E C M A

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-176

PRIVATE TELECOMMUNICATION NETWORKS (PTN)

-

INTER-EXCHANGE SIGNALLING PROTOCOL

-

PATH REPLACEMENT ADDITIONAL NETWORK FEATURE

(QSIG-PR)

June 1992

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Brief History

This Standard is one of a series of ECMA Standards defining services and signalling protocols applicable to Private Telecommunication Networks (PTNs). The series uses the ISDN concepts as developed by CCITT and is also within the framework of standards for open systems interconnection as defined by ISO. It has been produced with the intention of submission to ETSI as a proposed ETS.

This particular Standard specifies the signalling protocol for use at the Q reference point in support of the Path Replacement additional network feature.

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, CCITT, ETSI and other international and national standardization bodies. It represents a pragmatic and widely based consensus.

This ECMA Standard has been contributed to ETSI for adoption as an ETS.

Adopted as an ECMA Standard by the General Assembly of June 1992.

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1 Scope

This Standard specifies the signalling protocol for the support of the Path Replacement additional network feature (ANF-PR) at the Q reference point between Private Telecommunication Network Exchanges (PTNXs) connected together within a Private Telecommunication Network (PTN).

ANF-PR is a feature which applies to an established call, allowing that call's connection through the PTN to be replaced by a new connection.

The Q reference point is defined in ECMA-133. Other Standards define protocols for use at other reference points, notably the S reference point between a PTNX and a Terminal Equipment. However, ANF-PR has impact on the signalling protocol only at the Q reference point.

Service specifications are produced in three stages and according to the method specified in ENV 41005. This Standard is the output from stage 3, the definition of signalling protocols, for ANF-PR. This Standard satisfies the requirements identified by the stage 1 and stage 2 specifications in ECMA-175.

The signalling protocol for ANF-PR operates on top of the signalling protocol for basic circuit switched call control, as specified in ECMA-143, and uses certain aspects of the generic procedures for the control of supplementary services specified in ECMA-165.

The impact on the protocol of interactions between the ANF specified in this Standard and other supplementary services and ANFs is outside the scope of this Standard.

This Standard is applicable to PTNXs which can interconnect to form a PTN.

2 Conformance

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

3 References

ECMA-133	Reference Configurations for Calls through Exchanges of Private Telecommunication Networks (1989)
ECMA-142	Specification, Functional Model and Information Flows for Control Aspects of Circuit Mode Basic Services in Private Telecommunication Networks (1990)
ECMA-143	Layer 3 Protocol for Signalling between Exchanges of Private Telecommunication Networks for the Control of Circuit-Switched Calls (1990)
ECMA-155	Addressing in Private Telecommunication Networks (1991)
ECMA-165	Private Telecommunication Networks - Signalling between Private Telecommunication Network Exchanges - Generic Functional Protocol for the Support of Supplementary Services (1992)
ECMA-175	Private Telecommunication Networks - Specification, Functional Model and Information Flows - Path Replacement Additional Network Feature (1992)
CCITT Rec. I.112 (1988)	Vocabulary of terms for ISDNs
CCITT Rec. I.210 (1988)	Principles of telecommunication services supported by an ISDN and the means to describe them
CCITT Rec. Z.100 (1988)	Specification and description language

ENV 41005 (1989)	Method for the Specification of Basic and Supplementary Services of Private Telecommunication Networks
ENV 41007 (1989)	Definition of Terms in Private Telecommunication Networks

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:

- ANF-PR user (ECMA-175)
- Application Protocol Data Unit (APDU) (ECMA-165)
- Basic Service (CCITT Rec. I.210)
- Call, Basic Call (ECMA-165)
- Connection (ECMA-175)
- Incoming Gateway PTNX (ECMA-143)
- Interpretation APDU (ECMA-165)
- Network Facility Extension (NFE) (ECMA-165)
- New Connection (ECMA-175)
- Old Connection (ECMA-175)
- Originating PTNX (ECMA-143)
- Outgoing Gateway PTNX (ECMA-143)
- Private (ENV 41007)
- Private Telecommunication Network Exchange (PTNX) (ENV 41007)
- Public ISDN (ENV 41007)
- Signalling (CCITT Rec. I.112)
- Supplementary Service (CCITT Rec. I.210)
- Supplementary Services Control Entity (ECMA-165)
- Telecommunication Network (ENV 41007)
- Terminating PTNX (ECMA-143)
- Transit PTNX (ECMA-143)
- Trombone Connection (ECMA-175)
- User (except in the context of ANF-PR user) (ECMA-142)

4.2 Branching PTNX

The Transit PTNX at which the retained connection finishes and the new connection starts.

4.3 Cooperating PTNX

The End PTNX which initiates the establishment of the new connection towards other End PTNX involved in the call.

4.4 End PTNX

Within the context of a call, a PTNX which is not acting as a Transit PTNX, i.e. an Originating PTNX, a Terminating PTNX, an Incoming Gateway PTNX or an Outgoing Gateway PTNX.

4.5 Preceding PTNX

The adjacent PTNX in the direction of the Cooperating PTNX, relative to a particular PTNX involved in the old connection.

NOTE 1

This can be the Cooperating PTNX itself or a Transit PTNX.

4.6 Replaced connection

That part of the old connection which is not retained and is replaced by the new connection.

4.7 Requesting PTNX

The End PTNX which invokes ANF-PR and towards which the new connection is routed.

4.8 Retained connection

That part of the old connection which is retained and not replaced by the new connection.

4.9 Subsequent PTNX

The adjacent PTNX in the direction of the Requesting PTNX, relative to a particular PTNX involved in the old connection.

NOTE 2

This can be the Requesting PTNX itself or a Transit PTNX.

5 List of acronyms

ANF-PR	Path Replacement Additional Network Feature
APDU	Application Protocol Data Unit
ASN.1	Abstract Syntax Notation no. 1
ISDN	Integrated Services Digital Network
NFE	Network Facility Extension
PICS	Protocol Implementation Conformance Statement
PTN	Private Telecommunication Network
PTNX	Private Telecommunication Network Exchange
SDL	Specification and Description Language

6 Signalling protocol for the support of ANF-PR

6.1 ANF-PR description

ANF-PR is invoked by an ANF-PR user for an established call, allowing that call's connection through the PTN to be replaced by a new connection. If the new connection is required to satisfy certain criteria, ANF-PR should be used in conjunction with other supplementary services and/or ANFs. In the absence of specific criteria, the new connection should be established using the routeing rules which apply to basic call establishment.

NOTE 3

Annex A of ECMA-175 gives examples of the circumstances under which ANF-PR can be used and criteria which can govern the selection of the new connection.

The Requesting PTNX shall request the Cooperating PTNX to attempt the establishment of a new connection from the Cooperating PTNX to the Requesting PTNX. If successful, the new connection shall replace the old connection.

NOTE 4

The Requesting PTNX can be either End PTNX involved in a call, i.e. the Originating PTNX or the Terminating PTNX or, in the case of interworking with another network, the Incoming Gateway PTNX or Outgoing Gateway PTNX.

Optional procedures and coding are specified for allowing the retention of one or more elements of the old connection, starting from the Cooperating PTNX and continuing as far as a Transit PTNX, subject to any given criteria being achievable in that way. A new connection is established from the Transit PTNX to the Requesting PTNX instead of from the Cooperating PTNX to the Requesting PTNX.

6.2 ANF-PR operational requirements

6.2.1 Requirements on the Cooperating PTNX

ANF-PR shall be applicable to a call whose protocol control state, as defined in ECMA-143, is Active.

NOTE 5

State Active will have been reached as a result of ECMA-143 call establishment procedures, possibly in conjunction with supplementary service and/or ANF procedures.

ECMA-143 protocol control procedures for call establishment at the outgoing side of an inter-PTNX link shall apply to the establishment of the new connection. ECMA-143 protocol control procedures for call clearing shall apply to the release of the old connection in the event of successful switchover to the new connection.

Generic procedures for the call-related control of supplementary services, as specified in ECMA-165 for an End PTNX, shall apply.

6.2.2 Requirements on the Requesting PTNX

ANF-PR shall be applicable to a call whose protocol control state, as defined in ECMA-143, is Active.

NOTE 6

State Active will have been reached as a result of ECMA-143 call establishment procedures, possibly in conjunction with supplementary service and/or ANF procedures.

ECMA-143 protocol control procedures for call establishment at the incoming side of an inter-PTNX link shall apply to the establishment of the new connection. ECMA-143 protocol control procedures for call clearing shall apply to the release of the old connection in the event of successful switchover to the new connection.

Generic procedures for the call-related control of supplementary services, as specified in ECMA-165 for an End PTNX, shall apply.

6.2.3 Requirements on a Transit PTNX

6.2.3.1 Transit PTNX Involved in the replaced connection

ANF-PR shall be applicable to a call whose protocol control state, as defined in ECMA-143, on each of the two links (incoming and outgoing) is Active and whose call control state, as defined in ECMA-143 is TCC_Active.

NOTE 7

State Active will have been reached as a result of ECMA-143 call establishment procedures, possibly in conjunction with supplementary service and/or ANF procedures.

ECMA-143 protocol control and call control procedures for call clearing at a Transit PTNX shall apply to the release of the old connection in the event of successful switchover to the new connection.

Generic procedures for the call-related control of supplementary services, as specified in ECMA-165 for a Transit PTNX, shall apply. For ANF-PR the requirements are limited to the passing on of Facility information elements for which the destination, as indicated in the Network Facility Extension (NFE), is not the Transit PTNX.

6.2.3.2 Transit PTNX Involved in the new connection

ECMA-143 protocol control and call control procedures for call establishment at a Transit PTNX shall apply to the establishment of the new connection.

ECMA-143 protocol control and call control procedures for call clearing at a Transit PTNX shall apply to the release of the new connection in the event of failure to complete ANF-PR successfully.

