

BRITISH STANDARD

**BS ISO/IEC
7809 : 1991**

*(Including
Amendments 6 and 7)*

Implementation of ISO/IEC 7809 : 1991

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

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National foreword

This British Standard reproduces verbatim ISO/IEC 7809 : 1991 including Amendments 5, 6 and 7 : 1991 and implements it as the UK national standard.



NOTE. International amendments originally numbered 1, 2 and 3 have been incorporated into the text of ISO 7809 : 1991. Amendment 4 is still in preparation. This British Standard therefore reproduces the currently amended text of ISO 7809.

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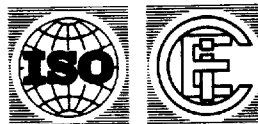
INTERNATIONAL STANDARD

ISO/IEC 7809

Second edition
1991-09-15

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

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



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Foreword

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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.

ISO/IEC 7809 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

This second edition cancels and replaces the first edition (ISO 7809 : 1984), which has been technically revised.

Annex A is for information only.

Introduction

High-level data link control (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 connection.

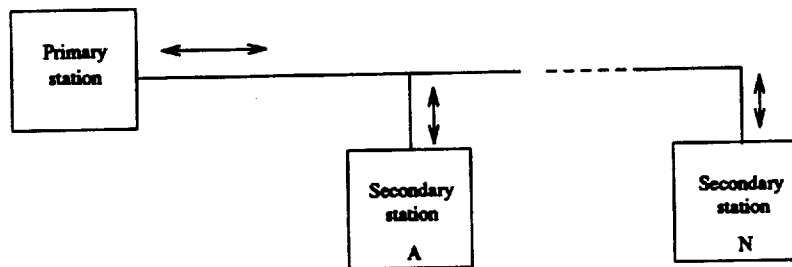


Figure 1 - Unbalanced data link configuration

This International Standard defines five fundamental classes of procedures (two unbalanced, one balanced, and two connectionless). The unbalanced classes apply to both point-to-point and multipoint configurations (as illustrated in figure 1) 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.

The balanced class applies to point-to-point configurations (as illustrated in figure 2) 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 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. 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.

The balanced connectionless class applies to point-to-point configurations over either dedicated or switched data transmission facilities. 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 found in clause 6.

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 3).

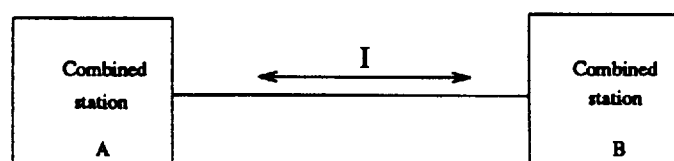


Figure 2 - Balanced data link configuration

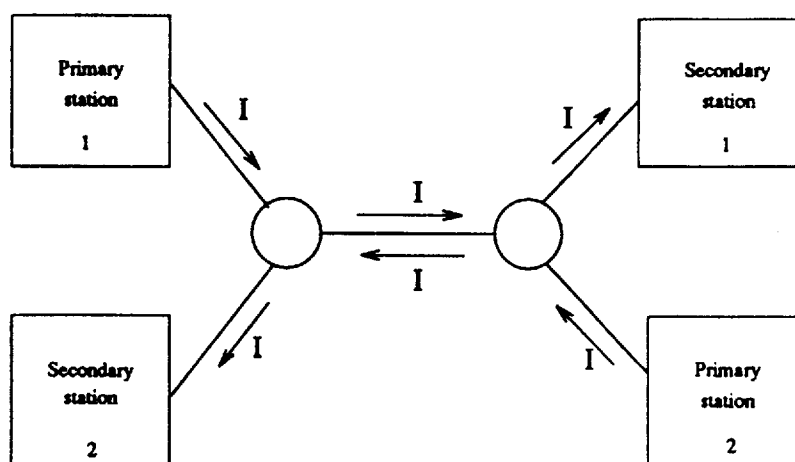


Figure 3 - Symmetrical data link configuration

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1 Scope



This International Standard describes the HDLC unbalanced classes of procedures and insert the HDLC balanced class of procedures and the HDLC connectionless classes of procedures for synchronous or start/stop data transmission.

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 procedures use the HDLC frame structure defined in ISO/IEC 3309 and the HDLC elements of procedures described in ISO/IEC 4335.

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.



2 Normative references

The following standards contain provisions which, through reference in this text, constitute provision 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 2382-9 : 1984, *Data processing - Vocabulary - Part 09: Data communication*.

