ETSI

EUROPEAN TELECOMMUNICATION STANDARD

ETS 300 258

November 1993

Source: ETSI TC-ECMA

Reference: DE/ECMA-00014

ICS: 33.080

Key words: PTN, ECMA-175, PRSD

Private Telecommunication Network (PTN);
Specification, functional models and information flows
Path replacement additional network feature

ETSI

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New presentation - see History box

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Foreword

This European Telecommunication Standard (ETS) has been produced by the European Computer Manufacturers Association (ECMA) on behalf of its members and those of the European Telecommunications Standards Institute (ETSI).

This ETS is one of a series of 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.

This ETS specifies the Path Replacement additional network feature.

The ETS 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 standardisation bodies. It represents a pragmatic and widely based consensus.

This ETS was produced by ECMA using the ECMA guidelines for the production of standards and using the ECMA stylesheet. In order to avoid undue delays in the voting process of this ETS it has been agreed that this ETS will not be converted to the ETSI stylesheet.

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1 Scope

This ETS specifies the Path Replacement additional network feature (ANF-PR), which is applicable to various basic services supported by Private Telecommunication Networks (PTNs). Basic services are specified in ETS 300 171.

ANF-PR is a feature which applies to an established call, allowing that call's connection between Private Telecommunication Network Exchanges (PTNXs) 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. Annex A gives examples of the circumstances under which ANF-PR can be used and criteria which can govern the selection of the new connection.

Additional network feature specifications are produced in three stages, according to the method described in ENV 41005 for supplementary services. This ETS contains the stage 1 and stage 2 specifications of ANF-PR. The stage 1 specification (clause 6) specifies the feature as seen by an entity which initiates path replacement, the ANF-PR user. The stage 2 specification (clauses 7 and 8) identifies the functional entities involved in the feature and the information flows between them. Clause 7 contains the stage 2 specification for basic operation of the feature. Clause 8 contains the stage 2 specification for an enhanced mode of working which can be employed when supported by all the equipment involved. It allows some of the elements of the old connection to be re-used.

2 Conformance

In order to conform to this ETS, a stage 3 standard shall specify signalling protocols and equipment behaviour that are capable of being used in a PTN which supports the feature specified in this ETS. This means that, to claim conformance, a stage 3 standard is required to be adequate for the support of those aspects of clause 6 (stage 1) and clauses 7 and 8 (stage 2) which are relevant to the interface or equipment to which the stage 3 standard applies.

3 References

ENV 41005	Method for the specification of basic and supplementary services of private telecommunication networks (1989)
ENV 41007	Definition of terms in private telecommunication networks (1989)
ETS 300 171	Private Telecommunication Network (PTN); Specification, functional models and information flows, Control aspects of circuit mode basic services (1992)
ETS 300 189	Private Telecommunication Network (PTN); Addressing (1992)
CCITT Recommendation I.112	Vocabulary of terms for ISDNs (1988)
CCITT Recommendation I.210	Principles of telecommunication services supported by an ISDN and the means to describe them (1988)
CCITT Recommendation Z.100	Specification and description language (1988)

4 Definitions

For the purpose of this ETS the following definitions apply.

4.1 External definitions

This ETS uses the following terms defined in other documents:

- Basic service	(CCITT Recommendation I.210);
- Private	(ENV 41007);
- Private Telecommunication Network Exchange (PTNX)	(ENV 41007);
- Service	(CCITT Recommendation I.112);
- Signalling	(CCITT Recommendation I.112);
- Supplementary Service	(CCITT Recommendation I.210);
- Telecommunication Network	(ENV 41007);
- User (except in the context of ANF-PR user)	(ETS 300 171).

This ETS refers to the following basic call functional entities (FEs) defined in ETS 300 171:

- Call Control (CC);
- Call Control Agent (CCA).

This ETS refers to the following basic call inter-FE relationships defined in ETS 300 171:

- r1;
- r2;
- r3.

This ETS refers to the following basic call information flows defined in ETS 300 171:

- Channel_Acknowledge request/indication;
- Release request/indication;
- Release response/confirmation;
- Setup request/indication;
- Setup response/confirmation.

This ETS refers to the following basic call information flow element defined in ETS 300 171:

- Destination Number.

4.2 Additional network feature

A capability, over and above that of a basic service, provided by a PTN, but not directly to a PTN user.

4.3 ANF-PR user

An entity, within a PTN, that requests ANF-PR.

4.4 Call, basic call

An instance of the use of a basic service.

4.5 Connection

As defined in CCITT Recommendation I.112, but limited to the case of providing for the transfer of signals between two PTNXs.

NOTE 1

A connection between two PTNXs can pass through zero or more Transit PTNXs.

4.6 New connection

The connection established by ANF-PR and used to replace all or part of the old connection.

4.7 Old connection

The connection existing before ANF-PR is invoked.

4.8 Trombone connection

A connection which has both its ends in the same PTNX but which involves at least one Transit PTNX.

5 List of acronyms

ANF	Additional Network Feature
ANF-PR	ANF Path Replacement
CC	Call Control (functional entity)
CCA	Call Control Agent (functional entity)
CID	Call Identity
FE	Functional Entity
ISDN	Integrated Services Digital Network
PRE	Path Replacement Error
PRP	Path Replacement Propose (information flow)
PRR	Path Replacement Re-use (information flow)
PRRR	PRR Result (information flow element)
PRS	Path Replacement Setup (information flow)
PRSR	PRS Result (information flow element)
PTN	Private Telecommunication Network
PTNX	Private Telecommunication Network Exchange
RN	Rerouting Number (information flow element)
SDL	Specification and Description Language

6 ANF-PR stage 1 specification

6.1 Description

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

6.1.2 Qualifications on applicability to telecommunication services

This supplementary service is applicable to all basic services defined in ETS 300 171.

NOTE 2

For certain teleservices or certain applications of certain basic bearer services the changeover from the old connection to the new connection can cause unacceptable disruption. See annex B.

6.2 Procedure

6.2.1 Provision/withdrawal

This ANF shall be PTN instigated.

NOTE 3

Means can be provided for preventing the use of ANF-PR for applications where the changeover from the old connection to the new connection is likely to cause unacceptable disruption. See annex B.

6.2.2 Normal procedures

6.2.2.1 Activation/deactivation/registration/interrogation

The feature shall be permanently activated.

6.2.2.2 Invocation and operation

Invocation shall be on request from an ANF-PR user and shall be permitted only after a call has reached the active state.

On invocation an attempt shall be made to establish a new connection between the Originating PTNX and the Terminating PTNX. In the absence of specific criteria, the new connection shall be established using the routing rules which apply to basic call establishment. If the new connection is successfully established it shall be used to replace the old connection, which shall be released.

Changeover from the old connection to the new connection should be done in a manner which minimises disruption to user information.

NOTE 4

The means of specifying criteria and ensuring that the new connection satisfies those criteria can involve the use of another ANF or supplementary service, which can be either standardized or manufacturer specific.

In some circumstances it may be possible to re-use some elements of the old connection, so that only part of the old connection has to be replaced by a new connection, subject to the given criteria being achievable in that way.

6.2.3 Exceptional procedures

6.2.3.1 Activation/deactivation/registration/interrogation

Not applicable.

6.2.3.2 Invocation and operation

If it is not possible to establish a new connection, the call shall continue to use the old connection and any resources reserved for the new connection shall be released. There shall be no disruption to user information.

In the event of two ANF-users (at opposite ends of the connection) requesting the feature simultaneously, both requests shall be rejected.

NOTE 5

An ANF-PR user can request the feature again later in the event of failure. In the case of failure due to simultaneous requests, care should be taken to avoid a repeat occurrence, e.g. by use of a random delay.

6.3 Interaction with other supplementary services and ANFs

Interactions with other supplementary services and ANFs for which PTN Standards were available at the time of publication of this ETS are specified below.

6.3.1 Identification supplementary services (Calling Line Identification Presentation, Connected Line Identification Presentation, and Calling/Connected Line Identification Restriction)

No interaction.

6.3.2 Name Identification supplementary services (Calling Name Identification Presentation, Connected Name Identification Presentation, Calling/Connected Name Identification Restriction)

No interaction.

6.3.3 Call Forwarding supplementary services (Call Forwarding Unconditional, Call Forwarding on Busy, Call Forwarding on No Reply)

ANF-PR can apply to a call which has been forwarded.

6.3.4 Call Transfer supplementary service

If call transfer occurs while ANF-PR is in progress, ANF-PR shall be aborted.

ANF-PR can apply to a call which has been transferred. The fact that transfer has occurred can be a reason for invoking ANF-PR (see annex A).

6.4 Interworking considerations

The requirements below apply to both incoming calls and outgoing calls.

It shall be possible to use ANF-PR on the PTN part of the connection. The new connection through the PTN shall replace the old connection through the PTN.

When interworking with another network which supports an equivalent feature, it may be possible to cooperate with the other network in order to replace the entire connection.

