Standard ECMA-245
June 1996

ECMA

Standardizing Information and Communication Systems

Private Integrated Services Network (PISN) - Inter-Exchange Signalling Protocol - PINX Clock Synchronization

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(SYNC-SIG)

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Brief History

This Standard is one of a series of ECMA standards defining services and signalling protocols applicable to Private Integrated Services Networks. The series uses the ISDN concepts as developed by ITU-T (formerly CCITT) and is also within the framework of standards for open systems interconnection as defined by ISO.

This particular Standard specifies the signalling protocol for the support of PINX clock synchronization.

The Standard is based upon the practical experience of ECMA member companies and the results of their active and continuous participation in the work of ISO/IEC JTC1, ITU-T, ETSI and other international and national standardization bodies. It has been produced under ETSI work item DE/ECMA-00115. It represents a pragmatic and widely based consensus.

This ECMA Standard is contributed to ISO/IEC JTC1 under the terms of the fast-track procedure, for adoption as an ISO/IEC International Standard.

This ECMA Standard has been adopted by the ECMA General Assembly of June 1996.

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1 Scope

This Standard specifies the signalling protocol for the support of clock synchronization (SYNC-SIG) between Private Integrated Services Network Exchanges (PINXs) connected together within a Private Integrated Services Network (PISN).

This protocol supports the synchronization of a PISN using the different sources of clocks available to each PINX. The protocol is based on the method of synchronization described in annex F of the International Standard ISO/IEC 11573.

This Standard is applicable to PINXs which can be interconnected to form a PISN.

2 Conformance

In order to conform to this Standard, a PINX shall satisfy the requirements identified in the Protocol Implementation Conformance Statement (PICS) proforma in annex A.

3 References

ISO/IEC 11573	Information technology - Telecommunications and information exchange between systems - Synchronization methods and technical requirements for Private Integrated Services Networks (1994)
ISO/IEC 11579-1	Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network - Part 1: Reference configuration for PISN exchanges (PINX) (1994)
ISO/IEC 11582	Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network - Generic functional protocol for the support of supplementary services - Inter-exchange signalling procedures and protocol (1995)
CCITT Rec. I.112	Vocabulary of terms for ISDNs (1988)
CCITT Rec. Z.100	Specification and description language (1988)

4 Definitions

For the purpose of this Standard the following definitions apply.

4.1 External definitions

This Standard uses the following terms defined in other documents:

- Application Protocol Data Unit (ISO/IEC 11582)
- End PINX (ISO/IEC 11582)
- Interpretation APDU (ISO/IEC 11582)
- Private Integrated Services Network (PISN) (ISO/IEC 11579-1)
- Private Integrated Services Network Exchange (PINX) (ISO/IEC 11579-1)
- Signalling (CCITT Rec. I.112)
- Originating PINX (ISO/IEC 11582)
- Terminating PINX (ISO/IEC 11582)

4.2 Adjacent PINX

One of two PINXs that are directly connected by means of an inter-PINX link.

4.3 Requesting PINX

PINX that initiates a confirmed or unconfirmed transaction.

4.4 Destination PINX

PINX which is the target of a confirmed or unconfirmed transaction.

4.5 Synchronization Entity

Entity which is in charge of the synchronization in a PINX.

NOTE 1

The functions of the Synchronization Entity are described in ISO/IEC 11573.

5 List of acronyms

APDU	Application Protocol Data Unit
ASN.1	Abstract Syntax Notation One
ISDN	Integrated Services Digital Network
NFE	Network Facility Extension
PICS	Protocol Implementation Conformance Statement
PINX	Private Integrated Network Exchange
PISN	Private Integrated Service Network
SDL	Specification and Description Language

6 Signalling protocol for the support of the protocol

6.1 Description

When two or more PINXs are connected to each other, it is required by ISO/IEC 11573 that these PINXs shall work for transmission with the same clock value: in that case PINXs are "synchronized". Without such synchronization, information can be lost from one PINX to another.

ISO/IEC 11573 describes the "clock synchronization" in detail and defines a method to use for a network synchronization. The signalling protocol for this method is defined in this Standard. The protocol involves the exchange of APDUs between adjacent PINXs using the call-independent signalling connection (connection-oriented) transport mechanism specified in ISO/IEC 11582.

6.2 Operational requirements

Generic procedures for the call-independent control (connection-oriented), as specified in ISO/IEC 11582 for an Originating PINX and Terminating PINX, shall apply.

A Synchronization Entity which can be called by a predetermined called party number shall exist in each PINX.

