# ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

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# STANDARD ECMA-61

# HDLC
# BALANCED CLASS OF PROCEDURE

August 1979

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## BRIEF HISTORY

In September 1971 ECMA TC 9 received a proposal for a bit oriented Data Link Control Protocol which used a dual numbering technique for control and error detection purposes. Further studies led to the conclusion that such a "double numbering" system would offer a wide range of applicability. It was further concluded that the standardization effort could best be achieved by dividing the work into separate phases.

The first phase which defined the transmission envelope was completed in 1973 and on December 13, 1973, the General Assembly of ECMA adopted the High Level Data Link Control (HDLC) Frame Structure Standard: Standard ECMA-40.
The more detailed second phase, which defined the commands, the responses and the error recovery principles led to the adoption of an Elements of Procedure Standard in September 1976: Standard ECMA-49.

In the course of this work it was decided to introduce a third phase of HDLC standardization. A set of guidelines or "Codes of Practice" was prepared in order to map Standards ECMA-40 and ECMA-49 into practical systems. The term "Classes of Procedure" was agreed for the description of the resulting Standards.

Whilst the Classes of Procedure Standards were in preparation it was thought necessary to revise Standard ECMA-49 with the addition of a number of commands, responses and modes.

In October 1978 ECMA TC 9 formally agreed to submit to the General Assembly this draft Standard on a Balanced Class of Procedure, together with the second edition of Standard ECMA-49, Elements of Procedure and a draft Standard on an Unbalanced Class of Procedure.

This Standard ECMA-61 has been adopted by the General Assembly of ECMA on June 21, 1979.

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## 1. SCOPE

This Standard ECMA-61 describes the HDLC Balanced Class of Procedure for data transmission, using the Frame Structure described in Standard ECMA-40 and the Elements of Procedure defined in Standard ECMA-49.
This class is specially intended for operation on point-to-point links over either permanent or switched data transmission circuits.
The characteristic of this class is that both stations have equal responsibilities and rights for link management. Hence the name Balanced Class of Procedure.
Stations capable of operating in this way are called Combined because they combine the properties of Primary and Secondary functions. In balanced operation the link consists of Combined operating in asynchronous balanced mode (ABM).
A basic set of functions is defined, which can be modified by means of optional functions.
It is the intention that this Standard should be compatible with the ISO Balanced Class of Procedure. The ISO Standard was developed in conjunction with CCITT and the conformity with CCITT X.25 LAP B is identified in this Standard.

## 2. REFERENCES

ECMA-40 HDLC - Frame Structure
ECMA-49 HDLC - Elements of Procedure
CCITT Recommendation X.25 Level 2

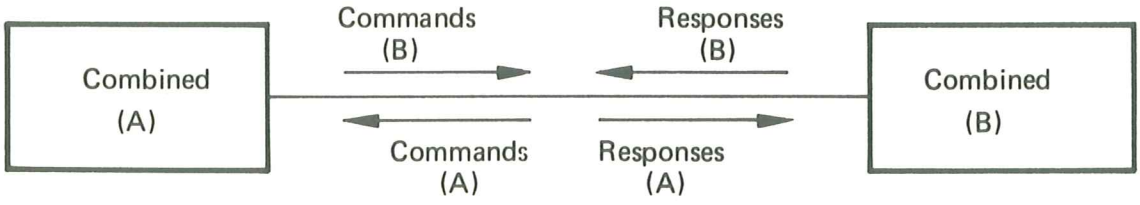
## 3. DEFINITIONS

The definitions given in Standard ECMA-49 apply.

## 4. SYSTEM DESCRIPTION

### 4.1 Configuration

The configuration shall consist of two Combined connected by a data transmission circuit.




This circuit may be switched or non-switched, and the data transfer can be two-way alternate or two-way simultaneous. It is assumed in this Standard that the data transmission circuit has been established.

### 4.2 Basic Functions

This Class of Procedure defines the dialogue between the two Combined as follows:

4.2.1 Operational mode

This operational mode of data transfer is the asynchronous balanced mode (ABM).
This mode shall be set when SABM is acknowledged by UA.

4.2.2 Disconnected mode

The disconnected mode is a mode in which a Combined is logically disconnected from the data link and in which no I frames are allowed. This procedure utilizes the asynchronous disconnected mode (ADM).

This mode shall be set when DISC is acknowledged by UA.

