ATIS-1000660.1998(R2013)

Signalling System Number 7 – Call Completion to a Portable Number – Integrated Text

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ATIS-1000660.1998(R2013), *Signalling System Number 7 – Call Completion to a Portable Number – Integrated Text*

Is an American National Standard developed by the **Signaling, Architecture, and Control (SAC)** Subcommittee under the **ATIS Packet Technologies and Systems Committee (PTSC)**.

American National Standard
for Telecommunications –

Signalling System Number 7 – Call Completion to a Portable Number – Integrated Text

Secretariat

Alliance for Telecommunications Industry Solutions

Approved June 4, 1998

American National Standards Institute, Inc.

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Contents

Foreword   (This foreword is not part of American National Standard T1.660-1998.)

This document is entitled *American National Standard for Telecommunications - Signalling System Number 7 (SS7) - Call Completion to a Portable Number (CCPN) - Integrated Text.* CCPN is a network capability that facilitates delivery of a call to a number that has been ported from the switch indicated by the NPA-NXX of the dialed number. CCPN has been developed for use between U.S. networks to meet the anticipated needs and applications of those entities primarily to meet the needs of service provider portability. This standard has 3 annexes. Annex A is normative and is part of this standard: that is, this annex includes requirements that are part of the specification. Annexes B and C are informative annexes. Informative annexes are not considered part of this standard but are, rather, auxiliary to the standard. In accordance with FCC Document #97-74, procedures defined in annexes B and C are not intended for use in U.S. networks. This standard is the result of extensive work by members of the T1S1.3 Working Group on U.S. Standards for Common Channel Signalling.

This standard is intended for use in conjunction with *American National Standard for Telecommunications - Signalling System Number 7 (SS7) - ISDN User Part (ISUP),* ANSI T1.113-1995, which includes an overview, messages and signals, protocol formats, procedures, and a chapter on performance. It should be noted, however, that some procedures specific to this standard are extensions beyond ANSI T1.113-1995. It is also intended for use in conjunction with *American National Standard for Telecommunications - Signalling System Number 7 (SS7) - Transaction Capabilities Application Part (TCAP),* ANSI T1.114-1996, which includes a description, definitions and functions, formats and codes, procedures, and a list of operations, parameters, and error codes. It should be noted, however, that some procedures specific to this standard are extensions beyond ANSI T1.114-1996.

Footnotes are not officially part of this standard.

Future control of this document will reside with Accredited Standards Committee on Telecommunications, T1. This control of additions to the specification, such as protocol evolution, new applications and operational requirements, will permit compatibility among U.S. networks. Such additions will be incorporated in an orderly manner with due consideration to the ITU-T layered model principles, conventions, and functional boundaries.

Suggestions for improvement of this standard will be welcome. These should be sent to the Alliance for Telecommunications Industry Solutions, T1 Secretariat, 1200 G Street, NW, Suite 500, Washington DC 20005.

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American National Standard
for Telecommunications −

Signalling System Number 7 −
Call Completion to a Portable Number −
Integrated Text

1   Scope, purpose, and application

1.1   Scope

This document describes the Signalling System Number 7 (SS7) network capabilities for completing calls to end users with portable numbers. The SS7 network capability, known as Call Completion to a Portable Number (CCPN), provides the core functionality. CCPN also includes optional network capabilities for obtaining the routing information outlined in 4.1 and described in Annexes A-C to supplement the CCPN capability. These optional network capabilities are:

−   Number Portability (NP) Query - Response

−   NP Release to Pivot (NP RTP)

−   NP Query on Release (NP QoR)

Service providers considering the use of these optional network capabilities for obtaining the routing information outlined in 4.1, may wish to take into account interconnection arrangements.

The CCPN network capability delivers the following information to each switch in the call path, once routing information has been obtained:

1. the original dialed number

2. the necessary routing information

3. an indication that NP routing information has been obtained

The capabilities of the CCPN build upon the existing SS7 capabilities. Backward compatibility is a necessary requirement. Only the new capabilities required for CCPN are described here.

Number portability affects any service that makes an assumption that a North American Numbering Plan (NANP) number indicates the correct network address. NP supports the use of numbers that do not directly provide an indication of the network address. NP is used with numbers that have traditionally contained network location information (i.e., numbering plan area and central office codes).

To route a call dialed with a non-geographic number (e.g., 800), the dialed number is translated to a geographic number. How to obtain such a translation is beyond the scope of this document. If the resulting translated geographic number is portable, the CCPN network capabilities apply.

Deployment of NP may require other network capabilities and network interfaces related to:

a) database architecture,

b) switch internal call processing,

c) network operations and administration.

These network capabilities and interfaces are outside the scope of CCPN.

1.2   Purpose

Number Portability (NP) allows end users of public switched networks to retain their NANP telephone numbers when they change their service provider (service provider portability), location within a specific geographical area (location portability), or network service (service portability).

This document describes the first phase of SS7 capabilities for NP. The focus of this phase of NP is on:

   a) service provider portability

   b) limited location portability[1]

1.3   Application

CCPN is to support the implementation of NP in the competitive local service environment.

2   Normative references

The following documents contain provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI T1.113-1995, *Telecommunications – Signalling System No. 7 (SS7) – Integrated Services Digital Network (ISDN) User Part*

ANSI T1.114-1996, *Telecommunications – Signalling System No. 7 (SS7) – Transaction Capabilities Application Part (TCAP)*

ANSI T1.661-1997, Telecommunications – Signalling System No. 7 (SS7) – Release to Pivot (RTP)

CCITT Recommendation X.208, Specification of Abstract Syntax Notation One (ASN.1), CCITT Blue Book Volume VIII-Fascicle VIII.4, 1988[2]

CCITT Recommendation X.209, Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1), CCITT Blue Book Volume VIII-Fascicle VIII.4, 1988[2]

Federal Communications Commission, FCC 97-74, Telephone number portability, March 11, 1997

Local Exchange Routing Guide (LERG) – Bellcore Traffic Routing Administration, TR-EOP-000315.

3   Definitions, acronyms, and terms

3.1   Acronyms

ACM   Address Complete Message
ANM   Answer Message
ANSI   American National Standards Institute
CCPN   Call Completion to a Portable Number
CdPN   Called Party Number

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[1]   For location portability the geographic area within which a given telephone number is portable is restricted. Establishing the boundaries for location portability is beyond the scope of this document.
[2]   Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

CO	Central Office
CPG	Call Progress Message
DN	Directory Number
DSS1	Digital Subscriber Signalling, Capability Set 1
FCI	Forward Call Indicators
FE	Functional Entity
GAP	Generic Address Parameter
GTT	Global Title Translations
IAM	Initial Address Message
ID	Identification
ISC	International Switch Center
ISDN	Integrated Services Digital Network
ISDN-UP	Integrated Services Digital Network - User Part
ISUP	Integrated Services Digital Network - User Part
LATA	Local Access and Transport Area
LERG	Local Exchange Routing Guide
MF	Multifrequency
MTP	Message Transfer Part
NANP	North American Numbering Plan
NP	Number Portability
NPA	Numbering Plan Area
NRN	Network Routing Number
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
QoR	Query on Release
RCP	Redirect Capability Parameter
REL	Release Message
RTP	Release To Pivot
SCCP	Signalling Connection Control Part
SDL	System Diagramming Language
SS7	Signalling System Number 7
T1	Committee T1
TCAP	Transaction Capabilities Application Part
UNI	User-Network Interface

3.2   Definitions and terms

The following terms and their definitions are specific to this document.