ISO/IEC 3309 : 1991, *Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - Frame structure*.

ISO/IEC 4335 : 1991, *Information technology - Telecommunications and information exchange between systems - High level data link control (HDLC) procedures - Elements of procedures*.

ISO/IEC 8885 : 1991, *Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - General purpose XID frame information field content and format*.

3 General description

3.1 Principles

3.1.1 Types of data station

3.1.1.1 Two types of data station are defined for the unbalanced classes of procedures (see figure 4):

- a) primary station, which sends commands, receives responses and is ultimately responsible for data link layer error recovery;
- b) secondary stations, which receive commands, send responses and may initiate data link layer error recovery.

3.1.1.2 One type of data station is defined for the balanced class of procedures (see figure 4), i.e. combined stations, which send both commands and responses, receive both commands and responses, and are responsible for data link layer error recovery.

3.1.1.3 Three types of data stations are defined for the connectionless classes of procedures (see figure 4):

- a) control station in unbalanced connectionless class of procedure, which sends commands, receives responses, but does not support any form of data link layer connection establishment/termination, flow control, acknowledgement, or error recovery;



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- b) tributary stations in unbalanced connectionless class of procedure, which receives commands, sends responses, but does not support any form of data link layer connection establishment/termination, flow control, acknowledgement, or error recovery;
- c) peer stations in balanced connectionless class of procedures, which send both commands and responses, receive both commands and responses, but are not responsible for any form of data link layer connection establishment/termination, flow control, acknowledgment, or error recovery."

NOTE - The above terms are introduced in order to avoid having to use compound terms such as "connectionless secondary station", etc., throughout the subclauses that deal with connectionless classes of procedures.

3.1.2 Configurations

For the unbalanced classes of procedures, a single primary station plus one or more secondary station(s) shall be connected together over various types of transmission facilities to build point-to-point or multipoint, half-duplex or duplex, switched or non-switched configurations.

For the balanced class of procedures, two combined stations shall be connected together over various types of transmission facilities to build point-to-point, half-duplex or duplex, switched or non-switched configurations.



For the unbalanced connectionless class of procedures, a single control station plus one or more tributary station(s) shall be connected together over various types of transmission facilities to build point-to-point or multipoint, half-duplex or duplex, switched or non-switched configurations.

For the balanced connectionless class of procedures, two peer stations shall be connected together over various types of transmission facilities to build point-to-point, half-duplex or duplex, switched or non-switched configurations.

3.1.3 Operational modes

In an unbalanced class, any coupling of a primary station with secondary station(s) shall be operated in either the normal response mode (NRM) or the asynchronous response mode (ARM), two-way alternate or two-way simultaneous, in accordance with the capability of the configuration being employed. In the balanced class, two combined stations shall be operated in the asynchronous balanced mode (ABM), two-way alternate or two-way simultaneous, in accordance with the capability of the configuration being employed.



In the unbalanced connectionless class, any coupling of a control station with tributary station(s) shall be operated in the unbalanced connectionless mode (UCM), two-way alternate or two-way simultaneous, in accordance with the capability of the configuration being employed.

In the balanced connectionless class, two peer stations shall be operated in the balanced connectionless mode (BCM), two-way alternate or two-way simultaneous, in accordance with the capability of the configuration being employed.



3.1.4 Addressing scheme

In all classes (unbalanced, balanced, and connectionless.), commands shall always be sent containing a destination data station address, and responses shall always be sent containing the assigned transmitting data station address.



The "all-station" address or a "group" address may be used to transmit a command frame simultaneously to all the secondary stations on a multipoint configuration or to the defined group of secondary stations. The addressing convention is specified in ISO/IEC 3309, clause 5. The mechanism to avoid overlapping responses to multiple station addressing is system dependent and is not specified in either ISO/IEC 3309 or this International Standard.

3.1.5 Send and receive state variables

For each primary-to-secondary or combined-to-combined pairing, a separate pair of send and receive state variables shall be used for each direction of transmission of information (I) frames. Upon receipt and acceptance of a mode setting command, both the send and receive state variables of the receiving station, shall be set to zero. Upon receipt and acceptance of an acknowledgement response to a mode setting command, both the send and receive state variables of the originating station shall be set to zero.

For each control-to-tributary or peer-to-peer pairing, there are no send and receive state variables used for each direction of transmission of data.