Generic procedures for the call-related control of supplementary services, as specified in ECMA-165 for a Transit PTNX, shall apply. For ANF-PR the requirements are limited to the passing on of Facility information elements for which the destination, as indicated in the Network Facility Extension (NFE), is not the Transit PTNX.

6.2.3.3 Transit PTNX Involved in the retained connection

The procedures below are applicable only if the optional procedures for retention of part of the old connection (6.6) are supported.

ANF-PR shall be applicable to a call whose protocol control state, as defined in ECMA-143, on each of the two links (incoming and outgoing) is Active and whose call control state, as defined in ECMA-143 is TCC_Active.

NOTE 8

State Active will have been reached as a result of ECMA-143 call establishment procedures, possibly in conjunction with supplementary service and/or ANF procedures.

Generic procedures for the call-related control of supplementary services, as specified in ECMA-165 for a Transit PTNX, shall apply.

6.2.3.4 Branching PTNX

The procedures below are applicable only if the optional procedures for retention of part of the old connection (6.6) are supported.

ANF-PR shall be applicable to a call whose protocol control state, as defined in ECMA-143, on each of the two links (incoming and outgoing) is Active and whose call control state, as defined in ECMA-143 is TCC_Active.

NOTE 9

State Active will have been reached as a result of ECMA-143 call establishment procedures, possibly in conjunction with supplementary service and/or ANF procedures.

ECMA-143 protocol control procedures for call establishment at the outgoing side of an inter-PTNX link shall apply to the establishment of the new connection. ECMA-143 protocol control procedures for call clearing shall apply to the release of the replaced connection in the event of successful switchover to the new connection.

Generic procedures for the call-related control of supplementary services, as specified in ECMA-165 for a Transit PTNX, shall apply.

6.3 ANF-PR coding requirements

6.3.1 Operations

The operations defined in Abstract Syntax Notation number 1 (ASN.1) in table 1 shall apply.

Table 1 - Operations in support of ANF-PR

```
Path-Replacement-Operations
        {iso (1) identified-organization (3) icd-ecma (0012) standard (0)
        qsig-path-replacement (176) pr-operations (0)}

DEFINITIONS EXPLICIT TAGS       ::=

BEGIN

EXPORTS     PathReplacePropose,
            PathReplaceSetup,
            PathReplaceRetain;

IMPORTS     OPERATION, ERROR FROM Remote-Operation-Notation
                {joint-iso-ccitt(2) remote-operations(4) notation (0)}
            Extension FROM ECMA-manufacturer-specific-service-extension-definition
                {iso(1) identified-organization(3) icd-ecma(12)  standard(0)
                qsig-generic-procedures (165) msi-definition (0)}
            notAvailable FROM General-Errors
                {ccitt(0) identified-organization(3) etsi(0) 196 general-errors (2)}
            invalidRerouteingNumber, unrecognizedCallIdentity,
            establishmentFailure FROM Call-Transfer-Operations
                {iso identified-organization icd-ecma standard qsig-call-transfer (178)
                call-transfer-operations (0)}
            PartyNumber FROM Addressing-Data-Elements
                {ccitt identified-organization etsi 196 addressing-data-elements(6)};
            -- Note. The definition of PartyNumber is reproduced in annex B.

ptn OBJECT IDENTIFIER       ::=     {iso(1) identified-organization(3) icd-ecma (0012)
                                    private-ISDN-signalling-domain (9)}

PathReplacePropose  ::=     OPERATION
                                ARGUMENT PRProposeArg
                                ERRORS {
                                    notAvailable,
                                    temporarilyUnavailable,
                                    criteriaPermanentlyUnachievable,
                                    criteriaTemporarilyUnachievable,
                                    invalidRerouteingNumber,
                                    unrecognizedCallIdentity,
                                    establishmentFailure,
                                    collision,
                                    unspecified
                                    }
```


Table 1 - Operations in support of ANF-PR (continued)

```
PathReplaceSetup    ::=     OPERATION
                                ARGUMENT    PRSetupArg
                                RESULT      DummyResult
                                ERRORS {
                                    criteriaPermanentlyUnachievable,
                                    criteriaTemporarilyUnachievable,
                                    invalidRerouteingNumber,
                                    unrecognizedCallIdentity,
                                    temporarilyUnavailable
                                    unspecified
                                    }

PathReplaceRetain   ::=     OPERATION
                                ARGUMENT PRRetainArg
                                RESULT      DummyResult
                                ERRORS {
                                    notAvailable,
                                    temporarilyUnavailable,
                                    criteriaPermanentlyUnachievable,
                                    criteriaTemporarilyUnachievable,
                                    invalidRerouteingNumber,
                                    unrecognizedCallIdentity,
                                    establishmentFailure
                                    unspecified
                                    }

PRProposeArg        ::=     SEQUENCE {
                                callIdentity        CallIdentity,
                                reRouteingNumber    PartyNumber,
                                extension   CHOICE {
                                    [1] IMPLICIT Extension,
                                    [2] IMPLICIT SEQUENCE OF Extension}
                                } OPTIONAL
                            }

PRSetupArg          ::=     SEQUENCE {
                                callIdentity        CallIdentity,
                                extension CHOICE {
                                    [1] IMPLICIT Extension,
                                    [2] IMPLICIT SEQUENCE OF Extension}
                                } OPTIONAL
                            }
```

Table 1 - Operations in support of ANF-PR (continued)

```
PRRetainArg             ::=   SEQUENCE {
                                  callIdentity          CallIdentity,
                                  reRouteingNumber      PartyNumber,
                                  extension   CHOICE {
                                      [1] IMPLICIT Extension,
                                      [2] IMPLICIT SEQUENCE OF Extension
                                  } OPTIONAL
                              }

DummyResult             ::=   CHOICE {
                                  NULL,
                                  [1] IMPLICIT Extension,
                                  [2] IMPLICIT SEQUENCE OF Extension
                              }

CallIdentity            ::=   NumericString SIZE(1..4)

pathReplacePropose      PathReplacePropose ::=      {ptn pr-propose (4)}
pathReplaceSetup        PathReplaceSetup ::=        {ptn pr-setup (5)}
pathReplaceRetain       PathReplaceRetain ::=       {ptn pr-retain (6)}

temporarilyUnavailable
                        ERROR ::= {ptn 1000}
                            -- used when the operation is temporarily not available and none of
                            -- the other errors applies - a later attempt could be successful

collision               ERROR ::= {ptn 1001}
                            -- used when a pathReplacePropose invoke APDU is received by a PTNX
                            -- which has sent a pathReplacePropose invoke APDU

criteriaPermanentlyUnachievable
                        ERROR ::= {ptn 1002}
                            -- used when the special criteria requested cannot be achieved
                            -- because the necessary resources are permanently unavailable

criteriaTemporarilyUnachievable
                        ERROR ::= {ptn 1003}
                            -- used when the special criteria requested cannot be achieved
                            -- because the necessary resources are temporarily unavailable
                            -- a later attempt could be successful

Unspecified             ERROR PARAMETER Extension
unspecified             Unspecified ::= {ptn 1008}
                            -- used to convey a manufacturer specific error, possibly with other information

END                     -- of Path-Replacement-Operations
```


6.3.2 Information elements

6.3.2.1 Facility information element

APDUs of the operations defined in 6.3.1 shall be coded in the Facility information element in accordance with ECMA-165.

When conveying APDUs of operations pathReplacePropose and pathReplaceSetup, the NFE shall be included.

When conveying the invoke APDU of operation pathReplacePropose, the destinationEntity data element of the NFE shall contain value endPTNX.

When conveying the invoke APDU of operation pathReplaceSetup, the destinationEntity data element of the NFE shall contain value endPTNX.

When conveying the invoke APDU of operation pathReplaceRetain, the NFE shall be omitted.

When conveying the invoke APDU of operation pathReplaceSetup, the Interpretation APDU shall be included and shall have the value clearCallIfAnyInvokePduNotRecognised. When conveying any other Remote Operations APDU, the Interpretation APDU shall either be omitted or have the value rejectAnyUnrecognisedInvokePdu.

6.3.2.2 Other information elements

The following information elements used during establishment of the new connection and release of the old connection shall be coded as specified in ECMA-143:

- Bearer capability
- Called party number
- Cause
- Sending complete
- Transit counter

6.3.3 Messages

Except for cases where a basic call message is to be conveyed at the same time, the Facility information shall be conveyed in a FACILITY message as specified in ECMA-165.

The following messages used during establishment of the new connection and release of the old connection shall be as specified in ECMA-143:

- CALL PROCEEDING
- CONNECT
- CONNECT ACKNOWLEDGE
- DISCONNECT
- RELEASE
- RELEASE COMPLETE
- SETUP

6.4 ANF-PR state definitions

6.4.1 States at the Requesting PTNX

The procedures for the Requesting PTNX are written in terms of the following conceptual states existing within the ANF-PR functional entity in that PTNX in association with a particular call.

6.4.1.1 State PR-Req-Idle

ANF-PR is not operating.

6.4.1.2 State PR-Req-Initiated

A pathReplacePropose invoke APDU has been sent to the Cooperating PTNX.

6.4.1.3 State PR-Req-Completing

The new connection has been established and a pathReplaceSetup return result APDU has been sent to the Cooperating PTNX.

6.4.2 States at the Cooperating PTNX

The procedures for the Cooperating PTNX are written in terms of the following conceptual states existing within the ANF-PR functional entity in that PTNX in association with a particular call.

6.4.2.1 State PR-Coop-Idle

ANF-PR is not operating.

6.4.2.2 State PR-Coop-Establishment

A pathReplaceSetup invoke APDU has been sent in conjunction with the establishment of the new connection.

6.4.2.3 State PR-Coop-Retain

A pathReplaceRetain invoke APDU has been sent to the Subsequent PTNX.

6.4.3 States at a Transit PTNX on the retained path, including the Branching PTNX

The procedures for a Transit PTNX on the retained path are written in terms of the following conceptual states existing within the ANF-PR functional entity in that PTNX in association with a particular call.