4.2.3 Addressing scheme

Commands are sent with their destination station address and responses are sent with the address of the responding station.

*NOTE 1: The restriction imposed by X.25 LAP B is for further study.*

4.2.4 Basic repertoire of commands and responses

The basic repertoire of commands and responses is :

| COMMANDS | RESPONSES |
|---|---|
| I | I |
| RR | RR |
| RNR | RNR |
| SABM | UA |
| DISC | DM |
| | FRMR |

4.3 Optional Functions

There are ten optional functions to this Class of procedure. These optional functions are achieved by the addition or deletion of commands and responses to the basic repertoire, as described in the table in the following page.

| OPTION NUMBER | OPTIONAL FUNCTION | COMMAND | RESPONSES | OTHER CHANGES |
|---|---|---|---|---|
| 1 | Provides the ability to:<br>– exchange identification and/or characteristics of stations<br>– request disconnection | Add XID | Add XID<br>Add RD | |
| 2 | Provides the ability for more timely reporting of I frame sequence errors | Add REJ | Add REJ | |
| 3 | Provides the ability for more efficient recovery from I frame sequence errors by requesting re-transmission of a single frame | Add SREJ | Add SREJ | |
| 4 | Provides the ability to exchange information fields without impacting the I frame sequence counts | Add UI | Add UI | |
| 5 | Provides the ability to initialize the remote station and the ability to request initialization | Add SIM | Add RIM | |
| 7 | Provides for greater than single octet addressing | | | uses extended addressing format (see ECMA-40) |
| 8 | Limits the procedure to allow I frame to be commands only | | Delete I | |
| 9 | Limits the procedure to allow I frames to be responses only | Delete I | | |
| 10 | Provides the ability to use extended sequence counts (modulo 128) | Add SABME<br>Delete SABM | | uses extended control field (see ECMA-49) |
| 13 | Provides test facilities | Add TEST | Add TEST | |

*NOTE 2 : Options number 6, 11 and 12 are not used in this Standard. Their number has not been reassigned to avoid confusion with the corresponding ISO Standard.*

### 4.4 Conformance

A Combined conforms with this Standard if it has the ability to transmit and receive all commands and responses in the basic repertoire as modified by the optional functions selected for the configuration.

### 4.5 Method of Designating the Selected Procedure

The procedure shall be identified by specifying the mnemonic designation BA (asynchronous balanced mode), followed by the number(s) of the selected optional functions, as specified in 4.3.
The specific set of options used is system-dependent and subject to bilateral agreement.

*Example : BA, 1, 2, 8 is the Balanced procedure operating in the asynchronous balanced mode with the optional functions for identification and request disconnection (XID, RD) more timely reporting of I frame sequence errors (REJ), and I frames as commands only.*
*In this notation the procedure compatible with X.25 LAP B is described as BA, 2,8.*

### 4.6 System Recovery Parameters

The specific values given to these parameters are system-dependent and subject to bilateral agreement.

In order to detect abnormal system operation each station shall provide time-out and counting functions. Timer expiration is used to initiate appropriate recovery procedures. Counting is used to limit the number of retransmissions before reporting to a higher level.

- t1 : maximum time which the Primary function should wait for a response to a transmitted command with the P bit set to ONE.
- t2 : maximum time which a station should wait for an acknowledgement of transmitted I frames while no P bit is outstanding.

If either t1 or t2 is exceeded, retransmission is initiated.

- N : maximum number of retransmission. If N is exceeded, further recovery shall be initiated.

The use of additional time-outs is not precluded.

## 5. OPERATION

### 5.1 General

The system shall use a control procedure with a Combined (see 4.1) at either end of the link, both in ABM.

Each Combined shall use the same set of commands and responses derived from the basic repertoire modified by the selected optional functions.

Each station of a balanced system shall be responsible for error recovery, for the transmission of Information (I), Supervisory (S) and Unnumbered (U) frames, and for checking received frames.

5.2 Data Link Set Up

Either Combined station may initialize the data link by transmitting SABM.

The opposite station, upon receiving SABM shall transmit a UA response and reset its V(R) and V(S) state variables to zero.

At the reception of UA the link shall be considered initialized and the state variables V(S) and V(R) of the initializing station reset to zero.

5.3 Data Link Disconnection

Either Combined station may take the initiative to disconnect the data link by transmitting a DISC command.
The Combined, receiving DISC shall send UA and enter the disconnected mode. The transmitting station shall enter the disconnected mode upon receipt of UA.