3.2 Fundamental classes of procedures

3.2.1 Designations

Five fundamental classes of procedures are defined. They are designated:

UNC - Unbalanced operation Normal response mode Class;

UAC - Unbalanced operation Asynchronous response mode Class; and

BAC - Balanced operation Asynchronous balanced mode Class.

UCC - Unbalanced operation Connectionless-mode Class

BCC - Balanced operation Connectionless-mode Class



In these designations

- the first letter, U or B, indicates unbalanced or balanced operation;
- the second letter, A, N, or C, indicates asynchronous, normal, or connectionless response mode;
- the second letter, A or N, indicates asynchronous or normal response mode; and
- the third letter, C, stands for class.



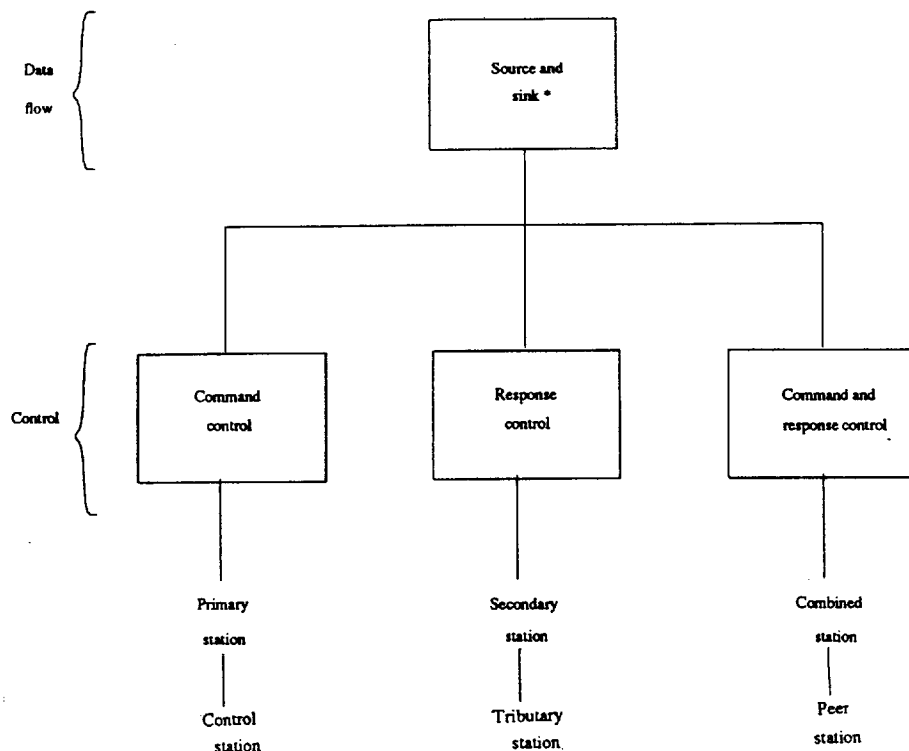
3.2.2 Basic repertoires

The following basic repertoires utilize single octet addressing, unextended control field format, a 16-bit FCS, and synchronous transmission.

3.2.2.1 UNC

The basic repertoire of commands and responses for UNC shall be as follows:

Commands	Responses
I	I
RR	RR
RNR	RNR
SNRM	UA
DISC	DM
	FRMR



* For send-only I frame stations or receive-only I frame stations, remove source or sink capability, as appropriate.

Figure 4 - HDLC stations - Building blocks

3.2.2.3 BAC

The basic repertoire of commands and responses for BAC shall be as follows:

Commands	Responses
I	I
RR	RR
RNR	RNR
SABM	UA
DISC	DM
	FRMR

3.2.2.4 UCC

The basic repertoire of commands and responses for UCC shall be as follows:

Commands	Responses
UI	UI

3.2.2.2 UAC

The basic repertoire of commands and responses for UAC shall be as follows:

Commands	Responses
I	I
RR	RR
RNR	RNR
SARM	UA
DISC	DM
	FRMR

3.2.2.5 BCC

The basic repertoire of commands and responses for BCC shall be as follows:

Commands	Responses
UI	

3.3 Optional functions

Fifteen optional functions are available (see table 1) to modify the fundamental classes of procedures defined in 3.2. These optional functions are obtained by the additions or deletions of commands and responses to or from the basic repertoires, or by the use of alternate address or control field formats or alternate frame checking sequences or alternate form of transmission (see figure 5). Option 11 is applicable to the balanced class of procedures only.