6.3 Coding requirements

6.3.1 Operations

To convey information defined by the method of synchronization in messages, the operations defined in Abstract Syntax Notation number 1 (ASN.1) in table 1 shall apply.

Table 1 - Operations in support of clock synchronization

```
Synchronization-Operations
                    { iso (1) identified-organization (3) icd-ecma (0012) standard (0)
                    qsig-synchronization (245) synchronization-operations (0) }

DEFINITIONS EXPLICIT TAGS       ::=

BEGIN

IMPORTS             OPERATION, ERROR FROM Remote-Operation-Notation
                            { joint-iso-ccitt (2) remote-operations (4) notation (0) }
                    Extension FROM Manufacturer-specific-service-extension-definition
                            {iso  (1)  standard (0)
                            pss1-generic-procedures (11582) msi-definition (0)};

-- The following two operations shall apply to SYNC-SIG

SynchronizationRequest      ::=     OPERATION
                                        ARGUMENT            SynchronizationReqArg
                                        RESULT              SynchronizationReqRes
                                        ERRORS              {unspecified}
SynchronizationInfo         ::=     OPERATION
                                        ARGUMENT            SynchronizationInfoArg

SynchronizationReqArg       ::=     SEQUENCE {
                                        type                Type,
                                        argExtension        ArgExtension OPTIONAL}

SynchronizationReqRes       ::=     SEQUENCE {
                                        type Type,
                                        response            BOOLEAN,  -- 1 = yes, 0 = no
                                        argExtension        ArgExtension OPTIONAL}

SynchronizationInfoArg      ::=     SEQUENCE {
                                        stateinfo INTEGER   { freerunning (0), idle (1)},
                                        argExtension ArgExtension OPTIONAL}

Type                ::= INTEGER     { enslavement (0), holdon (1)}
ArgExtension        ::= CHOICE      {extension [1] IMPLICIT Extension,
                                    sequOfExtn [2] IMPLICIT SEQUENCE OF Extension }

synchronizationRequest      SynchronizationRequest      ::= 78
synchronizationInfo         SynchronizationInfo         ::= 79

unspecified                 Unspecified                 ::= { ptn 1008 }
Unspecified                 ERROR                       PARAMETER Extension

END -- of Synchronization-Operations
```

6.3.2 Information elements

6.3.2.1 Facility information element

The operations defined in 6.3.1 shall be coded in the Facility information element in accordance with ISO/IEC 11582.

When conveying the invoke APDU of the operations defined in 6.3.1, the destinationEntity data element of the NFE shall contain value endPINX and the interpretation APDU shall either be omitted or be included with the value rejectAnyUnrecognisedInvokePdu.

6.3.2.2 Other information elements

Any other information element (e.g. Called party number) shall be coded in accordance with ISO/IEC 11582.

6.3.3 Messages

The transport mechanism is based on call-independent signalling connection (connection-oriented).The Facility information element shall be conveyed in the FACILITY message as specified in clause 10 of ISO/IEC 11582.

6.4 State definitions

The procedures for each PINX in the network are written in terms of the following conceptual states existing within the SYNC-SIG control entity in that PINX.

6.4.1 States at the Requesting PINX

6.4.1.1 SYNC-Idle

This state exists when the connection for synchronization is not established (exchange of information is not possible).

6.4.1.2 SYNC-Active

This state exists when the connection for synchronization is established (exchange of information is possible).

6.4.1.3 SYNC-Wait

This state exists when the connection is established and a synchronizationRequest invoke APDU is sent to the Destination PINX and the response is not yet received.

6.4.2 States at the Destination PINX

6.4.2.1 SYNC-Idle

This state exists when the connection for synchronization is not established (exchange of information is not possible).

6.4.2.2 SYNC-Active

This state exists when the connection for synchronization is established (exchange of information is possible).

6.5 Signalling procedures

Annex B contains examples of message sequences of the signalling procedures.

6.5.1 Actions at the Requesting PINX

The SDL representation of procedures of the Requesting PINX is shown in C.1 of annex C.

NOTE 2

Choice of information to request by the Requesting PINX and actions in the Synchronization Entity on receipt or absence of response from the Destination PINX are to be made in conformance with ISO/IEC 11573 and are outside the scope of this Standard.

