplex transmission:
See ISO/IEC 2382-9, term 09.03.02.

3.1.29 HDLC-based protocol:
A protocol which is a subset of the elements and classes of procedure and optional functions defined in the HDLC standard, and adopted as a standard by ISO or a recognized international standards body (e.g., ITU-T).

3.1.30 higher layer:
The conceptual layer of control or processing logic existing in the hierarchical structure of a data station (primary, secondary, combined, control, tributary or peer station) that is above the data link layer and upon which the performance of data link layer functions are dependent; for example device control, buffer allocation, station management, etc.

3.1.31 information field (INFO):
The sequence of bits, occurring between the last bit of the control field and the first bit of the frame check sequence.

NOTE — The information field contents of I, UI, and UIH frames are not interpreted at the data link layer.

3.1.32 initiating combined station:
A station that sends the initial XID command frame as part of the address resolution process.

3.1.33 interframe time fill:
The sequence or condition transmitted between frames.

3.1.34 intraframe time fill:
In start/stop transmission, the sequence or condition transmitted within a frame when the next octet is not available for contiguous transmission immediately following the preceding octet. For synchronous transmission, there is no provision for intraframe time fill.

3.1.35 invalid frame:
A sequence of bits, following the receipt of an apparent opening flag sequence, that either

a) is terminated by an abort sequence; or

b) contains less than 32 bits before an apparent closing flag sequence is detected.

3.1.36 layer parameter:
The specification of data link layer characteristics and parameters, and their values, available or chosen.

3.1.37 non-initiating combined station:
A station that waits for the other combined station to send the initial XID command frame as part of the address resolution process.

3.1.38 peer station:
The data station that supports the peer station control functions of the data link.

NOTE — The peer station generates commands for transmission and interprets received commands and responses.

3.1.39 primary station:
The data station that supports the primary station control functions of the data link.

NOTE — The primary station generates commands for transmission and interprets received responses. Specific responsibilities assigned to the primary station include:

a) initialization of control signal interchange;

b) organization of data flow; and

c) actions regarding error control and error recovery functions at the data link layer.

3.1.40 primary/secondary station:
The general case where the station may be either a primary station or a secondary station.