Options 2, 3, 4, 8, 9, 10, 11 and 13 are not applicable to the connectionless classes of procedures.



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3.4 Consistency of classes of procedures

The consistency in the five classes of procedures, obtained through the use of the concepts of modes of operation, basic

command/response repertoires, and hierarchical structuring, is shown in figure 5. This consistency in repertoire facilitates the inclusion of multiple versions of the classes of procedures in a data station that is configurable.

Table 1 - Optional functions

Option	Functional description	Required change
1	Provides the ability to exchange identification and/or characteristics of data stations	Add command: XID Add response: XID
2	Provides the ability for more timely reporting of I frame sequence errors (not for UCC or BCC)	Add command: REJ Add response: REJ
3	Provides the ability for more efficient recovery from I frame sequence errors by requesting retransmission of a single frame (not for UCC or BCC)	Add command: SREJ Add response: SREJ
4	Provides the ability to exchange information fields independent of the mode (operational or non-operational) without impacting the I frame sequence numbers (not for UCC or BCC)	Add command: UI Add response: UI
5	Provides the ability to initialize a remote data station, and the ability to request initialization	Add command: SIM Add response: RIM
6	Provides the ability to perform unnumbered group and all-station polling as well as unnumbered individual polling	Add command: UP
7	Provides for greater than single octet addressing	Use extended addressing format instead of basic addressing format
8	Limits the procedures to allow I frames to be commands only (not for UCC or BCC)	Delete response: I
9	Limits the procedures to allow I frames to be responses only (not for UCC or BCC)	Delete command: I
10	Provides the ability to use extended sequence numbering (modulo 128) (not for UCC or BCC)	Use extended control field format instead of basic control field format. Use SXXME instead of SXXM
11	Provides the ability to reset the state variables associated with only one direction of information flow (for BAC only) (not for UCC or BCC)	Add command: RSET
12	Provides the ability to perform a basic data link test	Add command: TEST Add response: TEST
13	Provides the ability to request logical disconnection (not for UCC or BCC)	Add response: RD
14	Provides for 32-bit frame checking sequence (FCS)	Use the 32-bit FCS instead of the 16-bit FCS
15	Provides for start/stop transmission	Use start/stop transmission instead of synchronous transmission