6.5 Overall SDL

Figure contains the dynamic description of ANF-PR using the Specification and Description Language (SDL) defined in CCITT Recommendation Z.100 (1988). The SDL process represents the behaviour of the PTN in providing ANF-PR. Input signals from the left and output signals to the left represent primitives from and to the ANF-PR user.
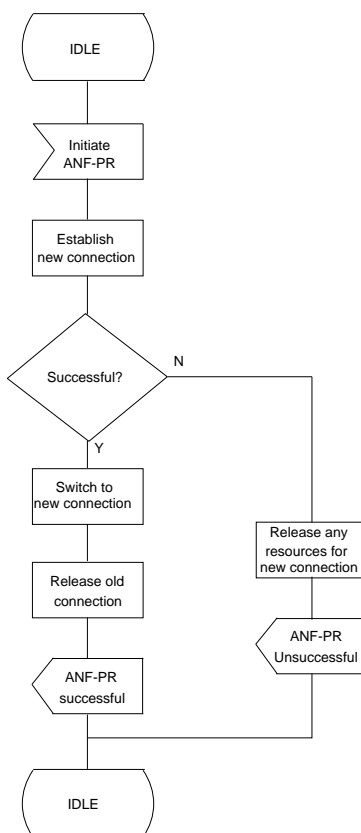
Figure 1 - ANF-PR, Overall SDL

7   ANF-PR stage 2 specification - basic operation

7.1   Functional model

7.1.1   Functional model description

The functional model shall comprise the FEs "Path Replacement Destination" (FE1) and "Path Replacement Source" (FE2). A relationship, rx, shall exist between FE1 and FE2. See figure 2.

PR   PR
DESTINATION   SOURCE

FE1 ————————— rx ————————— FE2
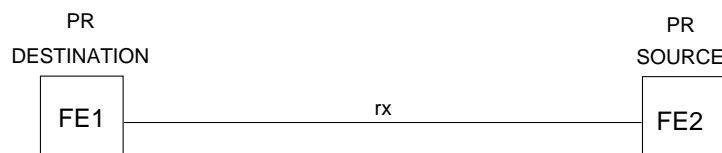
Figure 2 - Functional model for ANF-PR

7.1.2   Description of functional entities

7.1.2.1   Path replacement destination functional entity, FE1

This functional entity receives a request from the ANF-PR user to initiate ANF-PR and instructs FE2 to attempt to establish a new connection back towards FE1. If the new connection is successfully established, FE1 switches to the new connection and awaits the release of the old connection.

7.1.2.2   Path replacement source functional entity, FE2

On receipt of instruction from FE1 and if able to proceed with ANF-PR, this functional entity initiates the establishment of a new connection back towards FE1. If the new connection is successfully established, FE2 switches to the new connection and initiates release of the old connection.

7.1.3   Relationship of functional model to basic call functional model

During successful invocation of ANF-PR, the Transit CCs, if any, involved in the old connection shall be replaced by the Transit CCs, if any, involved in the new connection. The Originating and Terminating CCs shall remain.

For the case of a call originating and terminating within the PTN, ANF-PR functional entities shall be related to basic call functional entities as follows:

-    FE1 shall be collocated with the Originating CC or the Terminating CC, depending on the location of the ANF-PR user;

-    FE2 shall be collocated with the Terminating CC if FE1 is collocated with the Originating CC, or with the Originating CC if FE1 is collocated with the Terminating CC.

Figure 3 shows an example of the relationship between the model for ANF-PR and the model for the basic call. This example is used as the basis of the information flow sequences in 7.2.3.

NOTE 6

The number of Transit CCs on the new connection can differ from the number on the old connection.
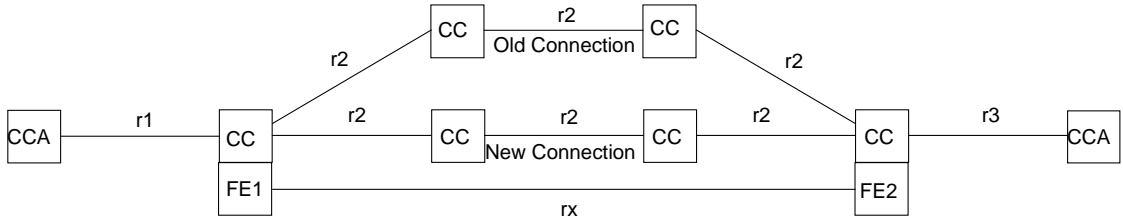
Figure 3 - Example relationship between models for ANF-PR and basic call

7.2 Information flows

7.2.1 Definition of information flows

In the tables listing the elements in information flows, the column headed "Request" indicates which of these elements are mandatory (M) and which are optional (O) in a request/indication information flow, and the column headed "Confirm" indicates which of these elements are mandatory (M) and which are optional (O) in a response/confirmation information flow.

7.2.1.1 PRP (Path Replacement Propose)

PRP is an unconfirmed information flow across rx from FE1 to FE2 which proposes path replacement to FE2.

PRP request/indication is sent using the signalling path of the old connection.

Table 1 lists the elements within the PRP information flow.

Table 1 - Content of PRP

Element	Request
Rerouting Number (RN)	M
Call Identity (CID)	M

Element RN shall always be included in the PRP request/indication information flow at rx. It shall contain a number from one of the native numbering plans of the PTN (see ETS 300 189). The number shall be suitable for use for routing the new connection to the physical location where FE1 resides.

Element CID shall always be included in the PRP request/indication information flow at rx. It shall contain a number which, in conjunction with the number in element RN, identifies the particular FE1, and therefore the call on which ANF-PR is being invoked. This number need not have significance outside the physical location where FE1 resides.

7.2.1.2 PRS (Path Replacement Setup)

PRS is a confirmed information flow across rx from FE2 to FE1 which indicates to FE1 that the new connection being established is for the purpose of path replacement. The response indicates whether FE1 has successfully correlated the new connection with the old connection and is prepared to switch to the new connection.

PRS request/indication and PRS response/confirmation are sent using the signalling path of the new connection at the time of establishment of that connection.

Table 2 lists the elements within the PRS information flow.

Table 2 - Content of PRS

Element	Request	Confirm
Call Identity (CID)	M	-
PRS Result (PRSR)	-	M

Element CID shall always be included in the PRS request/indication information flow at rx. It shall contain the value received in the corresponding element of the PRP request/indication information flow.

Element PRSR shall always be included in the PRS response/confirmation information flow at rx. It indicates whether the request was successful, and if not the reason for failure.

7.2.1.3   PRE (Path Replacement Error)

PRE is an unconfirmed information flow across rx from FE2 to FE1 which indicates to FE1 that path replacement has failed.

Table 3 lists the elements within the PRE information flow.

Table 3 - Content of PRE

Element	Request
Reason for failure	M

7.2.2   Relationship of information flows to basic call information flows

The PRS request/indication information flow shall be sent in conjunction with the basic call information flow Setup request/indication for the new connection sent across basic call relationship r2. Element Destination Number of information flow Setup request/indication shall contain the number provided in element RN of information flow PRP request/indication.

The PRS response/confirmation information flow shall be sent in conjunction with the basic call information flow Setup response/confirmation for the new connection across basic call relationship r2.

Failure to establish the new connection shall result in the initiation of its release using basic call information flow Release request/indication across relationship r2.

Successful switch over to the new connection shall result in the initiation of the release of the old connection using basic call information flow Release request/indication across relationship r2.

7.2.3   Examples of information flow sequences

A stage 3 Standard for ANF-PR shall provide signalling procedures in support of the information flow sequences specified below. In addition, signalling procedures should be provided to cover other sequences arising from error situations, interactions with basic call, interactions with other supplementary services, different topologies, etc..

In the figures, ANF-PR information flows are represented by solid arrows and basic call information flows are represented by broken arrows. An ellipse embracing two information flows indicates that the two information flows occur simultaneously. Within a column representing an ANF-PR functional entity, the numbers refer to functional entity actions listed in 7.3.

