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Information technology — Telecommunications and information exchange between systems — Protocol mappings for the OSI Data Link service

Technologies de l'information — Télécommunications et échange d'information entre systèmes — Applications du protocole au service de liaison de données OSI

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Foreword

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

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 11575 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

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Information technology — Telecommunications and information exchange between systems — Protocol mappings for the OSI Data Link service

1 Scope

This International Standard specifies general principles for the mappings between the OSI Data Link service (ISO/IEC 8886), both connection-mode (CO-DLS) and connectionless-mode (CL-DLS), and standard Data Link protocols, as follows:

M1: CO-DLS — HDLC X.25 LAPB-compatible DTE procedures, single link procedures (ISO/IEC 7776)
M2: CO-DLS — HDLC Unbalanced operation Normal response mode Class, UNC (ISO/IEC 3309, ISO/IEC 4335 and ISO/IEC 7809)
M3: CO-DLS — Logical link control (LLC) Type 2 (ISO/IEC 8802-2)
M4: CL-DLS — LLC Type 1 (ISO/IEC 8802-2)
M5: CL-DLS — HDLC Balanced operation Connectionless-mode Class, BCC (ISO/IEC 3309, ISO/IEC 4335 and ISO/IEC 7809)
M6: CL-DLS — HDLC Unbalanced operation Connectionless-mode Class, UCC (ISO/IEC 3309, ISO/IEC 4335 and ISO/IEC 7809)

This International Standard specifies the detailed mappings M1, M2, M5 and M6; it also specifies the main features of the mappings M3 and M4.

This International Standard does not specify individual implementations or products, nor does it constrain the implementation of Data Link entities and interfaces within an information processing system.

NOTES

1 The above designations M1 to M6 for the mappings are used elsewhere in this International Standard.

2 The possibility of adding further mappings to the above list in the future is not precluded (for example, to cover Frame Relay protocols).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards 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 listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 3309: 1993, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Frame structure.*

ISO/IEC 4335: 1993, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Elements of procedures.*

ITU-T Recommendation X.200 (1994) | 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 7809: 1993, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures — Classes of procedures.*

ISO/IEC 8802-2:1994, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 2: Logical link control.*

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

ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1994, *Information technology — Open Systems Interconnnection — Basic Reference Model — Conventions for the definition of OSI services.*

3 Definitions

3.1 This International Standard uses the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

DL-address
DL-connection
DL-connectionless-mode transmission
DL-entity
DL-group address
DL-layer
DL-protocol-data-unit
DL-service access point
DL-service access point address
DL-service-data-unit
DL-subsystem

3.2 This International Standard uses the following terms defined in ITU-T Rec. X.210 | ISO/IEC 10731:

DLS provider
DLS user
primitive
request (primitive)
indication (primitive)
response (primitive)
confirm (primitive)

3.3 For the purposes of this International Standard, the following definitions apply:

3.3.1 frame: A DL-PDU.
3.3.2 instance of DL-communication: A DL connection or a single DL-connectionless-mode transmission.

4 Abbreviations

BCC	balanced operation connectionless-mode class
CL	connectionless-mode
CO	connection-mode
DISC	disconnect
DL	Data Link
DLC	Data Link connection
DLS	Data Link service
DLSAP	Data Link service access point
DLSDU	Data Link service data unit
DM	disconnected mode
FRMR	frame reject
HDLC	High-level data link control
I	information
LLC	Logical Link Control
NRM	normal response mode
PDU	protocol data unit
QOS	quality of service
SABM	set asynchronous balanced mode
SABME	set asynchronous balanced mode extended
SLP	single link procedure
SNRM	set normal response mode
SNRME	set normal response mode extended
UA	unnumbered acknowledgment

UCC	unbalanced operation connectionless-mode class
UI	unnumbered information
UNC	unbalanced operation normal response mode class

5 Conformance

There is no direct conformance of equipment to this International Standard considered in isolation. The provisions of this International Standard have normative application to equipment implementing Network-layer protocols that are specified in terms of their use of the OSI Data Link service. For such Network-layer protocols, this International Standard links the behaviour of the underlying Data Link protocols to the relevant features of the Data Link service, and thus provides the basis for establishing conformance of the Network-layer protocol implementations to the specified usage of the Data Link layer.