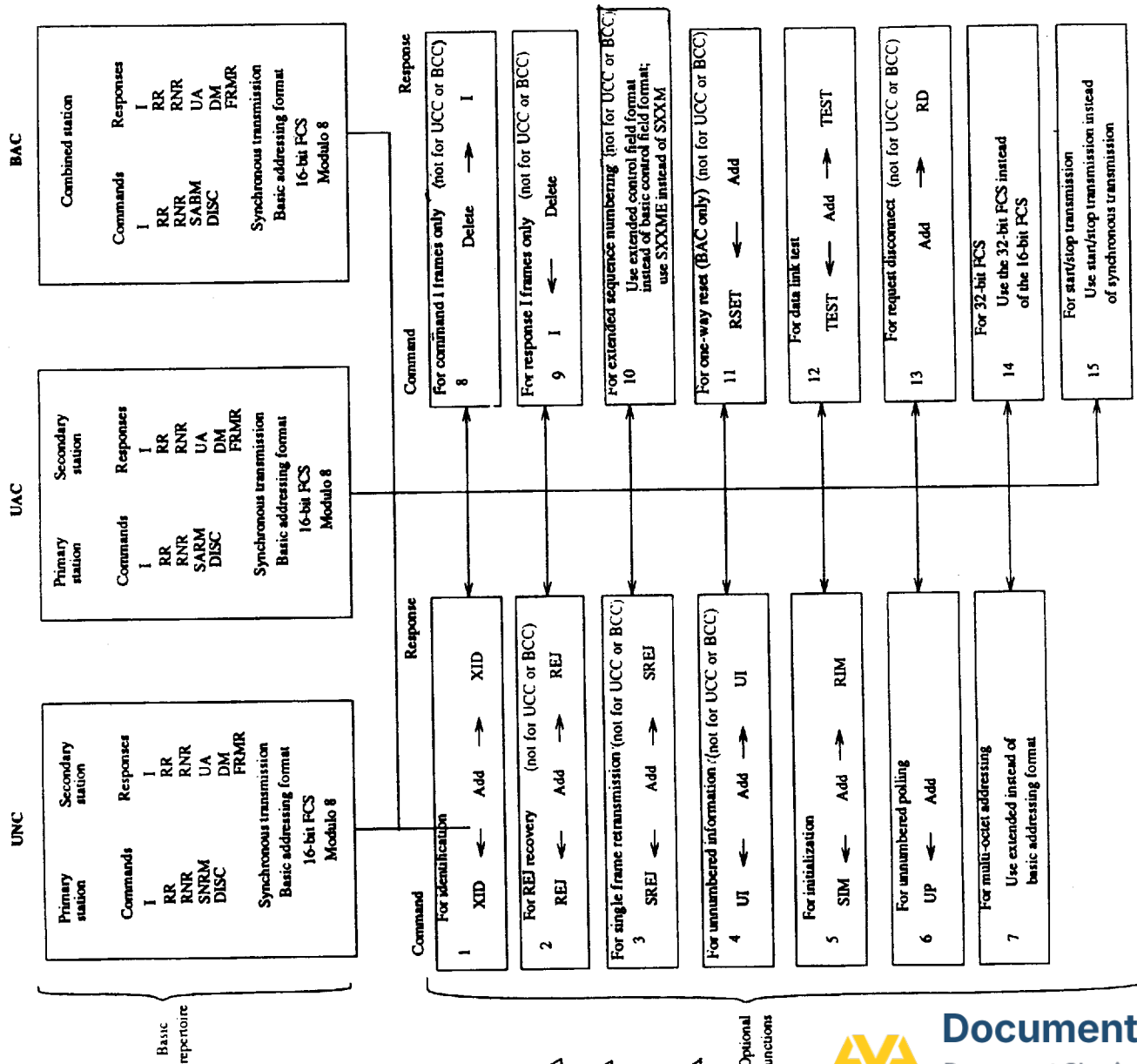


Figure 5 - HDLC classes of procedures

3.5 Conformance to the HDLC classes of procedures

A data station shall be described as conforming to a given class of procedures, with optional functions, if it implements all commands and responses in the basic repertoire for the class of procedures as modified by the selected optional functions, i.e.

- a) a primary station shall have the ability to receive all of the responses in the basic repertoire for the unbalanced class of procedures as modified by the selected optional functions;
- b) a secondary station shall have the ability to receive all of the commands in the basic repertoire for the unbalanced class of procedures as modified by the selected optional functions;
- c) a combined station shall have the ability to receive all of the commands and responses in the basic repertoire for the balanced class of procedures as modified by the selected optional functions.
- d) a control station shall have the ability to receive all of the responses in the basic repertoire for the unbalanced connectionless class of procedures as modified by the selected optional functions;
- e) a tributary station shall have the ability to receive all of the commands in the basic repertoire for the unbalanced connectionless class of procedures as modified by the selected optional functions;
- f) a peer station shall have the ability to receive all of the commands and responses in the basic repertoire for the balanced connectionless class of procedures as modified by the selected optional functions.

3.6 Method of indicating classes and optional functions

The classes of procedures and the optional functions shall be indicated by specifying the designation of the class (see 3.2.1) plus the number(s) of the accompanying optional functions (see 3.3).

Example 1: Class UNC1,2,6,9 indicates the unbalanced operation normal response mode class of procedures with the optional function for identification (XID), REJ recovery (REJ), unnumbered polling (UP), and one-way data flow from the secondary station(s) to the primary station.

Example 2: Class UAC1,5,10,13 indicates the unbalanced operation asynchronous response mode class of procedures with the optional functions for identification (XID), initialization (SIM, RIM), extended sequence numbering (modulo 128), and request disconnect (RD).

Example 3: Class BAC2,8 indicates the balanced operation asynchronous balanced mode class of procedures with the optional functions for REJ recovery (REJ) and the ability to send I frames as commands only.

Example 4: Class UCC1,12 indicates the unbalanced connectionless operation connectionless-mode class of procedures with the optional functions for identification (XID) and data link test (TEST).

Example 5: Class BCC1,14 indicates the balanced connectionless operation connectionless-mode class of procedures with the optional functions for identification (XID) and 32-bit FCS.

4 Unbalanced operation (point-to-point and multipoint)

4.1 General

The following requirements apply to the procedure for unbalanced operation of synchronous or start/stop data transmission over point-to-point or multipoint data links with two-way alternate or two-way simultaneous data transfer. The procedure uses the HDLC frame structure defined in ISO/IEC 3309 and the HDLC elements of procedures described in ISO/IEC 4335. It uses the basic command/response repertoire (see figure 5) designated UNC (or UAC). Although only the basic commands and responses are described, there are several optional functions available for enhanced operation. These are listed in 3.3 and shown in figure 5.