7.2.3.1   Normal operation of ANF-PR

Figure 4 shows the information flow sequence for normal operation of ANF-PR.
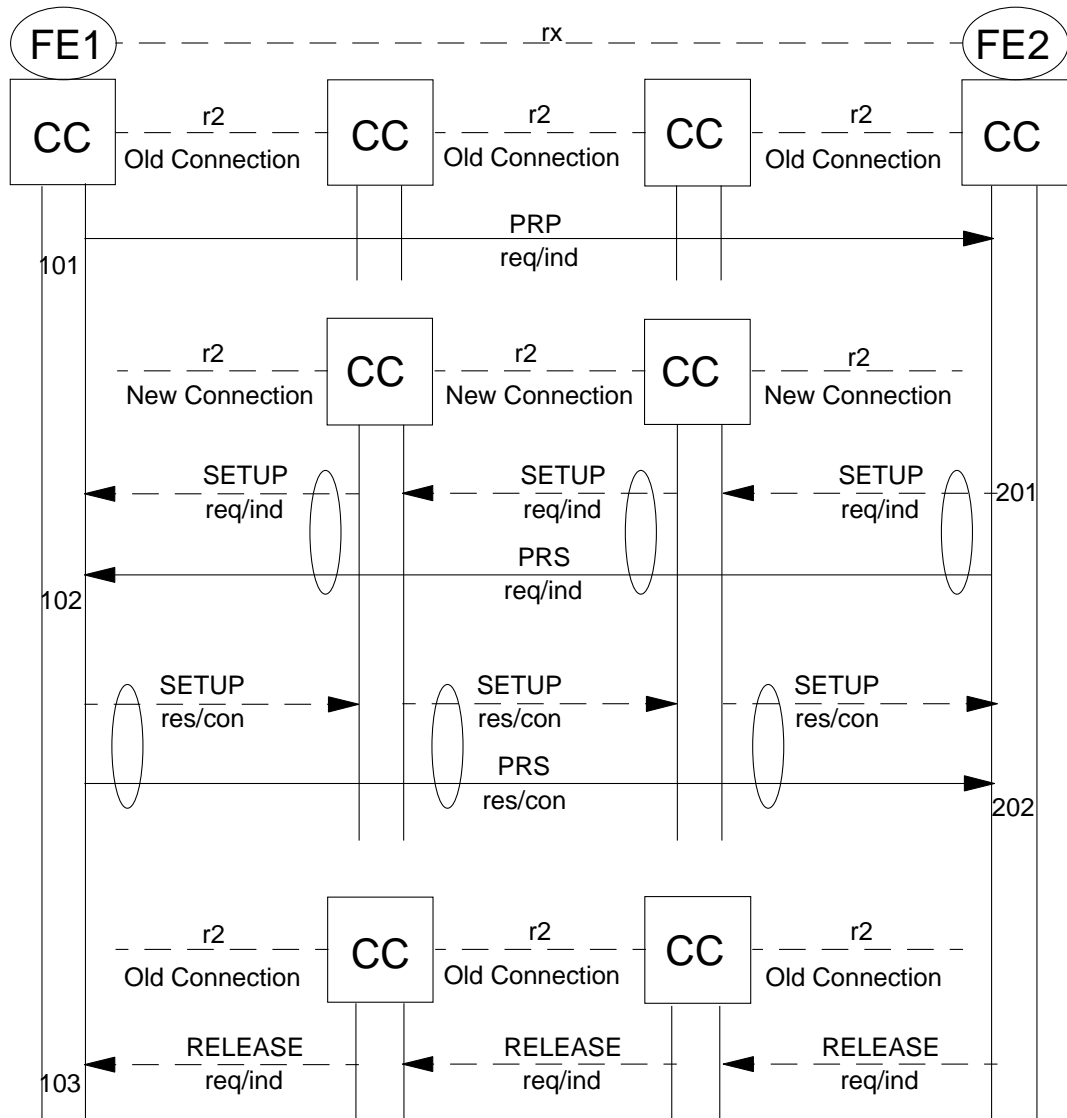
NOTE - For simplicity, basic call information flows Channel_Acknowledge request/indication and Release response/confirmation are not shown.

Figure 4 - Information flow sequence - Normal operation of ANF-PR

7.2.3.2   Failure to establish new connection

Figure 5 shows the information flow sequence when establishment of the new connection fails.
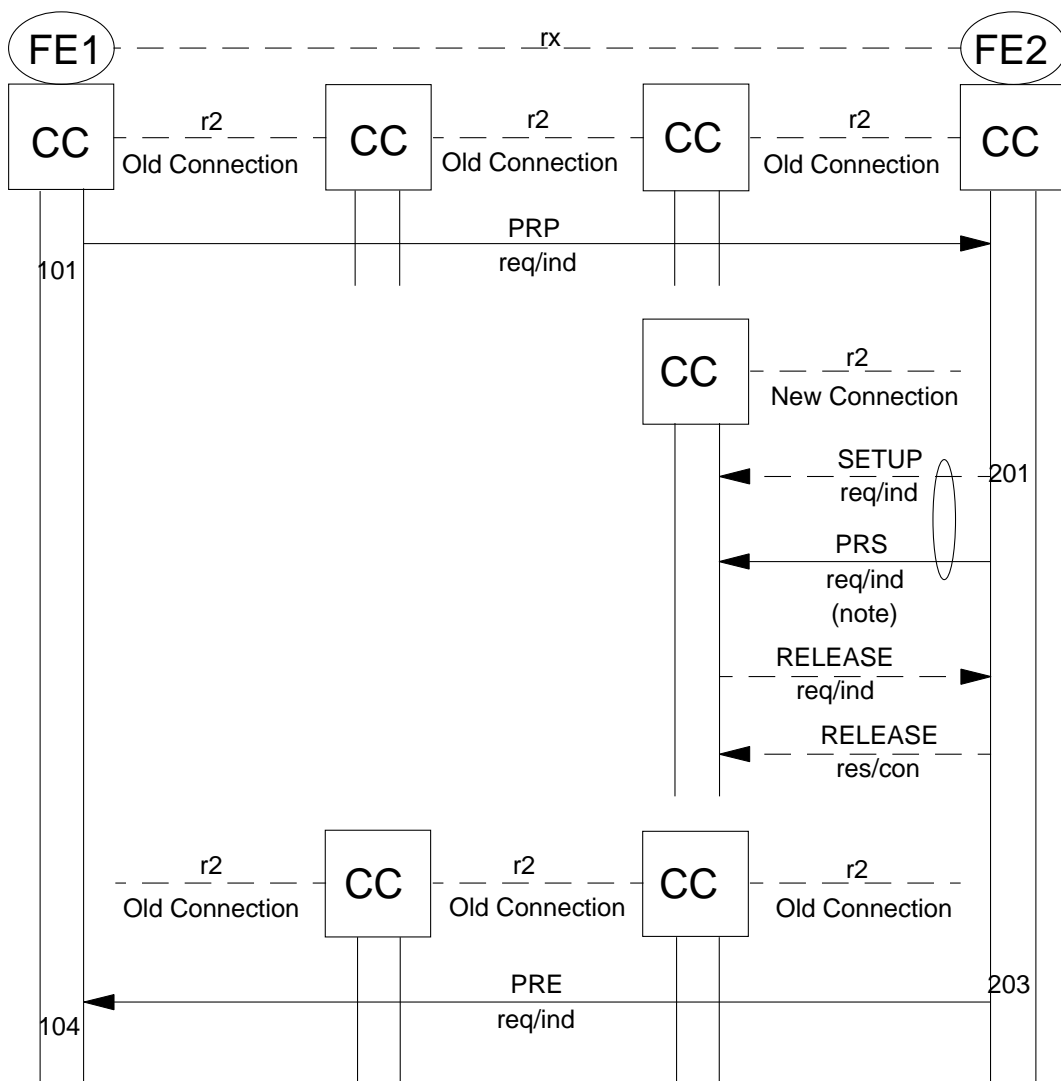
NOTE - Because of failure to establish the new connection, the PRS request/indication will not reach FE1.

Figure 5 - Information flow sequence - Failure to establish new connection

7.3   Functional entity actions

The following FE actions shall occur at the points indicated in the figures of 7.2.3.

7.3.1 Functional entity actions of FE1

101 On receipt of a request from the ANF-PR user, obtain Rerouting Number and Call Identity, and include in PRP request/indication to FE2.

102 On receipt of PRS request/indication (in conjunction with basic call Setup request/indication): correlate new connection with old connection; switch over to the user information channel of the new connection; terminate the user information channel of the old connection in a suitable manner (pending its release); stimulate the sending of a basic call Setup response/confirmation; and return with it a PRS response/confirmation.

NOTE 7

The method of terminating the old connection's user information channel is an implementation matter. See also annex B.

103 On receipt of an indication from the local CC that the old connection has been released, indicate successful completion of ANF-PR to the ANF-PR user.

104 On receipt of PRE request/indication, terminate ANF-PR and retain the old connection. Depending on the reason for failure, indicate to the ANF-PR user whether it is worthwhile invoking again later.

7.3.2 Functional entity actions of FE2

201 On receipt of PRP request/indication, check that ANF-PR is allowed and stimulate the establishment of a new connection. In conjunction with basic call SETUP request/-indication, send PRS request/indication to FE1. Terminate the new connection's user information channel suitably.

NOTE 8

The method of terminating the new connection's user information channel is an implementation matter. See also annex B.

202 On receipt of PRS response/confirmation indicating success (in conjunction with basic call Setup response/confirmation), switch over to the new connection. Disconnect the old user information channel and initiate release of the old connection. Terminate ANF-PR.

203 On inability to accept the PRP request/indication, failure to establish the new connection, or receipt of PRS response/confirmation indicating failure (in conjunction with basic call Release request/indication), send PRE request/indication to FE1 and terminate ANF-PR.

7.4 Functional entity behaviour

The FE behaviours shown below are intended to illustrate typical FE behaviour in terms of information flows sent and received.

The behaviour of each FE is shown using the Specification and Description Language (SDL) defined in CCITT Recommendation Z.100 (1988).