6.5.1.1 Normal procedures

In state SYNC-Idle, on request of the Synchronization Entity the SYNC-SIG Control entity shall invoke SYNC-SIG towards an adjacent PINX. The Requesting PINX shall act as an Originating PINX and establish a call-independent signalling connection (connection-oriented) towards the Terminating PINX using the specific called party number given by the Synchronization entity. The SYNC-SIG Control entity shall inform the Synchronization Entity when the connection is established and enters state SYNC-Active. Only the call reference of this call-independent signalling connection shall be used to transport SYNC-SIG operations. On

request of the Synchronization Entity, the SYNC-SIG Control entity releases the connection towards the adjacent PINX and SYNC-SIG enters state SYNC-Idle.

In states SYNC-Wait and SYNC-Idle, requests from the Synchronization Entity for sending information to the adjacent PINX are ignored. In SYNC-Active state, if the Synchronization Entity requests for sending information not requiring a response (free-running, idle), the Requesting PINX shall send a synchronizationInfo invoke APDU, and remain in state SYNC-Active.

In state SYNC-Active, if the Synchronization Entity requests for sending information requiring a response from the Destination PINX (enslavement or holdon request), the Requesting PINX shall send a synchronizationRequest invoke APDU, start timer T1, and enter state SYNC-Wait. In state SYNC-Wait, on receipt of the synchronizationRequest return result APDU from the Destination PINX, the Requesting PINX shall convey the result to the Synchronization Entity, stop timer T1, and enter state SYNC-Active.

In state SYNC-Wait, if the connection is released, the Requesting PINX shall inform the Synchronization Entity, stop timer T1, and enter state SYNC-Idle. In state SYNC-Active, if the connection is released by the adjacent PINX, the Requesting PINX shall inform Synchronization Entity and enter state SYNC-Idle.

6.5.1.2 Exceptional procedures

In state SYNC-Wait, on receipt of the synchronizationRequest return error APDU from the Destination PINX, the Requesting PINX shall inform the Synchronization Entity, stop timer T1, and enter state SYNC-Active. If timer T1 expires in state SYNC-Wait, the Requesting PINX shall inform the Synchronization Entity, and enter state SYNC-Active.

6.5.2 Actions at the Destination PINX

The SDL representation of procedures of the Destination PINX is shown in C.2 of annex C.

NOTE 3

Choice of response to send by the Destination PINX and actions in the Synchronization Entity on receipt of requests from the Requesting PINX are to be made in conformance with ISO/IEC 11573 and are outside the scope of this Standard.

6.5.2.1 Normal procedures

The call reference of the call-independent signalling connection that was established by the Requesting PINX shall be used to transport SYNC-SIG operations.

The SYNC-SIG Control entity shall inform the Synchronization Entity when the connection is established and enter state SYNC-Active.

In state SYNC-Active, on receipt of the synchronizationRequest invoke APDU or synchronizationInfo invoke APDU from the Requesting PINX, the Destination PINX shall convey the information to the Synchronization Entity and remain in state SYNC-Active. In state SYNC-Active, if the Synchronization Entity requests sending a response to a synchronizationRequest invoke APDU, the Destination PINX shall send a synchronizationRequest return result APDU to the Requesting PINX and remain in state SYNC-Active.

On request of the Synchronization Entity, the Destination PINX shall release the connection towards the Requesting PINX and enter state SYNC-Idle.

In state SYNC-Active, if the connection is released by the adjacent PINX, the Destination PINX shall inform the Synchronization Entity and enter state SYNC-Idle.

6.5.2.2 Exceptional procedures

Not applicable.

6.6 Impact of interworking with public ISDNs

Not applicable.

6.7 Impact of interworking with non-ISDNs

Not applicable.

6.8 Protocol interactions between Synchronization and supplementary services and ANFs

Not applicable.

6.9 Parameter values (timers)

6.9.1 Timer T1

Timer T1 operates at the Requesting PINX in state SYNC-Wait. Its purpose is to protect against the absence of a response to the synchronizationRequest invoke APDU.

Timer T1 shall have a value not less than 15 s.

Annex A

(normative)

Protocol Implementation Conformance Statement (PICS) Proforma

A.1 Introduction

The supplier of a protocol implementation which is claimed to conform to this Standard shall complete the Protocol Implementation Conformance Statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. The PICS can have a number of uses, including use:

- by a protocol implementer, as a check-list to reduce the risk of failure to conform to the standard through oversight;
- by the supplier and acquirer (or potential acquirer) of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma;
- by the user (or potential user) of the implementation, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking cannot be guaranteed, failure to interwork can often be predicted from incompatible PICS);
- by a protocol tester, as the basis for selecting appropriate tests against which to asses the claim for conformance of the implementation.