NOTE — The HDLC unbalanced classes of procedures operate as illustrated in the examples given in ISO/IEC 4335, Annex B. (See clause 1.)

4.2 Description of the data link

4.2.1 Configuration (see figure 1)

The unbalanced operation data link configuration shall consist of one primary station and one or more secondary stations interconnected by physical layer transmission facilities.

4.2.2 Physical layer transmission facilities

The physical layer transmission facilities may provide either half-duplex or duplex transmission over switched or non-switched data circuits.

NOTE — In the case of a switched data circuit, the procedures described assume that the switched data circuit has been established.

The data link layer shall not initiate data transmission until an indication of circuit availability is provided by the physical layer. (In some systems providing two-way alternate data exchange on physical layer data circuits using half-duplex transmission, this indication of physical layer circuit availability is indicated by an idle data link channel state.)

4.3 Description of the procedures

4.3.1 General

Unbalanced control procedures shall operate on a data link with one primary station and one or more secondary station(s) in either normal or asynchronous response mode. Only one secondary station at a time shall be put in asynchronous response mode. The primary station shall be ultimately responsible for overall data link error recovery.

Each data station shall check for correct receipt of the I frames it has sent to the remote data station by checking the N(R) of each received I frame and supervisory frame.

4.3.2 Data station characteristics

The primary station shall be responsible for:

- a) setting up the data link and disconnecting the data link;
- b) sending information transfer, supervisory and unnumbered commands; and
- c) checking received responses.

Each secondary station shall be responsible for:

- a) checking received commands; and
- b) sending information transfer, supervisory and unnumbered responses as required by the received commands.

4.4 Detailed definition of the procedures

The procedures for a permanently connected data link or an established switched connection are defined in 4.4.1 to 4.4.6.

The protocol for establishing and disconnecting a switched data circuit is not within the scope of this International Standard. However, the ability to exchange identification and/or characteristics after the switched connection is established is available as an optional function.

4.4.1 Setting up and disconnecting the data link

4.4.1.1 Setting up the data link

The primary station shall initialize the data link with a secondary station by sending a SNRM (or SARM) command and shall start a response time-out function (or equivalent). The addressed secondary station, upon receiving the SNRM (or SARM) command correctly, shall send the UA response at its first opportunity and shall set its send and receive state variables to zero. If the UA response is received correctly, the data link set up to the addressed secondary station is complete, and the primary station shall set its send and receive state variables relative to that secondary station to zero and shall stop the response time-out function (or equivalent). If, upon receipt of the SNRM (or SARM) command, the secondary station determines that it cannot enter the indicated mode, it shall send the DM response. If the DM response is received correctly, the primary station shall stop the response time-out function (or equivalent).

If the SNRM (or SARM) command, UA response or DM response is not received correctly, it shall be ignored. The result will be that the primary station's response time-out function (or equivalent) will run out, and the primary station may resend the SNRM (or SARM) command and restart the response time-out function (or equivalent) (see 4.4.3).

This action may continue until a UA response has been received correctly or until recovery action takes place at a higher level.

4.4.1.2 Disconnecting the data link

The primary station shall disconnect the data link(s) with secondary station(s) by sending a DISC command and shall start a response time-out function (or equivalent). The

addressed secondary station(s), upon receiving the DISC command correctly, shall send a UA response at its first opportunity and shall enter the normal disconnect mode (NDM), or the asynchronous disconnected mode (ADM), as predefined for that secondary station. If, upon receipt of the DISC command, the addressed secondary station is already in the disconnected mode, it shall send the DM response. The primary station, upon receiving a UA or DM response to a sent DISC command, shall stop the response time-out function (or equivalent).

When it is a multipoint configuration, the UA response from secondary stations shall not interfere with one another. The mechanism used to avoid overlapping responses to the disconnect (DISC) command using a group address or the all station address is system-defined.

If the DISC command, UA response or DM response is not received correctly, it shall be ignored by the receiving station. This will result in the expiry of the primary station's response time-out function (or equivalent), and the primary station may resend the DISC command and restart the response time-out function (or equivalent) (see 4.4.3).

This action may continue until either the UA response or a DM response has been received correctly or until recovery action takes place at a higher level.