7.4.1 Behaviour of FE1

Figure 6 shows the normal behaviour of FE1. Input signals from the right and output signals to the right represent information flows from and to FE2 and from the local basic call CC. Input signals from the left and output signals to the left represent primitives from and to the ANF-PR user.

```
                              ┌─────────────┐
                             (  FE1-Idle    )
                              └─────────────┘
                                    │
                              ┌─────────────┐
                              │  Initiate   │
                              │   ANF-PR    │
                              └─────────────┘
                                    │
                              ┌─────────────┐
                              │Obtain RN and CID│
                              └─────────────┘
                                    │
                              ┌─────────────┐
                              │ PRP req/ind │
                              │(old connection)│
                              └─────────────┘
                                    │
                              ┌─────────────┐
                             ( FE1-Proposing )
                              └─────────────┘
                                    │
         ┌──────────────────────────┼────────────────────────────────────┐
   ┌─────────────┐          ┌─────────────┐                    ┌─────────────┐
   │ PRS req/ind │          │ PRE req/ind │                    │ Basic call  │
   │   (new      │          │(old connection)│                 │  released   │
   │ connection) │          └─────────────┘                    └─────────────┘
   └─────────────┘                 │                                   │
         │                         │                                   │
   ┌─────────────┐                 │                                   │
   │Associate with old│            │                                   │
   │  connection │                 │                                   │
   └─────────────┘                 │                                   │
         │                         │                                   │
       ◇ OK? ◇────N──────┐         │                                   │
         │               │         │                                   │
         Y               │         │                                   │
   ┌─────────────┐ ┌─────────────┐ │                                   │
   │ Switch to new│ │  Release new │ │                                  │
   │user information│ │ connection │ │                                  │
   │   channel   │ └─────────────┘ │                                    │
   └─────────────┘       │         │                                    │
         │         ┌─────────────┐ │                                    │
   ┌─────────────┐ │ PRS res/con │ │                                    │
   │ PRS res/con │ │Result=Failed│ │                                    │
   │  Result =   │ └─────────────┘ │                                    │
   │ successful  │       │         │                                    │
   └─────────────┘ ┌─────────────┐ │                                    │
         │        ( FE1-Rejecting )│                                    │
   ┌─────────────┐ └─────────────┘ │                                    │
  ( FE1-Switched )      │          │                                    │
   └─────────────┘ ┌─────────────┐ │                                    │
         │         │ PRE req/ind │ │                                     │
   ┌─────────────┐ │(old connection)│                                   │
   │Old connection│ └─────────────┘ │                                   │
   │  released   │       │          │                                   │
   │(from local CC)│      └─────────┘                                   │
   └─────────────┘       │                                              │
         │         ┌─────────────┐                                      │
   ┌─────────────┐ │   ANF-PR    │                                      │
   │   ANF-PR    │ │ Unsuccessful│                                      │
   │ Successful  │ └─────────────┘                                      │
   └─────────────┘       │                                              │
         │               └──────────────────────────────────────────────┘
         └───────┬───────┘
          ┌─────────────┐
         (  FE1-Idle    )
          └─────────────┘
```
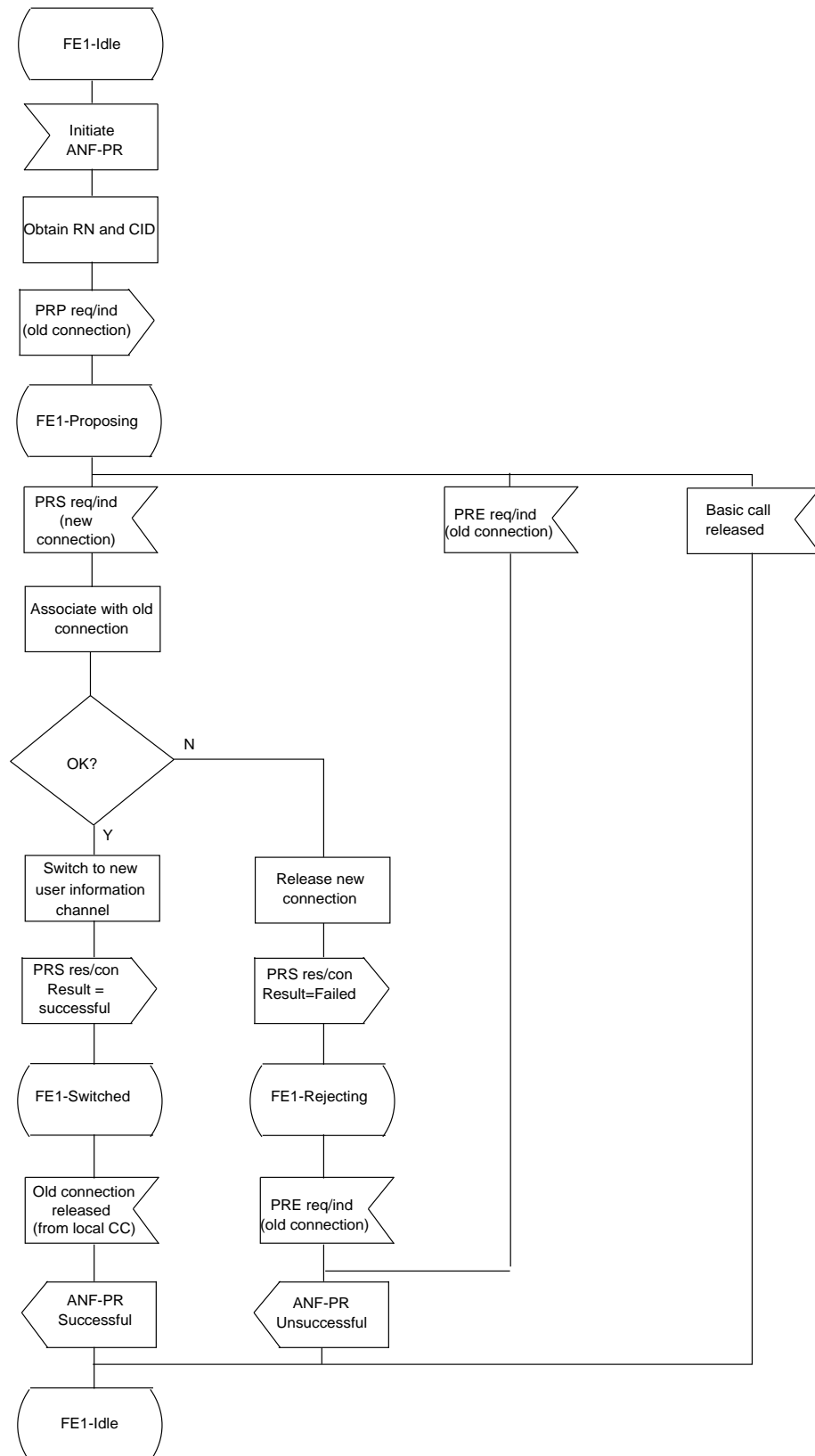
Figure 6 - ANF-PR, SDL for functional entity FE1

7.4.2   Behaviour of FE2

Figure 7 shows the normal behaviour of FE2. Input signals from the left and output signals to the left represent information flows from and to FE1. Input signals from the right represent indications from the local CC.
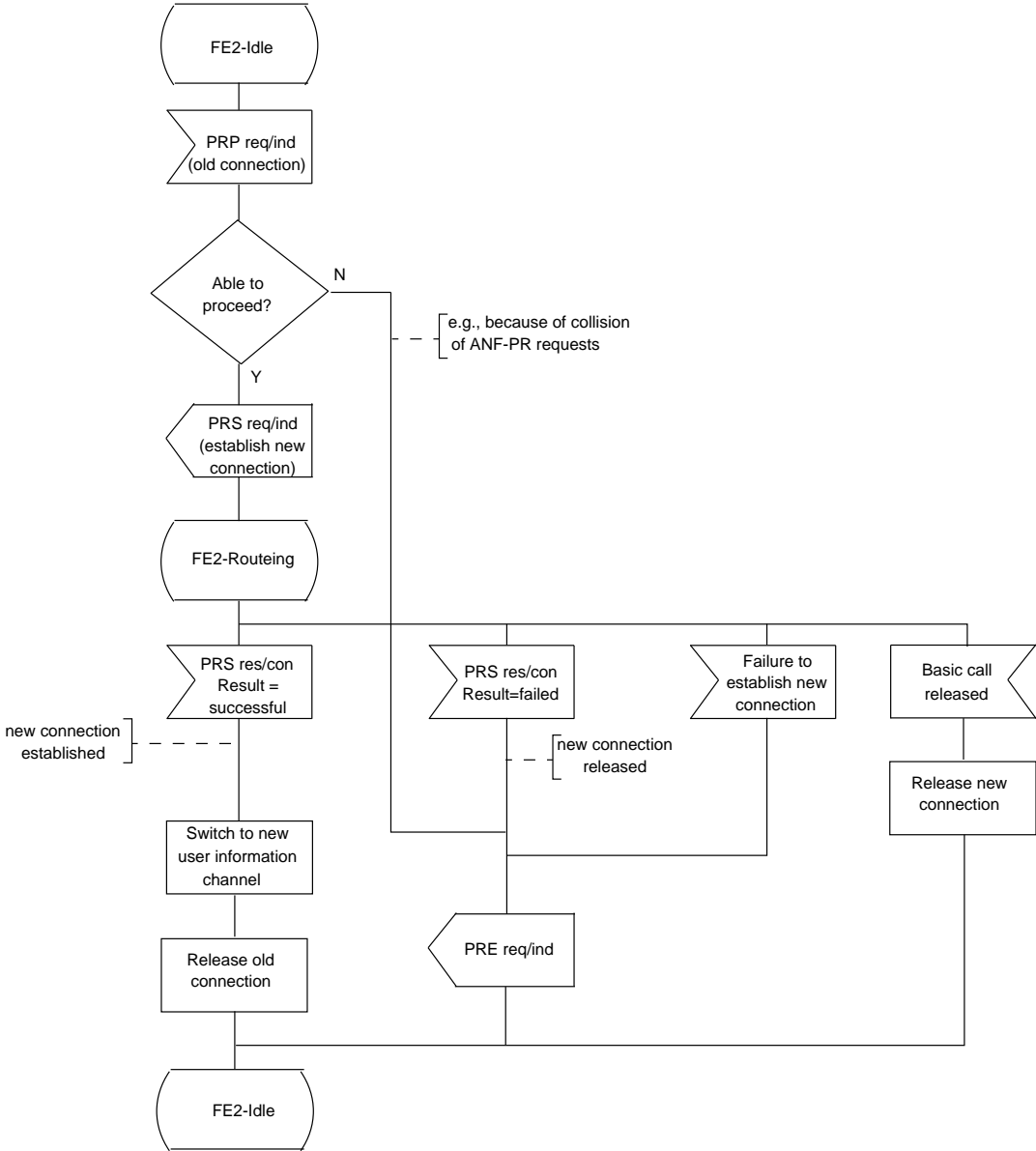
Figure 7 - ANF-PR, SDL for functional entity FE2

7.5   **Allocation of functional entities to physical equipment**

The allocations of FEs to physical equipment shown in table 4 shall apply.

