International Standard 6256

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Data communication — HDLC balanced class of procedures

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Foreword

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Australia	Italy	South Africa, Rep. of
Belgium	Japan	Spain
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Germany, F.R.	New Zealand	United Kingdom
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Iran	Romania	USSR

No member body expressed disapproval of the document.

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Data communication — HDLC balanced class of procedures

0 Introduction

This International Standard describes the HDLC balanced class of procedures. It applies to a variety of point-to-point configurations over either dedicated or switched data transmission facilities. The characteristic of this class is the existence of stations at both ends of the data link, called combined stations, that may equally share the responsibility in link management. Hence, the name of "balanced" class of procedures.

In its present form, this International Standard, which was developed in consultation with CCITT (International Telegraph and Telephone Consultative Committee), specifies procedures for the basic repertoire of commands and responses. Procedures for use of the optional functions are being considered for future enhancement of this International Standard.

The aim of the developers of this International Standard is that maximum commonality be maintained between the basic classes of procedures, unbalanced and balanced, as this is particularly desirable for stations with configurable capability which may provide characteristics of a primary, secondary, or combined stations as required for a specific connection.

1 Scope and field of application

Balanced operation is intended for use in circumstances which require equal control at either end of the link. This International Standard describes HDLC balanced class of procedures for synchronous data transmission. It covers balanced operation requirements and is consistent with an overall HDLC architecture. It uses the frame structure as defined in ISO 3309 and elements of procedure described in ISO 4335, plus addenda 1 and 2[1] of ISO 4335.

For the balanced operation, the link consists of two combined stations and operates in the asynchronous balanced 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 References

ISO 3309, *Data communication — High level data link control procedures — Frame structure.*

ISO 4335, *Data communication — High level data link control procedures — Elements of procedures.*

3 General description

3.1 Principles

3.1.1 Station type

One station type is defined for the balanced class of procedures (see figure 1) :

— combined station, which sends both commands and responses and also receives both commands and responses, and is responsible for link level error recovery.

3.1.2 Operational mode

The balanced procedures are described for two combined stations connected in a point-to-point configuration operating in asynchronous balanced mode (ABM) (see clause 4).

1) Addendum 2 is at present at the stage of draft.

3.1.3 Addressing scheme

Commands shall be sent with the remote station address and responses shall be sent with the local station address.

3.1.4 Send and receive state variables

For each combined-to-combined link a single set of send and receive state variables is required in each station. Both state variables of a station shall be reset to zero upon receipt and acceptance of a mode setting command.

3.2 Balanced class of procedures

The balanced class of procedures is composed of :

— one station type : combined station;

— one type of response mode : asynchronous.

The balanced class is designated as :

BAC Balanced operation. Asynchronous balanced mode. Class.

The basic repertoire of commands and responses is :

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

3.3 Optional functions

There are eleven optional functions used to modify the balanced class of procedures. These optional functions are achieved mainly by the addition or deletion of commands and responses to the basic repertoire (see figure 2).

Option number	Functional description	Required change
1 A	Provides the ability to :	
	— exchange identification and/or characteristics of stations	Add command : XID Add response : XID
1 B	— request logical disconnection	Add response : RD
2	Provides the ability for more timely 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 numbers	Add command : UI Add response : UI
5	Provides the ability to initialize the remote station and ability to request initialization	Add command : SIM Add response : RIM
6	Provides the ability to perform unnumbered group polling as well as individual polling	Add command : UP
7	Provides addressing for greater than single octet addressing	Use extended addressing format in lieu of basic addressing format
8	Limits the procedure to allow I frame to be commands only	Delete response : I
9	Limits the procedure to allow I frame to be responses only	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 SABME in lieu of SABM
11	Provides the ability to reset the state variables associated with only one direction of information flow	Add command : RSET

3.4 Conformance to the balanced class of procedures

A combined station conforms to the balanced class of procedures (with optional functions) if it implements all commands and responses in the class of procedures basic repertoire plus those specified in the selected optional functions.

