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Data communication — HDLC unbalanced classes of procedures

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Foreword

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It has been approved by the member bodies of the following countries :

Australia	Hungary	South Africa, Rep. of
Belgium	Italy	Spain
Canada	Japan	Sweden
Egypt, Arab Rep. of	Mexico	Switzerland
Finland	Netherlands	United Kingdom
France	Poland	USA
Germany, F. R.	Romania	Yugoslavia

No member body expressed disapproval of the document.

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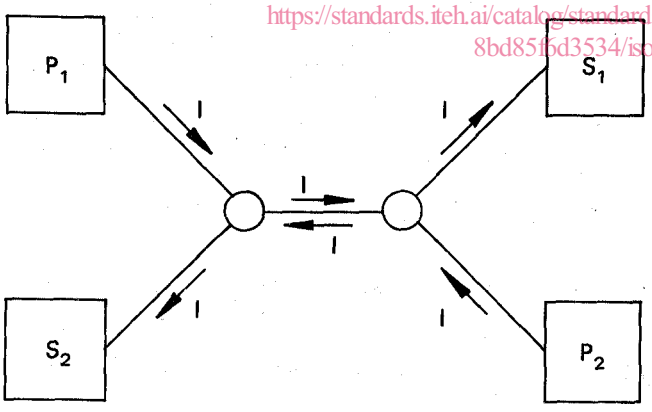
Data communication — HDLC unbalanced classes of procedures

0 Introduction

This International Standard deals with the unbalanced classes of procedures. It is also 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 below. For example, the combination of two procedures (with I frame flow as commands only) in opposite directions would create a symmetrical point-to-point configuration as illustrated in the diagram below.



1 Scope and field of application

This International Standard describes the HDLC unbalanced classes of procedures for synchronous data transmission. It covers operation requirements in accordance with the overall HDLC architecture. It uses the frame structure as defined in ISO 3309 and elements of procedure described in ISO 4335 and its addendum ISO 4335/DAD 1.

The link consists of a primary station plus secondary stations, and operates in either the asynchronous or normal response mode. A basic repertoire of commands and responses is defined. The capability of the data link may be modified by the use of optional functions.

2 General description

2.1 Principles

2.1.1 Station types

Two types of stations are defined for the unbalanced classes of procedures (see figure 1) :

— Primary stations, which send commands, receive responses and are ultimately responsible for link level error recovery.

— Secondary stations, which receive commands, send responses and may initiate link level error recovery.

2.1.2 Operational modes

Any coupling of a primary station with secondary station(s) can be operated over various types of transmission facilities to build unbalanced point-to-point or multipoint configurations. These stations may be operated in the normal response mode (NRM) or the asynchronous response mode (ARM), two-way alternate or two-way simultaneous.

2.1.3 Addressing scheme

Commands are always sent by the primary station and always contain the destination secondary station(s) address. Responses are always sent by a secondary station and always contain its own station address.

2.1.4 Send and receive state variable

For each primary-to-secondary link, a separate pair of send and receive state variables is required in each station for each direction of transmission of I frames. Upon receipt and acceptance of a set mode command both the send and receive state variables of a secondary station shall be reset to ZERO.

2.2 Fundamental classes of procedures

These classes of procedures are composed of :

— two types of stations : primary stations and secondary stations

— two types of response modes : normal and asynchronous.

They are designated as :

UAC Unbalanced operation, Asynchronous response mode, Class

UNC Unbalanced operation, Normal response mode, Class.

In the above designations, the first letter U defines unbalanced operation and the second letter A or N defines asynchronous response mode or normal response mode.

The basic repertoire of commands and responses is :

Commands	Responses
I	I
RR	RR
RNR	RNR
SXRM*	UA
DISC	DM
	CMDR

* SXRM command is : SARM for UAC
SNRM for UNC

2.3 Optional functions

There are ten optional functions used to modify the fundamental classes of procedures. These oprtional functions are achieved by the addition or deletion of commands and responses to the basic repertoire.