FE1 shall be located at either End PTNX, depending on where the need for invoking ANF-PR arises. This will depend on the application.

In the case of a trombone connection, the Originating PTNX or Incoming Gateway PTNX will be the same PTNX as the Terminating PTNX or Outgoing Gateway PTNX. Therefore FE1 and FE2 will be collocated and the new connection and those information flows sent using the signalling path of the new connection will be intra-PTNX. Information flow PRP request/indication sent using the signalling path of the old connection will enable FE2 to determine that FE1 is collocated.

Table 4 - Scenarios for the allocation of FEs to physical equipment

	FE1	**FE2**
Scenario 1	Originating PTNX	Terminating PTNX
Scenario 2	Originating PTNX	Outgoing Gateway PTNX (note)
Scenario 3	Incoming Gateway PTNX (note)	Terminating PTNX
Scenario 4	Incoming Gateway PTNX (note)	Outgoing Gateway PTNX (note)
Scenario 5	Terminating PTNX	Originating PTNX
Scenario 6	Terminating PTNX	Incoming Gateway PTNX (note)
Scenario 7	Outgoing Gateway PTNX (note)	Originating PTNX
Scenario 8	Outgoing Gateway PTNX (note)	Incoming Gateway PTNX (note)
NOTE - When interworking with another network which supports an equivalent feature, FE1 or FE2 may be located in that other network, thereby permitting replacement of the entire connection.		

7.6   **Interworking considerations**

When interworking with another network which does not support an equivalent feature, the FEs for ANF-PR shall be located within PTNXs, in accordance with 7.5. All information flows will be internal to the PTN.

When interworking with another network which supports an equivalent feature, the two networks may cooperate in the operation of ANF-PR. In this case, either FE1 or FE2 will be located in the other network and the information flows within the PTN will map on to equivalent information flows in the other network.

8   ANF-PR stage 2 specification - re-use of connection elements

The enhanced functional breakdown of the feature as specified in this clause allows the possibility of re-using some elements of the old connection, so that only part of the old connection has to be replaced by a new connection.

8.1   Functional model

8.1.1   Functional model description

The functional model shall be as specified in 7.1.1 for basic operation, but with the addition of one or more instances of FE "Path Replacement Re-use" (FE3). The functionality of FE2 is enhanced. Additional relationship rz shall exist between FE1 and the adjacent instance of FE3. Additional relationship ry shall exist between adjacent instances of FE3 and between FE2 and the adjacent instance of FE3. See figure 8.
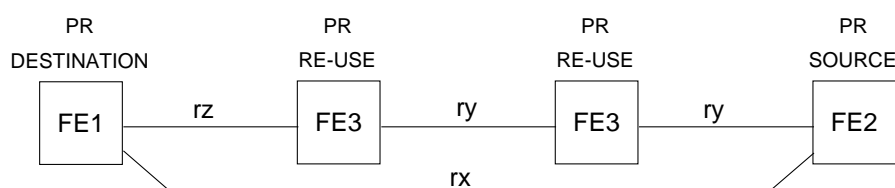

Figure 8 - Functional model for enhanced operation of ANF-PR

8.1.2   Description of functional entities

8.1.2.1   Path replacement destination functional entity, FE1

7.1.2.1 shall apply.

8.1.2.2   Path replacement source functional entity, FE2

The functions of FE2 are as specified in 7.1.2.2 with the following enhancement.

FE2 determines whether the existing element of the old connection as far as the next CC can be re-used, and if so instructs an instance of FE3 located at the next CC to establish and switch to the new connection.

8.1.2.3   Path replacement re-use functional entity, FE3

On receipt of instruction from FE2 or an intervening FE3, this functional entity initiates the establishment of a new connection back towards FE1. If the new connection is successfully established, FE3 connects the re-used connection element from FE2 to the new connection and initiates release of the unwanted parts of the old connection.

FE3 determines whether the existing element of the old connection as far as the next CC can be re-used, and if so instructs a further instance of FE3 located at the next CC to establish and switch to the new connection.

8.1.3   Relationship of functional model to basic call functional model

7.1.3 shall apply with the following modifications.

During successful invocation of ANF-PR with re-use of some or all of the elements of the old connection, the Transit CCs in that part of the old connection which is not re-used are replaced by the Transit CCs, if any, involved in the new connection. Other Transit CCs, including the one from which the new connection starts, are retained, and each has a collocated FE3.

Figure 9 shows an example of the relationship between the model for ANF-PR and the model for the basic call. In this example elements of the old connection are re-used from FE2 as far as the first Transit CC. This example is used as the basis of the information flow sequences in 8.2.3.
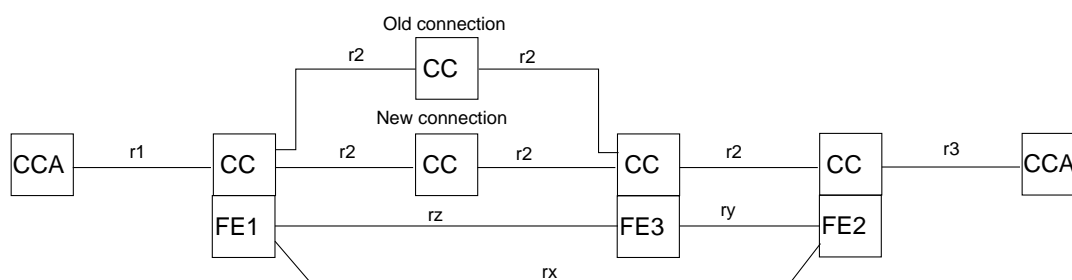
**Figure 9 - Example relationship between models for ANF-PR and basic call -
Re-use of part of the old connection**

8.2 Information flows

8.2.1 Definition of information flows

8.2.1.1 PRP (Path Replacement Propose)

7.2.1.1 shall apply.

8.2.1.2 PRS (Path Replacement Setup)

7.2.1.2 shall apply, with the exception that information flow PRS shall occur across relationship rz instead of rx.

8.2.1.3 PRE (Path Replacement Error)

7.2.1.3 shall apply.

8.2.1.4 PRR (Path Replacement Re-use)

PRR is a confirmed information flow across ry from FE2 or FE3 to the next FE3. It instructs the next FE3 to establish and switch to a new connection, elements of the old connection as far as that next FE3 being re-used. The response indicates whether a new connection has been successfully established and switched to.

PRR request/indication and PRR response/confirmation are sent using the signalling path of the old connection.

Table 5 lists the elements within the PRR information flow. The column headed "Request" indicates which of these elements are mandatory (M) and which are optional (O) in a PRR request/indication information flow. The column headed "Confirm" indicates which of these elements are mandatory (M) and which are optional (O) in a PRR response/confirmation information flow.

Table 5 - Content of PRR

Element	Request	Confirm
Rerouting Number (RN)	M	-
Call Identity (CID)	M	-
PRR Result (PRRR)	-	M

Element RN shall always be included in the PRR request/indication information flow at ry. It shall contain the number sent to FE2 in element RN of the PRP request/indication information flow.

Element CID shall always be included in the PRR request/indication information flow at ry. It shall contain the value received in the corresponding element of the PRP request/indication information flow.

Element PRRR shall always be included in the PRR response/confirmation information flow at ry. It indicates whether the request was successful, and if not the reason for failure.

8.2.2 Relationship of information flows to basic call information flows

7.2.2 shall apply.

8.2.3 Examples of information flow sequences

Below are examples of typical sequences of information flows. In addition to providing signalling procedures in support of these sequences, a stage 3 Standard shall also cover other sequences arising from error situations, interactions with basic call, interactions with other supplementary services, different topologies, etc..

In the figures, ANF-PR information flows are represented by solid arrows and basic call information flows are represented by broken arrows. An ellipse embracing two information flows indicates that the two information flows occur simultaneously. Within a column representing an ANF-PR functional entity, the numbers refer to functional entity actions listed in 8.3.