6.4.3.1 State PR-Transit-Idle

ANF-PR is not operating.

6.4.3.2 State PR-Transit-Establishment

A pathReplaceSetup invoke APDU has been sent in conjunction with the establishment of the new connection.

6.4.3.3 State PR-Transit-Retain

A pathReplaceRetain invoke APDU has been sent to the Subsequent PTNX.

6.5 ANF-PR signalling procedures at the Q reference point

The signalling procedures specified below are in support of replacement of the entire connection. Additional optional procedures for retention of part of the old connection are specified in 6.6.

Examples of message sequences are shown in C.1 and C.2 of annex C.

6.5.1 Actions at the Requesting PTNX

The SDL representation of procedures at the Requesting PTNX is shown in D.1 of annex D.

6.5.1.1 Normal procedures

On determining that ANF-PR is to be invoked during a call whose protocol control state is Active, the Requesting PTNX shall send a pathReplacePropose invoke APDU in a FACILITY message to the Cooperating PTNX and enter state PR-Req-Initiated. Within the argument, the reRouteingNumber data element shall contain a number from one of the native numbering plans of the PTN (see ECMA-155). The number, when used as the contents of information element Called party number in a SETUP message, shall be sufficient to cause routeing of the new connection to the Requesting PTNX.

The callIdentity data element shall contain a number which, in conjunction with the reRouteingNumber data element, identifies the particular ANF-PR entity, and therefore the call on which ANF-PR is being invoked. This number need not have significance outside the Requesting PTNX.

NOTE 10

The number in the callIdentity data element should be sufficient to distinguish the call concerned from any other call for which the PTNX is acting as an ANF-PR Requesting PTNX at that time.

Having agreed the B-channel and sent back a CALL PROCEEDING message in response to an incoming SETUP message, in accordance with the procedures of ECMA-143, if the SETUP contains a pathReplaceSetup invoke APDU the Requesting PTNX shall proceed as follows. If the callIdentity data element in the argument of pathReplaceSetup, in conjunction with the reRouteingNumber data element, identifies an ANF-PR entity in state PR-Req-Initiated, the Requesting PTNX shall associate the new connection (as requested by the SETUP message) with the call on whose behalf that ANF-PR entity is acting.

The Requesting PTNX shall connect the calling / called user to the B-channel of the new connection and terminate the B-channel of the old connection in a suitable manner (pending its release).

NOTE 11

The method of terminating the old connection's B-channel is an implementation matter. Annex B of ECMA-175 contains more information on this.

A pathReplaceSetup return result APDU shall be sent in a CONNECT message using the call reference of the new connection and state PR-Req-Completing shall be entered.

NOTE 12

On sending CONNECT, the protocol control state for the new connection will become Active.

While in state PR-Req-Completing, if a DISCONNECT message is received using the call reference of the old connection, the Requesting PTNX shall complete the release of the old connection in accordance with the procedures of ECMA-143, and enter state PR-Req-Idle. The call shall continue as an active call using the new connection.

6.5.1.2 Exceptional procedures

Receipt of a FACILITY message containing a pathReplacePropose return error APDU or reject APDU during state PR-Req-Initiated shall cause entry to state PR-Req-Idle, thereby abandoning ANF-PR. The call shall continue to use the old connection.

NOTE 13

Depending on the error, it may be appropriate to invoke ANF-PR again later. If the error is collision, steps should be taken to reduce the probability of a further collision, e.g. by using a random delay before invoking again.

Failure to associate an incoming SETUP message containing a pathReplaceSetup invoke APDU with an ANF-PR entity in state PR-Req-Initiated shall result in the sending of a DISCONNECT message to initiate the clearing of the new connection. Depending on implementation, the DISCONNECT message shall contain either:

- a suitable cause number in the Cause information element, e.g. 1 "unallocated (unassigned) number"; or
- cause number 29 "facility rejected" in the Cause information element and a return error APDU containing error invalidReroutingNumber; or

- cause number 29 "facility rejected" in the Cause information element and a return error APDU containing error unrecognizedCallIdentity.

If the incoming SETUP message containing a pathReplaceSetup invoke APDU is successfully associated with an ANF-PR entity in state PR-Req-Initiated but the new connection is unsuitable for some reason, e.g. criteria not satisfied, a DISCONNECT message shall be sent to initiate clearing of the new connection. The disconnect message shall contain cause number 29 "facility rejected" in the Cause information element and a return error APDU containing an appropriate error. The ANF-PR entity shall remain in state PR-Req-Initiated.

NOTE 14

Receipt of a pathReplacePropose return error APDU can be expected.

On receipt of a FACILITY message containing a pathReplacePropose invoke APDU while in state PR-Req-Initiated, a pathReplacePropose return error APDU containing error collision shall be returned. No state change shall occur.

NOTE 15

Receipt of a pathReplacePropose return error APDU containing error collision can be expected.

6.5.2 Actions at the Cooperating PTNX

The SDL representation of procedures at the Cooperating PTNX is shown in D.2 of annex D.

6.5.2.1 Normal procedures

On receipt of a FACILITY message containing a pathReplacePropose invoke APDU while in protocol control state Active and ANF-PR state PR-Coop-Idle, the Cooperating PTNX shall determine whether it can proceed with ANF-PR. If so, it shall attempt to establish a new connection by selecting an outgoing B-channel on a route determined by the contents of the reRouteingNumber data element within the received argument. If a B-channel is available, a SETUP message shall be sent using a new call reference in accordance with the procedures of ECMA-143. The SETUP shall contain a new call reference and the following information elements:

- Bearer capability, containing bearer capability information as for the old connection;
- Called party number, containing the number received in the reRouteingNumber data element within the received argument;
- Sending complete;
- Transit counter, with value zero (optional);
- Facility.

The Facility information element shall contain a pathReplaceSetup invoke APDU. Within the argument, data element callIdentity shall have the same contents as the corresponding data element in the argument of the received pathReplacePropose invoke APDU.

The Cooperating PTNX shall terminate the new connection's B-channel suitably.

NOTE 16

The method of terminating the new connection's B-channel is an implementation matter. Annex B of ECMA-175 contains more information on this.

State PR-Coop-Establishment shall be entered.

The protocol control procedures of ECMA-143 shall apply during the establishment of the new connection.

NOTE 17

Initially protocol control will enter state Call Initiated. On receipt of a CALL PROCEEDING message, state Outgoing Call Proceeding will be entered and on receipt of CONNECT, state Active will be entered.

On receipt of a CONNECT message (using the call reference of the new connection) containing a pathReplaceSetup return result APDU, the Cooperating PTNX shall disconnect the B-channel of the old connection and connect the calling / called user instead to the B-channel of the new connection. A DISCONNECT message shall be sent using the call reference of the old connection, thereby initiating the clearing procedures of ECMA-143 for the old connection. State PR-Coop-Idle shall be entered. The call shall continue as an active call using the new connection.

6.5.2.2 Exceptional procedures

If the Cooperating PTNX is unable to comply with the pathReplacePropose invoke APDU, it shall send back a FACILITY message containing a pathReplacePropose return error APDU with a suitable error.

If the new connection fails to be established for any reason, the Cooperating PTNX shall send using the old connection a FACILITY message containing a pathReplacePropose return error APDU with a suitable error. Reasons can include:

- unable to select a B-channel for the new connection;
- receipt of a call clearing message using the new connection's call reference without a pathReplaceSetup return error APDU or reject APDU;
- receipt of a call clearing message using the new connection's call reference with a pathReplaceSetup return error APDU or reject APDU;
- timer expiry at the Cooperating PTNX.

In each case state PR-Coop-Idle shall be entered and the call shall continue as an active call using the old connection.

6.5.3 Actions at a Cooperating/Requesting PTNX in the case of a trombone connection

On receipt of a FACILITY message containing a pathReplacePropose invoke APDU, the Cooperating PTNX can determine from the reRouteingNumber data element in the argument whether the Requesting PTNX is the same as the Cooperating PTNX, i.e. whether a trombone connection exists.

In the case of a trombone connection, establishment of the new connection and switching over to it will be intra-PTNX matters. The only further signalling which will occur at the Q reference point will be the clearing of the old connection.

6.5.4 Actions at a Transit PTNX

No special actions are required in support of ANF-PR.

6.6 ANF-PR optional signalling procedures at the Q reference point for retention of part of the old connection

Examples of message sequences are shown in C.3 to C.5 of annex C.

6.6.1 Actions at the Requesting PTNX

The procedures of 6.5.1 shall apply, with the following addition.

If the Requesting PTNX receives a FACILITY message containing a pathReplaceRetain invoke APDU from the Preceding PTNX, it shall send back a FACILITY message containing a pathReplaceRetain return result APDU and enter state PR-Req-Idle.

6.6.2 Actions at the Cooperating PTNX

The SDL representation of procedures at the Cooperating PTNX, including optional retention of part of the old connection, is shown in D.3 of annex D.

6.6.2.1 Normal procedures

On receipt of a FACILITY message containing a pathReplacePropose invoke APDU while in protocol control state Active and ANF-PR state PR-Coop-Idle, the Cooperating PTNX shall determine whether it can proceed with ANF-PR, and whether it can retain that part of the old connection as far as the Subsequent PTNX while still meeting any given criteria. If so, it shall send a FACILITY message containing a pathReplaceRetain invoke APDU to the Subsequent PTNX and enter state PR-Coop-Retain. The reRouteingNumber and callIdentity data elements shall have the same contents as the corresponding data elements received in the pathReplacePropose invoke APDU.

NOTE 18

The omission of the NFE from the Facility information element ensures that the APDU will be processed by the Subsequent PTNX. If the Subsequent PTNX does not support these optional procedures it will send back a reject APDU.

If it cannot retain that part of the old connection as far as the Subsequent PTNX it shall proceed according to the provisions of 6.5.2.