Option	Functional description	Required change
1A	Provide the ability to — exchange identification and/or characteristics of stations	Add command : XID Add response : XID
1B	— request logical disconnection	Add response RD
2	Provides the ability for more time reporting of I frame sequence errors	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	Add command : SREJ Add response : SREJ
4	Provides the ability to exchange information fields without impacting the I frame sequence counts	Add command : UI Add response : UI
5	Provides primary ability to initialize remote stations, and secondary ability to request initialization	Add command : SIM Add response : RIM
6	Provides primary ability to perform unnumbered group polling as well as individual polling	Add command : UP
7	Provides for greater than single octer addressing	Use extended addressing format in lieu of basic addressing format
8	Limits the procedure to one-way I frame transfer using commands	Delete response : I
9	Limits the procedure to one-way I frame transfer using responses	Delete command : I
10	Provides the ability to use extended sequence numbering (modulo 128)	Use extended control field format in lieu of basic control field format. Use SXRME in lieu of SXRM

2.4 Consistency of classes of procedures

Figure 2 gives a summary of the basic command/response repertoire of the classes of procedures, and the commands/responses of the optional functions. The primary station command repertoire is listed on the left side of each class and the secondary station response repertoire is listed on the right side.

This figure shows the consistency in the classes of procedures obtained through the use of the concepts of modes of operation, basic command/response repertoire, and hierarchical structuring. This repertoire consistency facilitates the inclusion of multiple versions of the classes of procedures in a station that is configurable.

2.5 Conformance to the unbalanced classes of procedures

A station conforms to a given class of procedures (with optional functions) if it implements the basic repertoire of that class of procedures plus those specified in the selected optional functions, i.e.

— a primary station has the ability to receive all responses in the class of procedures basic repertoire plus those specified in the selected optional functions,

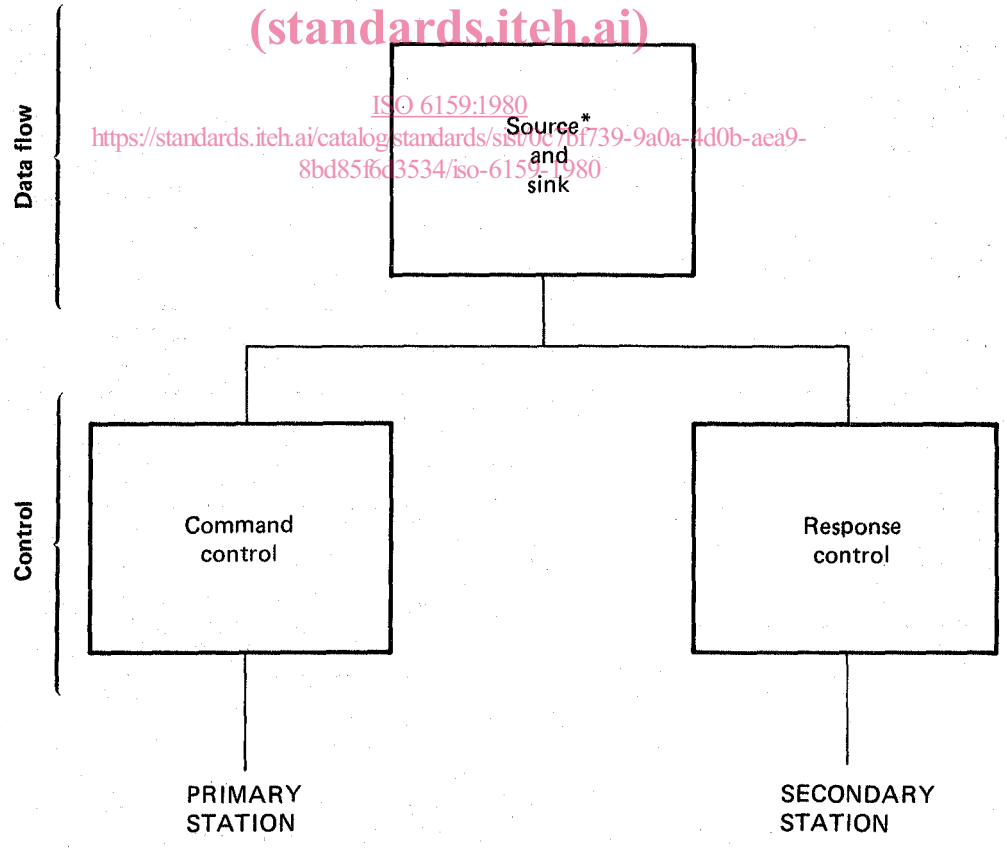
— a secondary station has the ability to receive all commands in the class of procedures basic repertoire plus those specified in the selected optional functions.

