ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-60

HDLC
UNBALANCED 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: 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 an Unbalanced Class of Procedure, together with the second edition of Standard ECMA-49, Elements of Procedure and a draft Standard on a Balanced Class of Procedure.

This Standard ECMA-60 has been adopted by the General Assembly of ECMA on June 21, 1979.

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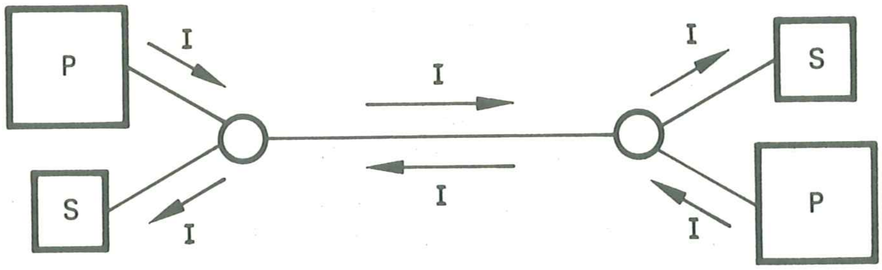
1. SCOPE

This Standard ECMA-60 describes the HDLC Unbalanced 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 applies to point-to-point and multipoint configurations only, over either permanent or switched data transmission circuits. The characteristic of this class is the existence of one privileged station with a Primary function, that bears an overall responsibility in link management. Hence the name Unbalanced Class of Procedure.

It is also recognized that it is possible to construct symmetrical configurations for operation on a single data transmission circuit from the class of procedure defined in this Standard. For example, the combination of two Primary to Secondary links (with I frame flow as commands only) would create a symmetrical point-to-point configuration as illustrated in the diagram below.



In unbalanced operation the link consists of a Primary and one or more Secondaries operating in asynchronous or normal response mode (ARM or NRM).

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 Unbalanced Class of Procedure.

2. REFERENCES

ECMA-40 HDLC - Frame Structure

ECMA-49 HDLC - Elements of Procedure

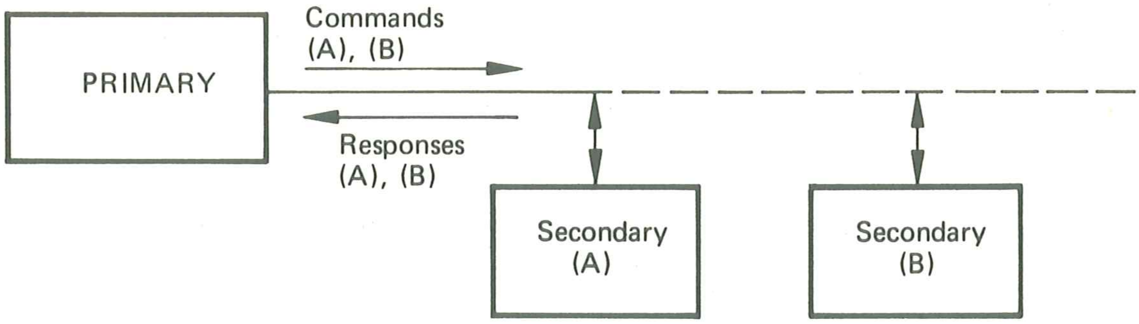
3. DEFINITIONS

The definitions given in Standard ECMA-49 apply.

4. SYSTEM DESCRIPTION

4.1 Configuration

The configuration shall consist of one Primary and one Secondary (point-to-point configuration) or several Secondaries (multi-point configuration) sharing 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. This Standard assumes that the data transmission circuit has been established.

4.2 Basic Functions

The class of procedure defines the dialogue between the Primary and Secondary as follows :

4.2.1 Operational modes

There are two operational modes of data transfer : normal response mode (NRM) and asynchronous response mode (ARM).

The implementation of a least one of the two operational modes is mandatory between each Secondary and the Primary.

These modes shall be set when one of the following commands is acknowledged by UA.

- SNRM for setting the normal response mode
- SARM for setting the asynchronous response mode

4.2.2 Disconnected modes

Disconnected modes are modes in which a station is logically disconnected from the data link and in which no I frames are allowed.