5.4 Simultaneous Attempts to Set Mode (Contention)

When a station transmits 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 transmitted and received mode setting commands are the same, each station shall send UA at the earliest opportunity. Each station shall either enter the indicated mode immediately or defer entering the indicated mode until receiving UA. In the latter case, when the response timer expires the mode-setting command may be re-issued.
- When the mode-setting commands are different, each station shall issue a DM response and enter ADM.

5.5 Exchange of Information

I frames may be transmitted as commands or responses. However, if a frame with the P bit set to ONE has been received, the Combined shall respond to this P bit. This response shall take the form of an I frame or an S frame, as appropriate, with the F bit set to ONE.

5.6 Use of the P/F Bit

Use of the P/F bit shall be as defined in Standard ECMA-49, with the understanding that P/F check-pointing will be performed by the Combined as a primary function only, that is, action of check-pointing will occur on the receipt of F bits only. In addition, receipt of an I frame with a P bit set to ONE will not be interpreted as an indication that a busy condition at the transmitting station has been cleared.

*NOTE 3: For more details of operation in the Balanced Class of Procedure refer to Standard ECMA-49.*

# ANNEX A

(NOT PART OF THE STANDARD)

## Illustration of Timer Behaviour

### A.1 INTRODUCTION

In this Annex the timer behaviour is illustrated by means of state diagrams.

The following assumptions have been made:

- A station can assume only one timing state at a time.
- Three different timing states are identified:
  - . Timing state 0, which indicates the "inactive" state. No timer is running.

    *NOTE A1: A "no activity" timer, if implemented, can be considered as running during state 0. However, this is not further considered here.*
  - . Timing state 1, which indicates the "wait for F bit" state. In this state there is a P bit outstanding, and timer T1 is running.
  - . Timing state 2, which indicates the "wait for N(R)=V(S)" state. In this state no P bit is outstanding, while I frames are sill waiting for acknowledgement, and timer T2 is running.
- If a station enters or re-enters state 1 or 2, the timer is started or re-started from zero. If a station enters state 0, the timer is reset to zero.
- A state is indicated by a circle. State transitions are indicated by an arrow between two states, with an indication of the condition which causes state transition, and between parentheses the action concerning the time-out functions.
- The numerical value of the time-out duration is dependent on the state, and may be different for states 1 and 2. If a timer expires, appropriate recovery action is taken, which in general leads to entering or re-entering state 1 or 2, and hence to restarting of the timer.
- In the state diagram LN(R) is the value of the last received N(R).
- The time-out value for state 1 is indicated as t1.
- The time-out value for state 2 is indicated as t2.
- The maximum number of retransmissions is N.

## A.2 EXAMPLE OF STATE DIAGRAM

### A.2.1 Asynchronous Balanced Mode-Combined Time-out Functions

| | |
|---|---|
| Implementation | : Combined station |
| Timer T1 | : To check whether an expected frame with the F bit set to ONE is received within a defined time period. |
| Start T1 from zero | : When a command with the P bit set to ONE is sent. |
| Reset T1 to zero | : When a frame with the F bit set to ONE is received. |
| Timer T2 | : To check whether transmitted I frames have been acknowledged within a defined time period (no P bit outstanding). |
| Start T2 from zero | : When an I response is transmitted whilst no P bit is outstanding,<br>or<br>when an I command is transmitted with P bit set to ZERO whilst no P bit is outstanding,<br>or<br>when a response with F bit set to ONE is received but one or more I frames remain outstanding. |
| Restart T2 from zero | : When a command or response is received with incremented N(R), but not acknowledging all outstanding I frames. |
| Reset T2 to zero | : When a command or response is received that acknowledges all outstanding I frames,<br>or<br>when a command with P bit set to ONE is transmitted. |
| Action when T1 or T2 expires | : e.g. (re)transmit command with P bit set to ONE. |

Fig. A1 shows the timing state diagram.