8.2.3.1 **Normal operation of ANF-PR with re-use of part of old connection**

Figure 10 shows the information flow sequence for normal operation of ANF-PR when that part of the old connection up to the first Transit CC is re-used. The new connection starts at the first Transit CC, at which an instance of FE3 is located.
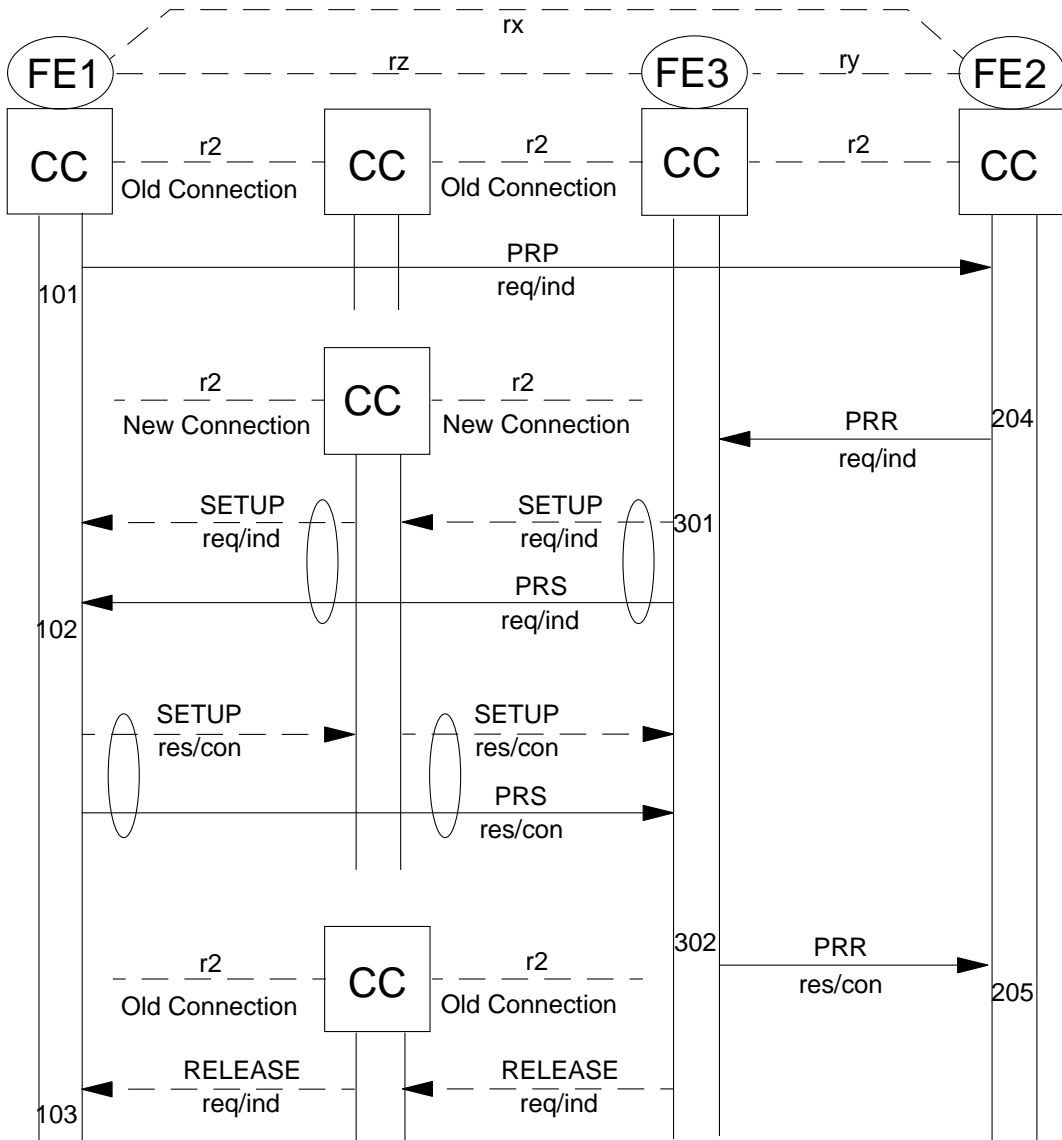
NOTE - For simplicity, basic call information flows Channel_Acknowledge request/indication and Release response/confirmation are not shown.

Figure 10 - Information flow sequence
- Normal operation of ANF-PR with re-use of part of old connection

8.2.3.2 Failure to establish new connection to replace part of old connection

Figure 11 shows the information flow sequence when establishment of a new connection to replace part of the old connection fails. The new connection attempt is from the first Transit CC, at which an instance of FE3 is located.
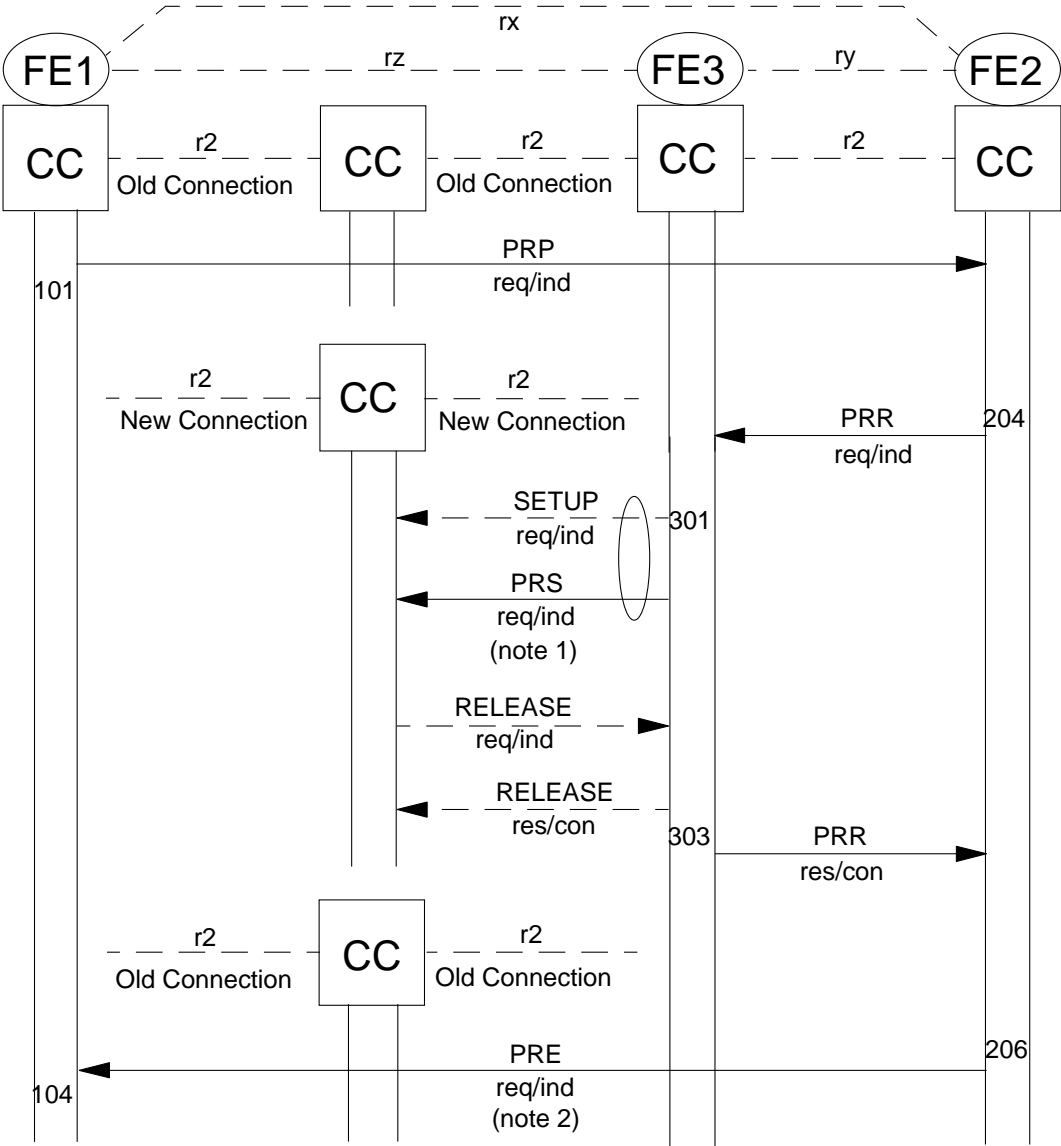
NOTE 1 - *Because of failure to establish the new connection, the PRS request/indication will not reach FE1.*

NOTE 2 - *Because of failure to establish the new connection, PRE request/indication is sent. Alternatively FE2 may revert to basic operation and attempt to establish a new connection without re-use of part of the old connection.*

Figure 11 - Information flow sequence
- Failure to establish new connection to replace part of old connection

