ECMA
EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-123

IN-BAND PARAMETER EXCHANGE IN PRIVATE PRE-ISDN NETWORKS USING STANDARD ECMA-102

Second Edition June 1990

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BRIEF HISTORY

This Standard ECMA-123 is one of a series of ECMA standards for the connection of data processing equipment to private circuit switching networks.

It uses Standard ECMA-102 "Rate Adaptation for the Support of Synchronous and Asynchronous Equipment using the V.-Series Type Interface on a PCSN". Standard ECMA-102 assumes that the transfer of end-to-end information relating to terminal transmission characteristics would be carried by out-of-band signalling. However, it has become evident to ECMA Member Companies that in many countries neither public nor private networks will have such capability widely available for several years.

This Standard ECMA-123 specifies an alternative mechanism providing for end-to-end in-band parameter exchange and limited negotiation between terminal adaptors. It is based on the practical experience of ECMA Member Companies and represents a pragmatic and widely based consensus.

A secondary but major goal of this Standard is to achieve maximum compatibility with the standards activity of CCITT Study Group XVII.

This Second Edition of Standard ECMA-123 clarifies and provides explanatory text for a number of details which will ease implementation of the Standard (Appendix B refers).

Adopted as 2nd Edition of Standard ECMA-123 at the General Assembly of 28th June 1990.

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1. SCOPE

This ECMA Standard defines an in-band parameter exchange (IPE) for use between terminal adaptors, and between terminal adaptors and interworking units, in private pre-ISDN networks which cannot support out-of-band signalling for parameter exchange.

The IPE specified in this Standard enhances the capability of the private pre-ISDN networks in order to support:

- an exchange of rate adaptation protocol information,
- an exchange of terminal adaptor parameter information, and
- an exchange of information related to maintenance operations.

2. FIELD OF APPLICATION

This ECMA Standard defines the use of IPE in the interconnection of private pre-ISDN networks and ISDN networks (i.e. private switched networks - PSNs) and the enhancement of communication across private pre-ISDN networks. In both situations the following applications of IPE are specified:

- the transfer of the end-to-end information required for the compatibility checking of data calls,
- the support of parameter negotiation, and
- the provision of a limited range of maintenance operations.

3. CONFORMANCE

Conformance with this Standard implies satisfying all the requirements of Clauses 8.1 to 8.6, 8.8, 8.9, Clause 9 and Clause 10.1.

Implementation of maintenance operations requires conformance with Clause 8.7 and Clause 10.2.

4. REFERENCES

ECMA-102	Rate Adaptation for the Support of Synchronous and Asynchronous Equipment using the V.-Series Type Interface on a PCSN
ECMA TR/34	Maintenance at the Interface between Data Processing Equipment and Private Switching Network
CCITT Rec. I.460	Multiplexing, rate adaptation and support of existing interfaces
CCITT Rec. X.30	Support of X.21 and X.21bis based data terminal equipment by an integrated services digital network

5. DEFINITIONS

For the purpose of this Standard the following definitions apply. These definitions are ordered logically to minimize forward referencing.

5.1 Pre-ISDN Network

A network which can provide a 64 kbit/s transparent channel, but which cannot support out-of-band signalling for parameter exchange.

5.2 TA'

A terminal adaptor for use with a private pre-ISDN network.

5.3 Calling TA'

The TA' requesting the connection to be established.

5.4 Called TA'

The TA' accepting the connection.

5.5 Originating TA'

The TA' which is responsible for initiating the next exchange of parameter information. Initially the calling TA' takes on the rôle of the originating TA'.

5.6 Answering TA'

The TA' which is not responsible for initiating the next exchange of parameter information. Initially the called TA' takes on the rôle of the answering TA'.

5.7 Parameter Information

Rate adaptation protocol information, TA' parameters, and (optionally) maintenance information.

5.8 Parameter Block

The complete set of parameter information structured into message groups, which are transferred by each TA' towards the other during each parameter exchange.

5.9 Message Group

The arrangement of octets based on a repeated sequence of command octets followed by a series of three LOW-HIGH data octet pairs. Each message group transfers one octet of the parameter information.

5.10 Sequence of Command Octets

The repeated transmission of at least 32 command octets transmitted without interval for 64 kbit/s unrestricted and restricted channels. In the case of asynchronous IPE the sequence may be interrupted, within the limits of the procedures.

5.11 Series of LOW-HIGH Data Octet Pairs

The transmission of six octets grouped into three pairs of LOW-HIGH data octets, the LOW data octet being transmitted in each pair before the HIGH data octet. The six octets are transmitted without interval for 64 kbit/s unrestricted and restricted channels. In the case of asynchronous IPE the transmission of the six octets may be interrupted, within the limits of the procedures.

5.12 Verification

Establishment of the validity of a piece of data according to the specified error handling procedures.

6. OVERVIEW

The in-band parameter exchange (IPE) described in this Standard is based on the transfer of parameter information within the user data stream of an established connection. Specific IPE rates have been selected to cover the application of IPE to connections based on 64 kbit/s unrestricted channels, 64 kbit/s restricted channels and intermediate rate channels. For IPE at rates other than unrestricted 64 kbit/s, rate adaptation according to Standard ECMA-102 is applied to the user data stream containing the parameter information.

In the case of IPE within intermediate rate channels it is first necessary to achieve frame synchronization according to Standard ECMA-102 before the exchange can commence. The parameter information is transferred in a parameter block during one or more exchanges between the two TA's. The block structure is based on message groups, containing a sequence of command octets which identify the information carried in the message group, and a series of general purpose LOW-HIGH data octet pairs which carry the information. The command octets are always transmitted in a repeated sequence of at least 32 octets to allow persistency error handling techniques to be employed. The LOW-HIGH data octet pairs are always transmitted in a series of three to enable majority voting error recovery techniques to be used.

After the first exchange of parameters the called TA' determines whether the parameter exchange has been successful. If it is, both TA's proceed to the Data Transfer state directly unless the agreed data transfer rate first requires re-synchronization to a new intermediate rate according to Standard ECMA-102. After the first exchange, and each subsequent exchange, the responsibility for determining the success of the exchange is transferred, to allow the negotiation of parameters to progress evenly. Status information is also transferred during the IPE to enable both TA's to monitor the progression of the exchange. If at any time either TA' concludes that a successful exchange of parameters cannot be achieved the TA' should clear the connection.

Interworking with TA's not supporting IPE is specified.

7. REFERENCE CONFIGURATION

Figure 1 gives three examples of application for IPE. The first (path A) reflects the use of IPE to enhance the capability of a private pre-ISDN network, enabling the communicating TA's to exchange parameters as well as enabling them to perform other operations such as maintenance functions. The second example (path B) shows how IPE can be used to provide enhanced interworking between private pre-ISDN networks and ISDN networks (i.e. private switched networks - PSNs). In this latter example, the IPE is used at least to transfer the end-to-end parameter information for the compatibility checking of data calls between the interworking unit and the TA'. The third example (path C) demonstrates how IPE can also be used to enhance interworking between a TA' and an interworking unit connected to an analogue network.

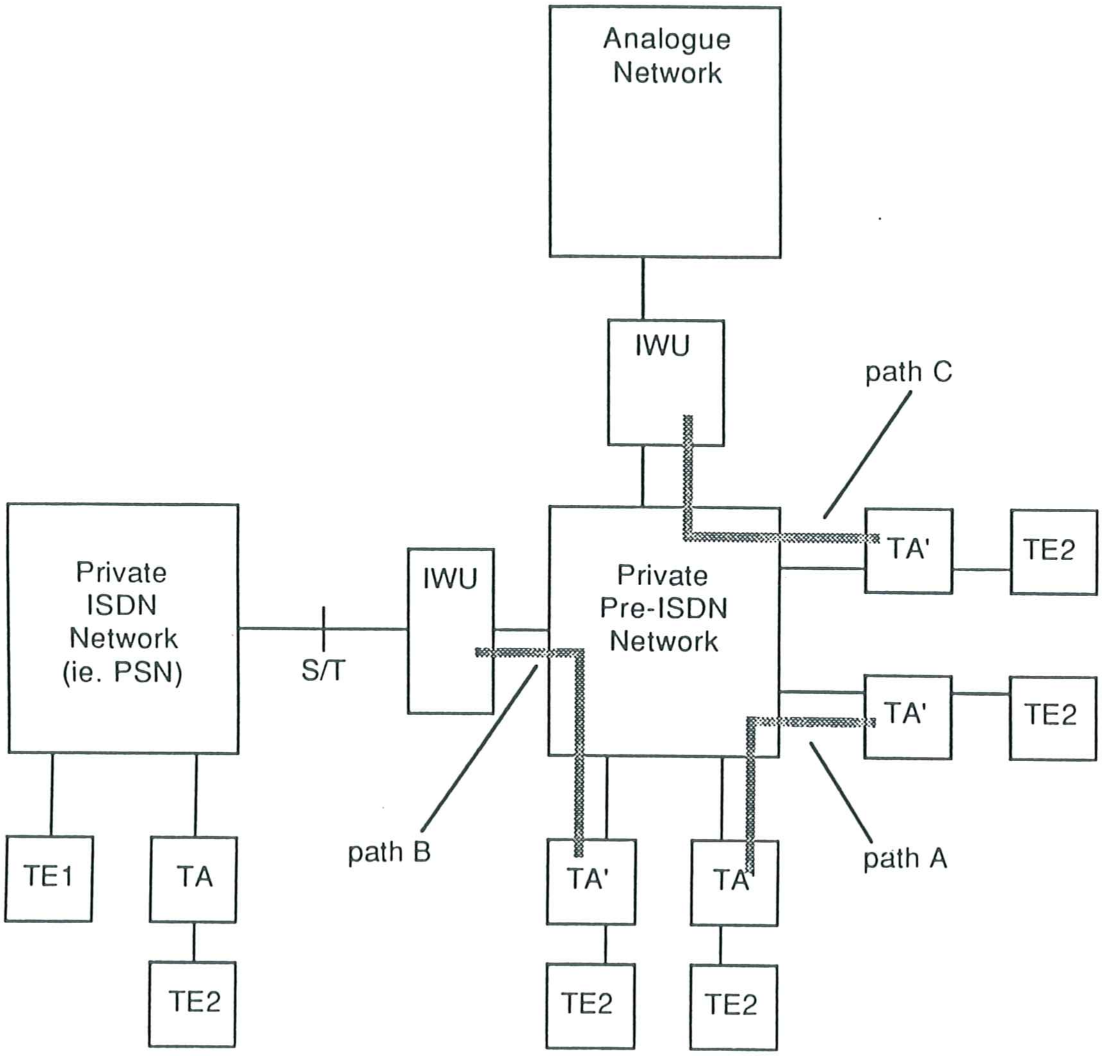


Figure 1 - Reference Configuration

8. PROCEDURES

8.1 General

Described in Clause 8 are the procedures which permit a TA' to exchange parameter and maintenance information in-band by using messages within the user data stream.