3.2.1   Central Office Code (CO code): Digits 4 through 6 of a ten-digit NANP number (immediately following the NPA), also known as the NXX.

3.2.2   End user: A consumer of telecommunications services.

3.2.3   End user's public number: The public telephone number of an end user in the North American Numbering Plan (NANP) format used by other end users to establish a call. This is the number usually listed in the directory. In the context of this document, this number does not identify a specific person.

3.2.4   Geographic number: NANP numbers which historically corresponded to discrete geographic areas within the NANP area. Some of the geographic significance of the NANP number may be lost if the number is ported.

3.2.5   Initiating switch: A switch that obtains routing information for CCPN capability.

3.2.6   Intermediate switch: A switch that is traversed during a call between the originating switch and the called user's serving switch.

3.2.7   Location portability: The ability of an end user to retain the same geographic telephone number (i.e., NANP number) while moving from one permanent physical location to another.

3.2.8   NANP (North American Numbering Plan) number: The national (significant) number portion of an ITU-T Rec. E.164 international public telecommunications number, as applied in the integrated numbering plan known as the North American Numbering Plan (NANP). A NANP number consists of a sequence of ten digits.[3]

3.2.9   NPA (Numbering Plan Area): The first 3 digits of a ten-digit NANP number (also referred to as an Area Code).

3.2.10   Network routing number: A number used to route from the initiating switch to the called end user's serving switch.

3.2.11   Number portability: Any one or a combination of location portability, service provider portability, or service portability.

3.2.12   Original destination switch: The switch to which a call would be routed for termination in the absence of number portability (NP) (also referred to as the donor switch).

3.2.13   Originating switch: The switch serving a calling end user.

3.2.14   Pivot switch: The switch which has routed a call to the release switch and has informed the release switch that it is capable of performing pivot functionality on this specific call. This terminology is used when the NP RTP network capability option is invoked.

3.2.15   Portable number: Any one of a block of NANP numbers identified to be involved in NP by an appropriate (local, state, or federal) authority. Members of the block can be identified by their NPA and central office code.

3.2.16   Ported number: A portable number that has been moved to a switch other than the original destination switch.

3.2.17   Release switch: The switch which is the initial destination of a call from a pivot switch. This terminology is used when the NP RTP network capability option is invoked.

3.2.18   Service portability: The ability of an end user to retain the same geographic telephone number (NANP number) when changing from one recognized type of service to another (e.g., POTS to ISDN).

3.2.19   Service provider: Any entity that is authorized, as appropriate, by local government, state, or federal authorities to provide communications service to the public.

3.2.20   Service provider portability: The ability of an end user to retain the same geographic telephone number (NANP number) when changing from one service provider to another.

3.2.21   Serving switch: The switch currently providing service to the called end user.

4   Call completion to a portable number general description

This clause provides general descriptions of the new SS7 capabilities for the support of NP. These capabilities may be used within a single network or across network-interconnect interfaces.

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[3]   Format of address is NXX-NXX-XXXX where N = digits 2-9, and X = digits 0-9.

These capabilities are Call Completion to a Portable Number (CCPN) and optional network capabilities NP Query - Response, NP Query on Release (QoR), NP Release to Pivot (RTP).

CCPN is a core NP capability, which determines that the called number is portable, ascertains the serving switch for the call, provides routing information to route the call to the serving switch, and incorporates additional information into the call request to enable the serving switch to connect the call to the called end user. The network capabilities in the Annexes provide options for obtaining the routing information but all use CCPN to deliver the call to the serving switch.

Subclause 4.1 gives an overview description of CCPN and the relationships between it and the optional NP network capabilities. Subclause 4.2 provides a user level description of the CCPN and optional NP network capabilities. Clauses 5 and 6 describe the CCPN functional model and protocol procedures respectively. More detailed descriptions of the optional NP network capabilities appear in the annexes of this standard.

4.1   Overview of number portability SS7 capabilities

Geographic numbers in the North American Numbering Plan (NANP) encode an identifier of the end user's serving switch contained in the numbering plan area and central office codes. Number Portability (NP) permits an end user to move their NANP number from one serving switch in a network to another serving switch in the same or a different network while retaining their same NANP number. Networks will therefore require additional capabilities to determine the serving switch for a NANP number when portability is involved.

The use of NP network capabilities is transparent both to the calling end user and to the called end user after a number is ported.

4.1.1   Inter-switch Call Completion to a Portable Number (CCPN)

The CCPN capability

Step 1: determines whether or not the number dialed by the calling user is portable,

Step 2: obtains routing information for the initiating switch to route the call to the serving switch possibly using the mechanisms discussed in this document:

– Invoking NP Query - Response

– Invoking NP Release to Pivot (the NP RTP option)

– Invoking NP Query on Release (the NP QoR option)

Step 3: routes the call to the serving switch and completes call setup to the portable end user.

In step 2, invocation of the NP Query - Response, NP RTP or NP QoR options is at the discretion of the operators of the involved networks. NP capabilities should not be invoked for outgoing international calls.

In step 2 above using the NP Query-Response option, the initiating switch launches a standard query (as described in Annex A) to an external database. The response message contains the network routing number.

In step 2 above using the NP RTP option, the initiating switch routes the call to the original destination switch with an indication that NP RTP is allowed. If the original destination switch is not the serving switch, it determines the routing information and releases the call with the appropriate cause value and routing information[4]. The original destination switch may obtain the network routing information using the NP Query-Response option, launching a standard query to an external database.

_____

[4]   Note that the original destination switch obtains and passes the routing information to the initiating switch using the RTP network capability.

In step 2 above using the NP QoR option, the initiating switch routes the call to the original destination switch with an indication that a QoR attempt is in progress. If the original destination switch is not the serving switch, the call is released with an appropriate cause value. On receipt of this release indication, the initiating switch determines the routing information. The initiating switch may obtain the network routing information using the NP Query-Response option, launching a standard query to an external database.

4.1.2   Configuration models

The following three configuration models depict the more typical CCPN network scenarios.   Other network scenarios are possible. The first configuration (Figure 1) shows separate originating and initiating switches while the second figure (Figure 2) depicts a scenario in which the originating and initiating switches are the same. The third scenario (Figure 3) shows a network scenario in which the original destination and initiating switches are the same.