These modes are :

- normal disconnected mode (NDM)
- asynchronous disconnected mode (ADM)

These modes shall be set when DISC is acknowledged by UA. See also Note 2.

4.2.3 Addressing scheme

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

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
SNRM	FRMR
SARM	UA
DISC	DM

It is not mandatory to implement both SNRM and SARM, but at least one shall be implemented.

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 below.

OPTION NUMBER	OPTIONAL FUNCTION	COMMAND	RESPONSES	OTHER CHANGES
1	Provides the ability to: – exchange identification and/or characteristics of stations – request disconnection	Add XID	Add XID Add RD	
2	Provides the ability for more timely reporting of I frame sequence errors in two-ways simultaneous only	Add REJ	Add REJ	
3	Provides the ability for more efficient recovery from I frame sequence errors by requesting retransmission 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 Primary ability to initialize remote stations and Secondary 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 frames to be commands only	Delete RR	Delete I	
9	Limits the procedure to allow I frames to be responses only	Delete I	Delete RR	
10	Provides the ability to use extended sequence counts (modulo 128)	Add SARME or SNRME Delete SARM or SNRM		uses extended control field (see ECMA-49)
13	Provides test facilities	Add TEST	Add TEST	

NOTE 1 : 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 Secondary conforms with this Standard, if it has the ability to:

- transmit all responses
- receive all commands

of the basic repertoire, as modified by the optional functions selected for the configuration.

A Primary may have to deal with Secondaries in one multipoint link having different optional functions. For this a Primary conforms with this Standard if for each Secondary address it has the ability to:

- transmit all commands
- receive all responses

of the basic repertoire, as modified by the optional functions selected for that Secondary address.

4.5 Method of Designating the Selected Procedure

The procedure shall be indicated by specifying the mnemonic designation UNR (Unbalanced Response Mode) or UAR (Unbalanced Asynchronous Response Mode), followed by the number of the selected optional functions, as specified in 4.3.

The specific set of options used is system-dependent and subject to bilateral agreement between the Primary and each Secondary.

Example: Class UNR 1, 2, 8 is the Unbalanced procedure operating in the normal response mode with the optional functions for identification and request disconnection (XID, RD), more timely reporting of I frame sequence errors (REJ) and one-way data flow from the Secondary(ies) to the Primary.

4.6 System Recovery Parameters

The specific values given to these parameters are system-dependent and subject to bilateral agreement between the the Primary and each Secondary.

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 retransmission 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 Secondary in ARM or a Primary in ARM should wait for an acknowledgement of transmitted I frames while no P bit is outstanding.

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

- N : maximum number of retransmissions. 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 one Primary and one or more Secondaries in the link. These can be either in NRM or ARM, but only one Secondary at a time can be in ARM.

NOTE 2: Due to the limitations of NDM and ADM the operational mode for each Secondary will be predetermined.

The Primary shall be responsible for setting up and disconnecting the link for the transmission of Information (I) frames, Supervisory (S) and Unnumbered (U) commands, and for checking received frames.

The Secondary shall be responsible for checking received frames and sending I, S and U responses. In NRM this shall be done under the direction of the Primary. The station will normally operate with the unextended control field. However, in the case of long propagation delays, a two-octet control field may be used.

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

5.2 Data Link Set Up

The Primary shall transmit SNRM or SARM.

The addressed Secondary upon receiving SNRM or SARM shall transmit UA and reset its V(R) and V(S) state variables to zero.

Upon receipt of the UA response the Primary resets to zero the state variables related to that Secondary.

5.3 Data Link Disconnection

The Primary shall transmit DISC.

The addressed Secondary, upon receiving DISC shall transmit UA and enter the disconnect mode.
The originating Primary shall enter the disconnected mode upon receipt of UA.

5.4 Preliminary Idle Channel State Detection Recovery

When a command with the P bit set to ONE is issued and the Primary has detected the active data channel state, then another command with the P bit set to ONE may be transmitted, if the idle data channel state is detected before a response with the F bit set to ONE has been received. The preliminary idle state detection may provide an earlier recovery than is possible by the "wait for F" time-out recovery.