Once the call has been established, the IPE is initiated at one of five user data rates depending on the type of connection established. See Figure 2. Default intermediate-rate channels are selected according to the recommendation for single stream operation described in CCITT Rec. I.460.

Connection type	IPE user rate
Unrestricted (64 kbit/s)	64 kbit/s
Restricted (56 kbit/s)	56 kbit/s
32 kbit/s intermediate-rate channel	19,2 kbit/s async
16 kbit/s intermediate-rate channel	9,6 kbit/s async
8 kbit/s intermediate-rate channel	4,8 kbit/s async

Figure 2 - Selection of IPE User Rate

The final rate of data transfer is not restricted by the choice of IPE user rate. It is therefore possible for an IPE at 4,8 kbit/s async, for example, to agree on the use of 64 kbit/s unrestricted during the Data Transfer state. For IPE at rates other than 64 kbit/s, rate adaptation according to Standard ECMA-102 is applied to the user data stream containing the IPE information. In order to prevent unintended disconnection when rate adaptation according to Standard ECMA-102 is used, it is necessary to avoid the condition S = OFF, X = ON and all the data bits set to ZERO. This is achieved by the use of asynchronous characters with one Stop bit and the permanent setting of bit 8 in all octets to ONE.

Clause 8.2 describes how IPE is initiated, with the procedures for IPE itself described in 8.3. If the parameter exchange results in the selection of a data rate based on a different intermediate rate to that used for IPE, re-synchronization is required. The procedures for re-synchronization and data transfer are given in 8.4 and 8.5 respectively. In 8.6 the procedures for interworking with a TA' not supporting IPE are given. In 8.7 the procedures associated with maintenance are described, 8.8 defines re-entry to IPE from the Data Transfer state, and 8.9 provides the procedures for error protection and handling. Message codings are given in Clause 9, timer values in Clause 10, state transition diagrams in Clause 11, and procedures to ensure com-patible connections in Clause 12.

8.2 Initiating the Exchange

An IPE TA' requires a local memory flag (the Re-entry flag) to control the re-entry into IPE from the Data Transfer state.

During the Inactive state, the TA' shall transmit continuous ONEs into the B channel (see Clause 11). Once a connection has been established both TA's will initiate the parameter exchange at the selected user rate and set the Re-entry flag to ZERO. Before beginning the parameter exchange, both TA's start Timer T2 and may send repeated IDLE status octets (see 9.5).

In the case where the TA's operate on a different IPE user rate, the following procedure shall be applied:

- During the first half of period T2, the called TA' only tries to adapt to the IPE rate of the calling TA' before transmitting its initial exchange of information,
- During the second half of period T2, the calling TA' only tries to adapt to the called TA', and retransmits the initial exchange of information at the called TA' user rate.

If Timer T2 expires before a complete parameter block has been received, both TA's shall begin data transfer using their default parameters.

In the case of user rates of 4,8 kbit/s, 9,6 kbit/s or 19,2 kbit/s the TA' first completes the frame synchronization procedure described in Standard ECMA-102, with the changes detailed below:

a) The transmitter sends frames towards its peer with status information S = OFF and X = OFF and enters the Awaiting Synchronization - Parameter Exchange state (State 6).

b) When the TA' recognizes the frame synchronization pattern in the Awaiting Synchronization - Parameter Exchange state (State 6), it verifies the status information received and then enters the appropriate state, in a coordinated manner, as follows:

   - Data Transfer (State 4), upon receipt of S = ON and X = ON (see 8.6),
   - IPE Default Exchange (State 5), upon receipt of S = OFF and X = OFF,
   - Parameter Exchange (State 7), upon receipt of S = OFF and X = ON (see 8.3).

c) When the TA' is in the IPE Default Exchange state (State 5) it shall transmit frames with status information S = OFF and X = ON and verify the status information received and then enter the appropriate state, in a coordinated manner, as follows:

   - Data Transfer (State 4), upon receipt of S = ON and X = ON (see 8.6),
   - Parameter Exchange (State 7), upon receipt of S = OFF and X = ON (see 8.3).

In the case of user rates of 56 kbit/s or 64 kbit/s there is no frame synchronization requirement.

8.3 The Parameter Exchange

8.3.1 Octet Alignment

In the case of user rates of 4,8 kbit/s, 9,6 kbit/s or 19,2 kbit/s, each octet of the parameter exchange message is carried as a single Start-Stop character (see 9.1). In the case of user rates of 56 kbit/s or 64 kbit/s network-provided octet alignment shall be used.

8.3.2 Transfer of Parameters

The correct interpretation of this Clause requires careful adherence to the definitions made in Clause 5, particularly for the meaning of a «sequence of command octets» (5.10) and a «series of LOW-HIGH data octet pairs» (5.11). Further detailed information is given in 8.9 and Clause 9.

After the connection has been established the calling TA' takes on the rôle of the originating TA' and the called TA' the rôle of the answering TA'.

The originating TA' begins by starting Timer T1 and transmitting a sequence of XSTART command octets (see 9.3). After verifying the receipt of the XSTART command octets the answering TA' starts Timer T1 and begins parameter transfer as described below. Once the originating TA' has verified the receipt of the RA STANDARD command octet (at the start of the parameter transfer) from the answering TA', the originating TA' also begins parameter transfer in the same manner. Figure 3 portrays the normal sequence of events during the parameter exchange.

The parameter transfer commences with the transmission of a sequence of RA STANDARD command octets followed by a series of LOW-HIGH data octet pairs containing the ECMA-102 Rate Adaptation identifier (see 9.2). Directly following the transmission of the Rate Adaptation identifier, the transfer continues with the parameters themselves in five groups: PARAM-0 to PARAM-4 (see 9.4), transmitted in ascending order. Each group begins with the transmission of a sequence of the appropriate PARAM command octet followed by a series of LOW-HIGH data octet pairs which carry the parameters. At the completion of the parameter information transfer, both TA's send repeated FILL status octets until the next stage of the parameter exchange. Transmission of the complete parameter block shall be made within the period T2.

After receiving and processing the rate adaptation and parameter information, the answering TA' determines whether the parameters exchanged in both directions are compatible, or whether it can adapt to the parameters of the originating TA'(see Clause 12). In either case, the exchange has been successful, Timer T4 is started and the procedures described in 8.3.3 are followed. If the parameters were not compatible and the answering TA' decides to continue, it now takes on the rôle of the originating TA' and recommences the parameter exchange with the transmission of a sequence of XSTART command octets. The parameter transfer procedures therefore continue as described above, but with the rôles of originating and answering carried out by the opposing TA's. In the first exchange, the called TA' should attempt to adapt to the parameters of the calling TA'. When continuing the exchange the new originating TA' should attempt, as far as possible, to move the values of its next transmitted parameters towards the values of those previously received. If either TA' determines that there is no point in continuing the parameter exchange and Timer T4 has expired the procedures described in 8.3.4 are followed.

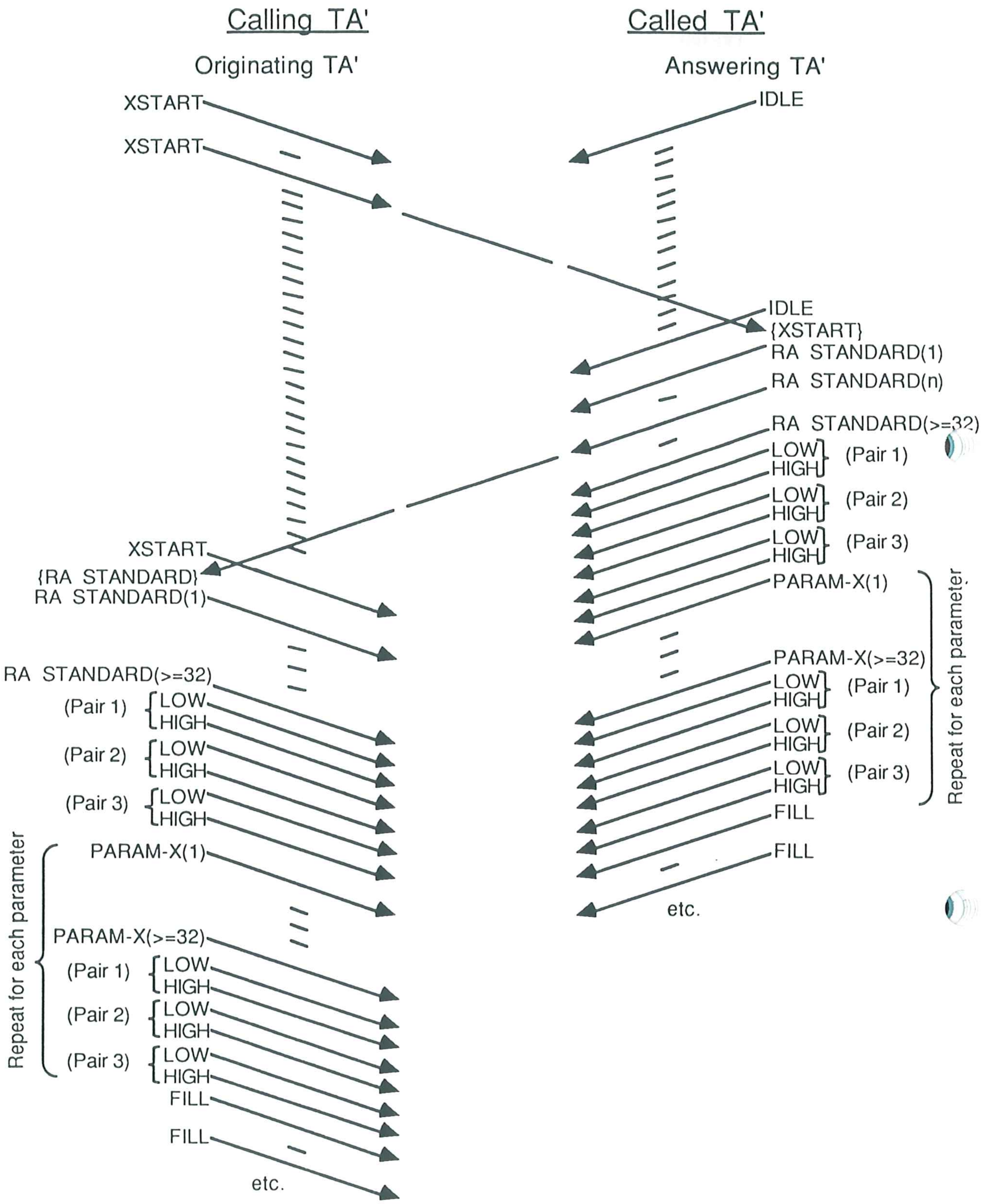


Figure 3 - Initial Sequence of Events during a Parameter Exchange

Parameter information continues to be exchanged in this manner, with alternate reversal of the rôles of originating and answering TA' until the outcome is successful, unsuccessful, or Timer T1 expires.