 Also, although not shown explicitly in these figures, there may be one or more intermediate switches between any of the originating, initiating, original destination, and serving switches. The NP database may be internal to the initiating switch or may be located at another node in the network.[5]
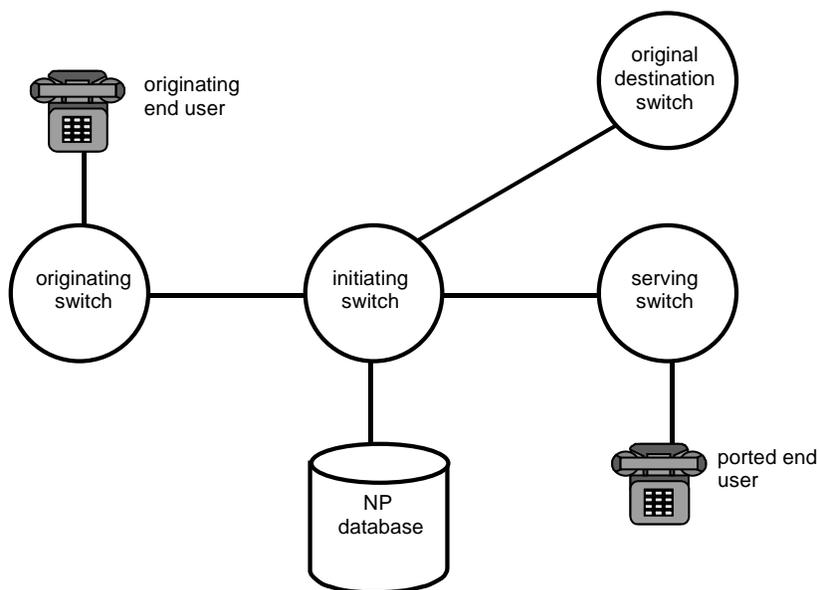

**Figure 1 – CCPN configuration – separate originating,
initiating, original destination switches**

_____
[5]   When a call spans interconnecting networks, the configuration applicable for the call depends on bilateral agreements between the concerned networks.
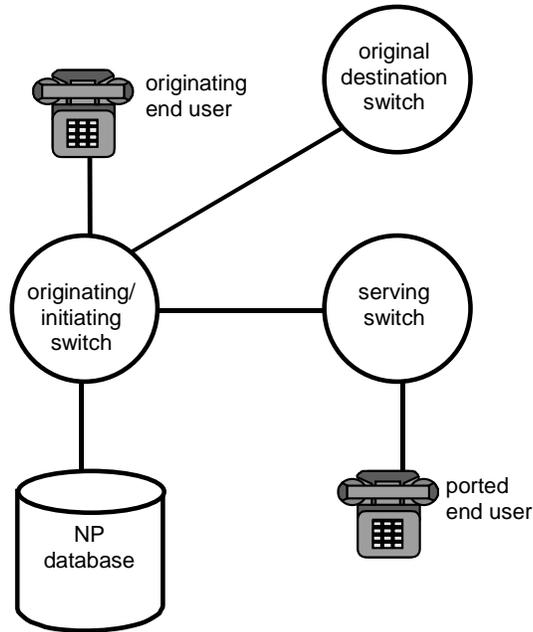
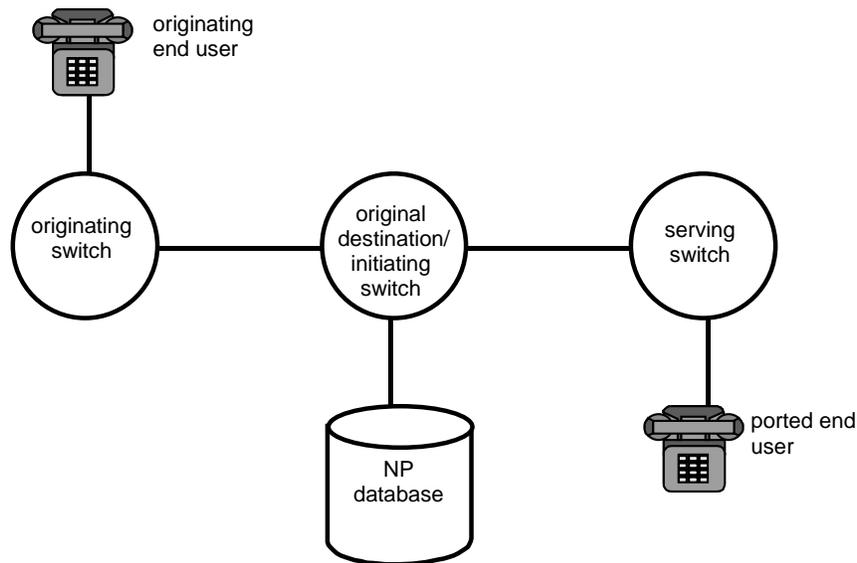**Figure 2 – CCPN configuration – identical originating and initiating switches**

Figure 3 – CCPN configuration – identical original destination and initiating switches

4.1.2.1 Mapping of NP switches and ISUP exchanges

The stage 1 descriptions and the stage 2 information flows for NP network capabilities are described using various switch names in clauses 4 and 5 of this document. The following table provides a mapping of the stage 1 and 2 switch names with the exchange types used in the stage 3 ISUP protocol description in clause 6 of this document.

stage 1 and 2 NP switch name	stage 3 ISUP exchange type
originating switch	originating exchange
initiating switch	originating exchange intermediate exchange destination exchange
original destination switch	destination exchange
serving switch	destination exchange
intermediate switch	intermediate exchange

4.2   Procedures

4.2.1   Provisioning/withdrawal

An end user cannot subscribe to CCPN since this capability is a network function that is transparent to the end user.

The optional NP Query-Response, NP QoR, and NP RTP network capabilities shall be provisionable. These capabilities might, for example, be provisionable per NPA-NXX (NPA and CO code) or per outgoing trunk group. CCPN should use only one mechanism to derive the network routing information for a given call. This can be guaranteed either by switch provisioning or by precedence of NP capabilities.

4.2.2   Activation/deactivation

CCPN is activated/deactivated on a per-switch or a per-network basis.

4.2.3   Normal procedures

4.2.3.1 Call Completion to a Portable Number

This description of CCPN uses the CCPN configuration shown in Figure 1 and assumes that the originating switch either locally terminates the call or routes the call to the initiating switch using the called number. The initiating switch will determine whether the called number is portable or not.

When it is determined that the called number is portable, the initiating switch uses the called end user's portable public number to obtain a network routing number (NRN) that identifies the serving switch. The initiating switch and any intermediate switches between the initiating and serving switches use the NRN to route the call to the serving switch. The serving switch uses the NRN and the user's portable public number to route to the end user. The initiating switch sends an indication in the forward call setup information that the NP status of the called number has been determined.

Some switch functions provided by separate switches in Figure 1 are provided in common switches in the configurations in Figures 2 and 3. In these cases, references in the description above to routing the call between two switches that are the same switch should be ignored.

The call routing is shown in Figure 4.
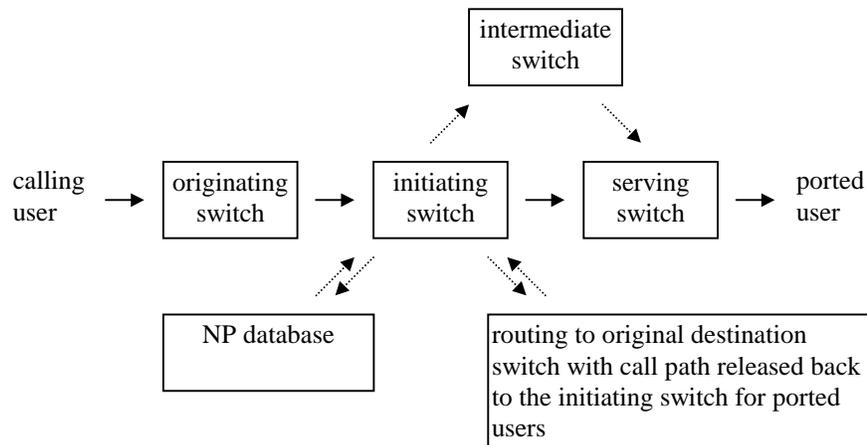
Note: solid arrows depict CCPN flows
dashed arrows depict optional flows

Figure 4 – CCPN routing flow

The CCPN capability completes calls to a portable number regardless of where the call originated. There are no modifications required for the international SS7 capabilities. For handling incoming international calls to a portable number, the International Switch Center (ISC) may provide the functions of the initiating switch.