8.2.3.3   Retention of all of the old connection

Figure 12 shows the information flow sequence for operation of ANF-PR when an attempt is made to re-use the old connection as far as the CC where FE1 is located. This can arise only if the old connection already meets the criteria for the new connection. The old connection is retained and ANF-PR is deemed to have terminated successfully. An FE3 occurs at each Transit CC and at the CC where FE1 is located.
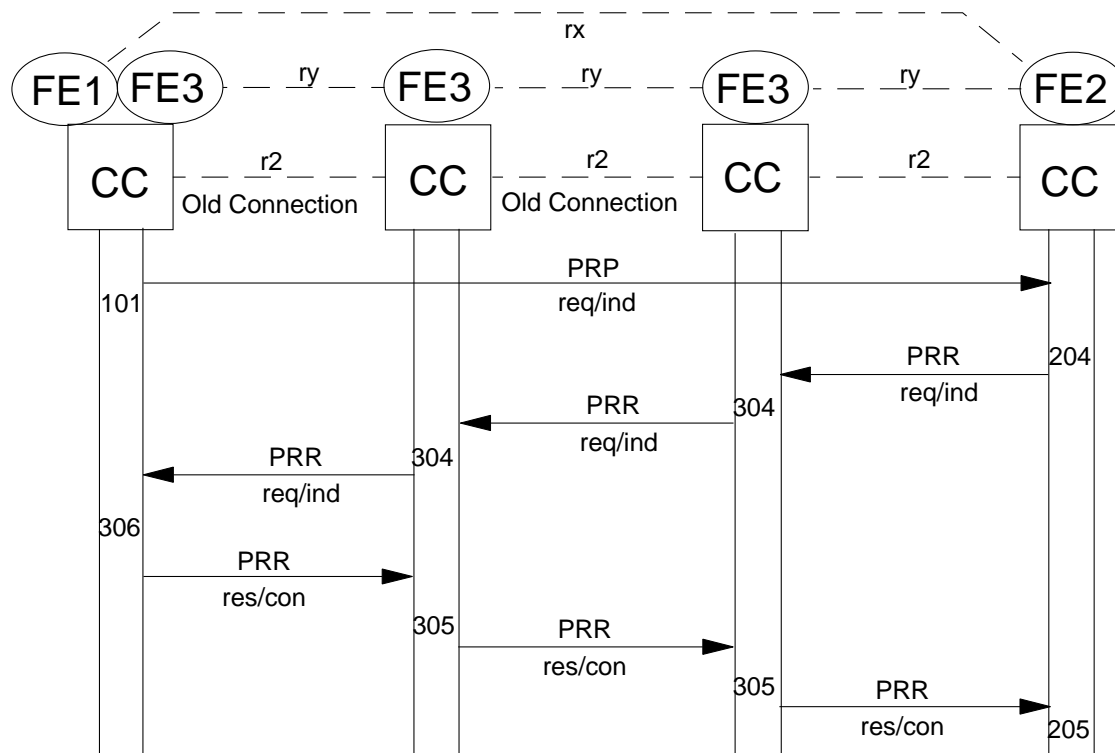
Figure 12 - Information flow sequence - Retention of all of the old connection

8.3   Functional entity actions

The following FE actions shall occur at the points indicated in the figures of 8.2.3.

8.3.1   Functional entity actions of FE1

7.3.1 shall apply.

8.3.2   Functional entity actions of FE2

7.3.2 shall apply. In addition, the following actions shall apply.

204   On receipt of PRP request/indication, check that ANF-PR is allowed and discover that the old connection can be re-used as far as the next CC. Send PRR request/indication to FE3.

205   On receipt of PRR response/confirmation indicating success, terminate ANF-PR.

206   On inability to accept the PRP request/indication or receipt of PRR response/confirmation indicating failure, send PRE request/indication to FE1 and terminate ANF-PR. Alternatively, on receipt of PRR response/confirmation indicating failure, attempt path replacement without re-use of elements of the old connection (action 201).

8.3.3 Functional entity actions of FE3

301 On receipt of PRR request/indication from FE2 or the previous FE3, check that ANF-PR is allowed and initiate the establishment of a new connection. In conjunction with basic call SETUP request/indication, send PRS request/indication to FE1. Terminate the new connection's user information channel suitably.

NOTE 9

The method of terminating the new connection's user information channel is an implementation matter. See also annex B.

302 On receipt of PRS response/confirmation indicating success (in conjunction with basic call Setup response/confirmation), switch over to the new connection and send a PRR response/confirmation to FE2 or the previous FE3. Initiate release of the unwanted part of the old connection and terminate ANF-PR.

303 On inability to accept the PRR request/indication, failure to establish the new connection, or receipt of PRS response/confirmation indicating failure (in conjunction with basic call Release request/indication), send PRR response/confirmation indicating failure to FE2 or the previous FE3 and terminate ANF-PR.

304 On receipt of PRR request/indication from FE2 or the previous FE3, check that ANF-PR is allowed and discover that the old connection can be re-used as far as the next CC. Send PRR request/indication to the next FE3.

305 On receipt of PRR response/confirmation from the next FE3, send PRR response/confirmation indicating success to FE2 or the previous FE3

306 On receipt of a PRR request/indication from FE2 or a previous FE3, if this FE3 is collocated with FE1 (i.e. the old connection has been found to satisfy the given criteria) send a PRR response/confirmation indicating success to FE2 or the previous FE3 and terminate ANF-PR.

8.4 Functional entity behaviour

The FE behaviours shown below are intended to illustrate typical FE behaviour in terms of information flows sent and received.

The behaviour of each FE is shown using the Specification and Description Language (SDL) defined in CCITT Recommendation Z.100 (1988).

8.4.1 Behaviour of FE1

7.4.1 is applicable.

8.4.2 Enhanced behaviour of FE2

Figure 13 shows the enhanced behaviour of FE2. Input signals from the left and output signals to the left represent information flows from and to FE3 (where stated) and FE1 (otherwise). Input signals from the right represent indications from the local CC.

Figure 13 - ANF-PR, SDL for enhanced functional entity FE2

8.4.3 Behaviour of FE3

Figure 14 shows the behaviour of FE3. Input signals from the left and output signals to the left represent information flows from and to the next FE3 (where stated) and FE1 (otherwise). Input signals from the right and output signals to the right represent information flows from and to FE2 or the previous FE3 and indications from the local CC.
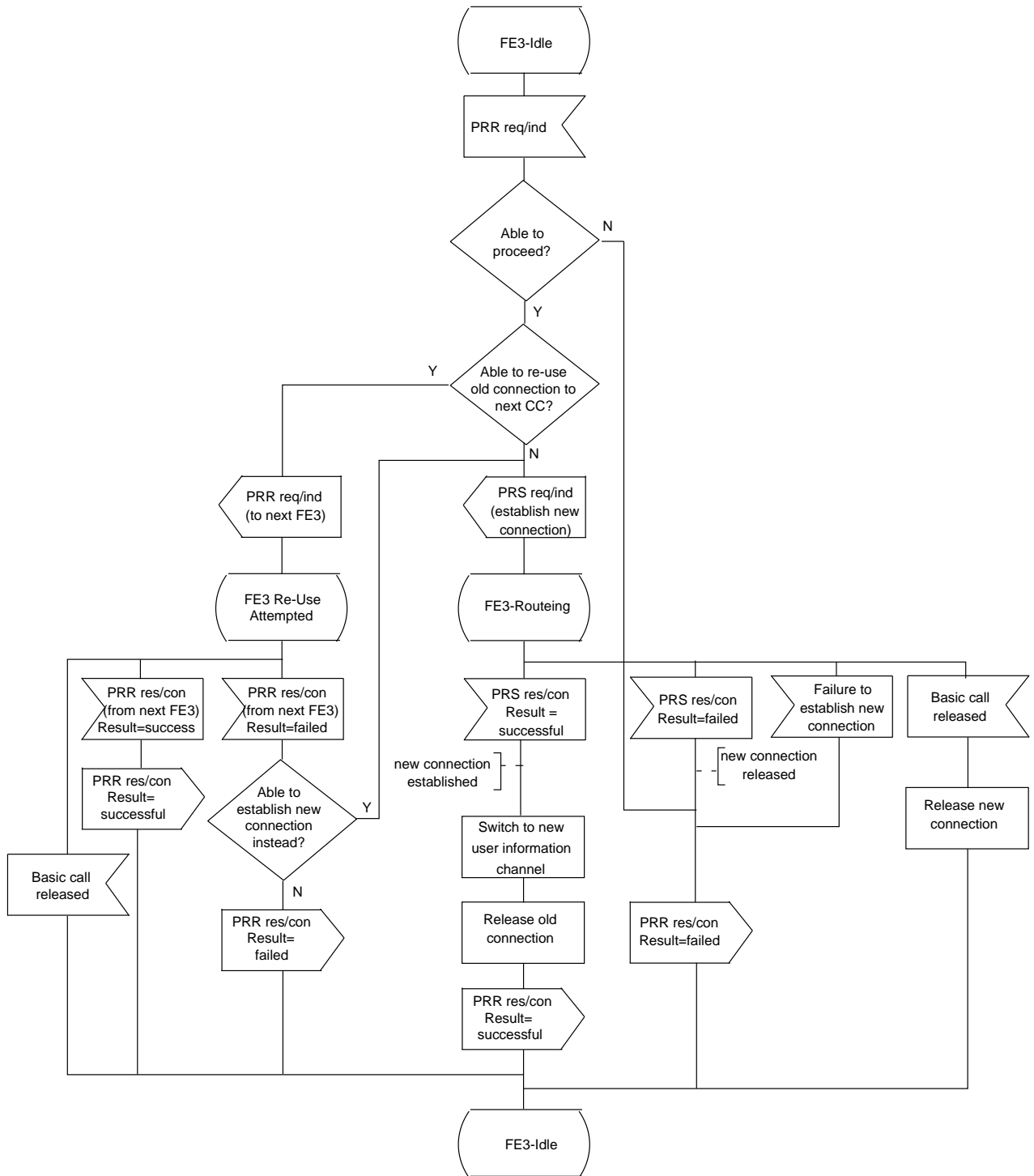
```
                              ┌──────────────┐
                              │   FE3-Idle   │
                              └──────────────┘
                                     │
                              ┌──────────────┐
                              │ PRR req/ind  ├─┐
                              └──────────────┘
                                     │
                                    ╱ ╲
                                   ╱   ╲        N
                                  ╱ Able ╲──────────────────────────┐
                                  ╲  to   ╱                          │
                                   ╲proceed╱                         │
                                    ╲ ? ╱                            │
                                     │ Y                             │
                              Y     ╱ ╲                              │
                         ┌────────╱     ╲                            │
                         │       ╱ Able to ╲                         │
                         │       ╲re-use old╱                        │
                         │       ╲conn. to ╱                         │
                         │        ╲next CC?╱                         │
                         │          ╲ ╱                              │
                         │           │ N                             │
            ┌───────────────┐   ┌──────────────┐                    │
            │ PRR req/ind   │   │ PRS req/ind  │                    │
            │ (to next FE3) │   │(establish new│                    │
            └───────────────┘   │ connection)  │                    │
                    │           └──────────────┘                    │
            ┌───────────────┐   ┌──────────────┐                    │
            │ FE3 Re-Use    │   │ FE3-Routeing │                    │
            │ Attempted     │   └──────────────┘                    │
            └───────────────┘                                       │
```

Figure 14 - ANF-PR, SDL for functional entity FE3

8.5   **Allocation of functional entities to physical equipment**

7.5 shall apply with the following enhancement.