A.2 Instructions for completing the PICS proforma

A.2.1 General structure of the PICS proforma

The PICS proforma is a fixed-format questionnaire divided into subclauses each containing a group of individual items. Each item is identified by an item number, the name of the item (question to be answered) and the reference(s) to the clause(s) that specifies (specify) the item in the main body of this Standard.

The "Status" column indicates whether an item is applicable and, if so, whether support is mandatory or optional. The following terms are used:

m	mandatory (the capability is required for conformance to the protocol);
o	optional (the capability is not required for conformance to the protocol, but if the capability is implemented it is required to conform to the protocol specifications);
o.<n>	optional, but support of at least one of the group of options labelled by the same numeral <n> is required;
x	prohibited;
c.<cond>	conditional requirement, depending on support for the item or items listed in condition <cond>;
<item>:m	simple conditional requirement, the capability being mandatory if item number <item> is supported, otherwise not applicable;
<item>:o	simple conditional requirement, the capability being optional if item number <item> is supported, otherwise not applicable.

Answers to the questionnaire items are to be provided either in the "Support" column, by simply marking an answer to indicate a restricted choice (Yes or No) or in the "Not Applicable" column (N/A).

A.2.2 Additional information

Items of additional information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and a PICS can be considered complete without any such information. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations.

References to items of additional information may be entered next to any answer in the questionnaire, and may be included in items of exception information.

A.2.3 Exception information

It may occasionally happen that a supplier will wish to answer an item with mandatory or prohibited status (after any conditions have been applied) in a way that conflicts with the indicated requirements. No pre-printed answer will be found in the Support column for this. Instead, the supplier is required to write into the Support column an x.<i> reference to an item of exception information, and to provide the appropriate rationale in the exception item itself.

An implementation for which an exception item is required in this way does not conform to this Standard. A possible reason for the situation described above is that a defect in the Standard has been reported, a correction for which is expected to change the requirement not met by the implementation.

A.3 PICS proforma for ECMA-245

A.3.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation name(s) and version(s)	
Other information necessary for full identification, e.g. name(s) and version(s) for machines and/or operating systems; system name(s)	

Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification.

The terms name and version should be interpreted appropriately to correspond with a supplier's terminology (e.g. type, series, model).

A.3.2 Protocol summary

Protocol version	1.0
Addenda implemented (if applicable)	
Amendments implemented	
Have any exception items been required (see A.2.3)?	No [ ] Yes [ ] (The answer Yes means that the implementation does not conform to this Standard)

Date of Statement	

A.3.3 Procedures

Item	Question/feature	Reference	Status	N/A	Support
A1	Support of ISO/IEC 11582 procedures at Requesting PINX	6.2	m		Yes [ ]
A2	Support of ISO/IEC 11582 procedures at Destination PINX	6.2	m		Yes [ ]
A3	Signalling procedures at Requesting PINX	6.5	m		Yes [ ]
A4	Signalling procedures at Destination PINX	6.5	m		Yes [ ]

A.3.4 Coding

Item	Question/feature	Reference	Status	N/A	Support
B1	Receipt of synchronizationRequest invoke APDU and sending or return result and return error APDUs	6.3	m		Yes [ ]
B2	Sending of synchronizationRequest invoke APDU and receipt or return result and return error APDUs	6.3	m		Yes [ ]
B3	Receipt of synchronizationInfo invoke APDU	6.3	m		Yes [ ]
B4	Sending of synchronizationInfo invoke APDU	6.3	m		Yes [ ]

A.3.5 Timers

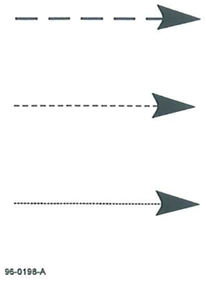
Item	Question/feature	Reference	Status	N/A	Support
C1	Support of timer T1	6.9	m		Yes [ ] Value [.....]

Annex B

(informative)

Examples of Message Sequences

This annex describes some typical message flows of Synchronization. The following conventions are used in the figures of this annex.



xxx.inv : Invoke APDU for operation xxx

xxx.res : Return result APDU for operation xxx

1. The figures show messages exchanged via Protocol Control between PINXs involved in Synchronization.
2. Only the relevant information content (i.e. remote operation APDUs) is listed below each message name. The Facility information elements containing remote operation APDUs are not explicitly shown. Information with no impact on Synchronization is not shown.

B.1 Message sequences for Synchronization

Figures B.1, B.2 and B.3 show examples of messages sequences for clock synchronization.