3.5 Method of indicating optional function within the balanced class of procedures

Optional functions are indicated by specifying the number(s) of the accompanying option(s) (see 3.3).

Examples

a) Class BAC, 2, 3 is the balanced operation, asynchronous balanced mode, class of procedures with the optional functions for improved performance (REJ) and single frame retransmission (SREJ).

b) Class BAC, 1, 8 is the balanced operation, asynchronous balanced mode class of procedures with the optional functions for identification (XID) request disconnect (RD) and the ability to send I frames as commands only.

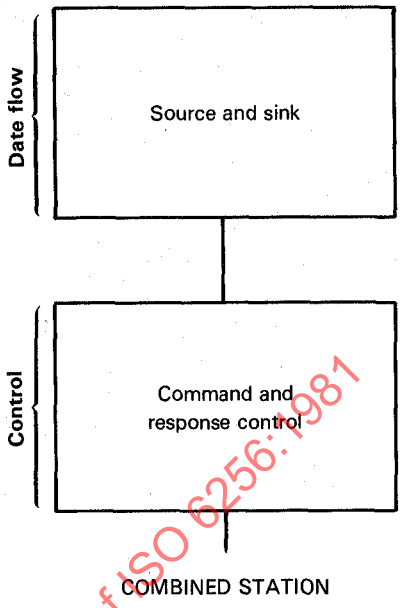


Figure 1 — HDLC combined station — Building blocks

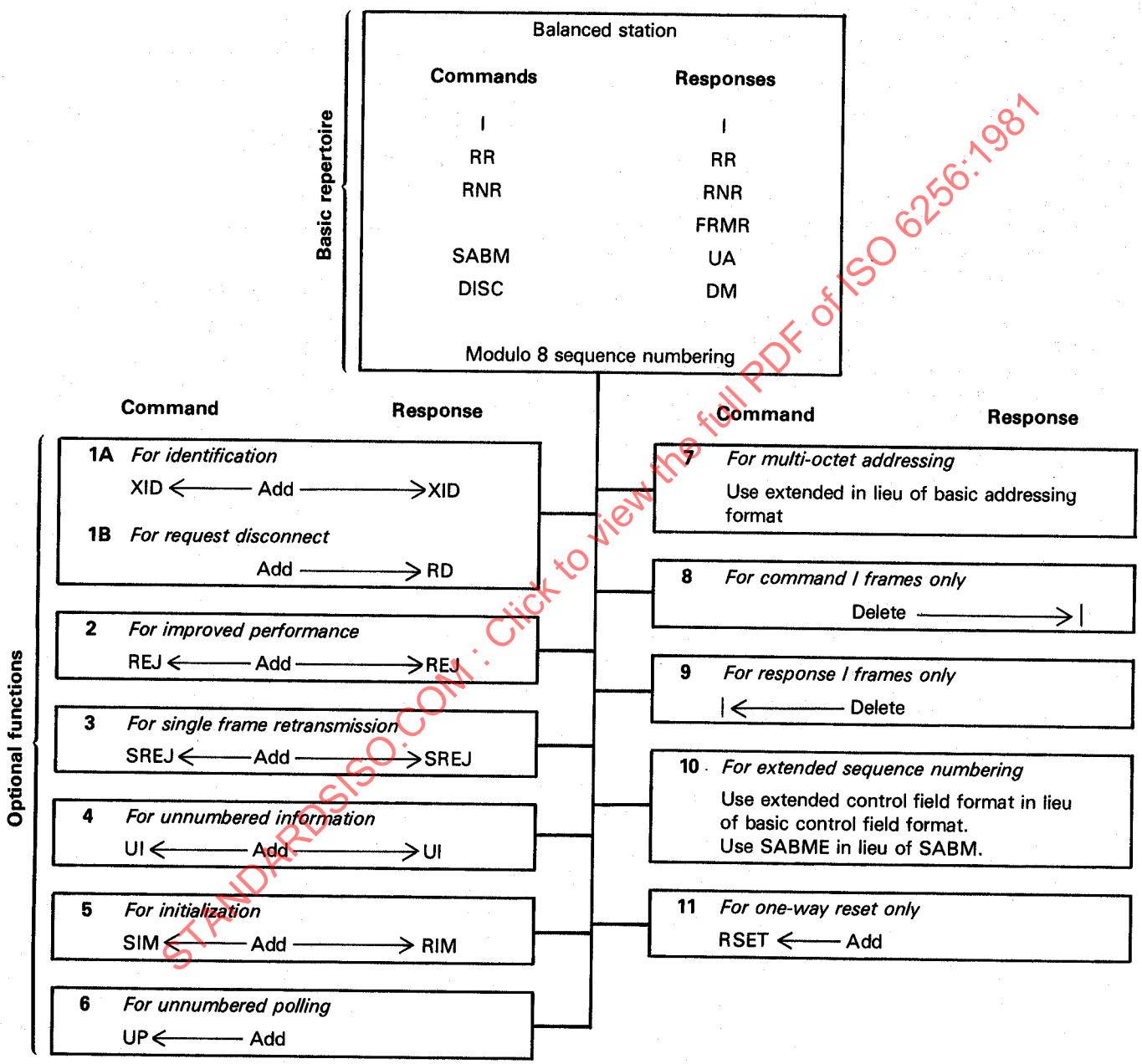


Figure 2 — HDLC balanced class of procedures

4 Balanced operation (point-to-point)

4.1 General

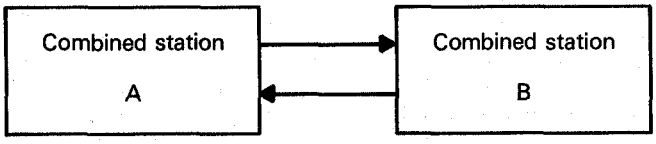
This clause specifies synchronous data transmission over point-to-point links with two-way alternate or two-way simultaneous transfer using the frame structure defined in ISO 3309 and elements of procedure described in ISO 4335, plus addenda 1 and 2 of ISO 4335.

As designated in 3.2 and depicted in figure 2, balanced operation uses a basic command/response repertoire designated as BAC. Although this clause describes only the basic commands and responses, there are several optional functions available for enhanced operation. They are listed in 3.3 and shown in figure 2.

4.2 Link description

4.2.1 Configuration

The configuration consists of two combined stations on a link.



4.2.2 Physical communication facilities

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

4.3 Description of the procedures

Balanced procedures are used when the stations at both ends of the link are combined stations. It uses the asynchronous balanced mode. Each station is equally responsible for link level error recovery.

4.3.1 Station characteristics

Each station is a combined station, i.e. it can set up the link, disconnect the link, and can both send and receive commands and responses.

4.4 Detailed definition of the procedures

Sub-clauses 4.4.1 to 4.4.4 define the procedures for a point-to-point system using 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, is an optional function.

4.4.1 Setting up/disconnecting the link

4.4.1.1 Setting up the link

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

If an SABM command, UA response or a DM response is not received correctly, it shall be ignored. The result will be that the response time-out function will expire in the station which originally sent the SABM and that station may re-send SABM and restart its response time-out function.

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

4.4.1.2 Disconnecting the link

Either combined station may take the initiative to disconnect the link. It shall send DISC and start its response time-out function.

A station, in an operational mode, on correctly receiving a DISC command, shall send a UA response and enter the asynchronous disconnected mode (ADM). The station, on correctly receiving a UA response to a sent DISC command, shall stop its timer.

If a DISC command or a UA response is not received correctly, it shall be ignored. This will result in the expiration of the timer in the station which originally sent the DISC command unless a separate mode-setting command is received. This station may re-send the DISC command and restart its timer.

This action may continue until a UA response or a DM response is correctly received, a DISC is correctly received, or until recovery action takes place at a higher level.