NOTES

1 This International Standard therefore functions as "glue" between Network-layer protocol standards, written in terms of their use of the OSI Data Link service, and Data Link protocol standards written — usually for historical reasons — without reference to the OSI Data Link service. Conformance to such a Data Link protocol standard will be expressed entirely in terms of the procedures and PDUs, etc., specified in that standard; conformance to such a Network-layer standard in respect of its use of the Data Link layer will be expressed in terms of, for example, the transfer of NPDUs as DLSDUs, and (for the CO-DLS) of procedures that apply in the event of DL connection reset or DL connection release. This International Standard specifies precisely how the procedures, etc., of the Data Link protocol in question are to be interpreted in terms of the OSI Data Link Service, and therefore establishes a precise relationship between the specifications of the Network-layer protocol and of the Data Link protocol.

2 Use of the OSI Data Link service in Network-layer protocol specifications offers the benefits of layer-independence, in that such a Network-layer specification is available, without change, for use over new or alternative Data Link technologies, provided only that the appropriate mapping is specified between the OSI Data Link service and the relevant Data Link technology.

6 General principles of the protocol mappings

6.1 Data Link architecture

The OSI Data Link service defines the properties of individual instances of DL-communication between pairs of DLS users.The definition is abstractly expressed in terms of primitives and parameters exchanged, at Data Link service access points (DLSAPs), between each DLS user and a single DLS provider: this is illustrated in figure 1.

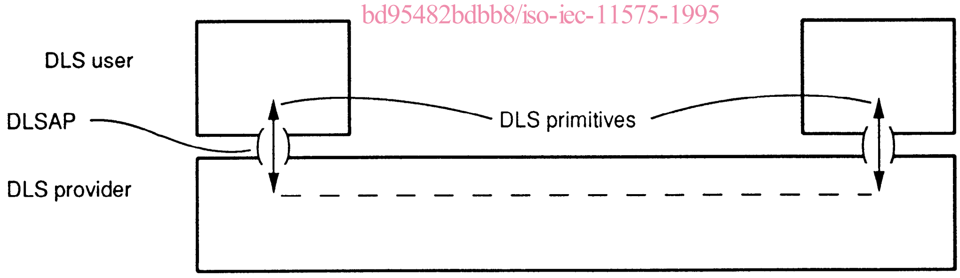


Figure 1 — Model of Data Link service provision

Operation of the DLS provider is modelled in terms of the exchange of DL-PDUs, in accordance with DL-protocols, between DL-entities (figure 2). Each DLSAP is attached to a unique DL-entity; a given DL-entity can have one or more DLSAPs attached to it, depending upon system configuration and the nature of the underlying DL-protocols.

When real equipment is considered, a data link consists of two or more stations communicating according to a particular DL-protocol or set of related DL-protocols, together with the interconnecting media supporting information exchange among the stations. Possible configurations of a real data link (see figure 3) include:

a) point-to-point data links, with just two stations (mappings M1 and M5 are for protocols used in data links of this type);
b) centralized multipoint data links, with one station controlling communication between itself and a number of subsidiary stations (mappings M2 and M6 are for protocols used in data links of this type);
c) distributed multipoint data links, with a number of stations any of which can communicate with any other (local area networks are of this type, see mappings M3 and M4).

The definition of stations and data links has a logical dimension, deriving from the protocols used, in addition to the physical equipment used in constructing particular real data links. A single real system can be attached to two or more data links, in which case it is considered to contain the corresponding number of distinct stations; a single real system can contain two or more stations attached to the same data link; and it is possible for a single set of communications equipment to support two or more distinct data links.

The Data Link service model deals primarily with the properties of individual instances of DL-communication, each occurring between a pair of DL-entities or, for multicast communication, between a single originating source DL-entity and a set of destination DL-entities. DL-protocols have to deal with multiple instances of communication, both between a given pair of DL-entities and, certainly for data links of types (b) and (c) above, between different pairs (or multicast sets) of DL-entities: representing the protocol facilities that support this forms a part of the specification of the mapping between the protocol and the DLS. Aspects to be considered include the number of DLSAPs supported by a given station, the number of DL connections that can be active simultaneously at a DLSAP, and the DL addressing facilities that support discrimination among multiple stations.