4.4.1.3 Procedure in a disconnected mode

A secondary station in NDM (or ADM) shall monitor commands, shall react, at the earliest respond opportunity, to a SNRM (or SARM) command as outlined in 4.4.1.1, and shall respond with a DM response to a received DISC command. The secondary station shall respond to other commands received with the P bit set to "1" with a disconnected mode (DM) response with the F bit set to "1". Other commands received with the P bit set to "0" shall be ignored. The DM response shall be used to report the secondary station status asynchronously in ADM.

4.4.2 Exchange of information (I) frames

4.4.2.1 Sending I frames

The control field format shall be as defined in ISO/IEC 4335 (see clause 1) for an I frame with N(S) set to the value of the send state variable V(S) and with N(R) set to the value of the receive state variable V(R). Following data link set-up, both V(S) and V(R) shall be set to zero. The maximum length of I frames shall be a system-defined parameter.

If the data station is ready to send an I frame numbered N(S), where N(S) is equal to the last received acknowledgement plus the modulo - 1, the data station shall not send the I frame but shall follow the procedures described in 4.4.3.

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4.4.2.2 Receiving I frames

After a data station receives correctly an in-sequence I frame [i.e., $N(S)$ equals the value of the receive state variable $V(R)$] that it can accept, it shall increment its receive state variable $V(R)$, and, at its next opportunity to send, take one of the following actions:

- a) If information is available for transmission and the remote data station is ready to receive, it shall act as described in 4.4.2.1 and acknowledge the received I frame(s) by setting $N(R)$ in the control field of the next transmitted I frame to the value of $V(R)$.
- b) If information is not available for transmission but the data station is ready to receive I frames, the data station shall send an RR frame and acknowledge the received I frame(s) by setting $N(R)$ to the value of $V(R)$.
- c) If the data station is not ready to receive further I frames, the data station may send an RNR frame and acknowledge the received I frame(s) by setting the $N(R)$ to the value of $V(R)$.

If the data station is unable to accept the correctly received I frame(s), $V(R)$ shall not be incremented. The data station may send an RNR frame with the $N(R)$ set to the value of $V(R)$.

4.4.2.3 Reception of incorrect frames

If a frame is received with an incorrect FCS, it shall be discarded.

If an I frame is received with a correct FCS but with an incorrect $N(S)$, the receiving data station shall ignore the $N(S)$ field and discard the information field in that frame. This shall continue until the expected I frame is received correctly. The data station shall, however, use the P/F and $N(R)$ indications in the discarded I frames. The data station shall then acknowledge the expected I frame, when received correctly, as described in 4.4.2.2.

The P/F recovery (checkpointing) shall cause retransmission of the I frames received incorrectly, as described in 4.4.4.

4.4.2.4 Data station receiving acknowledgments

A data station receiving an I, RR or RNR frame with a valid $N(R)=x$ shall treat as acknowledged all previously transmitted I frames up to and including the I frame transmitted with $N(S)$ equal to $x-1$.

4.4.3 Time-out considerations

In order to detect a non-reply or lost-reply condition, each primary station shall provide a response time-out function (or equivalent). Also, in ARM, each secondary station shall provide a command time-out function (or equivalent). In each case, the expiry of the time-out function (or equivalent) shall be used to initiate appropriate error recovery procedures.

In NRM, a secondary station shall depend on the primary station to initiate time-out recovery.

The duration of time-out functions (or equivalent) shall be system-dependent and subject to bilateral agreement. To resolve possible contention situations in ARM, the duration of the secondary station's time-out function shall be different from that of the primary station.

4.4.4 P/F bit usage

P/F bit usage in the unbalanced classes of procedures, UNC and UAC, shall be as described in ISO/IEC 4335.

4.4.5 Two-way alternate considerations

In the case of normal respond opportunity, two-way alternate, data link operation

- a) transmission from the primary station shall not be allowed until either
 - 1) receipt of a frame with the F bit set to "1", or
 - 2) expiry of a no-response time-out function; and
- b) transmission from the secondary station shall not be allowed until receipt of a frame with the P bit set to "1".

NOTE 1 — In multipoint configurations of normal respond opportunity, two-way alternate, data link operation over duplex physical facilities, the primary station may transmit frames with the P bit set to "0" to non-pollled secondary stations in the above mentioned period.