In order that the service offered is not degraded from that provided without IPE, a TA' should connect using its default parameters upon expiry of Timer T1. This does not prohibit either TA' initiating disconnection at any time.

8.3.3 Successful Exchange

A parameter exchange is considered successful when the last set of TA' parameters transferred in both directions are compatible, or when the answering TA' can adapt to the parameters of the originating TA'. The answering TA' shall notify the originating TA' of a successful exchange before proceeding; this notification is provided by the transmission of a sequence of READY status octets followed immediately by INACTIVE status octets for the case of user rates of 56 kbit/s, or by a sequence of READY status octets with S = OFF, X = ON followed immediately with d bits = ONE and S = X = ON for lower user rates. The originating TA' on validated receipt of the READY status octets will transmit INACTIVE status octets for the case of user rates of 56 kbit/s or 64 kbit/s, or S = OFF, X = ON and d bits = ONE for lower user rates. Both TA's shall set the Re-entry flag to ONE. For user rates lower than 56 kbit/s the originating TA' on receipt of S = X = ON and d bits = ONE shall send S = X = ON, d bit = data, and in all cases both TA's will proceed into the Data Transfer state (see 8.5.1) unless re-synchronization to a new intermediate rate is required (see 8.4).

Figure 3a portrays the normal sequence of events at the end of a successful parameter exchange.

8.3.4 Unsuccessful Exchange

If at any time during the exchange either TA' concludes that a successful exchange of parameters cannot be achieved or that the rate adaptation standards are not compatible, the TA' should clear the connection.

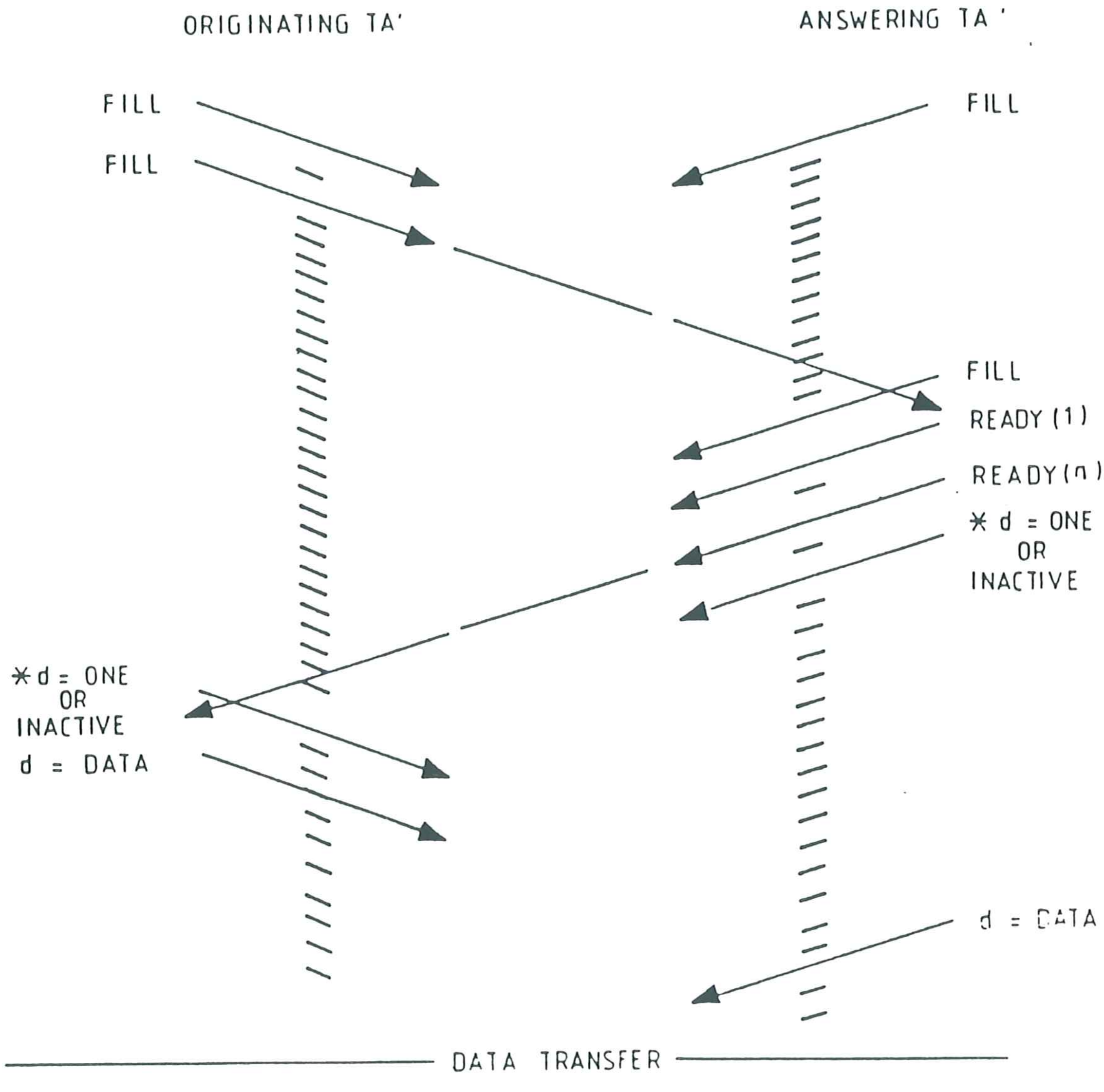
8.4 Re-synchronization to a New Intermediate Rate

If the outcome of the IPE is the selection of a user data rate requiring a new intermediate rate, re-synchronization will be necessary, and the TA' enters the Awaiting Re-synchronization state (State 8). Whilst in this state the transmitter of the TA' will send frames with S = OFF and X = OFF towards the peer TA' in the new intermediate rate channel agreed. The default intermediate-rate channel positions correspond to those recommended for single stream operation in CCITT Rec. I.460.

At the same time the receiver of the TA' will commence searching for the frame synchronization pattern in the selected subrate channel. When the TA' recognizes the frame synchronization pattern, it shall verify the status information received and enter the appropriate state, in a coordinated manner, as follows:

- Data Transfer (State 4), upon receipt of S = ON and X = ON (see 8.5),
- No Exchange (State 9), upon receipt of S = OFF and X = OFF.

When the TA' is in the No Exchange state (State 9), it shall transmit frames with status information S = ON and X = ON and enter the Data Transfer state (State 4) upon the receipt of S = ON and X = ON.



* See 8.3.3

Figure 3a - Closing Sequence of Events for a Successful Parameter Exchange

8.5 Data Transfer

8.5.1 Transition into the Data Transfer State

Entry into the Data Transfer state should be carried out in a coordinated manner, as described by Standard ECMA-102, by both TA's after sufficient time has been given to enable the processing of the parameter information.

8.5.2 The Data Transfer State

The procedures on entering the Data Transfer state (State 4) and the values of the S and X status information in the case of data rates less than 56 kbit/s are described in Standard ECMA-102.

8.6 Interworking with a TA' not supporting IPE

A TA' may choose to by-pass IPE; for example, when it is used in a pre-configured arrangement, or when the parameter exchange can be effected by out-of-band signalling. In this situation a TA' supporting IPE may receive S = ON and X = ON verified status information, causing the TA' to directly enter the Data Transfer state. See Clause 11.

A TA' not supporting IPE can receive frames containing the status information S = OFF and X = ON from its peer. In this situation the non-IPE TA' may either continue to transmit the status information S = OFF and X = OFF, or change to the Data Transfer state and transmit the status information S = ON and X = ON. Both cases will lead to entry into the Data Transfer state without IPE. See Clause 11.

In the case of IPE at 64 kbit/s unrestricted or restricted, or in the case of a TA' continuing to transmit the status information S = OFF and X = OFF, Timer T2 ensures that the service is not degraded from that provided without IPE. See Clause 11.

8.7 Maintenance

A TA' maintenance (MNT) call is made by indicating in PARAM-0 that the calling TA' requires MNT support and by directly following the parameter transfer with a MAINTENANCE message group identifying the function required (see 9.6). A TA' which supports MNT shall indicate in PARAM-0 that MNT support is available. When an MNT function is requested by a calling TA', the called TA' capable of supporting MNT shall acknowledge the request by initiating a subsequent parameter exchange including at the end the identical MAINTENANCE message group, before continuing directly to invoke the required MNT function.

A successful MNT call with no timer required is terminated by either TA' clearing the call. A successful MNT call with timer required returns the called TA' to the Inactive state upon expiry of Timer T3, or to the Null state upon disconnection.

A TA' which does not support MNT shall indicate in PARAM-0 of the initial exchange that no MNT support is provided, and should clear the connection after the initial parameter exchange when an MNT call is received.