4.2.3.2 NP Query-Response capability

The NP Query-Response capability provides a standard interface between a query switch and a NP database. The NP Query-Response describes the NP database capabilities and information flows between the query switch and the NP database. The NP Query-Response capability also provides a protocol that may optionally be used for a database query and response across network boundaries.

The NP Query-Response network capability may be used to query an external NP database by:

1) the initiating switch after determining that the number dialed by the calling user's number is portable.

2) the original destination switch if NP RTP is invoked.

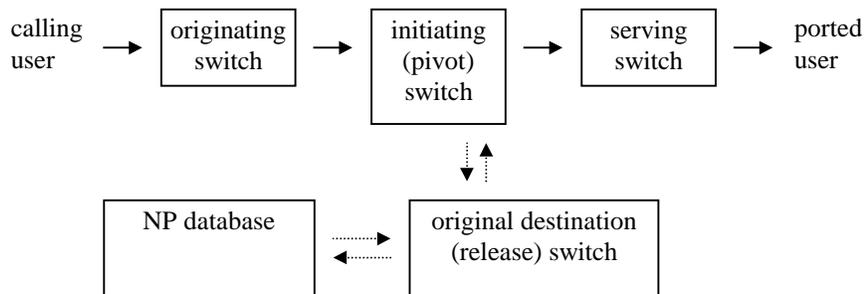3) the initiating switch after receiving a release message as part of NP QoR.

The query requests the NP database to identify the serving switch for the end user public number. The NP database responds with a network routing number allowing the query switch to route the call to the serving switch by using existing circuit selection procedures.

4.2.3.3 NP Release To Pivot capability

The optional NP RTP capability may be invoked by the initiating switch to obtain routing information. The call is first routed to the original destination switch with an indication that the initiating switch is pivot capable and NP RTP capable. The original destination switch determines whether the intended called user's number has been ported or not. If the called user's number has been ported, the original destination switch obtains the routing information and invokes the RTP network capability. The original destination switch may use the NP Query-Response capability to obtain routing information. If the called user's number has not been ported, the call completes normally.

The NP RTP network capability uses the RTP network capability to release the call path between the original destination switch and initiating (pivot) switch. NP RTP returns the network routing number for the serving switch to the initiating (pivot) switch. The original destination switch also indicates to the initiating (pivot) switch that this RTP involves NP.

The call routing using the NP RTP rerouting capability is shown in the Figure 5.

```
  calling      ┌──────────────┐     ┌──────────────┐      ┌──────────────┐     ported
  user    ──→  │ originating  │ ──→ │ initiating   │ ──→  │   serving    │ ──→ user
               │   switch     │     │   (pivot)    │      │   switch     │
               └──────────────┘     │   switch     │      └──────────────┘
                                    └──────────────┘
                                          ↕

  ┌──────────────┐           ┌──────────────────────┐
  │ NP database  │ ········→  │ original destination │
  │              │ ←········  │   (release) switch   │
  └──────────────┘           └──────────────────────┘
```

Note: solid arrows depict CCPN flows
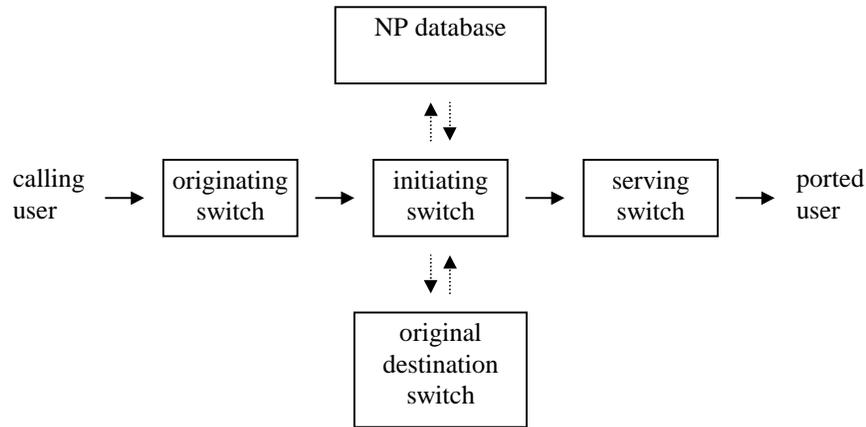   dashed arrows depict optional NP RTP flows

Figure 5 – NP RTP routing flow

The original destination switch with the NP RTP capability may choose not to use the RTP network capability for a particular call. In this case, the call is not released back to the initiating switch, and the original destination switch acts as an initiating switch and routes the call. The resulting configuration will be the same as that shown in Figure 3. The criteria used by the original destination switch when determining whether or not to invoke RTP are outside the scope of this document.

4.2.3.4 NP Query on Release capability

The optional NP QoR capability may be invoked by the initiating switch to obtain routing information. The call is first routed to the original destination switch with an indication that NP QoR is invoked. The original destination switch determines whether the intended called user is served by the switch or not. If the called user is not served by the switch, the original destination switch releases the call with the appropriate cause indication. Based on the REL information, the initiating switch then obtains the routing information, possibly invoking the NP Query-Response capability, and proceeds with the CCPN capability. If the called user's number has not been ported, the call is completed normally.

The call routing with the NP QoR option is shown in the Figure 6.

Note: solid arrows depict CCPN flows
        dashed arrows depict optional NP QoR flows

Figure 6 – NP QoR routing flow

4.2.3.5 NP network capability interactions

The interactions between CCPN and the optional NP QoR and NP RTP network capabilities are described in the following subclauses.   The NP Query-Response capability is independent of these interactions.

4.2.3.5.1   Indicators

CCPN, NP QoR, and NP RTP shall each have its own indicator in the call setup information which will indicate to the subsequent switches that the capability has been initiated. If both the NP RTP and NP QoR indicators are set in the incoming call setup information at the original destination switch, the network capability invoked is a network provider or vendor option.

4.2.3.5.2   Suppression

The CCPN indicator suppresses initiation of CCPN, NP RTP, and NP QoR at subsequent switches.

The NP QoR indicator suppresses initiation of NP QoR at subsequent switches. It does not suppress initiation of CCPN at subsequent switches.

The NP RTP indicator suppresses initiation of NP RTP at subsequent switches. It does not suppress initiation of CCPN at subsequent switches.

The interaction of NP QoR and NP RTP is a vendor-specific or network provider option.

Based on these suppression requirements for switches understanding the relevant capabilities and indicators,

1) CCPN will be initiated only if it is allowed by provisioning, and the CCPN indicator is not set from a previous switch during call setup.

2) NP QoR will be initiated only if it is allowed by provisioning, and neither the CCPN indicator nor the NP QoR indicator is set from a previous switch during call setup.

3) NP RTP will be initiated only if it is allowed by provisioning, and neither the CCPN indicator nor the NP RTP indicator is set from a previous switch during call setup.

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4.2.3.5.3   Partially NP-capable switches

All NP capable switches will detect and process the CCPN indicator. If a switch does not recognize the NP QoR indicator or the NP RTP indicator, the switch will ignore the indicator and may initiate its own NP capability (e.g., NP Query-Response).

4.2.4   Exceptional procedures

CCPN requires call routing information in order to direct calls to portable numbers to the switch serving the called end user. When a switch normally serving as a CCPN initiating switch is unable to obtain this routing information its procedure depends on whether or not the switch is the original destination switch for the call.