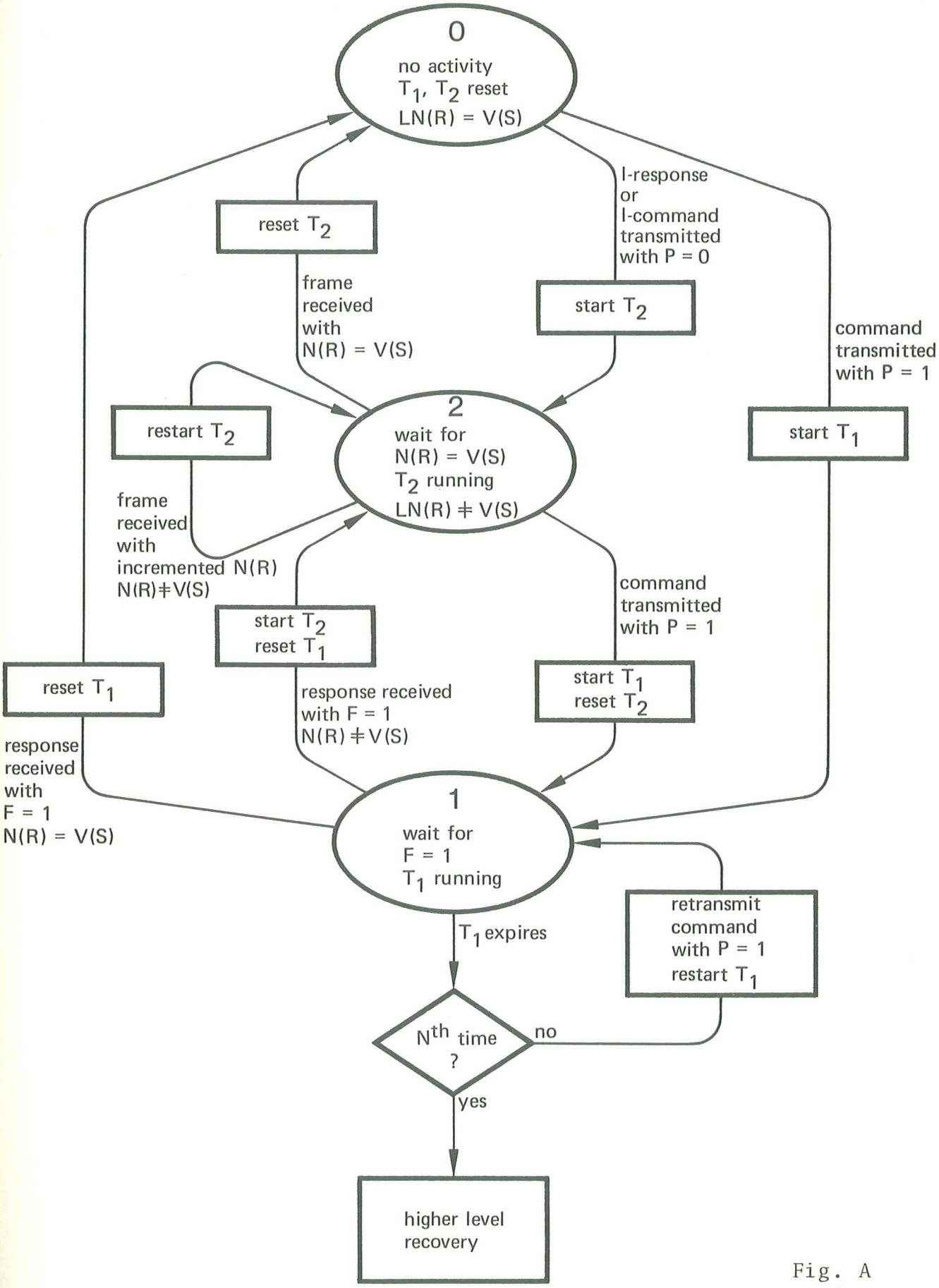

0
no activity
$T_1$, $T_2$ reset
LN(R) = V(S)
I-response
or
I-command
transmitted
with P = 0
reset $T_2$
start $T_2$
command
transmitted
with P = 1
frame
received
with
N(R) = V(S)
restart $T_2$
2
wait for
N(R) = V(S)
$T_2$ running
LN(R) ≠ V(S)
start $T_1$
frame
received
with
incremented N(R)
N(R)≠V(S)
command
transmitted
with P = 1
start $T_2$
reset $T_1$
reset $T_1$
start $T_1$
reset $T_2$
response received
with F = 1
N(R) ≠ V(S)
response
received
with
F = 1
N(R) = V(S)
1
wait for
F = 1
$T_1$ running
retransmit
command
with P = 1
restart $T_1$
$T_1$ expires
$N^{th}$ time
?
no
yes
higher level
recovery

Fig. A