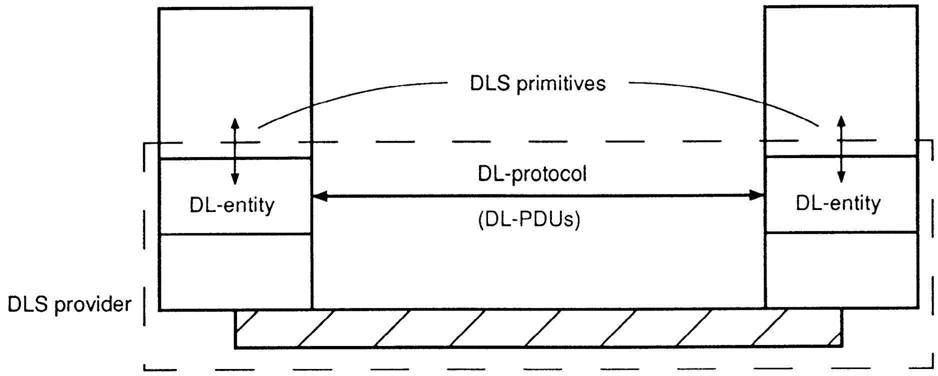
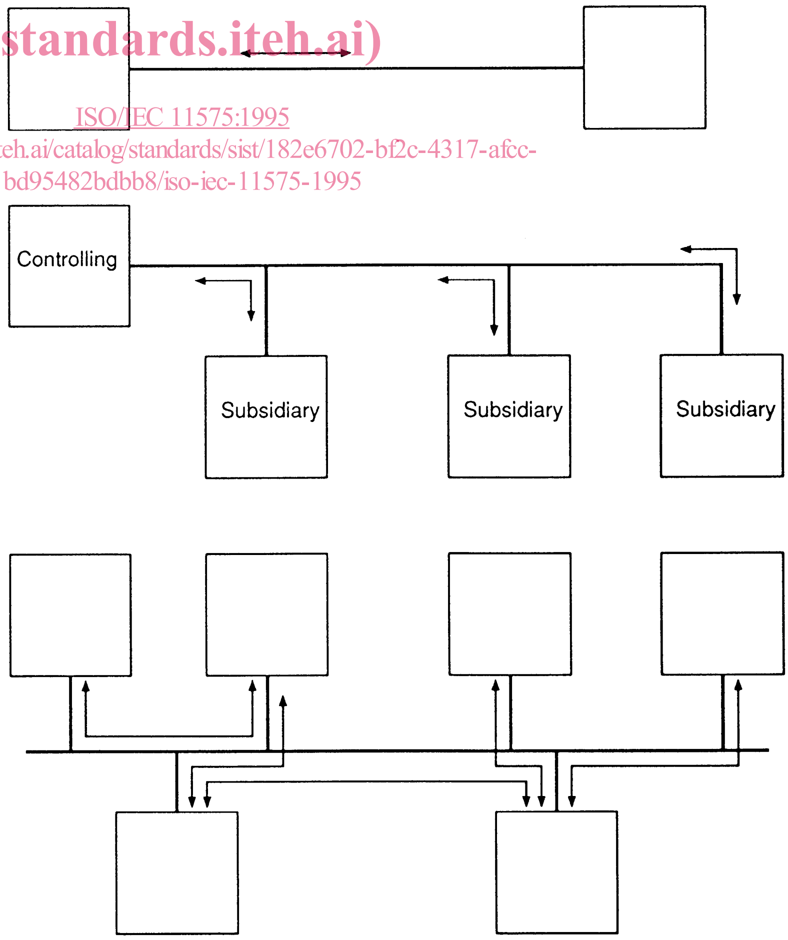


Figure 2 — Structure of DLS provider

a) Point-to-point data link, two stations only (e.g. combined stations or peer stations)

b) Centralized multi-point data link, communication between controlling station (e.g., primary station or control station) and subsidiary stations (e.g., secondary stations or tributary stations)

c) Distributed multipoint data link, any station to any station



Fgure 3 — Types of data link configuration

6.2 Modelling of service primitives

Primitives are abstractions of the behaviour of real systems engaging in data communication: in specifying the mapping between these abstract primitives and the activity of real implementations of DL-protocol entities, this allows freedom in modelling the timing of when primitives occur, so as to simplify the mapping specification.