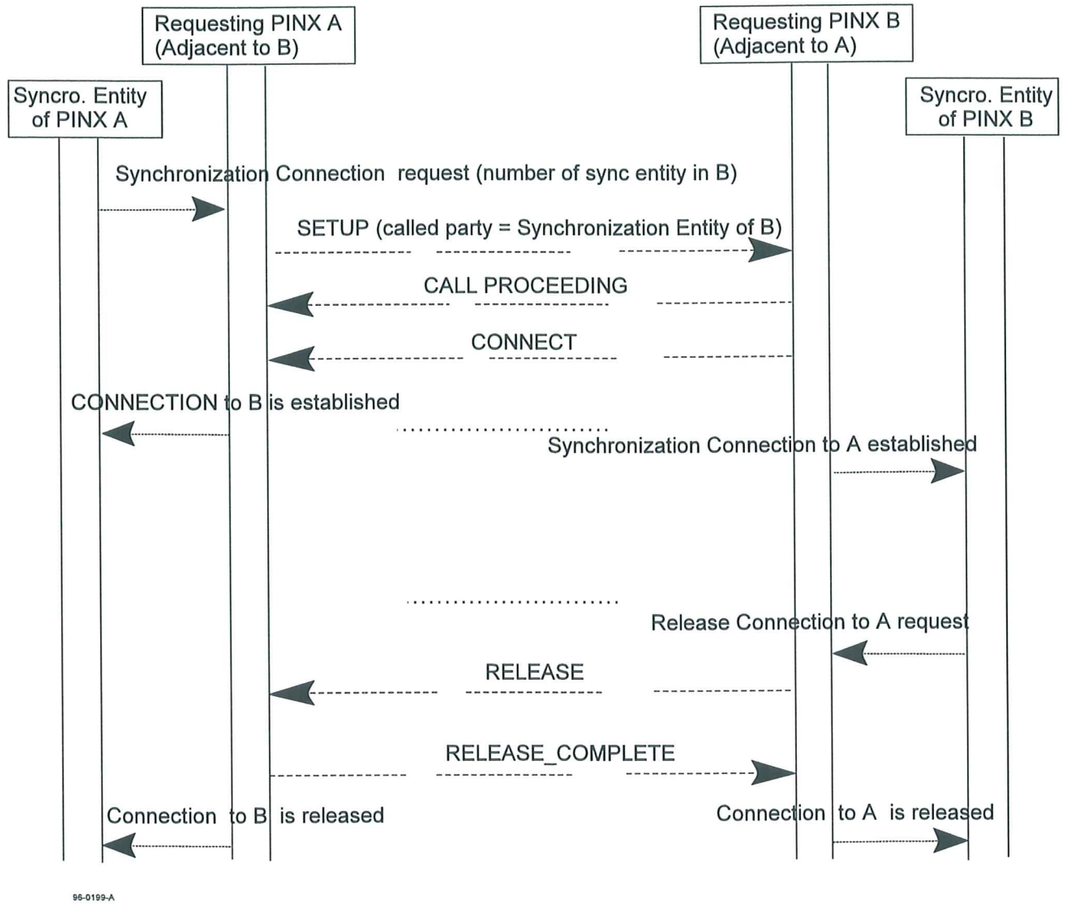


Figure B.1 - Establishment and release of call-independent signalling connection for Synchronization between two adjacent PINXs