On receipt of a FACILITY message containing a pathReplaceRetain return result APDU from the Subsequent PTNX, the Cooperating PTNX shall enter state PR-Coop-Idle:

6.6.2.2 Exceptional procedures

On receipt of a FACILITY message containing a pathReplaceRetain return error APDU or reject APDU from the Subsequent PTNX while in state PR-Coop-Retain, the Cooperating PTNX shall either, depending on the reason for the error or reject APDU:

- proceed according to the provisions of 6.5.2, as if there had been no attempt to retain part of the old connection; or
- send back a FACILITY message containing a pathReplacePropose return error APDU with a suitable error to the Requesting PTNX and enter state PR-Coop-Idle.

6.6.3 Actions at a Transit PTNX on the retained connection

The SDL representation of procedures at a Transit PTNX on the Retained Connection is shown in D.4 of annex D.

On receipt of a FACILITY message containing a pathReplaceRetain invoke APDU from the Preceding PTNX while in protocol control state Active and ANF-PR state PR-Transit-Idle, the Transit PTNX shall determine whether it can retain that part of the old connection as far as the Subsequent PTNX while still meeting any given criteria.

6.6.3.1 Able to retain old connection as far as Subsequent PTNX

6.6.3.1.1 Normal procedures

If the Transit PTNX determines that it can retain that part of the old connection as far as the Subsequent PTNX, it shall send a FACILITY message containing a pathReplaceRetain invoke APDU to the Subsequent PTNX and enter state PR-Transit-Retain. The reRouteingNumber and callIdentity data elements shall have the same contents as the corresponding data elements in the received pathReplaceRetain invoke APDU.

NOTE 19

The omission of the NFE from the Facility information element ensures that the APDU will be processed by the Subsequent PTNX. If the Subsequent PTNX does not support these optional procedures it will send back a reject APDU.

On receipt of a FACILITY message containing a pathReplaceRetain return result APDU from the Subsequent PTNX while in state PR-Transit-Retain, the Transit PTNX shall send a pathReplaceRetain return result APDU to the Preceding PTNX and enter state PR-Transit-Idle.

6.6.3.1.2 Exceptional procedures

On receipt of a FACILITY message containing a pathReplaceRetain return error APDU or reject APDU from the Subsequent PTNX while in state PR-Transit-Retain, the Transit PTNX shall either, depending on the reason for the error or reject APDU:

- proceed according to the provisions of 6.6.3.2, as if there had been no attempt to retain the old connection as far as the Subsequent PTNX; or
- send a pathReplaceRetain return error APDU to the Preceding PTNX and enter state PR-Transit-Idle.

6.6.3.2 Unable to retain old connection as far as Subsequent PTNX

6.6.3.2.1 Normal procedures

If the Transit PTNX determines that it is unable to retain that part of the old connection as far as the Subsequent PTNX, it shall attempt to establish a new connection by selecting an outgoing B-channel on a route determined by the contents of the reRouteingNumber data element within the received argument. If a B-channel is available, a SETUP message shall be sent using a new call reference in accordance with the procedures of ECMA-143. The SETUP shall contain a new call reference and the following information elements:

- Bearer capability, containing bearer capability information as for the old connection;
- Called party number, containing the number received in the reRouteingNumber data element within the received argument;
- Sending complete;
- Transit counter, with value zero (optional);
- Facility.

The Facility information element shall contain a pathReplaceSetup invoke APDU. Within the argument, data element callIdentity shall have the same contents as the corresponding data element in the argument of the received pathReplaceRetain invoke APDU.

The Transit PTNX shall terminate the new connection's B-channel suitably.

NOTE 20

The method of terminating the new connection's B-channel is an implementation matter. Annex B of ECMA-175 contains more information on this.

State PR-Transit-Establishment shall be entered.

The protocol control procedures of ECMA-143 shall apply during the establishment of the new connection.

NOTE 21

Initially protocol control will enter state Call Initiated. On receipt of a CALL PROCEEDING message, state Outgoing Call Proceeding will be entered and on receipt of CONNECT, state Active will be entered.

On receipt of a CONNECT message (using the call reference of the new connection) containing a pathReplaceSetup return result APDU, the Transit PTNX shall disconnect the B-channel of the replaced connection and connect the B-channel of the retained connection instead to the B-channel of the new connection. A DISCONNECT message shall be sent using the call reference of the replaced connection, thereby initiating the clearing procedures of ECMA-143 for the replaced connection. The Transit PTNX shall send a FACILITY message containing a pathReplaceRetain return result APDU to the Preceding PTNX and enter state PR-Transit-Idle. The call shall continue as an active call using the new connection.

6.6.3.2.2 Exceptional procedures

If the Transit PTNX is unable to comply with the pathReplaceRetain invoke APDU, it shall send back to the Preceding PTNX a FACILITY message containing a pathReplaceRetain return error APDU with a suitable error.

If the new connection fails to be established for any reason, the Transit PTNX shall send back to the Preceding PTNX a FACILITY message containing a pathReplaceRetain return error APDU with a suitable error. Reasons can include:

- unable to select a B-channel for the new connection;
- receipt of a call clearing message using the new connection's call reference without a pathReplaceSetup return error APDU or reject APDU;
- receipt of a call clearing message using the new connection's call reference with a pathReplaceSetup return error APDU or reject APDU;
- timer expiry at the Transit PTNX.

In each case state PR-Transit-Idle shall be entered and the call shall continue as an active call using the old connection.

6.6.4 Actions at a Transit PTNX on the new connection or replaced connection

No special actions are required in support of ANF-PR.

6.7 ANF-PR impact of interworking with public ISDNs

When interworking with a public ISDN which does not support an equivalent feature, the Incoming or Outgoing Gateway PTNX can act as the Cooperating PTNX or Requesting PTNX in order to perform ANF-PR within the PTN.

NOTE 22

At the time of publication of this Standard, no equivalent feature in public ISDNs was envisaged.

6.8 ANF-PR impact of interworking with non-ISDNs

When interworking with a non-ISDN which does not support an equivalent feature, the Incoming or Outgoing Gateway PTNX can act as the Cooperating PTNX or Requesting PTNX in order to perform ANF-PR within the PTN.

When interworking with a non-ISDN which supports an equivalent feature, the two networks may cooperate in the operation of ANF-PR. In this case, either Cooperating PTNX functionality or Requesting PTNX functionality will be provided in the non-ISDN. The Incoming or Outgoing Gateway PTNXs on the

old and new paths shall provide conversion between the signalling specified in this Standard and the signalling protocol of the non-ISDN.

When interworking with a non-ISDN which supports an equivalent feature, the Requesting PTNX shall be able to limit the length of the value of element callIdentity in accordance with the capabilities of the non-ISDN.

6.9 ANF-PR parameter values (timers)

6.9.1 Timer T1

Timer T1 shall operate at the Requesting PTNX during state PR-Req-Initiated. Its purpose is to protect against the absence of a response to the pathReplacePropose invoke APDU. A response can be either a pathReplacePropose return error APDU or a pathReplaceSetup invoke APDU.

Timer T1 shall be started on entering state PR-Req-Initiated and stopped on leaving that state.

On expiry of timer T1, the Requesting PTNX shall return to state PR-Req-Idle. The call shall continue as an active call using the old connection.

Timer T1 shall have a value not less than 30s.

6.9.2 Timer T2

Timer T2 shall operate at the Requesting PTNX during state PR-Req-Completing. Its purpose is to protect against failure to release the old connection.

Timer T2 shall be started on entering state PR-Req-Completing and stopped on leaving that state.

On expiry of timer T2, the Requesting PTNX shall initiate clearing of the old connection by sending a DISCONNECT message with cause number 31 "normal, unspecified" and return to state PR-Req-Idle. The call shall continue as an active call using the new connection.

Timer T2 shall have a value not less than 15s.

6.9.3 Timer T3

Timer T3 may optionally operate at the Cooperating PTNX or a Transit PTNX during state PR-Coop-Establishment or PR-Transit-Establishment respectively. Its purpose is to protect against failure to establish the new connection.

NOTE 23

Alternatively an implementation can rely on basic call timers for this protection.

Timer T3 shall be started on entering state PR-Coop-Establishment or PR-Transit-Establishment and stopped on leaving that state.

On expiry of timer T3, the PTNX shall clear the new connection using the procedures of ECMA-143, and continue according to the procedures of 6.5.2.2 or 6.6.3.2.2 of this Standard respectively.

Timer T3 shall have a value not less than protocol control timer T310.

6.9.4 Timer T4

Timer T4 shall operate at the Cooperating PTNX or a Transit PTNX during state PR-Coop-Retain or PR-Transit-Retain respectively. Its purpose is to protect against the absence of a response to the pathReplaceRetain invoke APDU.

Timer T4 shall be started on entering state PR-Coop-Retain or PR-Transit-Retain and stopped on leaving that state.

On expiry of timer T4, the PTNX shall continue according to the procedures of 6.6.2.2 or 6.6.3.1.2 of this Standard respectively.

Timer T4 shall have a value not less than 30s.