NOTE 1 — ISO/IEC 8886 explicitly allows this freedom; it defines the constraints on the sequence in which primitives can occur, but states that other constraints affect the ability of a DLS user or DLS provider to issue a primitive at any particular time.

For primitives issued by the DLS user — those of types request and response — this International Standard uses a rendezvous model: that is, a primitive can only occur if both the DLS user and the local DLS provider are prepared for it to occur. This provides two valuable simplifications:

a) occurrence of DLS-user issued primitives can always be related to the externally observable transmission of corresponding frames — the ability to transmit the frames is considered to be an essential part of the DLS provider being prepared for the primitive to occur; and

b) there is no need to complicate the mapping by, for example, introducing any queueing of primitives that have been issued by the DLS user but have not yet resulted in any protocol activity.

Conversely, for primitives issued by the DLS provider — those of types indication and confirm — it is convenient to simplify the model by considering primitives to occur as soon as the DLS provider is ready.

NOTES

2 An implementation of a DL-protocol is free to use an interface that queues requests, eg, for data transmission; however, the issuing of corresponding DLS primitives is modelled as occurring after the requests are removed from such a queue, not when they are entered into the queue.

3 Any queueing mechanisms in real systems are matters of implementation detail; as in the case described in Note 2, the boundary between DLS provider and DLS user is modelled as being at the DLS provider's end of the queue.

4 This model does not impose a requirement to support queues of unbounded size; interface flow control by the DLS user will in general affect the behaviour of the DL-protocol entity and prevent excessive demands.

6.3 Relationships between service features and protocol functions

All of the mappings covered by this International Standard use natural relationships between functions of the various protocols and corresponding abstractions as Data Link service features.

The primary function in each mapping is that of transferring units of user data. For each mapping, the correspondence is between the DLSDU of a DL-DATA or DL-UNITDATA primitive (in connection-mode or connectionless-mode operation, respectively) and the basic delimited unit of data transfer in the protocol: that is, for the mappings M1 to M6, the contents of the Information field of a single frame conveying user data.

NOTE 1 — It is possible that future Data Link layer protocols could provide intrinsic support for segmentation and reassembly of user data across sequences of frames; the absence of this feature from the protocols considered in M1 to M6 does not preclude the possibility of single DLSDUs mapping to multiple frames of such future DL-protocols.

The other functions of DL-protocols are defined to complement the primary data-transfer function, and the correspondences in the DLS mappings are similarly direct.

For connectionless-mode operation, only functions related to addressing and quality of service apply.

For connection-mode operation, protocol functions for setting up, disconnecting, and resetting the connections used for data transfer are mapped to DL connection establishment, DL connection release and DL connection reset.

NOTE 2 — ISO/IEC 8886 defines a somewhat idealized connection-mode service, which does not fully represent all the peer-to-peer interactions that can occur when real DL-protocols such as ISO/IEC 7776 SLP and LLC Type 2 are used. The differences affect only link setup, disconnection and reset, and not any successfully established period of data transfer. They occur typically when DL PDUs responding to link setup, disconnection or reset are lost, and are more likely to occur if, at the same time, one of the DL-entities undergoes two or more changes in its readiness to participate in data transfer. In such circumstances, one DL-entity may observe, for example, a single successful DLC establishment, whereas the other observes a rejected incoming DLC establishment attempt followed by a successful incoming DLC establishment; or one DL-entity may observe a single DLC reset where the other observes two DLC resets, with no data received between the two. These do not represent malfunctions of the protocols, since they never affect the integrity of any successful transfers of user data between the DL-entities.

7 Protocol mapping for ISO/IEC 7776 single link procedure

7.1 General protocol functions

ISO/IEC 7776 SLP applies to a point-to-point data link (as in figure 3a), connecting the single station for which the SLP is specified (the DTE) with a single remote station (the DCE or remote DTE). The protocol for the SLP provides no facilities for addressing or multiplexing; consequently, the data link supports a single DLSAP in the DTE and a single DLSAP in the DCE or remote DTE, and there can be at most one DL connection in existence between the two DLSAPs at any given time.