8.8 Re-entering IPE from the Data Transfer State

The major application of this facility is to provide a mechanism to allow a remote loopback to be established for maintenance purposes without disconnecting the equipment in the established path. This mechanism may also be used generally to re-enter IPE.

This mechanism is not applicable to unrestricted 64 kbit/s or restricted 64 kbit/s connection types, or when the rate during data transfer is 64 kbit/s, 56 kbit/s or 48 kbit/s.

If re-entry to IPE is required and the Re-entry flag has the value ONE then the initiating TA' enters the Awaiting Re-entry to IPE state (State 10) and transmits S = OFF, X = ON and D = IDLE. Re-entry to IPE in order to set a B loopback shall only be initiated by a calling TA'.

Receipt of S = OFF, X = ON and D = IDLE (bit 8 is ignored on receipt - see Figure 5) shall cause a TA' in State 4 to re-enter the IPE Default Exchange state (State 5) at the IPE user rate defined in 8.1 which is of the same intermediate rate as that used for data transfer.

When the initiating TA' has completed the transmission of a sequence of IDLE command octets the IPE Default Exchange state (State 5) is re-entered at the IPE user rate defined in 8.1 which is of the same intermediate rate as that used for data transfer.

8.9 Error Protection and Handling

Error protection and handling is required to overcome the possibility of data corruption. In addition, error recovery procedures are required, for example in the case of loss of frame synchronization.

To protect against data corruption, IPE commands shall be sent in a repeated sequence of at least 32 octets. Verification of the correct receipt of a command octet can then be carried out based on persistence checking techniques. Once a verified command octet has been received it can be identified by the codings given in Clause 9. Any command octet not recognized shall be ignored. To protect against data corruption, LOW-HIGH data message pairs shall be sent in groups of three pairs. This enables majority voting techniques to be employed by the receiving TA'.

Upon the detection of irrecoverable data corruption during the parameter exchange, loss of frame synchronization or other situations requiring the exchange to be restarted, the TA' shall complete the current message flow and initiate error recovery by transmitting a sequence of XSTART command octets and assuming the rôle of the originating TA'. Upon receipt of a sequence of XSTART command octets a TA' will re-commence the parameter exchange as described in 8.3.2. In the case of a collision of XSTART octets, the original originating and answering rôles are assumed by the TA's.

9. CODING

9.1 General

Information transfer during IPE is based on a group of messages. These messages are used to carry out a variety of tasks. The messages associated with rate adaptation identification are described in 9.2, whilst those associated with the actual parameter transfer are given in 9.4. The messages associated with the control of the IPE are described in 9.3, and 9.5 covers those used to indicate status. Finally, 9.6 covers the coding of the maintenance message.

The messages are all based on octets structured as shown in Figure 5.

In the case of a user rate of 64 kbit/s the octets are transmitted to line in bit sequence from bit 1 to bit 8. Network-provided octet alignment shall be used.

In the case of a user rate of 56 kbit/s the data is transmitted to line in bit sequence from bit 1 to bit 7 followed by an 8th bit set to ONE - according to the ECMA-102 Rate Adaptation Standard (in total this is the equivalent data stream to 64 kbit/s). Network-provided octet alignment shall be used.

In the case of user rates of 4,8 kbit/s, 9,6 kbit/s or 19,2 kbit/s the octets are packaged as single Start-Stop characters, using the following format:

- 1 Start bit,
- 8 data bits (in order of transmission shown in Figure 4),
- No parity, and
- 1 Stop bit.

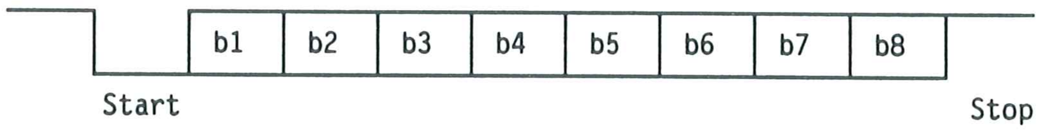


Figure 4 - Asynchronous Character Format

◄--- 4,8; 9,6; 19,2 and 64 kbit/s --►
◄---------- 56 kbit/s --------►

bit	1	2	3	4	5	6	7	8

bit 8: Set to ONE (and ignored on receipt)

Note 1

Equivalent data stream to that for 64 kbit/s is created with 56 kbit/s when rate adaptation according to Standard ECMA-102 is used.

bit 7: Set to ZERO for IPE data
Set to ONE for IPE signal

For IPE data

bit 6: Set to ONE
(Set to ZERO: message reserved for private use and ignored if not implemented)

bit 5: Set to ZERO when carrying data bits d0-d3
Set to ONE when carrying data bits d4-d7

bits 1-4: Carrying data bits (d0-d3) or (d4-d7)

For IPE signal

bit 6: Set to ONE
(Set to ZERO: message reserved for private use and ignored if not implemented)

bit 5: Set to ZERO for command messages
Set to ONE for status messages

bits 1-4: The signal code

Figure 5 - Octet Structure of the IPE Coding

Figure 6 below provides a complete set of octet codings for use in IPE.

		Message	b1	b2	b3	b4	b5	b6	b7	b8
			← 4,8; 9,6; 19,2 and 64 kbit/s →							
			← 56 kbit/s →							
IPE SIGNALS	COMMAND	PARAM-0	0	0	0	0	0	1	1	1
		PARAM-1	0	0	0	1	0	1	1	1
		PARAM-2	0	0	1	0	0	1	1	1
		PARAM-3	0	0	1	1	0	1	1	1
		PARAM-4	0	1	0	0	0	1	1	1
		RA STANDARD	0	1	0	1	0	1	1	1
		XSTART	0	1	1	0	0	1	1	1
		MAINTENANCE	0	1	1	1	0	1	1	1
	STATUS									
		READY	0	1	0	1	1	1	1	1
		IDLE	0	1	1	1	1	1	1	1
		FILL	1	1	0	1	1	1	1	1
		INACTIVE	1	1	1	1	1	1	1	1
IPE	DATA									
		LOW	d0	d1	d2	d3	0	1	0	1
		HIGH	d4	d5	d6	d7	1	1	0	1

Note 2

All spare codings are reserved for future standardization (unless indicated for private use). Any octet received, and verified, which is not recognized shall be ignored.

Figure 6 - IPE Octet Codings

9.2 Rate Adaptation Identification

Transfer of the Rate Adaptation identifier is achieved by a message group based on three octets and transferred according to the procedures described in 8.3.2 and 8.9. The message consists of a sequence of RA STANDARD command octets followed by a series of LOW-HIGH data octet pairs, the LOW data octet being transmitted in the pair before the HIGH data octet. Figure 7 shows the message codings for rate adaptation identification.

	b1	b2	b3	b4	b5	b6	b7	b8
RA STANDARD	0	1	0	1	0	1	1	1
LOW	d0	d1	d2	d3	0	1	0	1
HIGH	d4	d5	d6	d7	1	1	0	1

Rate Adaptation identifier encoding

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
I3	I2	I1	I0				

I3-I0:

	I3	I2	I1	I0
Private RA standard	0	0	0	0
Identifier ECMA-102	0	0	0	1

	d3	d2	d1	d0
Reserved for private use: (if not used set to ZERO and ignored on receipt)	x	x	x	x

Note 3

All other codings are reserved.

Figure 7 - Rate Adaptation Identifier

9.3 Control

Before each transfer of TA' parameter information can begin a sequence of XSTART command octets is transmitted by the originating TA' towards the answering TA' as described in 8.3.2 and 8.9. Figure 8 shows the coding for the XSTART command octet.

	b1	b2	b3	b4	b5	b6	b7	b8
XSTART	0	1	1	0	0	1	1	1

Figure 8 - XSTART Coding

9.4 Parameters

Transfer of the TA' parameters is achieved in a series of five message groups each based on three octets and transferred according to the procedures described in 8.3.2 and 8.9. Each message group consists of a sequence of PARAM-X command octets (PARAM-0 to PARAM-4) followed by a series of LOW-HIGH data octet pairs, the LOW data octet being transmitted in the pair before the HIGH data octet. Figure 9 shows the command octet codings and Figures 10 to 14 show the data octet codings for parameter transfer.

	b1	b2	b3	b4	b5	b6	b7	b8
PARAM-X	0	x2	x1	x0	0	1	1	1

	x2	x1	x0
PARAM-0	0	0	0
PARAM-1	0	0	1
PARAM-2	0	1	0
PARAM-3	0	1	1
PARAM-4	1	0	0

LOW	d0	d1	d2	d3	0	1	0	1
HIGH	d4	d5	d6	d7	1	1	0	1

Figure 9 - Format of Parameter Message Group

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
Sp	Sp	Ms	Mr				

Mr (Maintenance required):
Maintenance not required 0
Maintenance required 1

Ms (Maintenance supported):
Maintenance not supported 0
Maintenance supported 1

Sp (Spare): Set to ZERO on transmission, ignored on reception.

	d3	d2	d1	d0
Reserved for private use: (if not used set to ZERO and ignored on receipt)	x	x	x	Ex

Ex (Extension):

if TA' does not require octet alignment according to CCITT Rec. X.30 0

if TA' does require octet alignment according to CCITT Rec. X.30 1

Figure 10 - Parameter 0 Encoding

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
P2	P1	P0	Mo				

Mo (Mode):	Asynchronous			0
	Synchronous			1
P2-P0 :	Parity	P2	P1	P0
	Odd	0	0	0
	Even	0	1	0
	None	0	1	1
	Forced to ZERO	1	0	0
	Forced to ONE	1	0	1

	d3	d2	d1	d0
Reserved for private use: (if not used set to ZERO and ignored on receipt)	x	x	x	Ch

Ch (Check):	DPE parity check made when required	0
	No DPE parity check made when required	1

Figure 11 - Parameter 1 Encoding

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
S1	S0	C1	C0				

C1-C0:

Character length	C1	C0
Not used	0	0
5	0	1
7	1	0
8	1	1

S1-S0:

Stop bits	S1	S0
Not used	0	0
1	0	1
1,5	1	0
2	1	1

Note 4
Character length includes parity.

	d3	d2	d1	d0
Reserved for private use: (if not used set to ZERO and ignored on receipt)	x	x	x	Cx

Cx (Character length extension):