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 following 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 the protocol implementor, 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's PICS proforma;
- by the user or potential user of the implementation, as a basis for initially checking the possibility of interworking with another implementation - while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICSs;
- by a protocol tester, as the basis for selecting appropriate tests against which to assess 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 sub-clauses 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 requirement. 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-176

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 suppliers 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.3.3)?	No [ ] Yes [ ] (The answer Yes means that the implementation does not conform to this Standard)

Date of Statement	

A.3.3 General

Item	Question/feature	References	Status	N/A	Support
A1	Behaviour as Cooperating PTNX for ANF-PR		o.1		Yes [ ] No [ ]
A2	Behaviour as Requesting PTNX for ANF-PR		o.1		Yes [ ] No [ ] Conditions for invoking ANF-PR should be given as Additional Information
A3	Behaviour as Transit PTNX for ANF-PR		o.1		Yes [ ] No [ ]
A4	Behaviour as Gateway PTNX to another network which provides Cooperating PTNX functionality	6.8	o.1		Yes [ ] No [ ]
A5	Behaviour as Gateway PTNX to another network which provides Requesting PTNX functionality	6.8	o.1		Yes [ ] No [ ]
A6	Optional procedures for retaining part or all of the old connection		o		Yes [ ] No [ ]

A.3.4 Procedures

Item	Question/feature	References	Status	N/A	Support
B1	Support of relevant ECMA-143 and ECMA-165 procedures at a Cooperating PTNX	6.2.1	A1:m	[ ]	m: Yes [ ]
B2	Support of relevant ECMA-143 and ECMA-165 procedures at a Requesting PTNX	6.2.2	A2:m	[ ]	m: Yes [ ]
B3	Support of relevant ECMA-143 and ECMA-165 procedures at a Transit PTNX	6.2.3.1 6.2.3.2	A3:m	[ ]	m: Yes [ ]
B4	Support of relevant ECMA-143 and ECMA-165 procedures at a Transit PTNX on a retained connection	6.2.3.3 6.2.3.4	c.1	[ ]	m: Yes [ ]
B5	Signalling procedures at a Cooperating PTNX	6.5.2	A1:m	[ ]	m: Yes [ ]
B6	Signalling procedures at a Requesting PTNX	6.5.1	A2:m	[ ]	m: Yes [ ]
B7	Signalling procedures at a Cooperating/ Requesting PTNX in the case of a trombone connection	6.5.3	c.2	[ ]	m: Yes [ ]
B8	Additional signalling procedures at a Requesting PTNX when whole of old connection is retained	6.6.1	c.3	[ ]	m: Yes [ ]
B9	Additional signalling procedures at a Cooperating PTNX for retention of part or all of the old connection	6.6.2	c.4	[ ]	m: Yes [ ]
B10	Additional signalling procedures at a Transit PTNX for retention of part or all of the old connection	6.6.3	c.1	[ ]	m: Yes [ ]

c.1: if A3 and A6 then m
else N/A

c.2: if A1 and A2 then m
else N/A

c.3: if A1 and A6 then m
else N/A

c.4: if A2 and A6 then m
else N/A

A.3.5 Coding

Item	Question/feature	References	Status	N/A	Support
C1	Sending of pathReplacePropose invoke APDU and receipt of return error APDU	6.3.1 6.3.2.1	c.1	[ ]	m: Yes[ ]
C2	Sending of pathReplaceSetup invoke APDU and receipt of return result and return error APDUs	6.3.1 6.3.2.1	c.2	[ ]	m: Yes [ ]
C3	Sending of pathReplaceRetain invoke APDU and receipt of return result and return error APDUs	6.3.1 6.3.2.1	c.3	[ ]	m: Yes [ ]
C4	Receipt of pathReplacePropose invoke APDU and sending of return error APDU	6.3.1 6.3.2.1	c.2	[ ]	m: Yes [ ]
C5	Receipt of pathReplaceSetup invoke APDU and sending of return result and return error APDUs	6.3.1 6.3.2.1	c.1	[ ]	m: Yes [ ]
C6	Receipt of pathReplaceRetain invoke APDU and sending of return result and return error APDUs	6.3.1 6.3.2.1	c.4	[ ]	m: Yes [ ]

c.1: if A2 or A5 then m
else N/A

c.2: if A1 or A4 then m
else N/A

c.3: if (A1 or A3 or A4) and A6 then m
else N/A

c.4: if (A2 or A3 or A5) and A6 then m
else N/A

A.3.6 Timers

Item	Question/feature	References	Status	N/A	Support
D1	Support of timer T1	6.9.1	A2:m	[ ]	m: Yes [ ]
D2	Support of timer T2	6.9.2	A2:m	[ ]	m: Yes [ ]
D3	Support of timer T3	6.9.3	c.1	[ ]	o: Yes [ ] No [ ]
D4	Support of timer T4	6.9.4	c.2	[ ]	m: Yes [ ]

c.1: if A1 or (A3 and A6) then o
else N/A

c.2: if (A1 or A3) and A6 then m
else N/A

Annex B

(informative)

Imported ASN.1 definitions relating to numbers

Table B.1 is an extract from module Addressing-Data-Elements in prETS 300 196 showing the definition of data type PartyNumber.

Table B.1 - Imported ASN.1 definition of PartyNumber

```
PartyNumber ::= CHOICE {
        unknownPartyNumber [0] IMPLICIT NumberDigits,
            -- the numbering plan is the default numbering plan
            -- of the network
        publicPartyNumber [1] IMPLICIT PublicPartyNumber,
            -- the numbering plan is according to Recommendation E.164
            -- or E.163
        dataPartyNumber [3] IMPLICIT Number Digits,
            -- not used, value reserved
        telexPartyNumber [4] IMPLICIT Number Digits,
            -- not used, value reserved
        privateNumber [5] IMPLICIT PrivateNumber
            -- the numbering plan is a Private Numbering Plan according
            -- to ECMA-155
        nationalStandardPartyNumber [8] IMPLICIT NumberDigits
            -- not used, value reserved }

PublicPartyNumber ::= SEQUENCE {
        publicTypeOfNumber PublicTypeOfNumber,
        publicNumberDigits NumberDigits }

PrivatePartyNumber ::= SEQUENCE {
        privateTypeOfNumber PrivateTypeOfNumber,
        privateNumberDigits NumberDigits }

NumberDigits ::= NumericString (SIZE(1..20))

PublicTypeOfNumber ::= ENUMERATED {
        unknown (0),
            -- if used, number digits carry prefix indicating type of
            -- number according to national recommendations
        internationalNumber (1),
        nationalNumber (2),
        networkSpecificNumber (3),
            -- not used, value reserved
        subscriberNumber (4),
        abbreviatedNumber (6) }
            -- valid only for called party number at the outgoing access,
            -- network substitutes appropriate number
```

Table B.1 - Imported ASN.1 definition of PartyNumber (continued)

```
PrivateTypeOfNumber   ::= ENUMERATED {
                              unknown (0),
                              level2RegionalNumber (1),
                              level1RegionalNumber (2),
                              pTNSpecificNumber (3),
                              localNumber (4),
                              level3RegionalNumber (5),
                              abbreviatedNumber (6) }
```


Annex C

(informative)

Examples of message sequences

This annex describes some typical message flows for ANF-PR. The following conventions are used in the figures of this annex.

1. The following notation is used:

⟶	Basic call message containing ANF-PR information
⟶	Basic call message without ANF-PR information
xxx.inv	Invoke APDU for operation xxx
xxx.rr	Return result APDU for operation xxx
xxx.re	Return error APDU for operation xxx

2. The figures show messages exchanged via Protocol Control between PTNXs involved in ANF-PR. Only messages relevant to ANF-PR are shown.

3. 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 ANF-PR is not shown.

C.1 Example message sequence for normal operation

Figure C.1 shows an example of normal operation of ANF-PR. The old connection and the new connection are each shown passing through two Transit PTNXs.

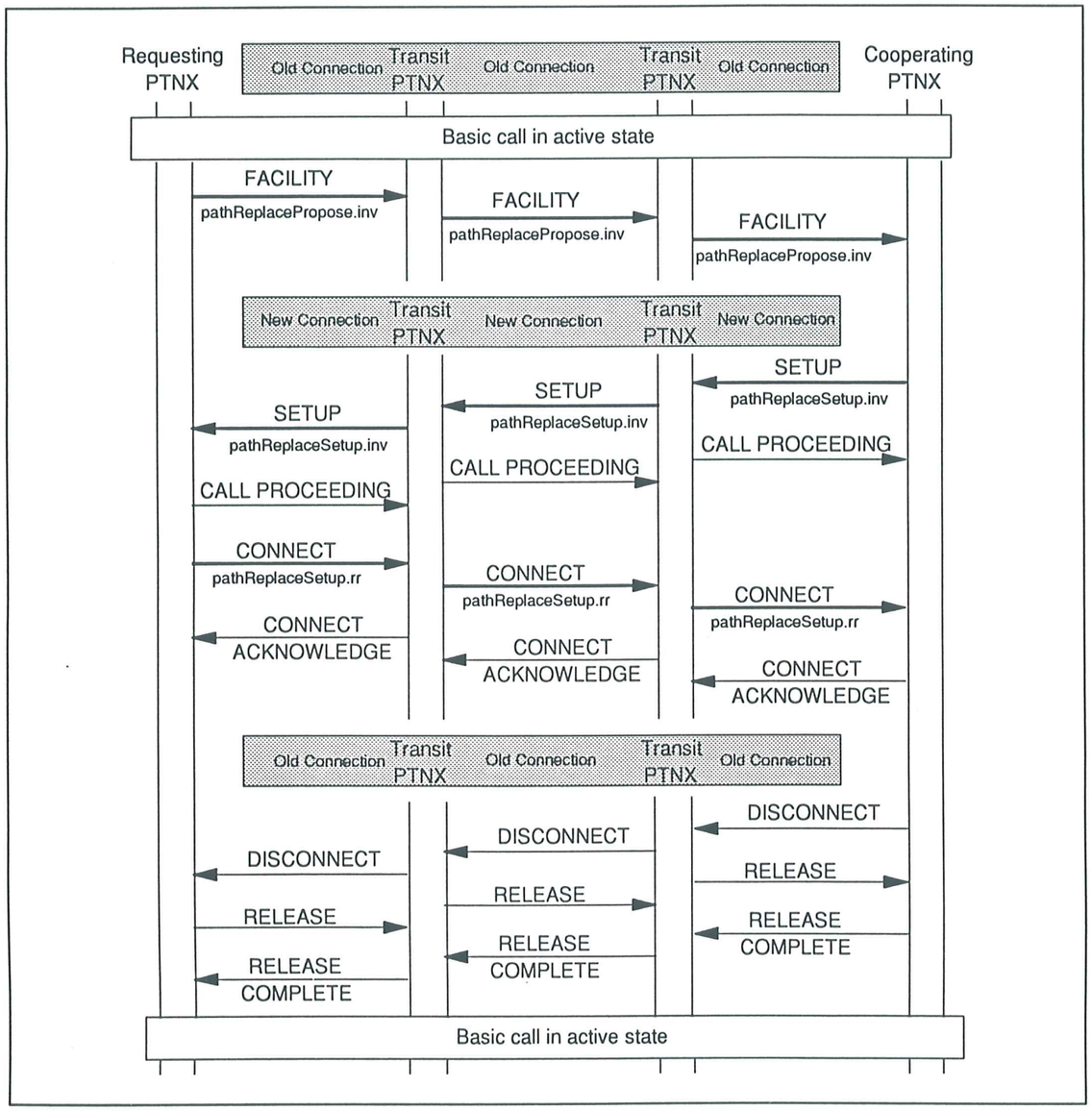

Figure C.1 - Message sequence for normal operation of ANF-PR

C.2 Example message sequence for case of congestion encountered at Transit PTNX

Figure C.2 shows an example of the operation of ANF-PR for the case where a Transit PTNX on the new connection is unable to proceed with connection establishment, e.g. because of congestion. Consequently ANF-PR fails.