In the case of normal respond opportunity, two-way alternate, data link operation, a data station shall not accept further frames after a frame with the P/F bit set to "1" was accepted and before it sends a frame with the F/P bit, respectively, set to "1".

In the case of asynchronous respond opportunity, two-way alternate, data link operation, transmission from a data station shall not be allowed until either

- a) detection of an idle data link channel state after receipt of a frame or a flag; or
- b) the end of an extended period of inactivity (idle data link channel state).

NOTE 2 — In the case of half-duplex data circuit facilities, appropriate accommodation has to be made to control the direction of data transmission. The direction of transmission is controlled by the data link layer, and may be signalled by the physical layer.

If no frames are transmitted from either data station while in ARM and information is waiting for transmission, it is advisable that the data station transmits at first a supervisory frame only in order to avoid long time recovery action, which would occur in the case of I frame contention.

If a data station has transmitted frames and no further frames are pending for transmission, it shall give the right to transmit to the remote data station.

4.4.6 Two-way simultaneous considerations

For each unbalanced class of procedures, two-way simultaneous communication protocols may be used independent of physical data circuit capability (i.e. half-duplex transmission). However, in the case of half-duplex data circuit facilities, appropriate accommodation has to be made to control the direction of data transmission. The direction of transmission is controlled by the data link layer. In addition, in the case of normal respond opportunity, data transmission from the secondary station shall not be allowed until receipt of a frame with the P bit set to "1".

5 Balanced operation (point-to-point)

5.1 General

The following requirements apply to the procedure for balanced operation of synchronous or start/stop data transmission over point-to-point data links with two-way alternate or two-way simultaneous data transfer. The procedure uses the HDLC frame structure defined in ISO/IEC 3309 and the HDLC elements of procedures described in ISO/IEC 4335.

It uses the basic command/response repertoire (see figure 5) designated BAC. Although only the basic commands and responses are described, there are several optional functions available for enhanced operation. These are listed in 3.3 and shown in figure 5.

NOTE — The HDLC balanced class of procedures operates as illustrated in the examples given in ISO/IEC 4335, Annex B. (See clause 1.)

5.2 Description of the data link

5.2.1 Configuration (see figure 2)

The balanced operation data link configuration shall consist of two combined stations interconnected by physical layer transmission facilities.

5.2.2 Physical layer transmission facilities

The physical layer transmission facilities may provide either half-duplex or duplex transmission over switched or non-switched data circuits.

NOTE — In the case of a switched data circuit, the procedures described assume that the switched data circuit has been established.

The data link layer shall not initiate data transmission until an indication of circuit availability is provided by the physical

layer. (In some systems providing two-way alternate data exchange on physical layer data circuits using half-duplex transmission, this indication of physical layer circuit availability is indicated by an idle data link channel state.)

5.3 Description of the procedures

5.3.1 General

Balanced control procedures shall operate on a data link where the data station at each end of the data link is a combined station. The procedures shall use the asynchronous balanced mode. Each combined station shall be equally responsible for data link layer error recovery.

Each combined station shall check for the correct receipt of the I frames it has sent to the remote combined station by checking the N(R) of each received I frame or supervisory frame.

5.3.2 Combined station characteristics

Each station shall be a combined station, i.e., it shall be able to set up the data link, disconnect the data link, and both send and receive commands and responses.

5.4 Detailed definition of the procedures

The procedures for a point-to-point data link using a permanently connected or an established switched connection are defined in 5.4.1 to 5.4.6.

The protocol for establishing and disconnecting a switched data circuit is not within the scope of this International Standard. However, the ability to exchange identification and/or characteristics after the switched connection is established is available as an optional function.

5.4.1 Setting up and disconnecting the data link

5.4.1.1 Setting up the data link

Either combined station may take the initiative to initialize the data link. It shall send the SABM command and start a response time-out function (or equivalent). The other combined station, upon receiving the SABM command correctly, shall send a UA response and reset both its send and receive state variables to zero. If the UA response is received correctly, the data link set-up shall be complete, and the initiating combined station shall set both its state variables to zero, stop the response time-out function (or equivalent), and enter the indicated mode. If, upon receipt of the SABM command, a combined station determines that it can not enter the indicated mode, it shall send the DM response. If the DM response is received correctly, the initiating combined station shall stop the response time-out function (or equivalent).

If an SABM command, UA response or DM response is not received correctly, it shall be ignored. The result will be that the response time-out function (or equivalent) will run out in the combined station which originally sent the SABM