1. If the switch is not the original destination switch for the call, it should route the call forward using normal procedures and without setting the CCPN indicator.

2. If the switch is the original destination switch, it should always be able to determine if the called user's number is still located at that switch or has been ported to another switch.

    a) If the switch still serves the called user, the call shall be completed normally.

    b) If the called user's number has been ported to another switch, the call cannot be completed and shall be released or connected to an appropriate tone or announcement.

4.2.5   Alternate procedures

None identified.

4.2.6   Interworking considerations

CCPN uses the existing ISUP call setup procedures and circuit selection procedures. CCPN assumes the use of ISUP between the initiating switch and the serving switch to carry additional information, i.e., indication of query and ported number. When either the NP RTP or the NP QoR capability is invoked and MF interworking is encountered, the initial offer of NP RTP or NP QoR processing will be lost and CCPN processing may be required later in the call path.

When a call setup encounters MF interworking, the interworking switch continues in-band call setup using the end user's public number. In this case, CCPN functions end at the interworking switch.

4.2.7   Network capability for charging

No requirements have been identified for exchanging signalling information in support of charging.

4.2.8   Interactions with supplementary services

None of the supplementary services defined by Committee T1 (ANSI T1.600 series) are affected by the CCPN network capability. The end user's public number is unaffected by this network capability and may be transported via a new ISUP parameter defined by this document. Supplementary services relying on the end user's public number may be impacted by this network capability due to this new routing method. Existing network and supplementary services will still be able to identify the calling end user.

4.2.9   SDL

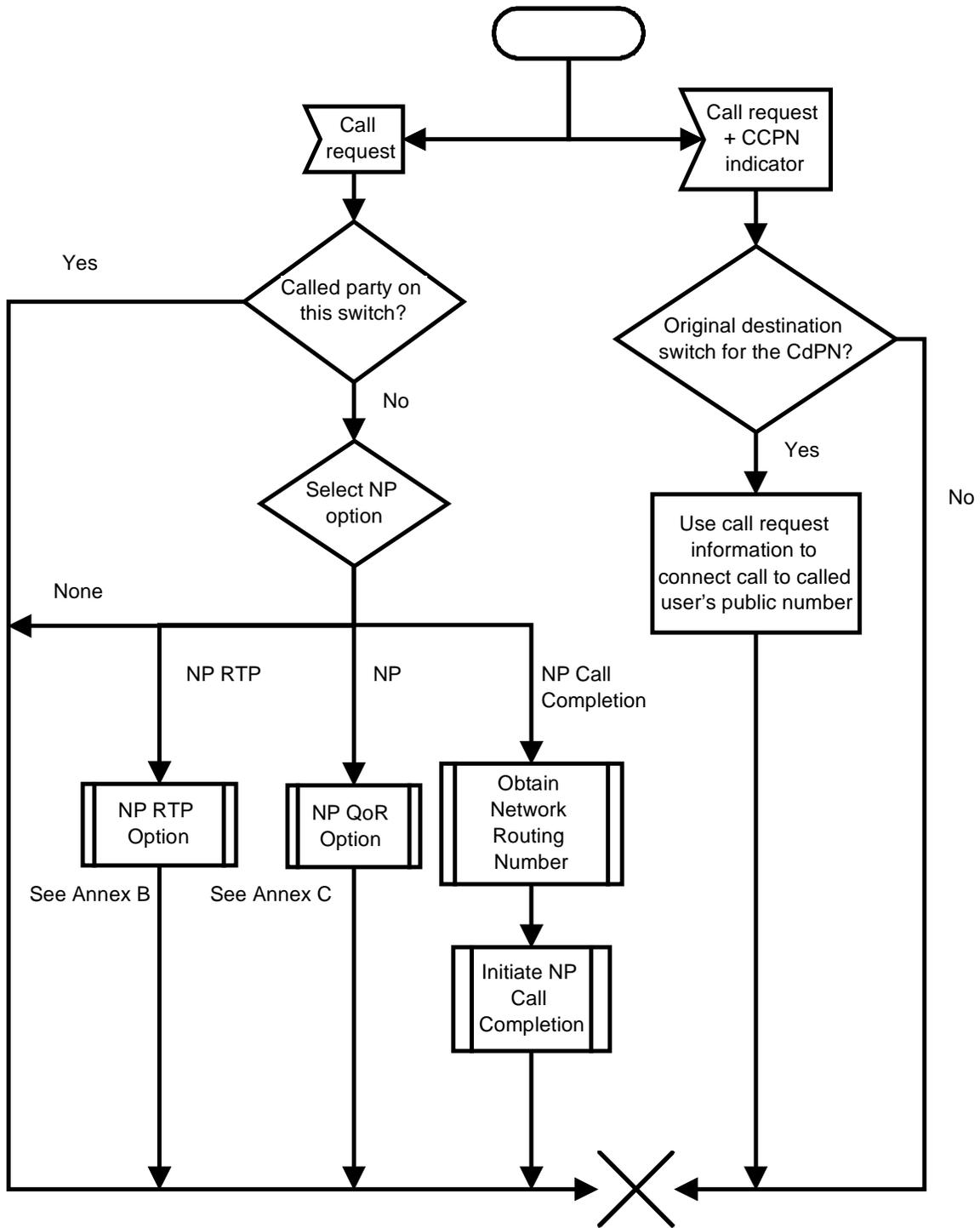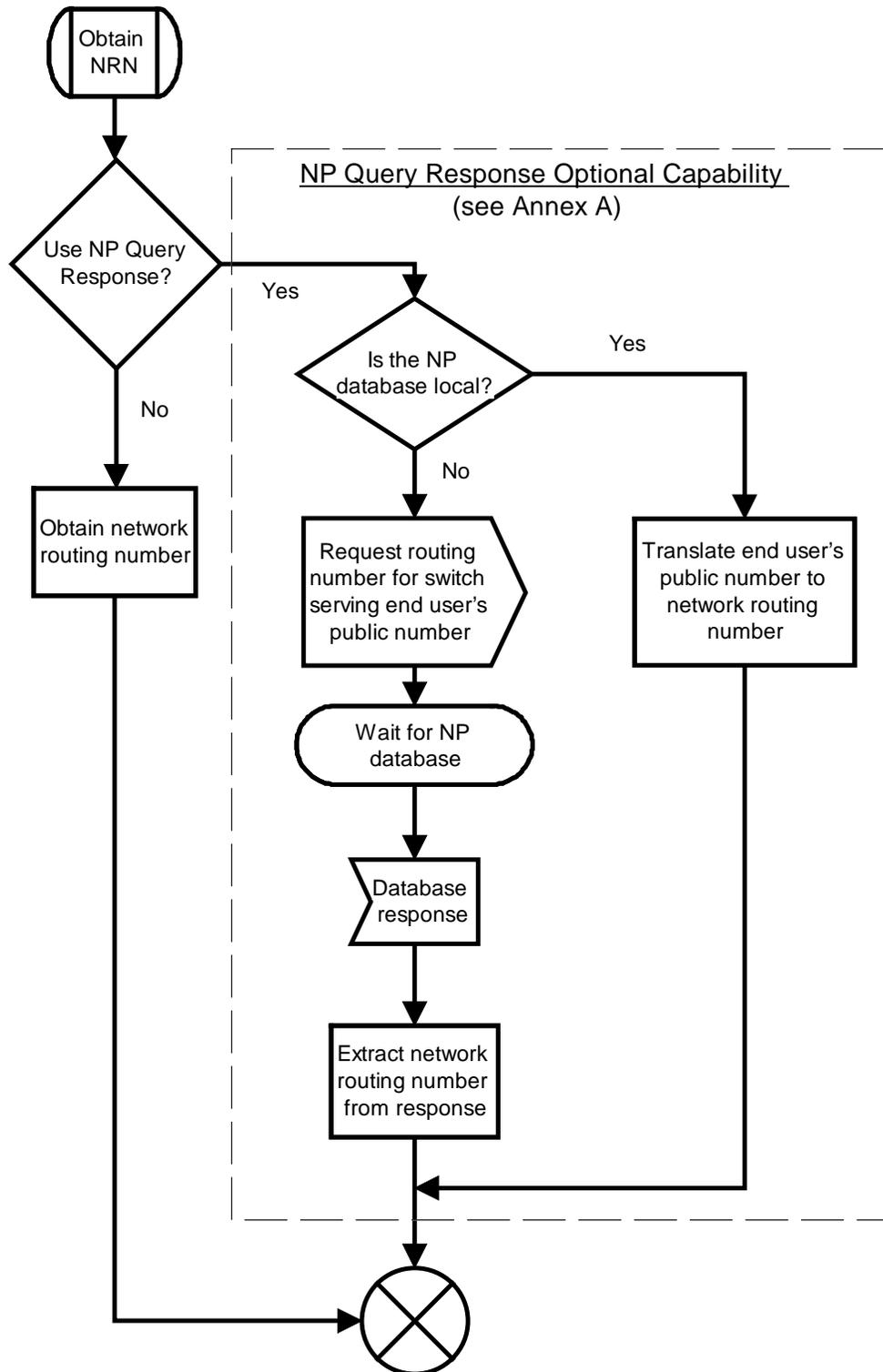Figures 7, 8, and 9 provide SDLs for CCPN:

Figure 7 – CCPN – main SDL

```
              ┌─────────┐
              │ Obtain  │
              │  NRN    │
              └────┬────┘
                   │
                   ▼
              ╱◇╲
             ╱    ╲
            ╱ Use NP Query ╲─────Yes─────┐
            ╲ Response?    ╱              │
             ╲          ╱                 │
              ╲◇╱                         │
               │                          │
               No                         │
               │                          │
               ▼                          ▼
```

NP Query Response Optional Capability
(see Annex A)

Is the NP database local?   Yes

Obtain network routing number

No

Request routing number for switch serving end user's public number

Translate end user's public number to network routing number

Wait for NP database

Database response

Extract network routing number from response

⊗

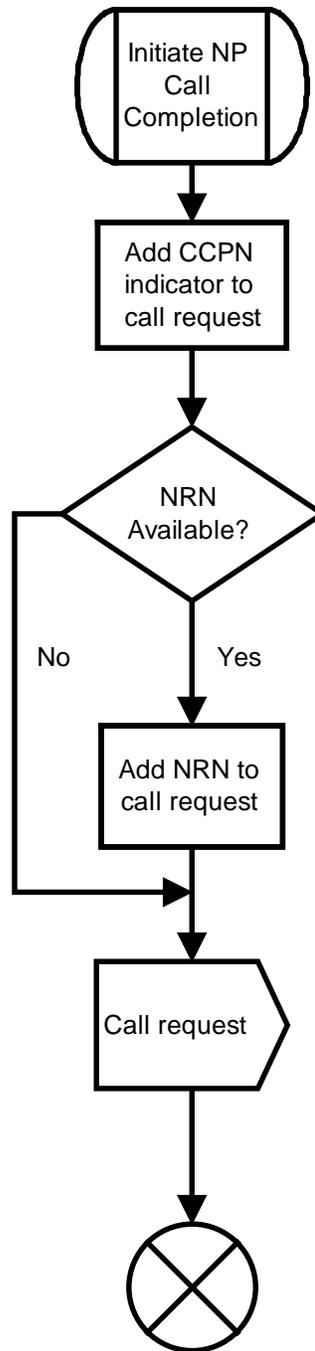**Figure 8 – CCPN – obtain NRN**

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Figure 9 – CCPN call completion

5   Functional capabilities and information flows

5.1   Functional entity model

A functional entity (FE) is a group of functions that cannot be split across multiple switches. Multiple functional entities can be implemented in a single switch. Figure 10 shows the functional entity model for CCPN.
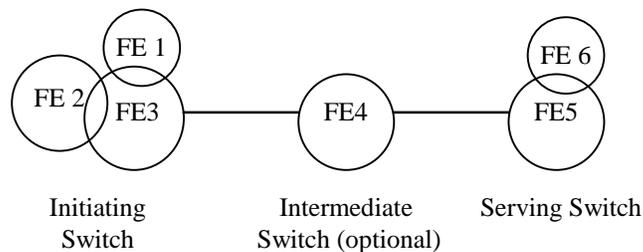

Figure 10 – FE model for CCPN

Below is a list of the functional entities:

−   FE1 detects the portable number and analyzes the indication of previous queries for the call. FE1 calls upon FE2 to obtain portable number information.

−   FE2 obtains routing information associated with a ported number's serving switch. It may obtain the routing information by invoking one of the NP optional capabilities or by an implementation dependent mechanism. FE2 provides this information to the FE3 for routing to the serving switch.

−   FE3 represents the basic call functional entity associated with FE1 and is used to route the call.

−   FE4 is an optional intermediate functional entity that executes the basic call procedures and relays information from FE3 to FE5.

−   FE5 is the basic call functional entity associated with FE6 and relays information from FE4 to FE6.

−   FE6 represents the function to identify itself as the serving switch and uses the call setup information to connect to the user's portable number.

5.1.1   Description of portable number detection functional entity (FE1)

The portable number detection functional entity (FE1) determines whether the call setup information specifies a connection request to a portable number. If so, this functional entity requests that the portable number query functional entity (FE2) obtain the routing information for routing the call to the serving switch. Otherwise, this functional entity shall return the call to FE3 for further call processing.

5.1.2   Description of portable number query functional entity (FE2)

The portable number query functional entity (FE2) obtains the routing information to route a call to the serving switch based on the end user's public number. This information is used by FE3 to route to the serving switch. FE2 may invoke one of the optional capabilities to obtain the routing information.

> NOTE – When FE2 invokes an optional capability, the capability may require internodal communication. Therefore it may be necessary to distribute functionality equivalent to FE2 across multiple functional entities in order to model the optional capability. Annexes describing the optional capabilities provide more detailed models of FE2's functions where applicable.

5.1.3   Description of FE3, FE4, and FE5

FE3, FE4, and FE5 represent the basic call functional entities. On instruction from FE2, FE3 modifies the call setup information to include the routing information to access the serving switch, the called number, and the query indicator.

5.1.4   Description of serving switch functional entity (FE6)

The serving switch functional entity (FE6) recognizes that the call can be completed at this switch. FE6 will use the call setup information to complete the call to the portable number.