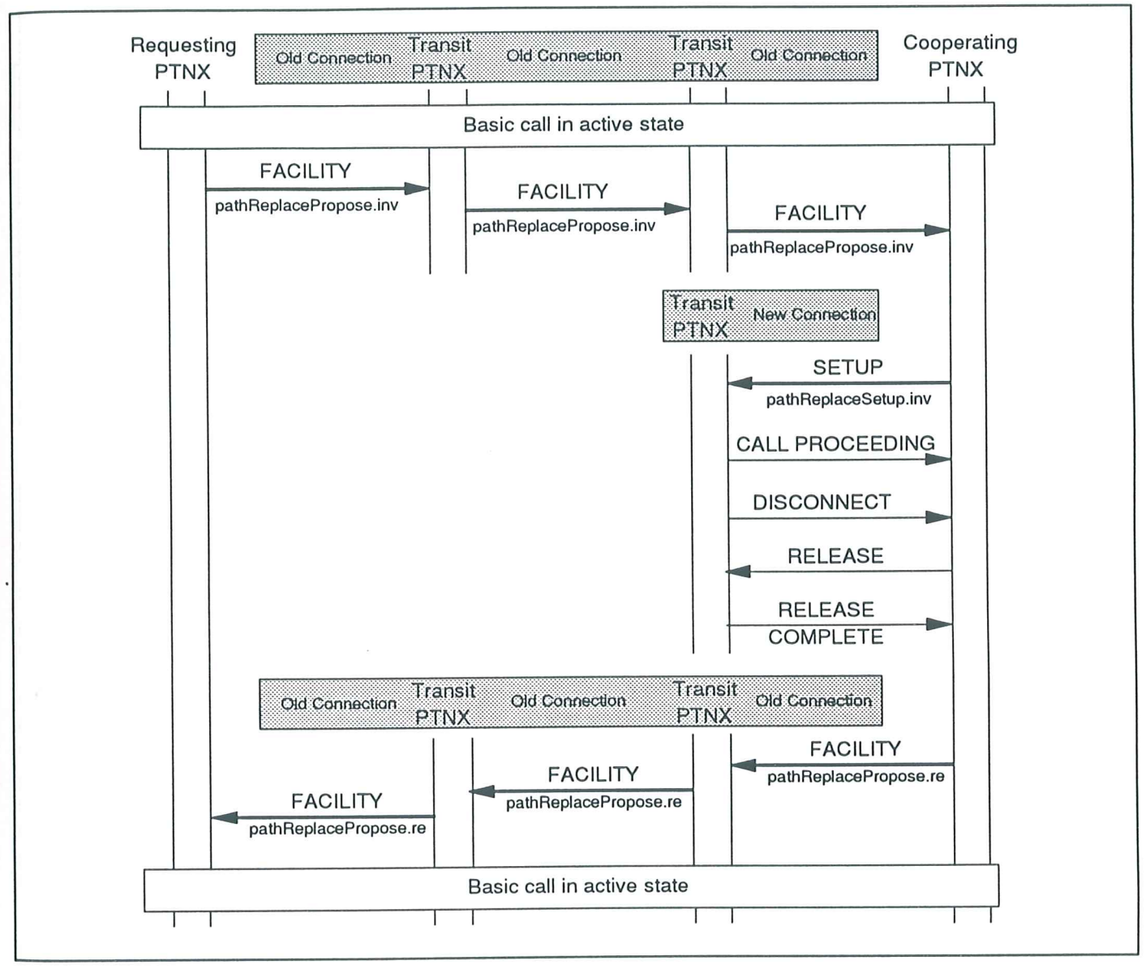

Figure C.2 - Message sequence for congestion case of ANF-PR

C.3 Example message sequence for normal operation, retaining part of the old connection

Figure C.3 shows an example of normal operation of ANF-PR with elements of the old connection retained as far as the first Transit PTNX. The old connection and the new connection are each shown passing through one Transit PTNX.

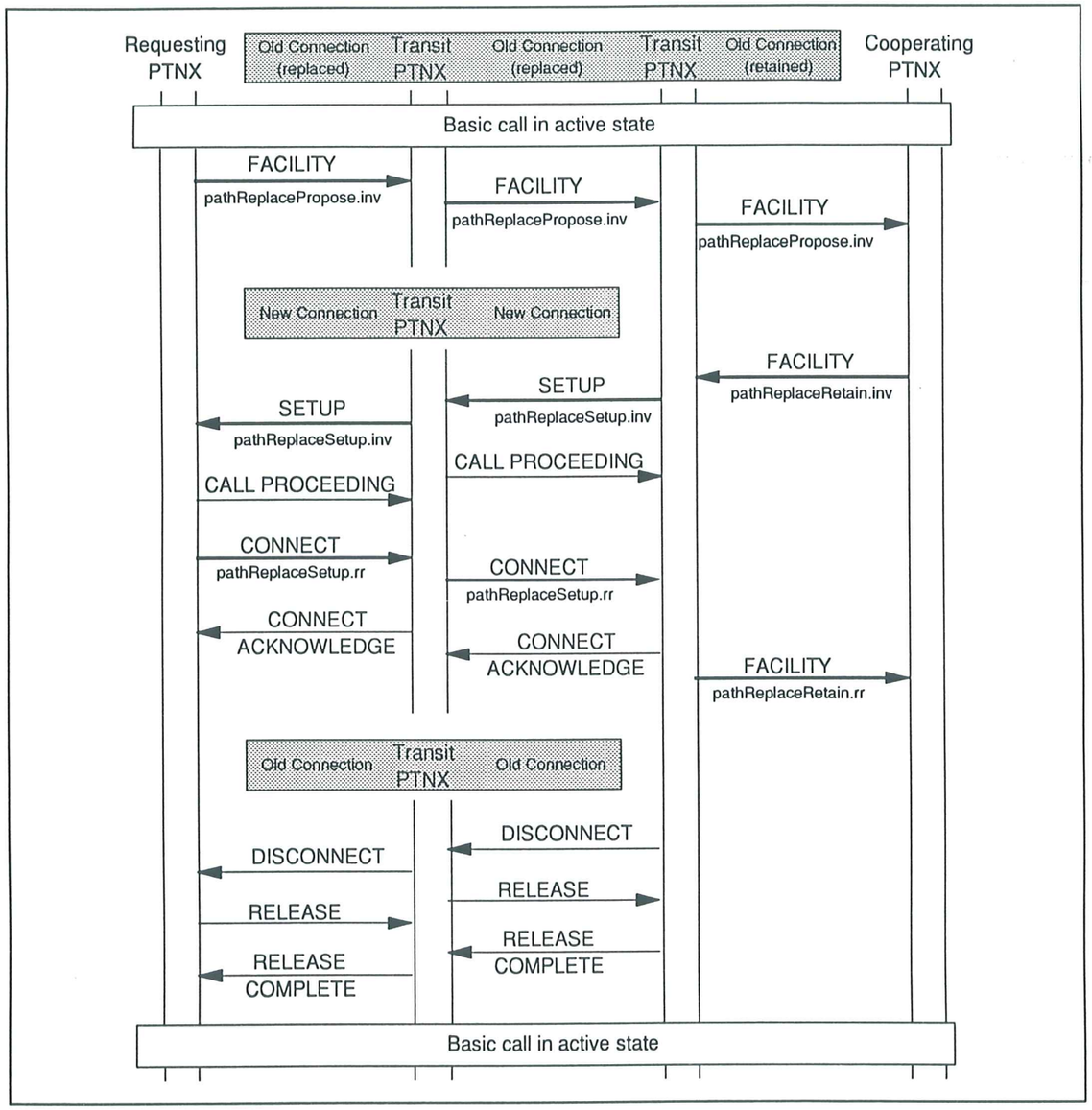

Figure C.3 - Message sequence for normal operation of ANF-PR, retaining part of the old connection

C.4 Example message sequence for case of congestion encountered at Transit PTNX, after attempting to retain part of the old connection

Figure C.4 shows an example of the operation of ANF-PR with elements of the old connection retained as far as the first Transit PTNX (Branching PTNX), but with failure to establish the new connection beyond the second Transit PTNX, e.g. because of congestion. The Cooperating PTNX does not re-attempt ANF-PR using a completely new connection, and therefore ANF-PR fails.