Standard C1-C0 codings used	0
9-bit character length used	1

Figure 12 - Parameter 2 Encoding

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
Sp	R6	R5	R4	R3	R2	R1	R0

R6-R0 :

Rates	R6	R5	R4	R3	R2	R1	R0
Undefined	0	0	0	0	0	0	0
600	0	0	0	0	0	0	1
1200	0	0	0	0	0	1	0
2400	0	0	0	0	0	1	1
3600	0	0	0	0	1	0	0
4800	0	0	0	0	1	0	1
7200	0	0	0	0	1	1	0
8000	0	0	0	0	1	1	1
9600	0	0	0	1	0	0	0
14400	0	0	0	1	0	0	1
16000	0	0	0	1	0	1	0
19200	0	0	0	1	0	1	1
32000	0	0	0	1	1	0	0
Spare	0	0	0	1	1	0	1
48000	0	0	0	1	1	1	0
56000	0	0	0	1	1	1	1
Spare	0	0	1	0	0	0	0
50	0	0	1	0	0	0	1
75	0	0	1	0	0	1	0
100	0	0	1	0	0	1	1
150	0	0	1	0	1	0	0
200	0	0	1	0	1	0	1
300	0	0	1	0	1	1	0
12000	0	0	1	0	1	1	1
Spare	0	0	1	1	0	0	0
			to				
Spare	0	1	0	0	0	0	0
75/1200 (*)	0	1	0	0	0	0	1
1200/75 (*)	0	1	0	0	0	1	0
Spare	0	1	0	0	0	1	1
			to				
Spare	1	1	1	1	1	1	0
64000	1	1	1	1	1	1	1

(*): Own DPE-TA interface tx rate
/ own DPE-TA interface rx rate.

Sp (Spare): Set to ZERO on transmission,
ignored on reception.

Figure 13 - Parameter 3 Encoding

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
DX	Fc	TNIC	RNIC				

RNIC:	if the TA' cannot accept NIC	0
	if the TA' can accept NIC	1
TNIC:	if TA' need not use NIC	0
	if TA' needs to use NIC	1
Fc (Flow control):		
	No end-to-end flow control supported	0
	End-to-end flow control supported	1
DX (Duplex mode):	Full duplex	0
	Half duplex	1

	d3	d2	d1	d0
Reserved for private use: (if not used set to ZERO and ignored on receipt)	x	x	CTS	Mm

Mm (Modem):	TA' not connected to a modem	0
	TA' connected to a modem	1
CTS:	DPE can respond to circuit 106	0
	DPE cannot respond to circuit 106	1

Note 5

NIC = Network-Independent Clock (see Standard ECMA-102).

Figure 14 - Parameter 4 Encoding

9.5 Status

To inform the peer TA' that a parameter exchange has been successful, a sequence of READY status octets shall be transmitted towards the peer according to the procedures in Clause 8. Figure 15 shows the coding for the READY status octet.

	b1	b2	b3	b4	b5	b6	b7	b8
READY	0	1	0	1	1	1	1	1

Figure 15 - READY Octet Coding

To inform the peer TA' that it is in an idle condition prior to parameter exchange, a sequence of IDLE status octets are transmitted towards the peer according to the procedures in Clause 8. Figure 16 shows the message coding for the IDLE status octet.

	b1	b2	b3	b4	b5	b6	b7	b8
IDLE	0	1	1	1	1	1	1	1

Figure 16 - IDLE Octet Coding

The FILL status octet is used as a fill between parameter transfers, according to the procedures in Clause 8. Figure 17 shows the coding for the FILL status octet.

	b1	b2	b3	b4	b5	b6	b7	b8
FILL	1	1	0	1	1	1	1	1

Figure 17 - FILL Octet Coding

To inform the peer TA' that the channel is currently inactive a sequence of INACTIVE status octets are transmitted towards the peer according to the procedures in Clause 8. Figure 18 shows the coding for the INACTIVE status octet.

	b1	b2	b3	b4	b5	b6	b7	b8
INACTIVE	1	1	1	1	1	1	1	1

Figure 18 - INACTIVE Octet Coding

9.6 Maintenance

This message group based on three octets is used to carry information in association with maintenance operations. The message group consists of a sequence of MAINTENANCE command octets followed by a series of LOW-HIGH data octet pairs, the LOW data octet being transmitted in the pair before the HIGH data octet. Figure 19 shows the message codings.

	b1	b2	b3	b4	b5	b6	b7	b8
MAINTENANCE	0	1	1	1	0	1	1	1
LOW	d0	d1	d2	d3	0	1	0	1
HIGH	d4	d5	d6	d7	1	1	0	1

Maintenance encoding

HIGH				LOW			
d7	d6	d5	d4	d3	d2	d1	d0
Sp	Rt	L1	L0				

L1-L0 (Loop required):	L1	L0
No loopback	0	0
B loop (A4)	0	1
Reserved	1	0
Reserved	1	1

Rt (Request for timer):	
No timer required	0
Timer required	1

Sp (Spare): Set to ZERO on transmission, ignored on reception.

	d3	d2	d1	d0
Reserved for private use: (if not used set to ZERO and ignored on receipt)	x	x	x	R1

R1 (R loop (A5)):	
R loop not required	0
R loop required	1

Figure 19 - Coding of MAINTENANCE Message Group

Note 6

The R loop is applied as near to the interface at the R reference point as practicable, and is outside the scope of this Standard.

Note 7

Loop definitions A4 and A5 are defined in ECMA TR/34.

Note 8

Definitions are for the direction of calling TA' to called TA'. In the reverse direction they represent confirmation of the maintenance function.

10. TIMER VALUES

10.1 Timer Values for Parameter Exchange

Timer T1 shall be at least 8 seconds but less than Timer T1 in Standard ECMA-102.

Timer T2 shall be 3 seconds.

Timer T4 shall be 1 second.

10.2 Timer Values for Maintenance

Timer T3 shall be 60 seconds.

11. STATE TRANSITION DIAGRAMS

11.1 General

In this Clause state transition diagrams are provided to show the states of a terminal adaptor in the following situations:

- a terminal adaptor not supporting the exchange of parameter information (11.3),
- a terminal adaptor interworking with a terminal adaptor not supporting the exchange of parameter information (11.4),
- a terminal adaptor capable of supporting the exchange of parameter information (11.5),
- a terminal adaptor capable of supporting a maintenance B loopback (11.6).

A summary of TA' states is given in 11.2.

11.2 Terminal Adaptor States

Provided in 11.3 to 11.6 are state transition diagrams showing possible TA' states. Following is a summary of the basic states involved:

State 0) Null

State 1) Inactive

State 2) Awaiting Synchronization - Data Transfer

State 3) Default Exchange

State 4) Data Transfer

State 5) IPE Default Exchange

State 6) Awaiting Synchronization - Parameter Exchange

State 7) Parameter Exchange

State 8) Awaiting Re-synchronization

State 9) No Exchange

State 10) Awaiting Re-entry to IPE

State 11) Maintenance B Loopback

11.3 TA' not supporting IPE

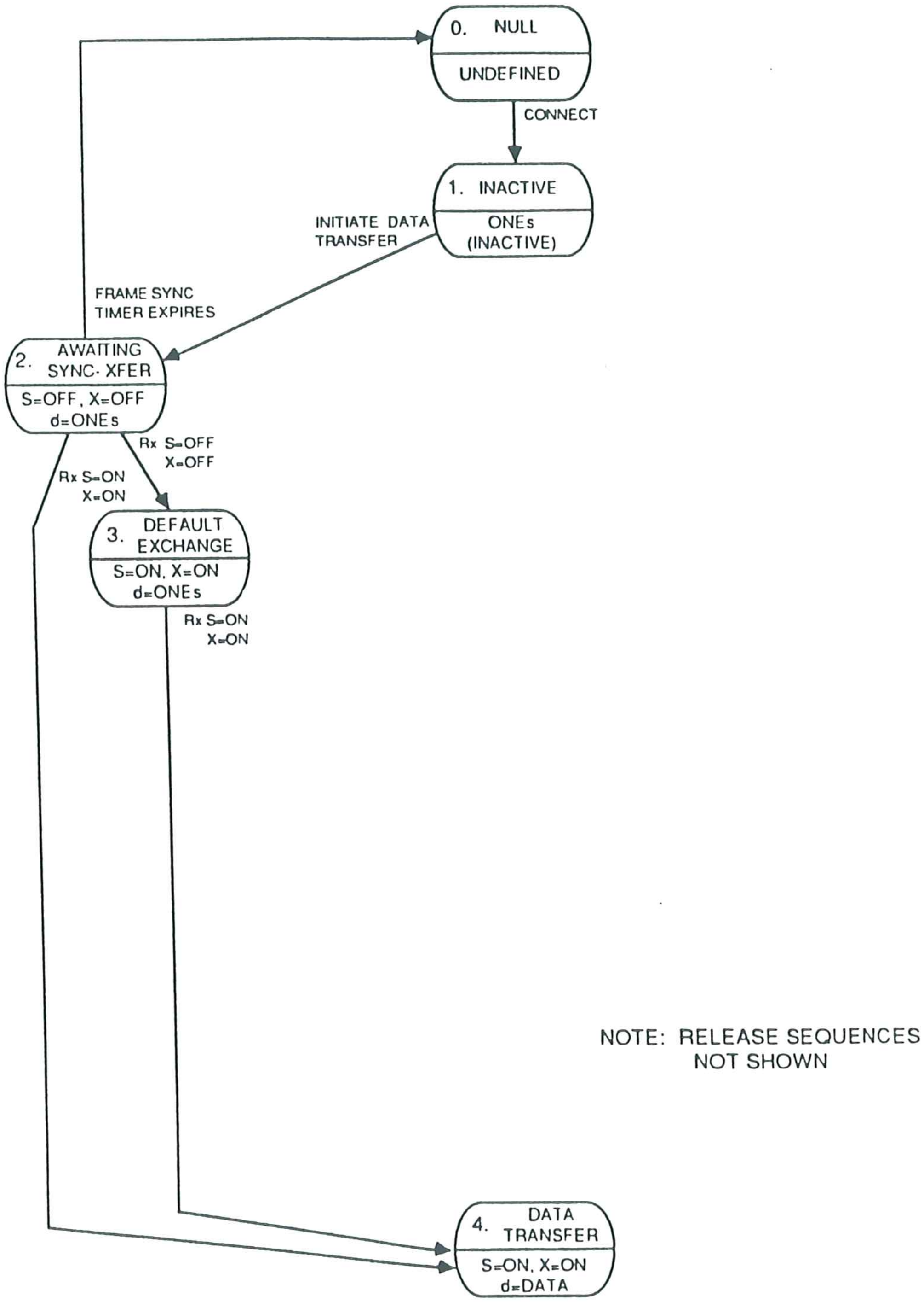


Figure 20 - State Diagram: TA' not supporting IPE

11.4 Interworking with a TA' not supporting IPE

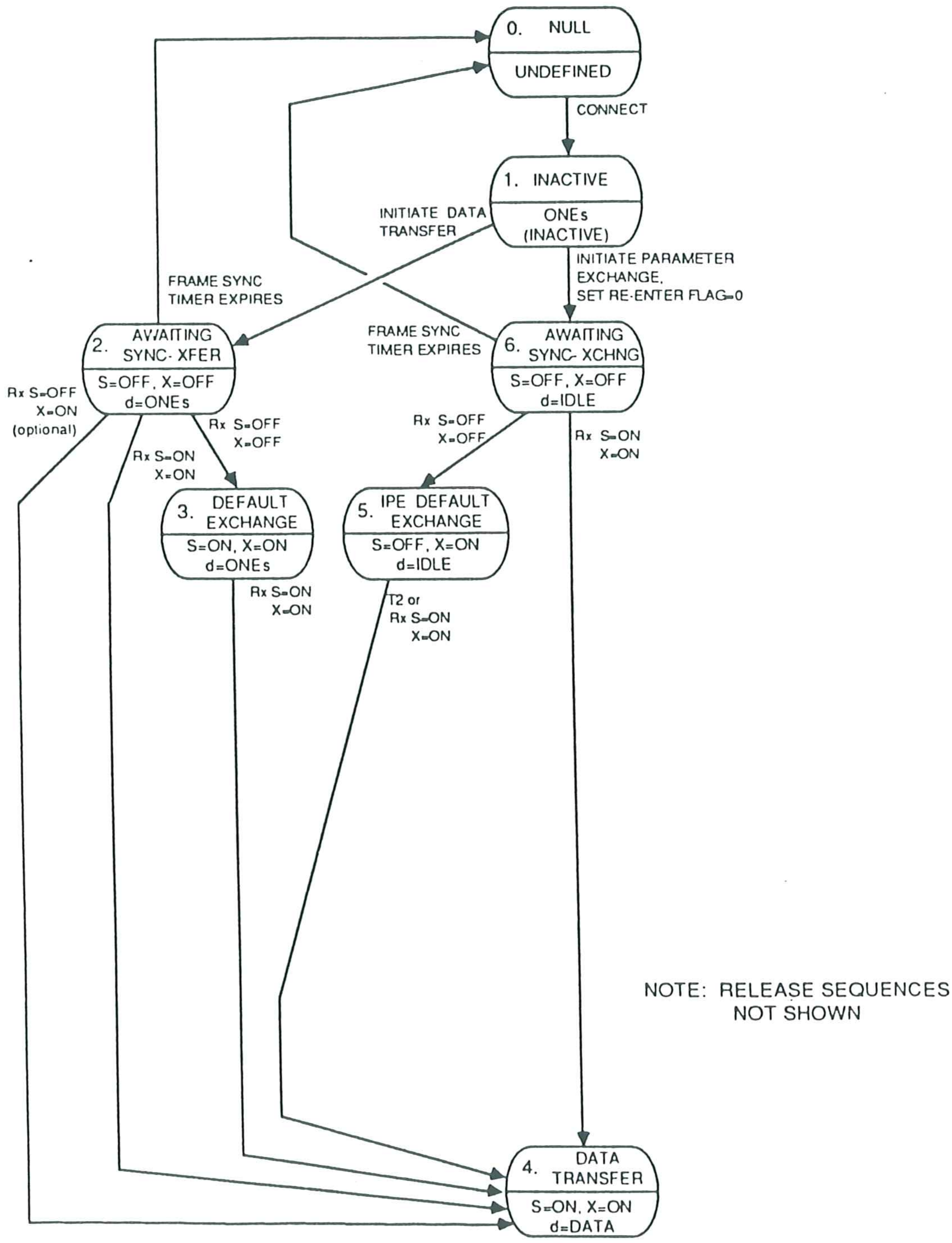


Figure 21 - State Diagram: Interworking with a TA' not supporting IPE

11.5 TA' supporting IPE

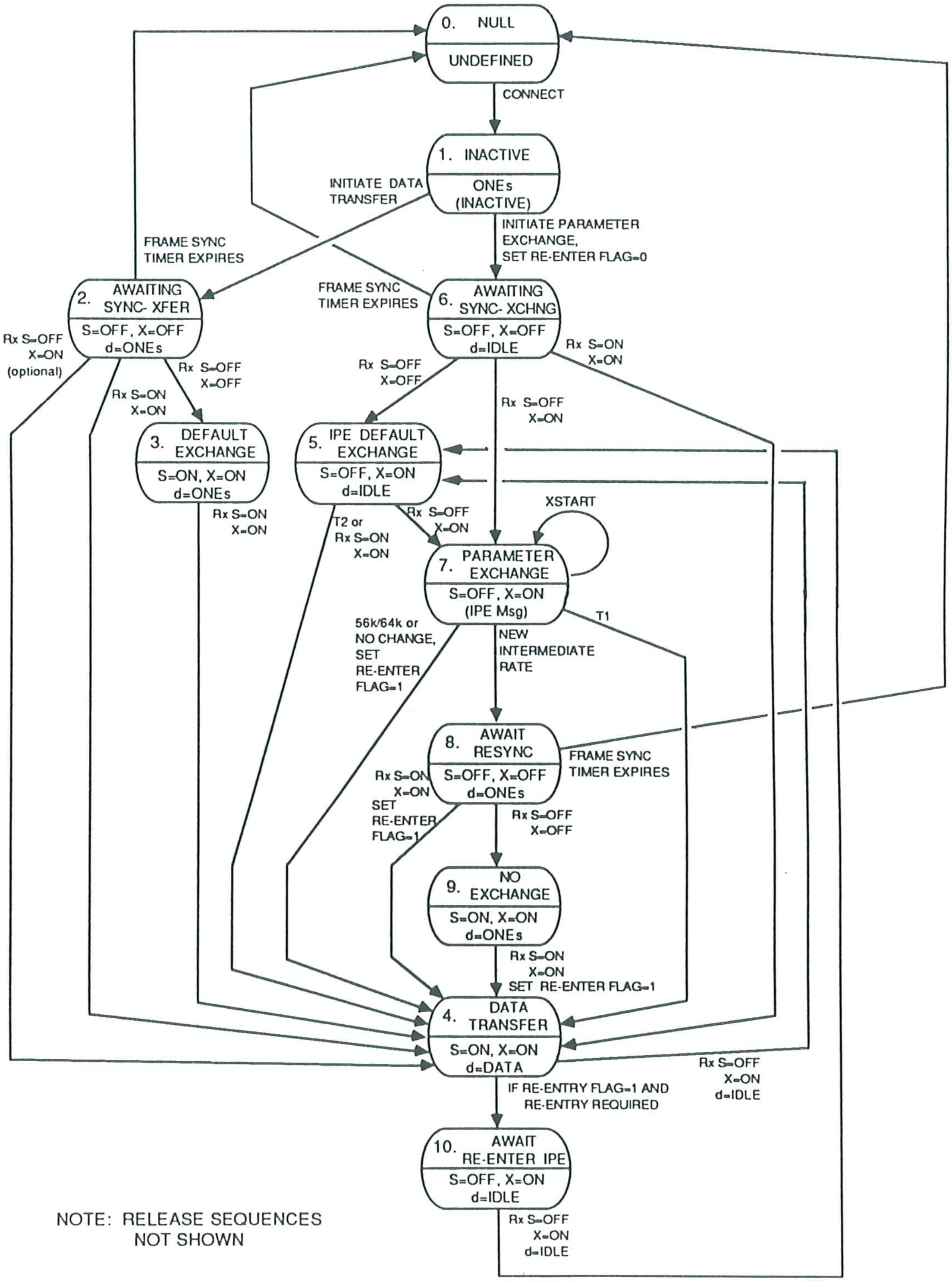


Figure 22 - State Diagram: TA' supporting IPE

11.6 TA' supporting a Maintenance B Loopback

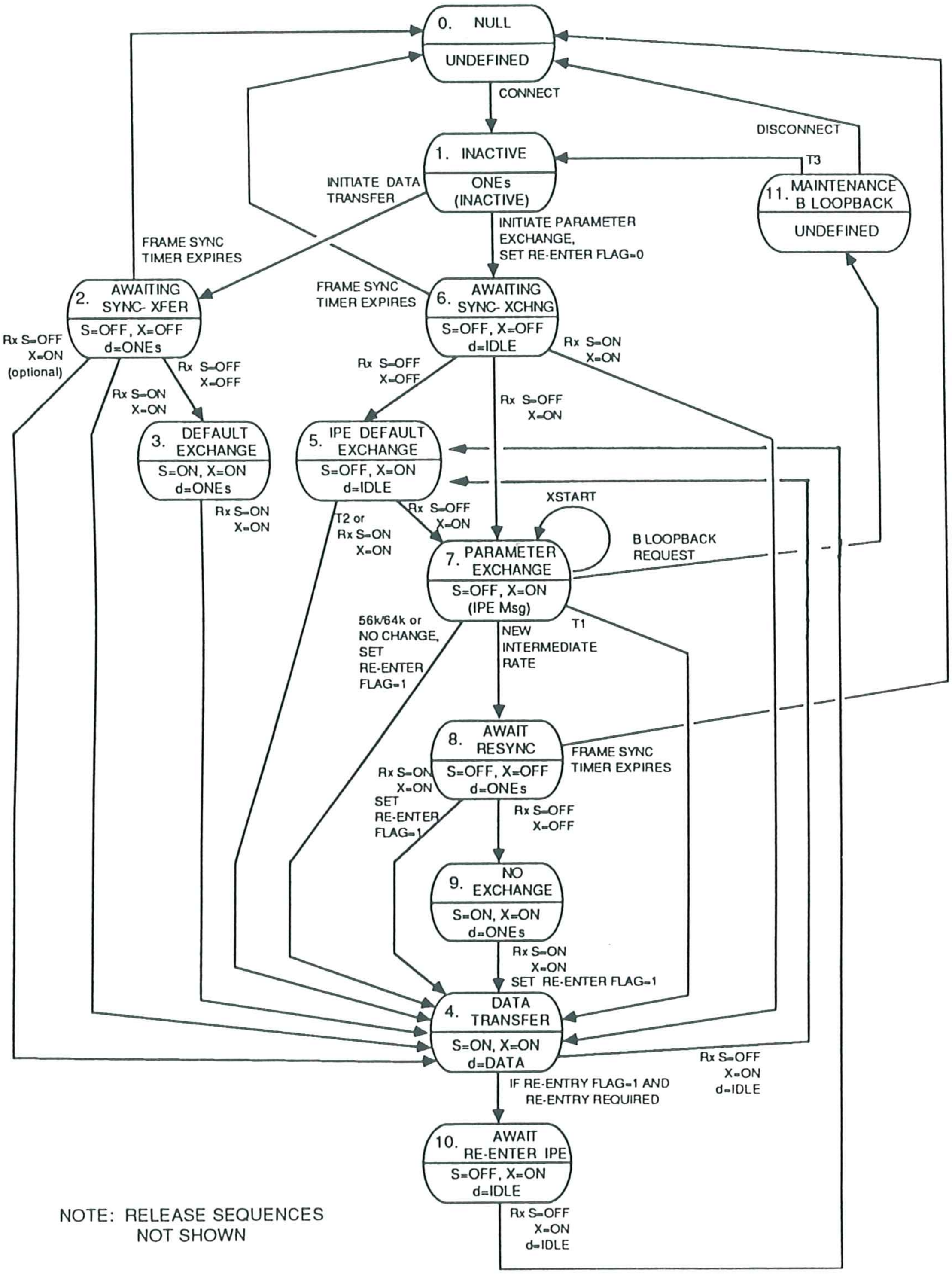


Figure 23 - State Diagram: Maintenance B Loopback

12. PROCEDURES FOR COMPATIBLE CONNECTIONS

12.1 General

In this Clause SDL diagrams are provided to illustrate the procedures to ensure the compatible connection of terminal adaptors.

Each procedure is applied in turn and assumes that a successful parameter exchange has taken place (see 8.3.3). The following situations are illustrated:

