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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)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of the joint technical committee is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 13239 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 13239:2000), which has been technically revised. It also cancels and replaces ISO/IEC 3309:1993, ISO/IEC 4335:1993, ISO/IEC 7809:1993 and ISO/IEC 8885:1993.

Annex H forms a normative part of this International Standard. Annexes A to G are for information only.

Introduction

This third edition adds a new frame format type to Annex H – Frame format types. This frame format type is used in those environments where additional error protection, identification of both the source and the destination(s), and/or longer frame sizes are needed.

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.
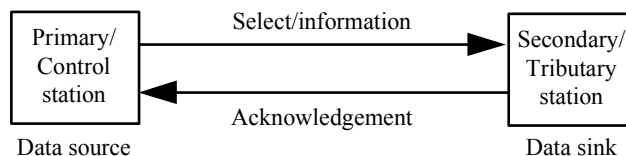
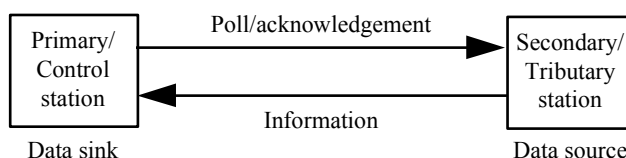**Figure A — Unbalanced data link functions (case 1)**

Figure B — Unbalanced data link functions (case 2)

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.
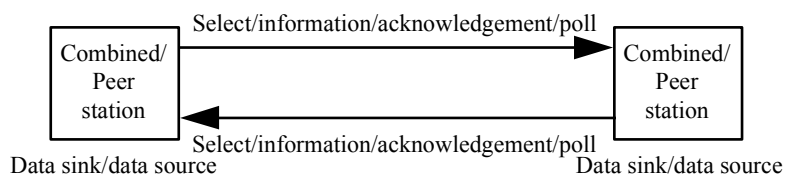
Figure C — Balanced data link functions

Data link configurations

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

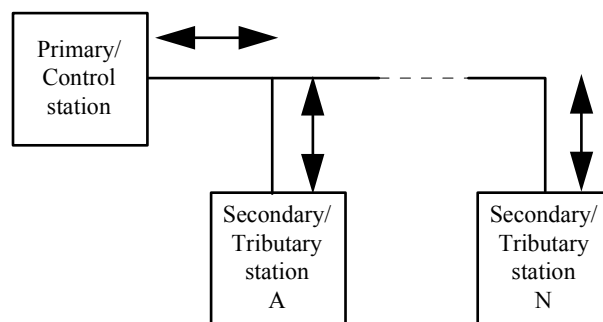The unbalanced connectionless class applies to point-to-point configurations over either dedicated or switched data transmission facilities, or to multipoint configurations over dedicated data transmission facilities (as illustrated in figure D using the control/tributary nomenclature). A characteristic 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 recorvery procedures, hence the designation "connectionless" class of procedures.

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.
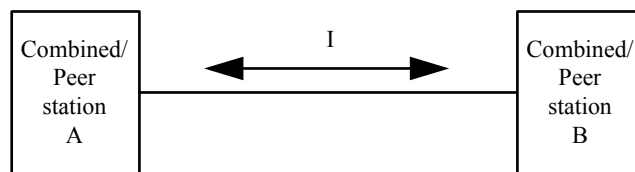
Figure E — Balanced data link configuration

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).
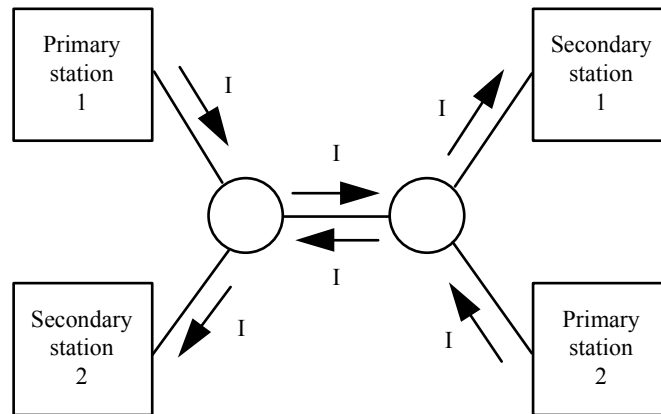
Figure F — Symmetrical data link configuration

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.

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1 Scope

This International Standard specifies the frame structures, 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 format and the non-basic frame format. The mechanisms used to achieve bit pattern independence (transparency), where and when required, within the frame are also defined. In addition, three 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 normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC 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 10171:2000, *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, list of standard XID format identifiers, list of standard mode-setting information field format identifiers, and list of standard user-defined parameter set identification values*