5.2   Information flow model

Figure 11 shows the information flow model between the functional entities for CCPN. The initiating switch will use the routing information to route the call through the network or networks to the serving switch. In addition, the initiating switch will send the end user's ported public number along with the call setup information. The serving switch will identify itself as the serving switch and use the call setup information to connect to the correct end user.
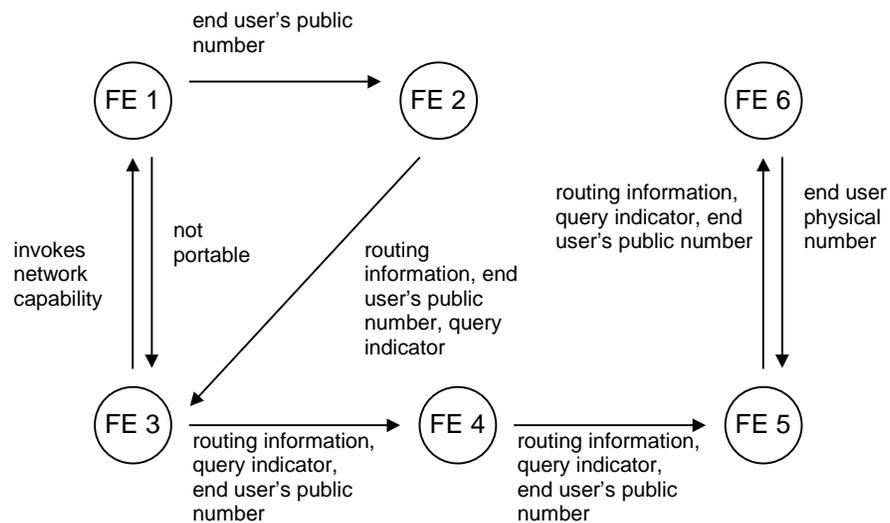

Figure 11 – Information flow diagram

5.2.1   Invoking the portable number detection functional entity (FE1)

FE 3 invokes FE1 as part of basic call processing.

5.2.2   Invoking the portable number query functional entity (FE2)

At the initiating switch, on detection of a portable number, FE1 invokes FE2.

5.2.3   Invoking the serving switch functional entity (FE6)

FE5 invokes FE6 on receipt of CCPN information in an incoming call.

5.2.4   Activation and deactivation of CCPN network capability

Activation and deactivation of CCPN is done on a per switch or per network basis.

5.2.5   Exceptional procedures

If FE2 can not obtain routing information corresponding to a given called number, FE2 shall attempt to progress the call using the called number and normal call routing procedures.

1.   If the initiating switch is the original destination switch for the called number, then the call cannot route to any other switch and shall be released after appropriate treatment (tone or announcement).

2.   At any switch other than the original destination switch, the call should be routed on toward the original destination switch using the original called party number and without setting the CCPN indicator.

5.3   Allocation of functions to equipment

FE1, FE2, and FE3 could reside in the originating, intermediate, or destination switch. FE 4 resides in the intermediate switch. FE5 and FE6 reside in the destination switch.

6   Protocol and procedures

6.1   Protocol and procedural assumptions

Below is a list of protocol and procedural assumptions:

−   CCPN can be accomplished with ISUP protocol modifications for signalling between network switches.

−   CCPN is invoked as a network capability when a call is set up to a portable number in a portable service area.

−   Call routing procedures are unaffected by this capability. The network address in the call setup information follows the existing routing tables and procedures. The routing number used to route to the terminating exchange uses the North American Numbering plan and follows the Local Exchange Routing Guide (LERG).

−   The end user's public number is in NANP format and can be positively identified in the call setup information.

−   Intermediate switches are unaffected by CCPN, except that they may use the "translated number" indicator to suppress attempts to obtain routing information.

Below is a list of the information that is transferred between network switches:

1)   The network routing information used in routing a call must identify the serving switch for the user with a portable number.

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2) The end user's public number must be transported to the serving switch so the serving switch can connect the end user's ported number or use the end user's public number for other supplementary services.

3) The call setup information must include an indication that the routing information used for the call underwent the query functions of CCPN. This will provide forward call information to intermediate switches. This information can be used by intermediate switches to avoid multiple CCPN database queries or for other supplementary services.

6.2   Formats of the ISUP parameters supporting Call Completion to a Portable Number

6.2.1   Signalling information (to be added to ANSI T1.113.2)

Ported Number Translation indicator. Information sent in the forward direction to indicate that the Call Completion to a Portable Number query has been done.

6.2.2   ANSI cause value (to be added to ANSI T1.113.2 and ANSI T1.113.3)

CCPN uses the following ANSI cause value:

Cause 26 - *Misrouted call to a ported number.* This cause indicates that the called party can not be reached because the "ported number" in the GAP identifies a called party that is not served by the exchange.

6.2.3   Format of the generic address parameter (see ANSI T1.113.3, 3.20A)

The CCPN network capability adds a new code in the "type of address" field in the GAP to define a distinct type of GAP identifying the ported number. See Figure 12.

	8	7	6	5	4	3	2	1
1	Type of Address							
2	O/E	Nature of address Indicator						
3	Spare	Numbering Plan		Presentation		Reserved		
4	2nd address signal				1st address signal			
n	Filler (if necessary)				nth address signal			

(1) Type of Address
        1100 0000   ported number

(2) Odd/Even indicator
        0   even number of address signals
        1   odd number of address signals

(3) Nature of address indicator
        0000011   national (significant) number

(4) Numbering plan indicator
        001   ISDN (Telephony) numbering plan

Figure 12 – GAP format *(continued)*

(5) Address presentation restriction indicator (Presentation)

> Not applicable for type of address of ported number.

(6) Address signal

> See Called Party Number Address Signal, T1.113 - Section 3.6 (4)

(7) Filler

> See Called Party Number Filler, T1.113, Section 3.6 (5)

Figure 12 – GAP format *(concluded)*

6.2.4   Format of the forward call indicators (see ANSI T1.113.3, section 3.20).

CCPN defines a new indicator in the Forward Call Indicators parameter. See Figure 13.

	8	7	6	5	4	3	2	1
1	H	G	F	E	D	C	B	A
2	P	O	N	M	L	K	J	I

bit   M: Ported Number Translation indicator
      0   number not translated
      1   number translated

Figure 13 – Forward call indicators

6.3   Procedures for CCPN

6.3.1   Actions required at originating exchange

The exchange should follow the existing ISUP procedures with the following modifications.

The originating exchange using the Call Completion to a Portable Number (CCPN) network capability and acting as the initiating switch may, in addition to existing ISUP optional parameters, include in the Initial Address Message (IAM) a Generic Address Parameter (GAP) containing the ported number dialed by the calling party (that is, the Type of Address of the GAP is coded with "ported number") when the number dialed by the calling party is translated to a different routing number.[6)][7)] The translated number is populated in the Called Party Number parameter and the Forward Call Indicators parameter shall be set to "number translated".

If the number dialed by the calling party is not translated to a different routing number, the originating switch acting as the initiating exchange shall set the Forward Call Indicators parameter

_____
[6)]   The translated number may be obtained using the NP RTP capability (see Annex B – NP RTP network capability for more detail). In the NP RTP option, the originating exchange acting as the initiating exchange will receive a REL message invoking RTP pivot functionality and NP RTP at this exchange. The routing information is contained in the received Redirection Number parameter which is used to populate the Called Party Number parameter.
The translated number may be obtained using the NP QoR capability (see Annex C – NP Query on Release network capability for more detail). In the NP QoR option, the originating exchange acting as the initiating exchange will receive a REL message with the appropriate cause value and the originating switch shall determine the routing information.

[7)]   The routing translation may be performed at the exchange or the assistance of a remote database that is consistent with the existing procedures.

to "number translated". The Called Party Number parameter shall remain unchanged and the "ported number" GAP will not be included in the IAM.