- verification of compatible character format (12.2),
- location of the conversion function (12.3),
- evaluation of speed conversion to an analogue network (12.4),
- resolution of end-to-end speed conversion (12.5).

12.2 Procedure 1 - Verification of Compatible Character Format

This procedure ensures that the character format (see 9.1) used for data transfer is the same for both TA's.

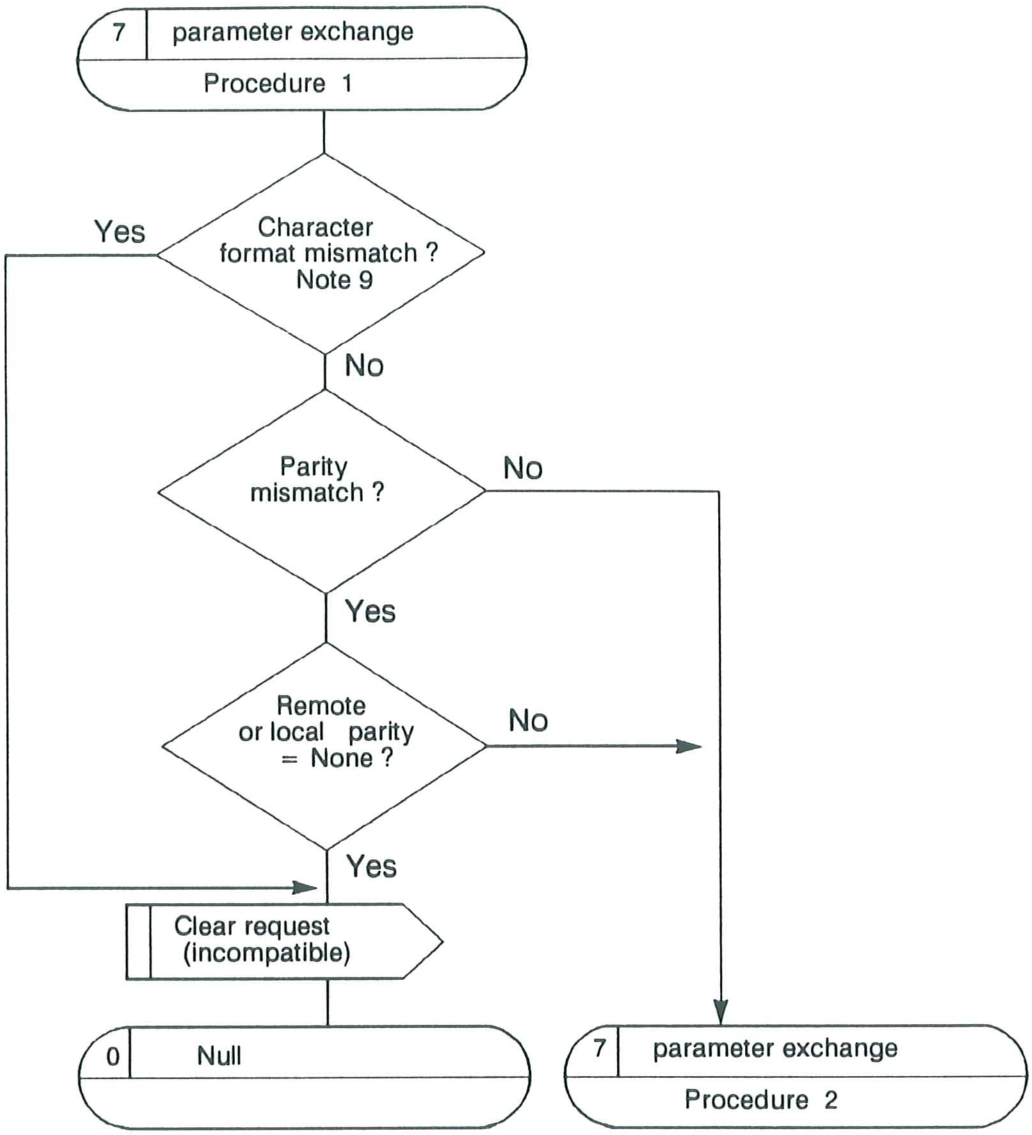


Figure 24 - Verification of Compatible Character Format

Note 9

Character formats which can be considered the same are:

7 data bits no parity 2 stop bits with
7 data bits Mark parity 1 stop bit, and
8 data bits no parity 2 stop bits with
8 data bits Mark parity 1 stop bit.

12.3 Procedure 2 - Location of the Conversion Function

This procedure ensures that the parity and/or number of stop bits conversion functions are located in one TA' only, and assumes that the flow control function will be invoked in order to perform the conversion function.

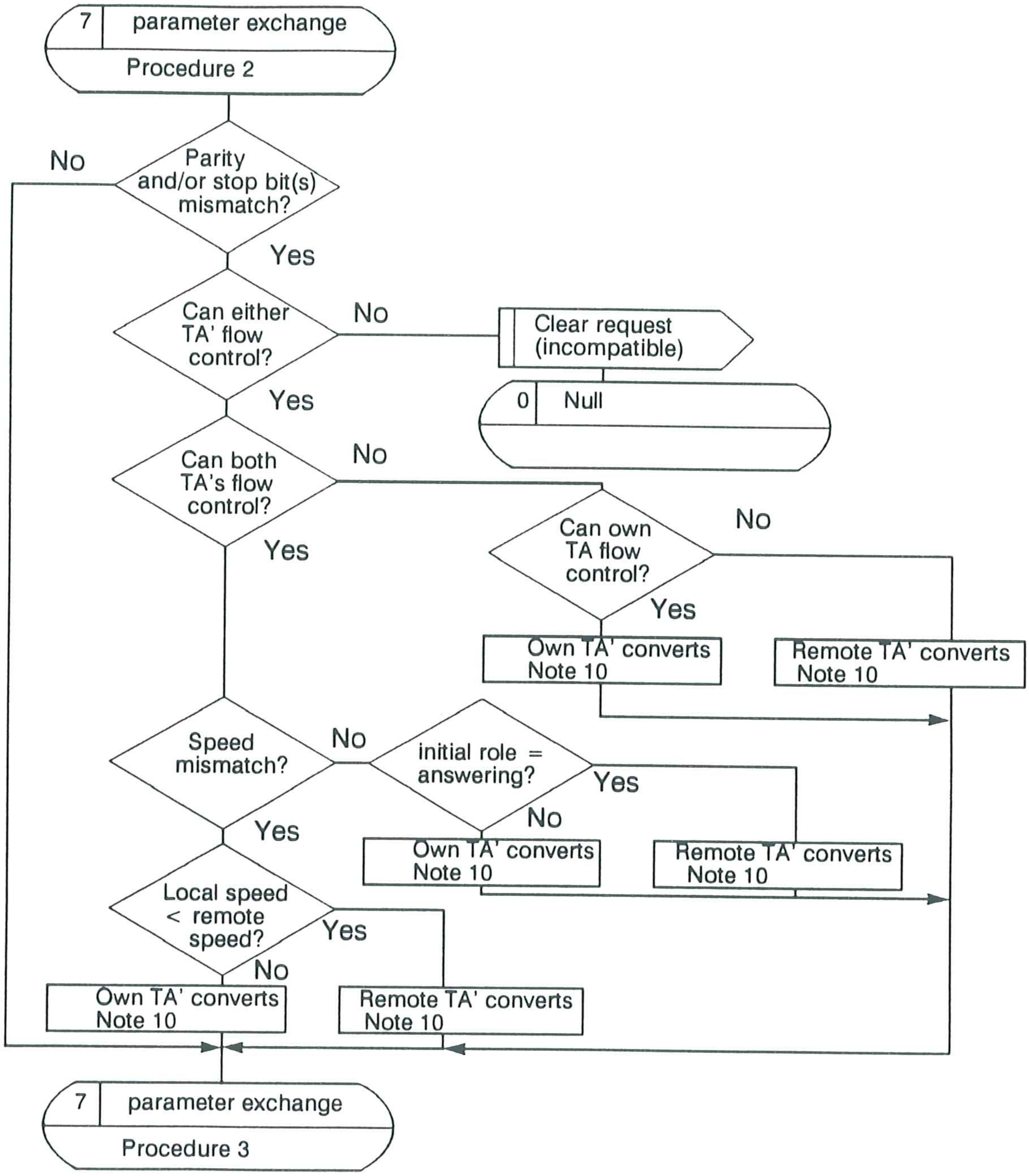


Figure 25 - Location of the Conversion Function

Note 10

The designated TA' performs flow control and the conversion function of parity and/or number of stop bits.