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 still 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 re-starting 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 EXAMPLES OF STATE DIAGRAMS

A.2.1 Normal Response Mode - Primary Time-Out Function

Implementation	: Primary station
Timer T1	: To check whether expected responses have been received within a defined time period.
Start T1 from zero	: When a command with P bit set to ONE is sent.
Restart T1 from zero	: When a response with the F bit set to ZERO is received.
Reset T1 to zero	: When a response with the F bit set to ONE is received.
Action when T1 expires	: e.g.(re)transmit command with the P bit set to ONE.

Fig. A1 shows the timing state diagram.

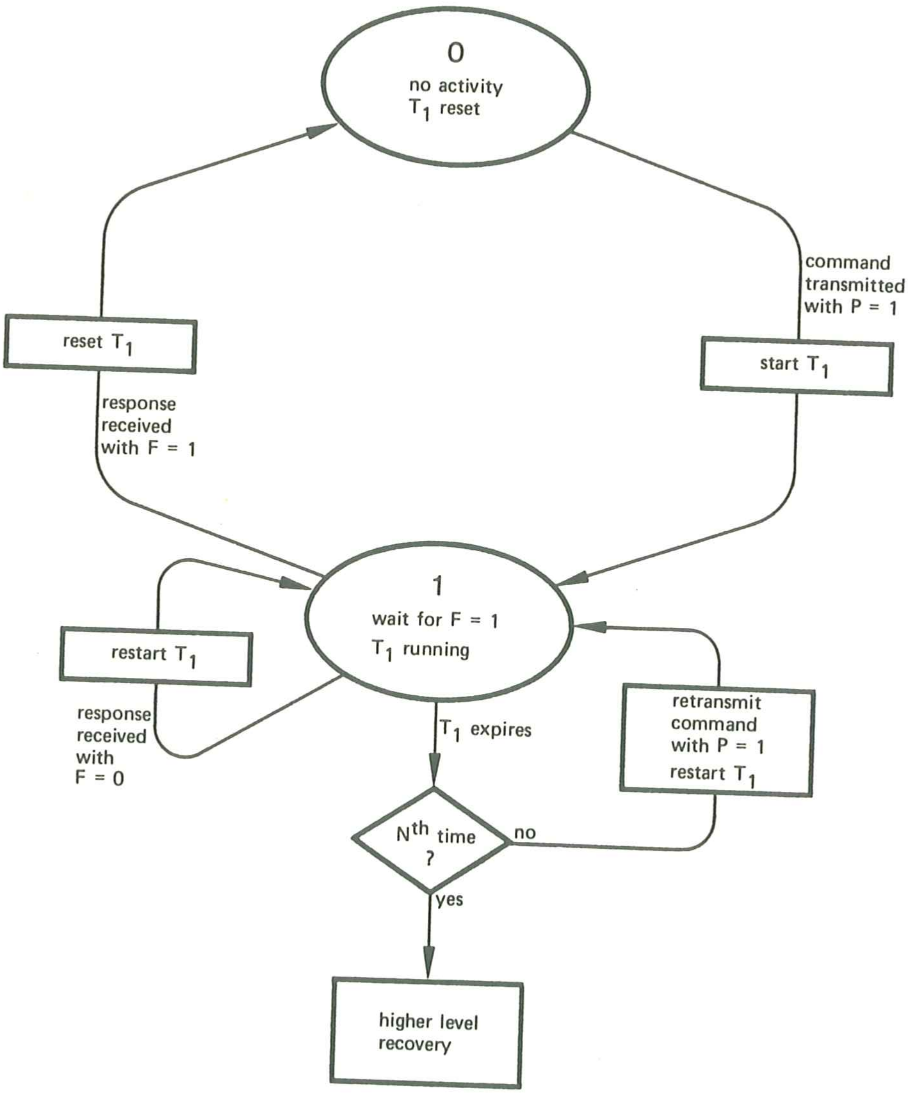


Fig. A1

A.2.2 Asynchronous Response Mode - Secondary Time-Out Functions

Implementation	: Secondary station
Timer T2	: To check whether transmitted I frames have been acknowledged within a defined time period.
Start T2 from zero	: When an I response is transmitted.
Restart T2 from zero	: When a command is received with incremented N(R), but not acknowledging all outstanding I frames.
Reset T2 to zero	: When a command frame is received which acknowledges all I frames transmitted.
Action when T2 expires	: e.g. retransmit the last I frame.