2.6 Method of indicating classes and optional functions

The classes of procedures and the optional functions are indicated by specifying the mnemonic designation of the class and the number(s) of the accompanying optional functions (see 2.2 and 2.3).

Example 1 : Class UNC 1, 2, 6, 9 is the unbalanced operation, normal response mode class of procedures with the optional functions for identification (XID), request disconnect (RD) improved performance, (REJ), unnumbered polling (UP), and one-way data flow from the secondary station(s) to the primary station.

Example 2 : Class UAC, 1, 5, 10 is the unbalanced operation, asynchronous response mode class of procedures with the optional functions for identification (XID), request disconnect (RD), initialization (SIM, RIM) and extended sequence numbering (modulo 128).



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

Figure 1 — HDLC unbalanced stations — Building blocks

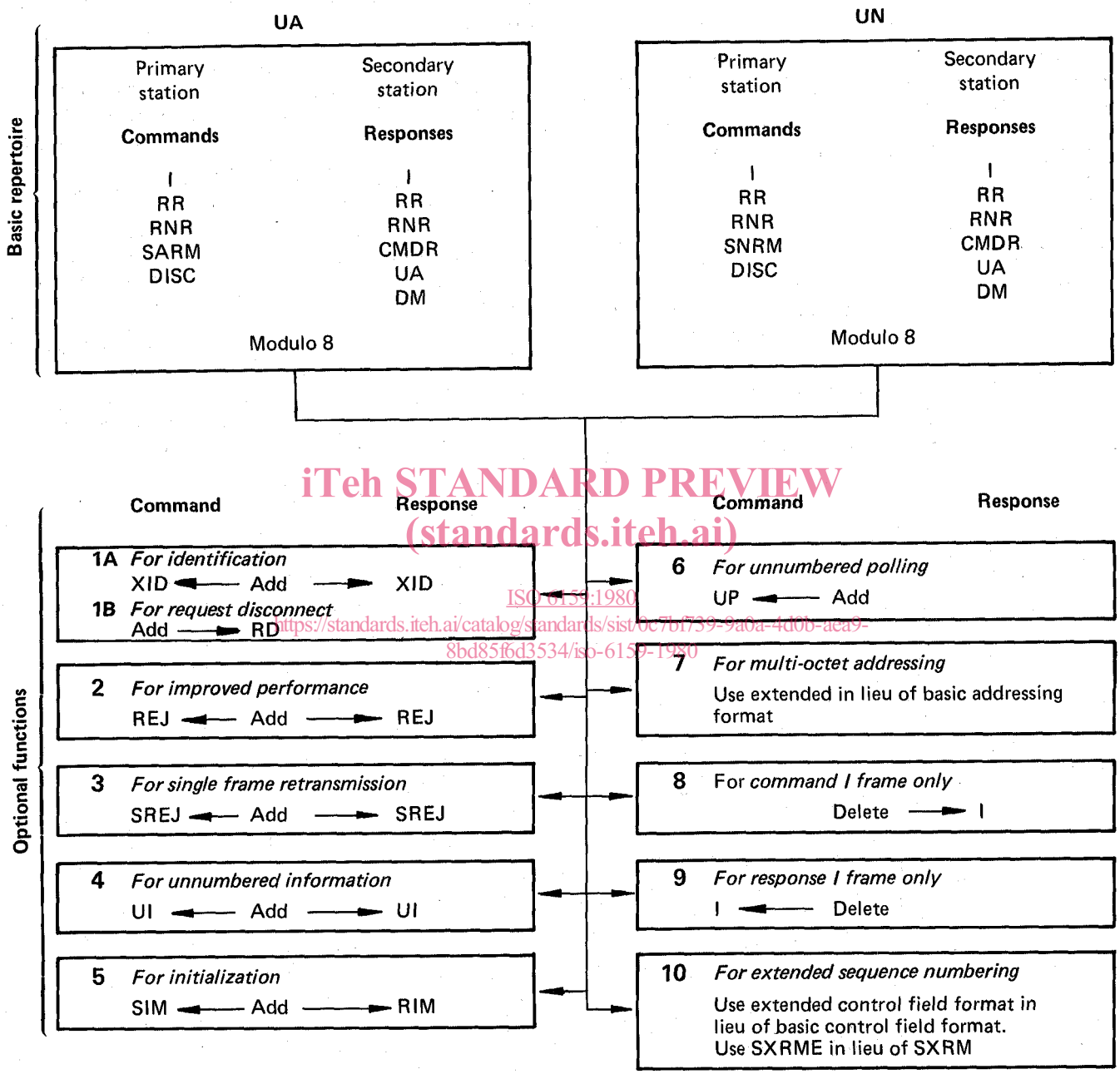


Figure 2 — HDLC unbalanced classes of procedures

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

3.1 General

This clause specifies synchronous data transmission for point-to-point or multipoint links with two-way alternate or two-way simultaneous transfer using the frame structure defined in ISO 3309 and the elements of procedures described in ISO 4335 and its addendum ISO 4335/DAD 1.

It uses the basic command/response repertoire (see figure 2) designated as UAC or UNC. Although this clause describes only the basic commands and responses, there are several optional functions available for enhanced operation. They are listed in 2.3.

3.2 Link description

3.2.1 Configuration

The configuration consists of one primary station and one or more secondary stations on a link as shown in figure 3.

3.2.2 Physical communication facilities