12.4 Procedure 3 - Evaluation of Speed Conversion to an Analogue Network

This procedure ensures that the analogue link (see Figure 1 path C) is not flow controlled, and assumes that the modem cannot operate its own flow control function.

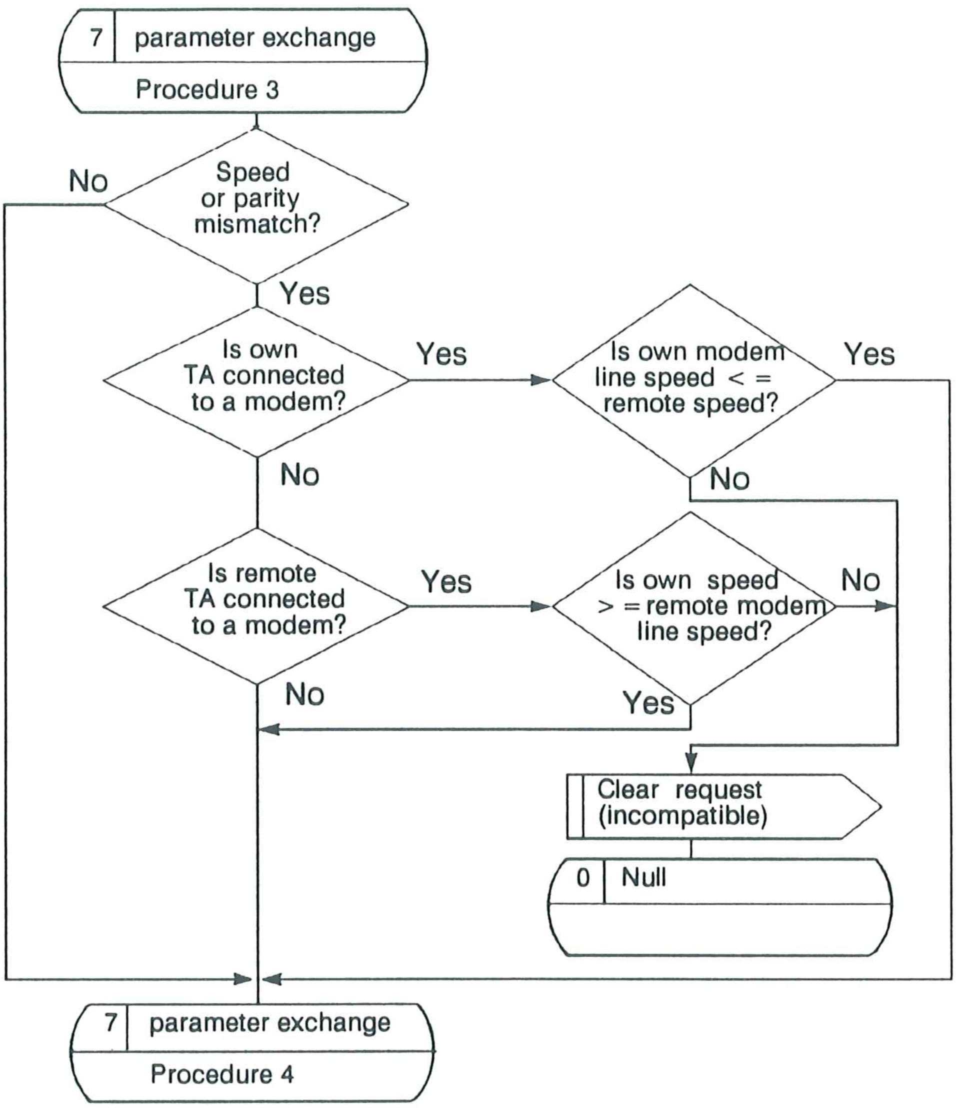


Figure 26 - Evaluation of Speed Conversion to an Analogue Network

12.5 Procedure 4 - Resolution of End-to-End Speed Conversion

This procedure ensures that the data is transferred at the lower TA' speed (i.e. for 9600 bit/s to 300 bit/s the end-to-end speed would be 300 bit/s), and that speed matching is only performed if practicable.

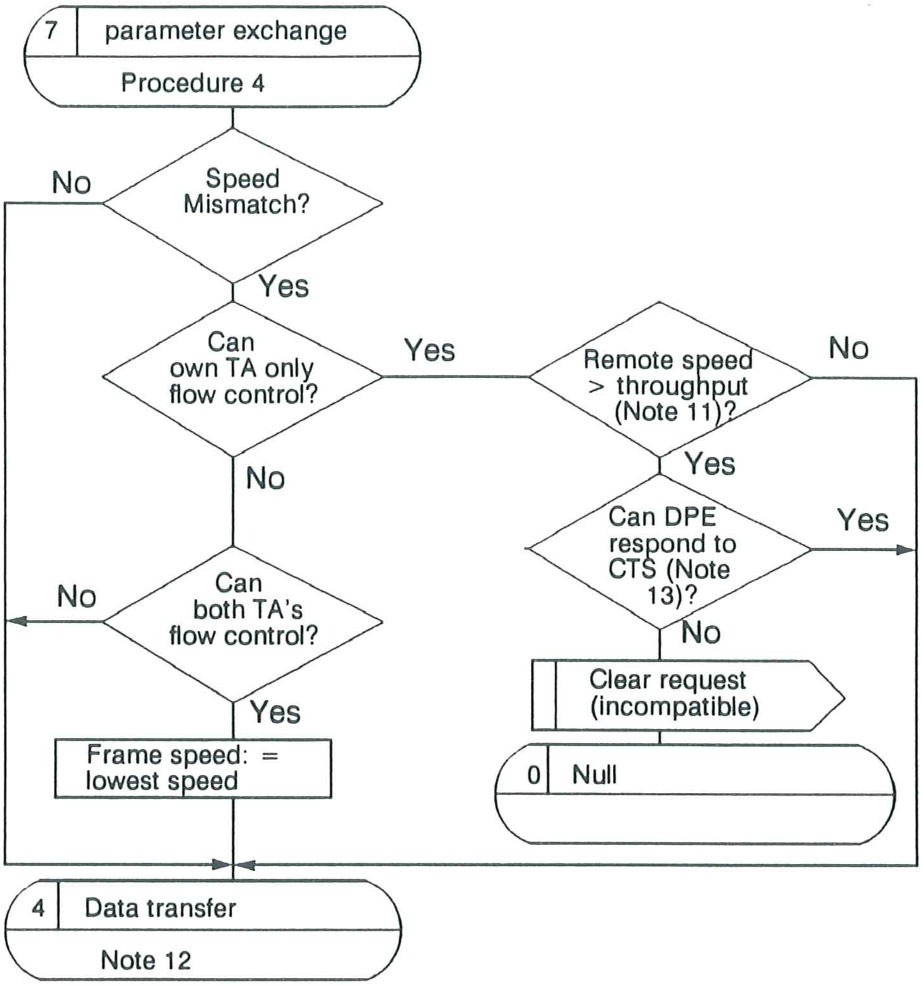


Figure 27 - Resolution of End-to-End Speed Conversion

Note 11

Where throughput is the rate that a high data rate would be reduced to by the overhead associated with the flow control process.

Note 12

Or State 8 Await Resync, dependent on the bearer rate used for the parameter exchange.

Note 13

See 9.4 Figure 14 where bit CTS indicates if the remote DPE can respond to circuit 106 flow control, i.e. end-to-end flow control operation of the X bit of the ECMA-102 frame will be effective as the flow control mechanism (see 9.2 of Standard ECMA-102).

APPENDIX A

LIST OF ACRONYMS

DPE	Data Processing Equipment
ISDN	Integrated Services Digital Network
IPE	In-band Parameter Exchange
IWU	Inter-Working Unit
MNT	Maintenance
NIC	Network Independent Clock
PARAM-X	Parameter X (X = 0, 1, 2, 3, 4)
PCSN	Private Circuit Switched Network
PSN	Private Switched Network
RA	Rate Adaptation
TA	Terminal Adaptor
TA'	Terminal Adaptor for use with a private pre-ISDN network
TE1	Terminal Equipment Type 1
TE2	Terminal Equipment Type 2
Tn	Timer Tn (n = 1, 2, 3, 4)

APPENDIX B

SUMMARY OF CHANGES INCORPORATED IN THE SECOND EDITION OF STANDARD ECMA-123

The Second Edition of Standard ECMA-123 clarifies and provides explanatory text for a number of details which will ease implementation of the Standard, as outlined below.

The entry to the Data Transfer state (State 4) has been clarified to ensure that the B-channel is clear of ECMA-123 commands (see 8.3.3 and the new Figure 3a).

A new Timer T4 (of 1 second duration) has been added to allow time for a subsequent parameter exchange in the event of the parameters being incompatible (see 8.3.2 and 10.1).

A full/half duplex code point (DX) has been added to Figure 14 - Parameter 4 Encoding, in order to distinguish between the two modes of ECMA-102 data transfer S - bit mapping.

A code point (CTS) has been added to Figure 14 - Parameter 4 Encoding, in order to distinguish between a DPE which can be end-to-end flow-controlled directly by circuit 106 and those which require TA' intervention.

Clause 12 has been added to provide procedures to ensure the compatible connection of terminal adaptors.