Fig. A2 shows the timing state diagram.

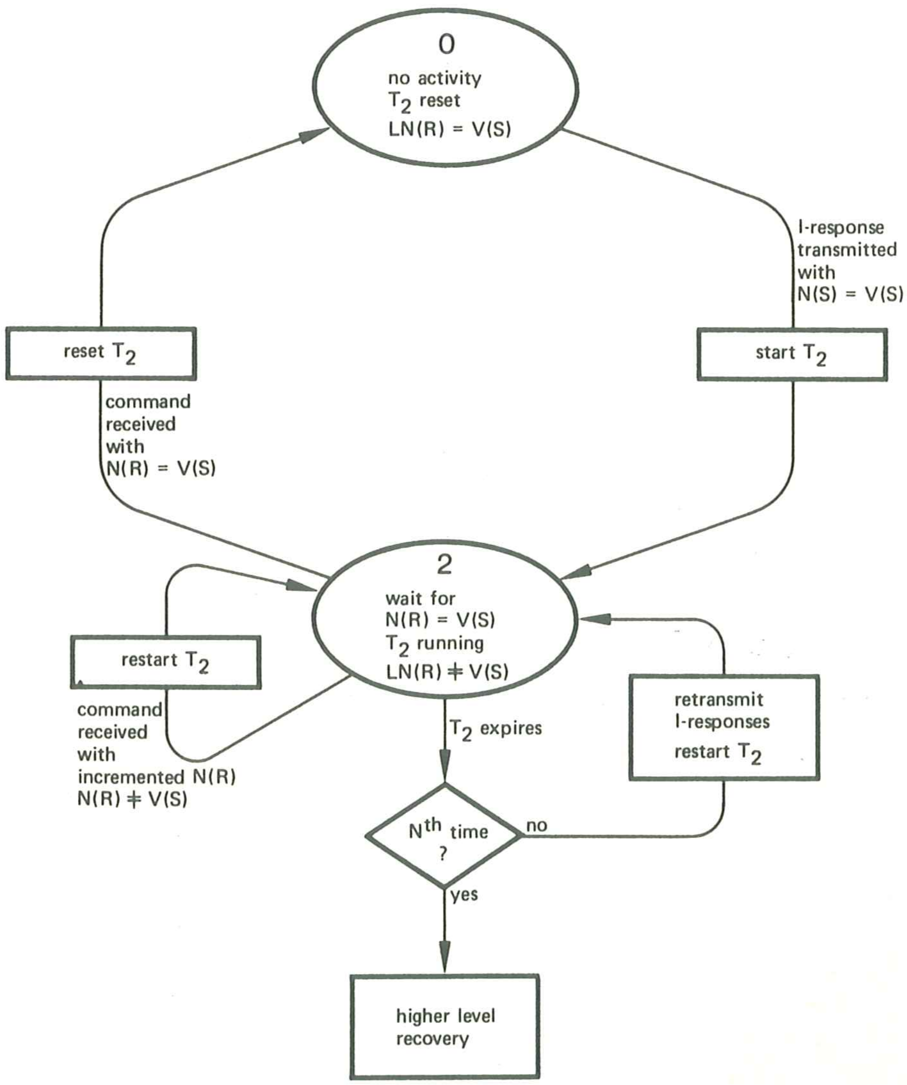


Fig. A2

A.2.3 Asynchronous Response Mode - Primary Time-Out Functions

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

Fig. A3 shows the timing state diagram.