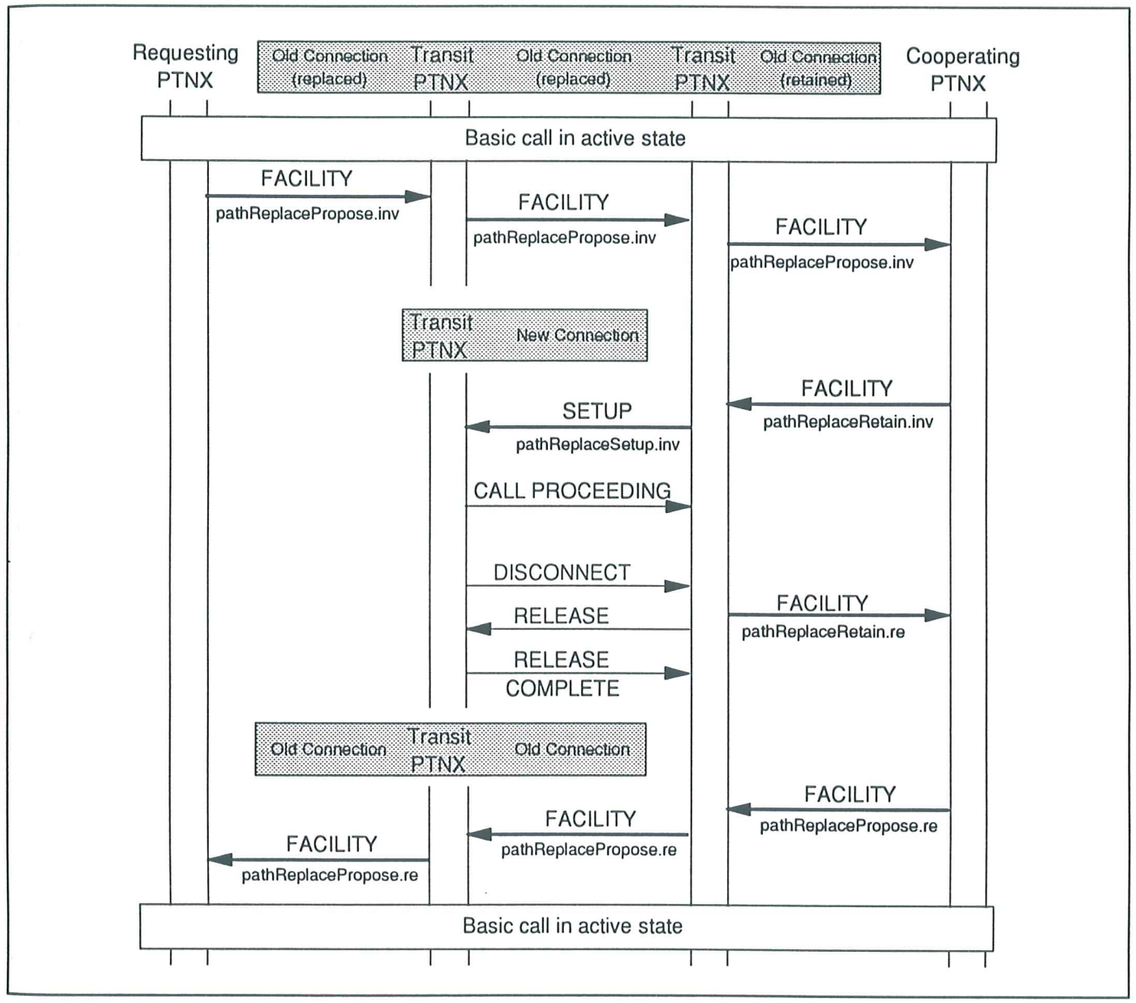

Figure C.4 - Message sequence for congestion case, retaining part of the old connection

C.5 Example message sequence for normal operation, retaining all of the old connection

Figure C.5 shows an example of normal operation of ANF-PR with the whole of the old connection retained.

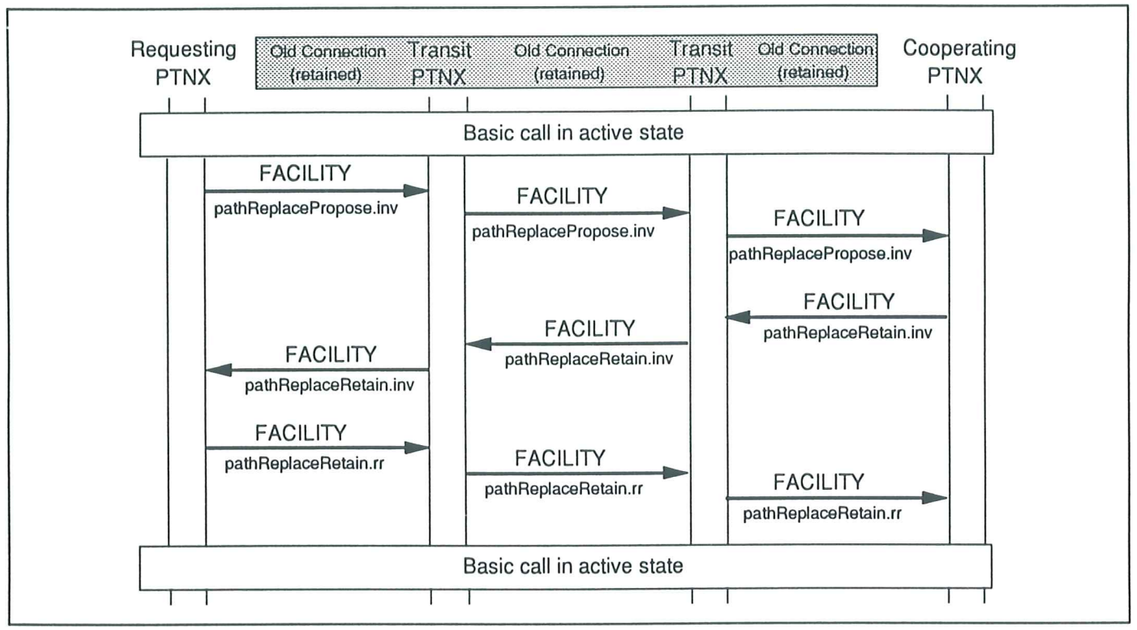

Figure C.5 - Message sequence for normal operation of ANF-PR, retaining all of the old connection

Annex D

(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 behaviour of an ANF-PR Supplementary Service Control entity at a particular type of PTNX. In accordance with the protocol model described in ECMA-165, the Supplementary Service Control entity uses, via the Coordination Function, the services of Generic Functional Transport Control and Basic Call Control.

Where an output symbol represents a primitive to the Coordination Function, and that primitive results in a QSIG message being sent, the output symbol bears the name of the message and any remote operations APDU(s) or notification(s) contained in that message. In the case of a message specified in ECMA-143, basic call actions associated with the sending of that message are deemed to occur.

Where an input symbol represents a primitive from the Coordination Function, and that primitive is the result of a QSIG message being received, the input symbol bears the name of the message and any remote operations APDU(s) or notification(s) contained in that message. In the case of a message specified in ECMA-143, basic call actions associated with the receipt of that message are deemed to have occurred.

The following abbreviations are used:

inv.	invoke APDU
res.	return result APDU
err.	return error APDU
rej.	reject APDU
prPropose	pathReplacePropose
prSetup	pathReplaceSetup
prRetain	pathReplaceRetain
rN	reRouteingNumber
cI	callIdentity

D.1 SDL representation of ANF-PR at the Requesting PTNX

Figure D.1 shows the behaviour of an ANF-PR Supplementary Service Control entity within the Requesting PTNX.

Input signals from the right and output signals to the right represent primitives to and from the Coordination Function in respect of messages sent and received. Also protocol timer expiry and indications from basic call control are indicated by input signals from the right.

Input signals from the left and output signals to the left represent stimuli between the ANF-PR Supplementary Service Control entity and the ANF-PR user.

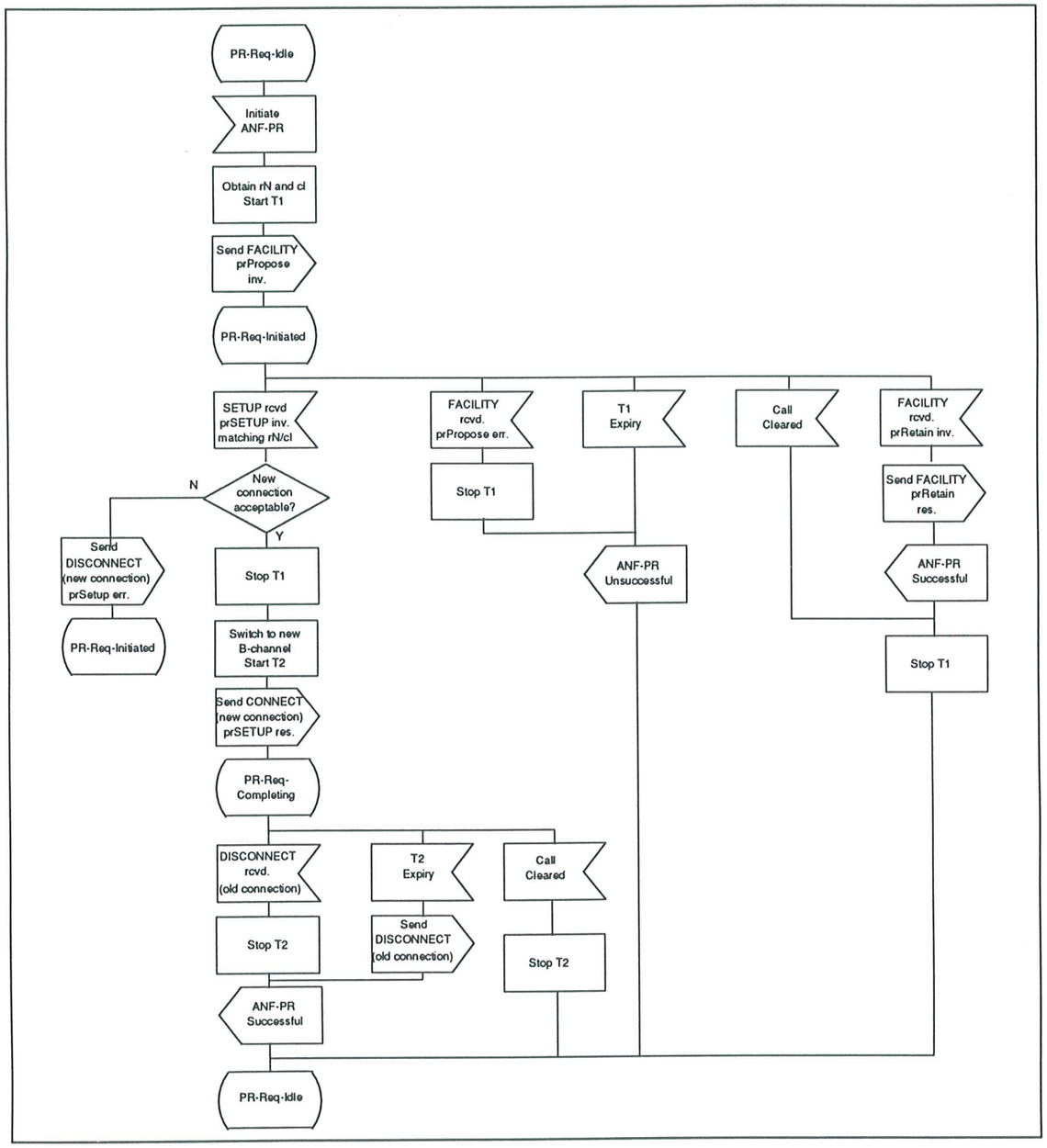

Figure D.1 - Requesting PTNX SDL

D.2 SDL representation of ANF-PR at the Cooperating PTNX

Figure D.2 shows the behaviour of an ANF-PR Supplementary Service Control entity within the Cooperating PTNX.