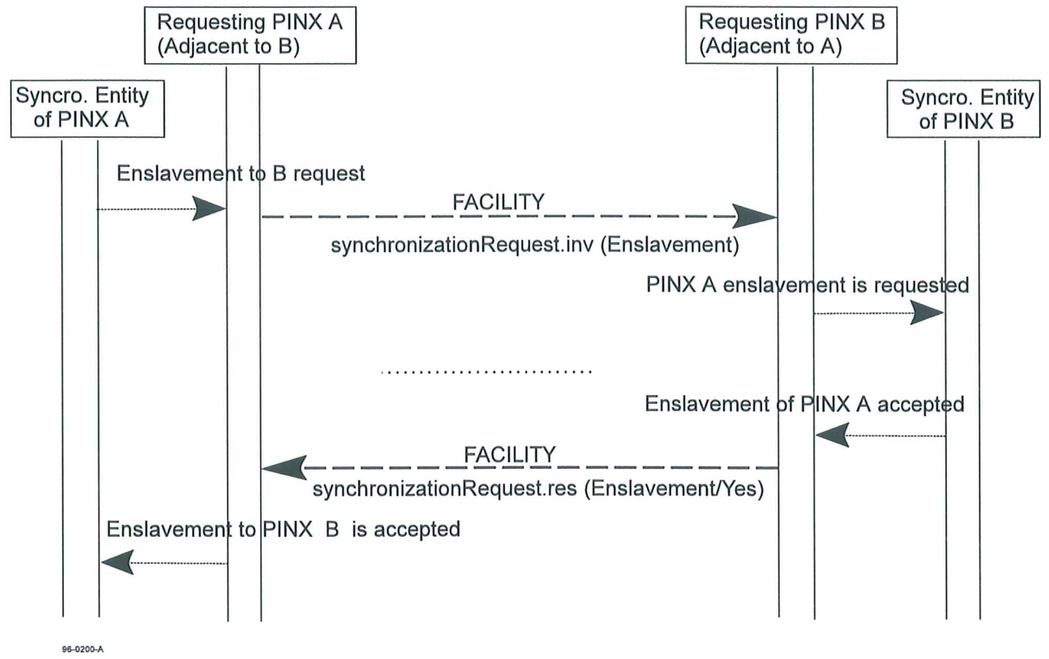


Figure B.2 - Successful clock enslavement of PINX A to adjacent PINX B

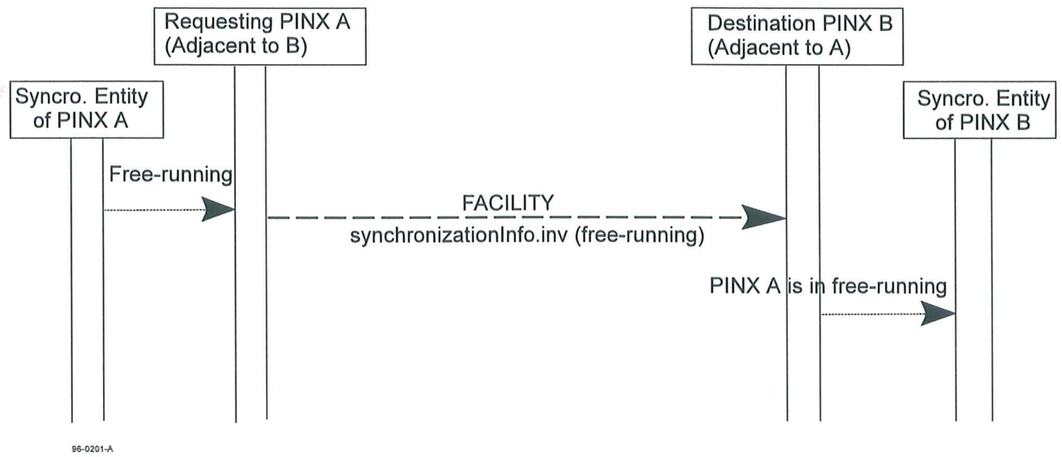


Figure B.3 - End of enslavement - PINX A informs PINX B that it is now in free-running state (it is running with its own clock source)

Annex C

(informative)

Specification and Description Language (SDL) Representation of Procedures

The diagrams in this annex use the Specification and Description Language defined in CCITT Rec. Z.100 (1988).

Each diagram represents the behavior of a Synchronization Control entity at a particular type of PINX. In accordance with the protocol model described in ISO/IEC 11582, the Control entity uses, via the Coordination Function, the services of Generic Functional Procedures Control.

Where an output symbol represents a primitive to the Coordination Function, and that primitive results in a message being sent, the output bears the name of the message and any remote operations APDU(s) or notification(s) contained in that message.

Where an input symbol represents a primitive from the Coordination Function and that primitive is the result of a message being received, the input signal bears the name of the message and any remote operation APDU(s) or notification(s) contained in that message.

The following abbreviations are used:

xxx.inv	:	Invoke APDU for operation xxx
xxx.res	:	Return result APDU for operation xxx
xxx.err	:	Return error APDU for operation xxx
xxx.rej	:	Reject APDU for operation xxx

NOTE

All operations are in the Facility information element and carried in the FACILITY message. This is not shown in the boxes of the diagram.

C.1 SDL representation of ECMA-SYNC-SIG at the Requesting PINX

Figure C.1 shows the behaviour of a SYNC-SIG Control entity within the Requesting PINX.

Input signals from the right and output signals to the right represent primitives from and to the Coordination Function in respect of messages being received and sent.

Input signals from the left and outputs signals to the left represent primitives between the Synchronization Control entity and the entity which controls synchronization in the PINX.