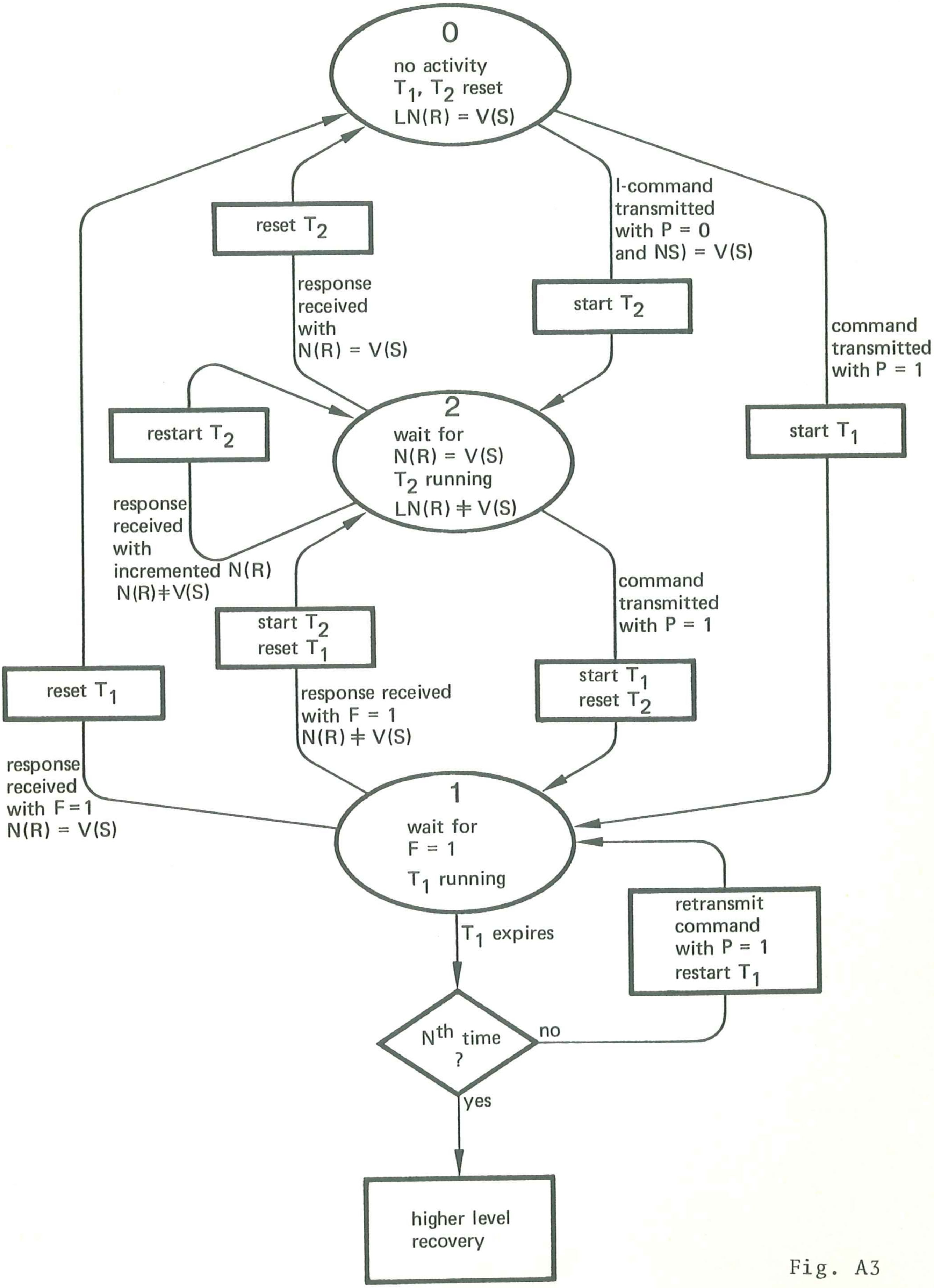

0
no activity
T1, T2 reset
LN(R) = V(S)
reset T2
I-command transmitted with P = 0 and NS) = V(S)
start T2
response received with N(R) = V(S)
command transmitted with P = 1
start T1
2
wait for N(R) = V(S)
T2 running
LN(R) ≠ V(S)
restart T2
response received with incremented N(R) N(R)≠V(S)
command transmitted with P = 1
start T2 reset T1
reset T1
start T1 reset T2
response received with F = 1 N(R) ≠ V(S)
response received with F=1 N(R) = V(S)
1
wait for F = 1
T1 running
T1 expires
retransmit command with P = 1 restart T1
Nth time ?
no
yes
higher level recovery

Fig. A3