Input signals from the left and output signals to the left represent primitives to and from the Coordination Function in respect of messages sent and received. Input signals from the right represent protocol timer expiry and indications from basic call control.

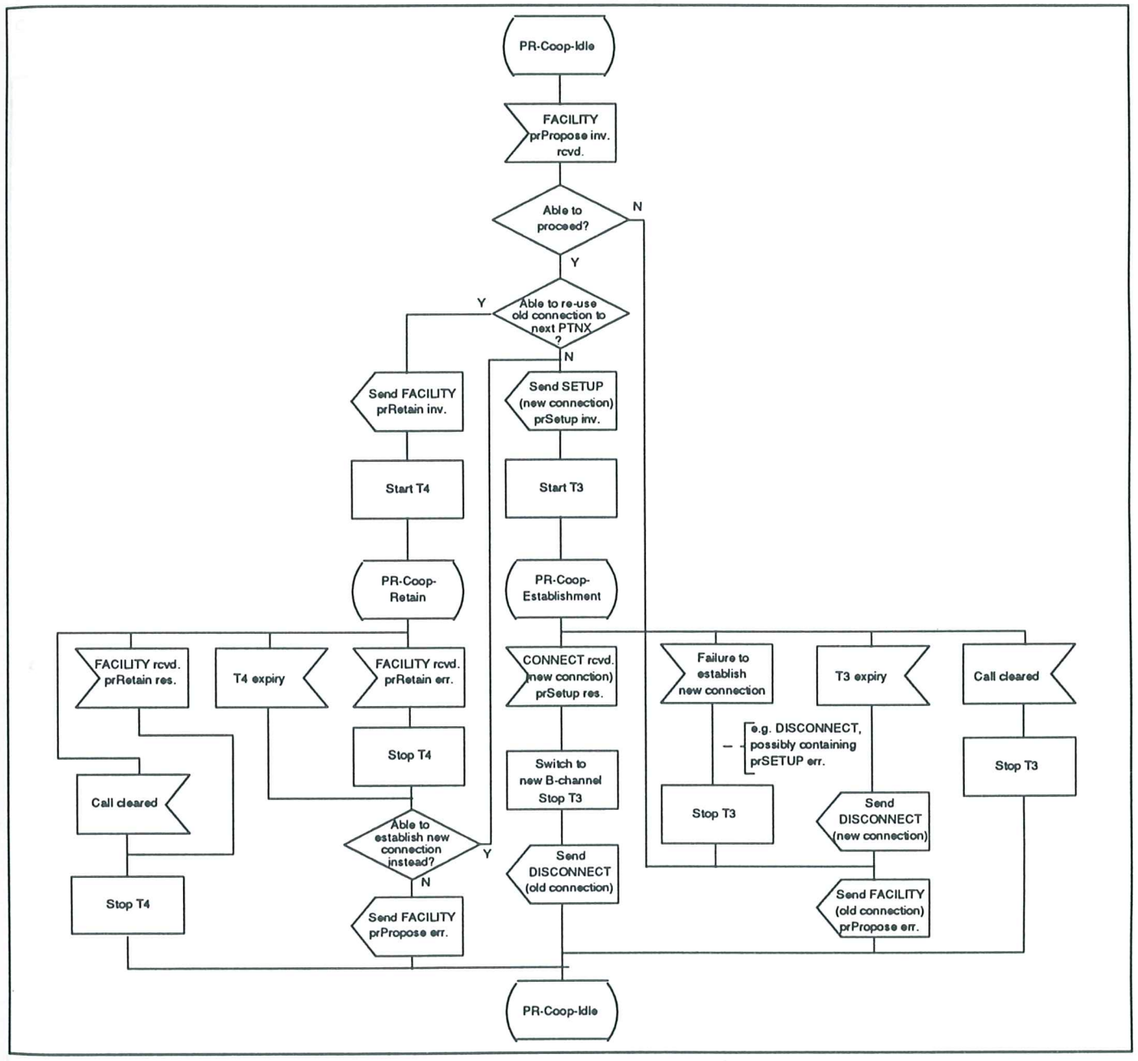

Figure D.2 - Cooperating PTNX SDL

D.3 SDL representation of ANF-PR at a Transit PTNX on the retained connection

Figure D.3 shows the behaviour of an ANF-PR Supplementary Service Control entity within a Transit PTNX on the retained connection.

Input signals from the left and output signals to the left represent primitives to and from the Coordination Function in respect of messages sent to and received from the Subsequent PTNX or the Requesting PTNX.

Input signals from the right and output signals to the right represent primitives to and from the Coordination Function in respect of messages sent to and received from the Preceding PTNX. Also protocol timer expiry and indications from basic call control are indicated by input signals from the right.

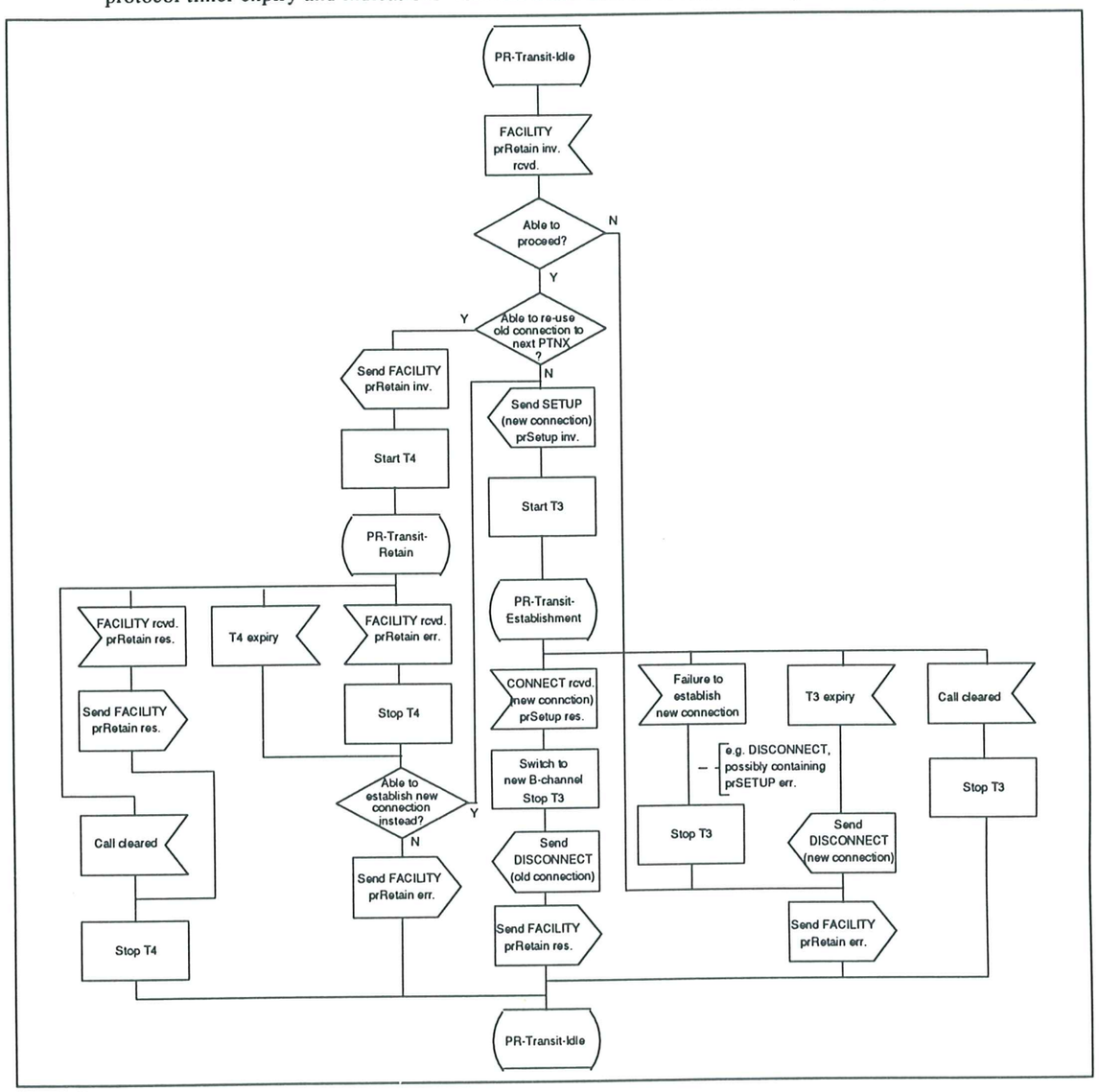

Figure D.3 - Transit PTNX SDL