Table 1 specifies the mapping between the principal protocol functions of ISO/IEC 7776 SLP and the corresponding features of the OSI CO-DLS.

Table 1 — Mapping between principal ISO/IEC 7776 SLP protocol functions and CO-DLS features

Protocol function	Data Link service feature
Asynchronous disconnected mode	Absence of a DL connection (Idle state): see Note
Link set-up	DL connection establishment phase
Link disconnection	DL connection release phase and absence of a DLC: see Note
Information transfer	Data transfer phase, normal data transfer
Link reset, including frame rejection exception condition	Data transfer phase, reset
NOTE — The DL connection release phase at each DLSAP is instantaneous, since it contains only a single DL-DISCONNECT primitive. However, the corresponding protocol exchanges are extended in time, with a resulting transient period at each DLSAP during which the protocol's link disconnection corresponds to absence of a DLC, with DLC establishment phase unable to be entered.	

7.2 DL connection establishment

Table 2 specifies the mapping between DL-CONNECT primitives and the frames used for link setup according to ISO/IEC 7776.

The called address, calling address and responding address parameters of the DL-CONNECT primitives are associated a priori with the DTE and the DCE or remote DTE at the two ends of the point-to-point data link, and hence are not mapped in the protocol.

Similarly, the Quality of Service parameter set parameters are not mapped in the protocol, since only one level of QOS is available and is assumed known a priori.

Table 2 — Mapping between primitives and ISO/IEC 7776 frames at DLC establishment

Primitive	Frame
DL-CONNECT request	SABM or SABME command transmitted when in disconnected mode, together with any retransmissions on timer expiry
DL-CONNECT indication	SABM or SABME command received when in disconnected mode
DL-CONNECT response	UA response transmitted in response to SABM or SABME command received in disconnected mode
DL-CONNECT confirm	UA response received for SABM or SABME command (re)transmitted in disconnected mode

7.3 DL connection release

Table 3 specifies the mapping between DL-DISCONNECT primitives and the frames used for link disconnection according to ISO/IEC 7776.

The Originator parameter in a DL-DISCONNECT indication primitive is "DLS provider" if the primitive corresponds to a DM frame received in data transfer phase, and otherwise is "unknown".

The Reason parameter in every DL-DISCONNECT request and indication primitive is "reason unspecified".

Table 3 — Mapping between primitives and ISO/IEC 7776 frames, etc., at DLC release

Primitive	Frame, etc.
DL-DISCONNECT request	DISC command transmitted when in information transfer phase, together with any retransmissions on timer expiry DM response transmitted in response to SABM or SABME command received in disconnected mode (rejection of DLC establishment)
DL-DISCONNECT indication	DISC command or DM response received when in information transfer phase DM response received for SABM or SABME command (re)transmitted in disconnected mode (rejection of DLC establishment) DM response transmitted during information transfer phase (in response to received FRMR or unsolicited UA response, or to unsolicited response frame with F bit set to 1), together with any retransmissions on timer expiry Entry to disconnected mode on retransmission-count expiry during information transfer phase or link set-up Detection of loss of Physical layer communication

7.4 Data transfer

Each DL-DATA request primitive maps to transmission of an I frame, together with any retransmissions required by the ISO/IEC 7776 procedures for information transfer. Each transmitted I frame with an Information field having non-zero length corresponds to a DL-DATA request primitive in this way.

Each new in-sequence I frame received and accepted with non-zero Information field length maps to a DL-DATA indication primitive.

The DLS User-data parameter of a DL-DATA primitive is the sequence of octets that forms the Information field of the corresponding transmitted or received I frame.

7.5 DL connection reset

Table 4 specifies the mapping between DL-RESET primitives and the frames used for link reset according to ISO/IEC 7776.

The Originator and Reason parameters in a DL-RESET indication primitive are respectively:

a) "DLS provider" and "Data Link error" if the primitive corresponds to a FRMR response transmitted or received, or to a SABM or SABME command transmitted by the DL-entity in response to an error; or

b) "unknown" and "reason unspecified" when the primitive corresponds to a SABM or SABME command received.

The Reason parameter in a DL-RESET request primitive is "user resynchronization".