The links may use half-duplex or full-duplex, switched or non-switched circuits. The procedures described assume the switched circuit as being established.

3.3 Description of the procedures

The control procedures operate in either normal or asynchronous response mode. Only one secondary station at a time can be put in asynchronous response mode.

The primary station is responsible for overall data link error recovery.

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

3.3.1 Station characteristics

The primary is responsible for setting up the link and disconnecting the link, sending information frames, supervisory and unnumbered commands and checking received frames.

The secondary is responsible for checking received frames and sending information, supervisory and unnumbered responses.

3.4 Detailed information of the procedures

Sub-clauses 3.4.1 to 3.4.2.5 define the procedures for a permanently connected link or an established switched connection.

The protocol for establishing and disconnecting a switched circuit is not within the scope of this International Standard. However, the exchange of identities and/or characteristics after the switched connection is established may optionally be part of the procedures.

3.4.1 Setting up/disconnecting the link

3.4.1.1 Setting up the link

The primary shall transmit SNRM or SARM.

The addressed secondary, upon receiving SNRM or SARM correctly, shall send UA at its first opportunity and set its send and receive state variables to zero.

If the UA response is correctly received, then the data link is set up to the addressed secondary and the primary shall set its send and receive state variables to zero relative to that secondary.

If the UA response is not received correctly, the primary may re-send SNRM or SARM after an appropriate interval.