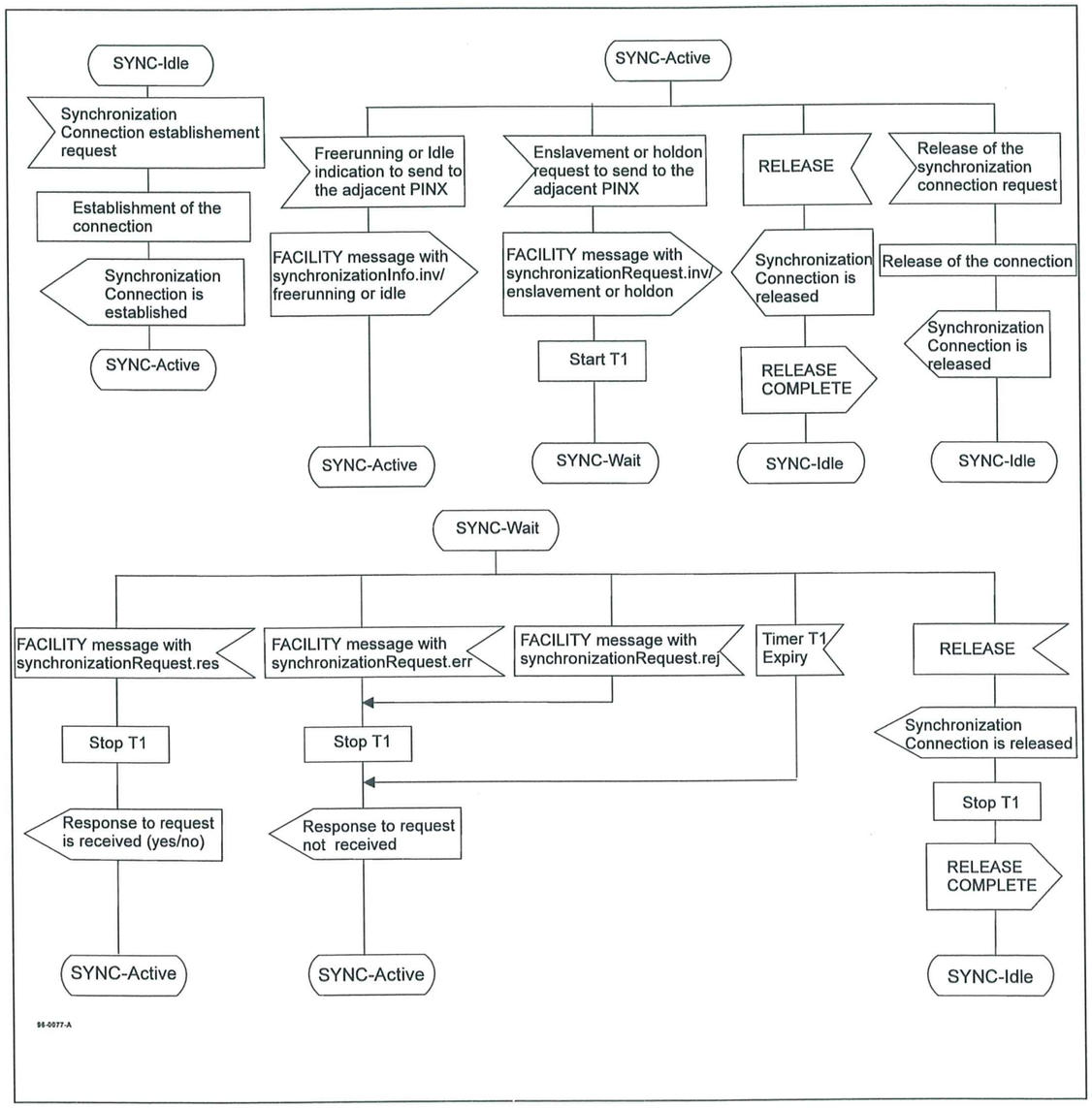


Figure C.1 - SDL representation of SYNC-SIG at the Requesting PINX

C.2 SDL representation of ECMA-SYNC-SIG at the Destination PINX

Figure C.2 shows the behaviour of a SYNC-SIG Control entity within the Destination PINX.

Input signals from the right and output signals to the right represent primitives from and to the Coordination Function in respect of messages being received and sent.

Input signals from the left and outputs signals to the left represent primitives between the Synchronization Control entity and the entity which controls synchronization in the PINX.