An instance of FE3 shall be located at the Transit PTNX at which the new connection starts and at each Transit PTNX between that PTNX and FE2.

8.6   **Interworking considerations**

7.6 shall apply. If FE2 is located in another network which supports the re-use of elements of the old connection, an FE3 can be located at the Gateway PTNX.

Annex A (informative):   Circumstances in which ANF-PR might be invoked

ANF-PR can be used either to replace a connection which is no longer suitable or to obtain an improved connection. This annex describes some of the reasons why such situations can arise.

In some cases a separate ANF is used to provide criteria governing the routing of the new connection. In the absence of specific criteria, the new connection will be established using the routing rules which apply to basic call establishment.

A.1   Cost reduction

Even if there are no direct costs involved in a connection through a PTN, there are indirect costs through the use of inter-PTNX connections and other resources which incur costs in some way, e.g. rental costs. Therefore the cost of a connection can be related to the resources used. By reducing the resources used, particularly the number of inter-PTNX connections (and therefore the number of Transit PTNXs), the cost can be reduced. The extreme case is the replacement of a trombone connection with an intra-PTNX connection.

A higher cost connection can arise as a result of a supplementary service, as a result of a change in the relative costs of different connections (e.g. at certain times of day) or because of lack of resources necessary to establish a least cost connection. Some examples of how supplementary services can lead to higher cost connections are:

- for a call created by means of the "transfer by join" option of supplementary service Explicit Call Transfer, the connection will pass through the transferring user's PTNX, which will not necessarily lie along a path which a least cost connection between the transferred users would occupy;

- for a call created by termination of an add-on conference, the connection will pass through the PTNX which supplied the conference bridge, which will not necessarily lie along a path which a least cost connection between the two remaining users would occupy;

- for a call which has undergone Call Forwarding by Forward Switching, the connection will be routed via the forwarding PTNX, which will not necessarily lie along a path which a least cost connection between the calling user and the forwarded to user would occupy;

- for a call which has undergone Line Hunting, the connection will be routed via the hunting PTNX, which will not necessarily lie along a path which a least cost connection between the calling user and the selected user would occupy;

Following a supplementary service which can lead to a higher cost connection, ANF-PR can be invoked immediately, provided the call has been answered. The decision to invoke ANF-PR can be based upon knowledge of whether the supplementary service has led to a connection which is not a least cost connection or, if that knowledge is not available, ANF-PR can be attempted anyway.

Similar considerations apply to the use of ANF-PR following a change in the relative costs of different connections.

Following normal call establishment, to avoid invoking ANF-PR on every call, it should be invoked only if it is known that a higher cost connection has been used. Invocation should wait until it is known that resources have become free or until sufficient time has elapsed for there to be a reasonable chance of resources having become free (e.g. 2 minutes).

The way in which it is determined that a higher cost connection is in use and the means by which it is ensured that the new connection is of lower cost than the old connection are outside the scope of this ETS. It may involve the use of a separate ANF or manufacturer specific signalling protocols. A simplified means of ensuring that the new connection is not of higher cost than the old connection would be to switch to a new connection only if it is a least cost connection.

Following failure of ANF-PR to establish a connection of lower cost, further invocations of ANF-PR can be made at intervals (e.g. 2 minutes) until successful or until the call is released.

A.2 Change of bearer capability

When supplementary service In-Call Modification is used, the bearer capabilities of the connection for the original call can be inadequate for the support of the new call. ANF-PR can be invoked by the PTN while carrying out In-Call Modification to obtain a new connection providing the bearer capabilities required by the second call. Failure to obtain a new path with the required bearer capabilities should result in rejection of In-Call Modification.

Detailed interactions with supplementary service In-Call Modification will be specified in the ETS for that service.

Because the flow of user information is interrupted during In-Call Modification, there is no need in this case for ANF-PR to take steps to minimise disruption.

A.3 Quality of service improvement

ANF-PR can be used to obtain a new connection having better quality of service characteristics than the old connection. This need can arise when a connection has inadequate quality of service due to lack of availability of resources at the time of establishment or as a result of a supplementary service such as Call Transfer.

Following a supplementary service such as Call Transfer, ANF-PR can be invoked immediately, provided the call has been answered. The decision to invoke ANF-PR can be based upon knowledge of whether the supplementary service has led to inadequate quality of service characteristics or, if that knowledge is not available, ANF-PR can be attempted anyway.

Following normal call establishment, to avoid invoking ANF-PR on every call, it should be invoked only if it is known that the connection has inadequate quality of service characteristics. Invocation should wait until it is known that resources have become free to provide improved characteristics or until sufficient time has elapsed for there to be a reasonable chance of resources having become free (e.g. 2 minutes).

The way in which it is determined that a connection has inadequate quality of service characteristics and the means by which it is ensured that the new connection has adequate or improved characteristics are outside the scope of this ETS. It may involve the use of a separate ANF or manufacturer specific signalling protocols.

Following failure of ANF-PR to establish a connection with improved quality of service characteristics, further invocations of ANF-PR can be made at intervals (e.g. 2 minutes) until successful or until the call is released.

A.4 Maintenance actions

ANF-PR can be used to change from a connection which involves failed equipment or equipment which is to be taken out of service. This is particularly useful for calls of long duration and permanent calls.

The way in which it is determined that a equipment has failed or is to be taken out of service and the means by which the new connection avoids the use of such equipment falls within the scope of network management. It is outside the scope of this ETS.

Annex B (informative): Avoidance of unacceptable disruption to user information

Disruption to the flow of user information will occur if there is a difference in transmission delay between the new connection and the old connection. This source of disruption, which is unavoidable, will result in a number of consecutive bits being lost or received twice. The effect will be similar in each direction.

Disruption can also occur because FE1 and FE2 switch over to the new connection at different times, owing to signalling delays. Whether this second source of disruption occurs and what its effect will be depends on the method of handling the user information channels at the two FEs.

B.1 Methods of handling user information channels

Although the method of handling user information channels is an implementation matter, two basic approaches are foreseen: simultaneous switchover of both directions of transmission and separate switchover of each direction of transmission. Each has certain advantages and disadvantages, and choice can be influenced or dictated by PTNX design.

B.1.1 Simultaneous switchover of both directions of transmission

With this approach, switchover occurs at FE1 (when sending PRS response/confirmation) followed by switchover at FE2 (on receipt of PRS response/confirmation). The effect is a loss of user information in each direction for the time taken for PRS response/confirmation to reach and be processed by FE2.

This method can be enhanced for certain services, e.g. telephony, by using a conference bridge at FE1 to connect the old user information channel in conference with the new user information channel until PRP response/confirmation is received. This enhancement avoids any loss of user information due to signalling delays. To avoid feeding unwanted information into the conference bridge, FE2 should ensure that a silence pattern is transmitted on the new user information channel prior to switchover and on the old user information channel after switchover.

B.1.2 Separate switchover of each direction of transmission

With this approach, FE2 transmits on the new user information channel as soon as it has been agreed with the next CC, whilst continuing to transmit and receive on the old user information channel. When sending the PRS response/confirmation, FE1 switches over to the new user information channel for transmission and reception, but also continues to transmit on the old user information channel. On receipt of the PRS response/confirmation, FE2 switches over to the new user information channel for reception as well as transmission. Effectively the two directions of transmission are switched over at different times, and any disruption in user information due to signalling delays is eliminated.

B.1.3 Mixed operation

Because the method of handling the user information channels is an implementation matter, the situation can arise where FE1 and FE2 adopt different approaches. This is likely to lead to loss of information in one or both directions for a period determined by signalling delays. In the case where FE1 uses a conference bridge, it can also lead to a period of noise.

B.2   Preventing the use of ANF-PR

Whichever, approach is taken, there will be some disruption to user information. For some applications this will not matter, e.g. because of recovery mechanisms at higher layers or because the transmission of user information has been interrupted anyway (as is the case during In-Call Modification). For other applications this disruption might be unacceptable, and therefore steps should be taken to prevent the use of ANF-PR on such calls. Possible means include:

-    limiting ANF-PR to basic services where it is known that the disruption caused can be tolerated;

-    service marking users which are known to use certain applications so that ANF-PR will not be invoked for certain basic services;

-    allowing users to request, on a per call basis, that ANF-PR be prevented.

B.3   Replacement of trombone connections

The special case of changing from a trombone connection to an intra-PTNX connection is not subject to additional disruption due to signalling delays, and therefore ANF-PR might be possible even for applications which cannot tolerate ANF-PR under normal circumstances.

History

Document history	
November 1993	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)