4.4.1.3 Simultaneous attempts to set mode (contention)

When a station issues a mode-setting command and, before receiving an appropriate response, receives a mode-setting command from the remote station, a contention situation has developed. Contention situations shall be resolved in the following manner.

When the send and receive mode setting commands are the same, each station shall send a UA response at the earliest respond opportunity. Each station shall either enter the indicated mode immediately or defer entering the indicated mode until receiving a UA response. In the latter case, if the UA response is not received, the mode may be entered when the response timer expires, or the mode-setting command may be reissued.

When the mode-setting commands are different, each station shall enter ADM and issue a DM response at the earliest respond opportunity. In the case of DISC contention with a different mode-setting command no further action is required. In the case of contention between SABM and SABME commands the station sending SABME shall have priority over the station sending SABM.

4.4.1.4 Procedure in a disconnected mode

A combined station in ADM shall monitor received commands, shall react to SABM as outlined in 4.4.1.1, and shall respond DM to a received DISC. Other commands received with the P-bit set to "1" shall be responded to with a disconnected mode (DM) response. Other commands received with the P-bit set to "0" shall be ignored. The DM response is used to report the combined station status asynchronously in ADM.

4.4.2 Exchange of information

The transmission of information is as described in 4.4.2.1 to 4.4.2.4.

In the following sections 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 8 series.

4.4.2.1 Sending I frames

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

The decision to send an I frame as a command or as a response, i.e. to use the remote or the local address to indicate a P- or an F-bit respectively, depends on the need to acknowledge a received P-bit set to "1" by transmitting a response with the F-bit set to "1".

4.4.2.2 Receiving I frames

After a station correctly receives an I frame (i.e. N(S) equals the value of the receive state variable) it shall, at its next opportunity to send, take one of the following actions :

a) If information is available for transmission and both stations are ready to receive, it shall act as 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 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 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 further I frames, the station may send an RNR 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 without incrementing N(R).

NOTE — In the above, the I or supervisory frame will be either a command or a response depending on whether a P- or an F-bit transmission, respectively, is required. If the P- or F-bit transmission is not required, the acknowledgement frames may be either commands or responses irrespectively.

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), then the receiving station shall discard the N(S) field and information field of 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 I frame(s), when received, as described in 4.4.2.2.

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

4.4.2.4 Station receiving acknowledgements

A station receiving an I, RR or RNR, with a valid N(R) shall treat as acknowledged all previously transmitted I frames up to and including the frame transmitted with N(S) equal to the received N(R) minus one.

4.4.3 P/F bit usage

Distinction between P-bit and F-bit shall be made by the addressing rules. With the exception of checkpoint retransmission, and the clearing of a busy condition, usage of the P/F bit is identical with that for ARM in ISO 4335.

Checkpoint retransmissions shall not be initiated based on an I, RR or RNR frame received with the P-bit set to "1". Rather, a combined station shall examine the N(R) contained in any received, I, RR, or RNR frame with the F-bit set to "1" and shall initiate appropriate error recovery procedures if this N(R) does not acknowledge all I frames transmitted by the combined station prior to and including the last command frame sent with the P-bit set to "1".

Receipt of an I frame with the P-bit set to "1" shall not be interpreted as an indication that a busy condition at the sending station has been cleared.

4.4.4 Time-out considerations

In order to detect a no-reply condition, each combined station shall provide a response time-out function. The expiration of the time shall be used to initiate appropriate error recovery procedures.

The duration for time-out functions shall be system dependent and subject to bilateral agreement. The interval of the timer in the two stations shall be unequal in order to resolve contention situations, especially in two-way alternate operation.

The timer shall be started whenever the station has transmitted a frame for which a reply is required. When the expected reply is received the timer shall be stopped.

If, during the interval the timer is running, other frames are sent for which acknowledgements are required, the timer may have to be restarted.

If the timer expires, a command with the P-bit set to "1" may be (re)transmitted and the timer restarted.

4.5 Examples of operation

The HDLC balanced class of procedures operates as illustrated in the examples in annex B of addendum 2 of ISO 4335.