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

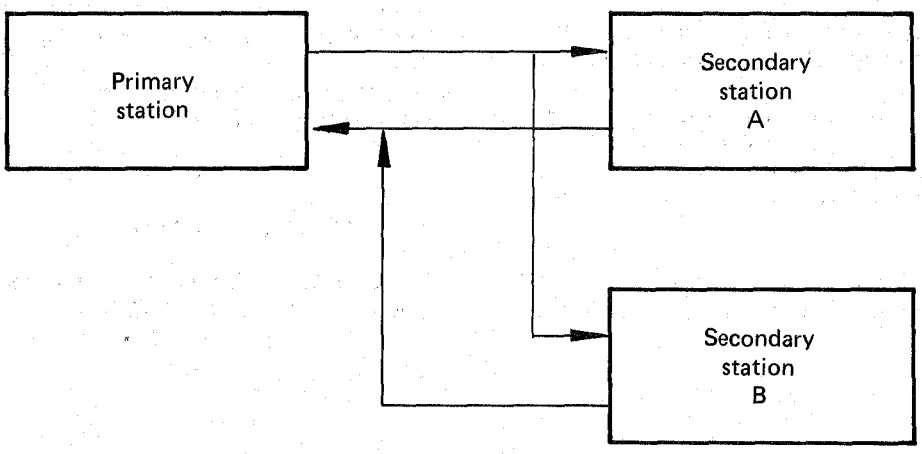


Figure 3 — Link configuration

3.4.1.2 Disconnecting the link

The primary shall send DISC.

The addressed secondary upon receiving DISC correctly, shall send UA at its first opportunity and enter either the normal disconnected mode (NDM) or asynchronous disconnected mode (ADM) as outlined on ISO 4335/DAD 1.

If the UA response is correctly received, the primary shall enter the disconnected mode with respect to that secondary.

If the UA response is not received correctly, the primary may re-send DISC after an appropriate interval (see 3.4.2.5).

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

3.4.2 Exchange of information

The transmission of information is described in 3.4.2.1 to 3.4.2.5.

In the following sub-clauses, a "number one higher" is in reference to a continuously repeated sequence series, for example 7 is one higher than 6 and 0 is one higher than 7 for modulo eight series.

3.4.2.1 Sending I frames

The maximum length of I frames is a system defined parameter.

The control field will be as defined in ISO 4335 for an I frame, with N(S) set to the correct send sequence number, and with N(R) set to the number of the next I frame expected. In the case of the first I frame transmitted on the link following link set-up, both N(S) and N(R) shall be set to zero.

If the station is ready to send and I frame numbered N(S), where N(S) is equal to the last received acknowledgement plus the modulo – 1, then it shall not send the frame but shall follow the procedures in 3.4.2.5.

3.4.2.2 Receiving I frames

After a station correctly receives an I frame, it shall, at its next opportunity to send, take one of the following actions :

a) If information is available for transmission and the station is ready to receive it shall act as in 3.4.2.1 and acknowledge the received I frame(s) by setting N(R) in the control field of the next transmitted I frame to the N(S) of the next expected I frame.

b) If information is not available for transmission but the station is ready to receive I frames, the station shall send an RR frame and acknowledge the received I frame(s) by setting N(R) to the N(S) of the next expected I frame.

c) If the station is not ready to receive I frames the station may send an RNR frame and acknowledge the received I frame(s) by setting the N(R) to the N(S) of the next expected I frame.

d) If the station is unable to accept the correctly received I frame(s) it may send an RNR frame without incrementing the N(R).

3.4.2.3 Reception of incorrect frames

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

If an I frame is received with correct FCS but with incorrect N(S), then the receiving station will discard the N(S) field and information field in that frame. This shall continue until the expected I frame(s) is correctly received. It shall however use the P/F and N(R) indications in the discarded I frames. The station shall then acknowledge the expected and correctly received I frame as described in 3.4.2.2.

The P/F recovery (checkpointing) shall cause retransmission of the incorrectly received I frame(s).

3.4.2.4 Station receiving acknowledgement

A station receiving an I, RR or RNR frame with N(R) = x shall treat as acknowledged all previously transmitted I frames, N(S) = x – 1 and earlier frames.

3.4.2.5 Time-out considerations

In order to detect a no-reply or lost-reply condition, each primary station shall provide a response time-out function. Also in ARM, each secondary station shall provide a command time-out function. In any case, the expiration of a time shall be used to initiate appropriate error recovery procedures.

The duration of time-out functions shall be system dependent and subject to bilateral agreement. To resolve possible contention situations, the secondary station's timer interval shall be longer than that of the primary station.

In NRM, if the station is a secondary, it shall wait for the primary station to initiate error recovery.

3.5 Examples of operation

This class of HDLC procedure operates as illustrated in the examples in annex C of ISO 4335.