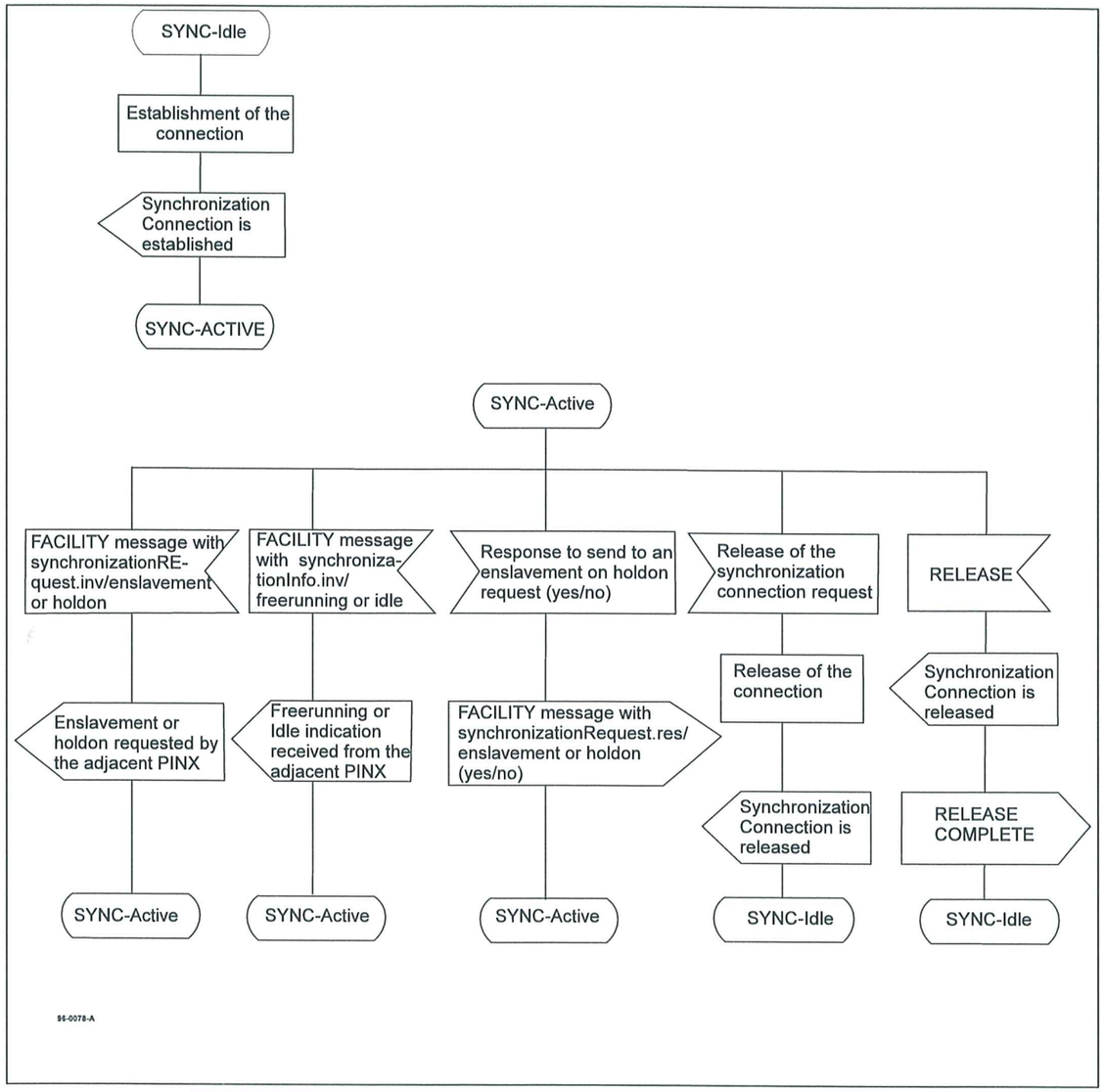


Figure C.2 - SDL representation of SYNC-SIG at the Destination PINX

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Files can be downloaded from our FTP site, **ftp.ecma.ch,** logging in as **anonymous** and giving your E-mail address as **password**. This Standard is available from library **ECMA-ST** as a compacted, self-expanding file in MSWord 6.0 format (file E245-DOC.EXE) and as a compacted, self-expanding PostScript file (file E245-PSC.EXE). File E245-EXP.TXT gives a short presentation of the Standard.

The ECMA site can be reached also via a modem. The phone number is +41 22 735.33.29, modem settings are 8/n/1. Telnet (at ftp.ecma.ch) can also be used.

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