When the exchange acting as an initiating switch receives a Release message with an ANSI Cause value 26 in the backward direction, the procedure to be taken by the exchange is one of the following:

  – The exchange, as an option, plays tone or announcement and sends an ACM or CPG message containing the ANSI Cause value 26 towards the originating User-Network Interface according to existing ISUP procedures.[8]

  – The exchange does not play tone or announcement but sends a Release message with the ANSI Cause value 26, "Misrouted call to a ported number", toward the originating User-Network Interface.

In either case, the originating UNI will interpret the received ANSI Cause value 26 as a Cause value 31 (normal unspecified) and use existing procedures to provide interworking with DSS1.

6.3.2   Actions required at an intermediate exchange

The actions at an intermediate exchange acting as the initiating exchange are the same as an originating exchange acting as the initiating exchange. Otherwise, no action is required at an intermediate exchange. In particular, an intermediate exchange that receives an IAM with the FCI set to "number translated" shall not act as the initiating exchange.

6.3.3   Actions required at the destination exchange

It should be noted that the destination exchange includes both the original destination switch and the serving switch designation from clauses 4 and 5 of this document.

The exchange should follow the existing ISUP procedures with the following modifications.

Upon receipt of an IAM, the destination exchange shall analyze the IAM for the presence of CCPN information. When the "ported number" GAP is present and the Forward Call Indicators parameter is set to "number translated", the ported number contained in the GAP shall be used to connect the call to the called party and used for services that need the ported number. If no "ported number" GAP is present, the Called Party Number shall be used to connect the call to the called party and used for services that need the ported number.

6.3.4   Specifications for protocol interworking

6.3.4.1 SS7/DSS1

None identified.

6.3.4.2 SS7/Inband

Using SS7 signalling, additional call related information can be transported during call setup. For a portable number, routing through the network(s) is done based on the routing information received in the IAM. If the call encounters a route that is inband signalling, the end user's public number will be signalled for routing to the subsequent switch via the inband signalling. At an interworking exchange, if the incoming IAM includes a GAP containing an address type "ported number," the ported number (Address field of the GAP) rather than the network routing number (Address field of the CdPN) shall be signalled to the subsequent switch via the inband signalling.

6.3.4.3 ISDN/non-ISDN

None identified.

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[8]   See 2.2.4, ANSI T1.113.4

6.3.5   Error conditions

In the event that the destination exchange cannot determine an end user's ported number based on the called party parameter and possibly a "ported number" GAP, it will do the following:

– if the IAM does not contain a "ported number" GAP, the exchange shall either release the call or provide a suitable tone or announcement using one of the existing cause values for unidentified users.

– if the IAM contains a "ported number" GAP, the exchange shall release the call using ANSI Cause value of 26, "Misrouted call to a ported number".

6.4   SDLs

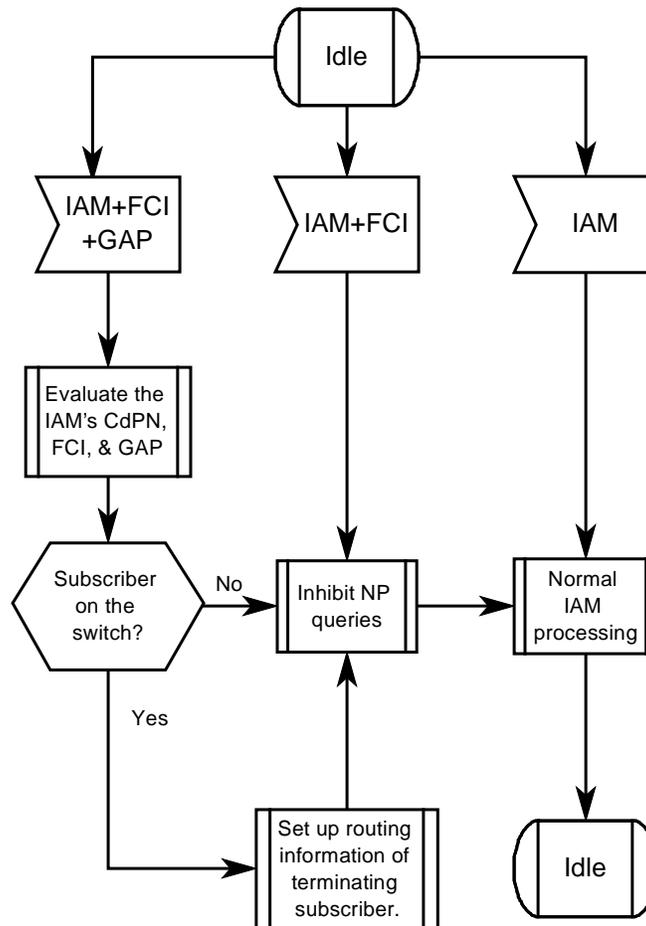Figure 14 illustrates the CCPN functionality.

Figure 14 – Signalling SDL for CCPN

Annex A
(normative)

NP Query-Response Network Capability

A.1   Scope, purpose, and application

The NP Query-Response network capability is one of a series of network capabilities supporting number portability. It allows a query node to request a network routing number for a portable end user from an NP database.

Either a telecommunications service or another network capability, as the requester, may invoke the NP Query-Response network capability. The requester is located at a network node called the query node. As part of the requester function it must identify a serving switch.

The requester invokes NP Query–Response, and provides the portable number. NP Query-Response uses the portable number provided by the requester to obtain a network routing number for the serving switch from an NP database. The requester uses the returned network routing number to identify and communicate with the serving switch. The purpose and form of the communication between the serving switch and the requester are a part of the requester definition; they fall outside the scope of the definition of the NP Query-Response network capability.

NP Query-Response requires SS7 signalling for communications between the query node and the NP database and therefore applies to networks using SS7 signalling. The capability may be used within a single network or across multiple interconnected networks. Where there are multiple networks, they may be operated by one or many service providers.

A.2   Description of NP Query-Response

Geographic numbers in the North American Numbering Plan (NANP) encode an identifier of the serving switch for each number in the numbering plan area and central office codes. For portable numbers this encoding is ambiguous. Therefore a telecommunications service or network capability detecting that a number used in providing the service or capability is portable can no longer assume the capability of determining the serving switch from the number directly.

A.2.1   General description

Service providers use NP Query-Response to provide services to their end users. Thus it is the service provider rather than end users who is the NP Query-Response user. This clause describes NP Query-Response from the point of view of its (service provider) user.

Figure A.1 shows the general configuration for NP Query-Response. A requester, which may be either a telecommunications service or another network capability, invokes NP Query-Response. The requester is located at a network node called the query node. The requester invokes NP Query-Response when it determines that an NANP number is a portable number and the requester must identify the serving switch.
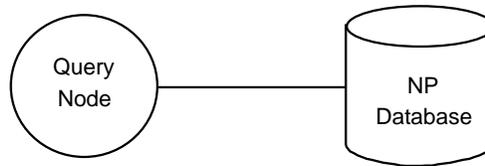
Figure A.1 – NP Query-Response configuration

The query node interrogates the NP database for routing information identifying the serving switch and provides the portable number as a key. The NP database determines the serving switch corresponding to the portable number and returns a network routing number whose numbering plan area and central office codes uniquely identify the serving switch. The network routing number may also provide additional information for the serving switch.

The form and content of the communication, if any, between the requester at the query node and the serving switch is outside the scope of NP Query-Response. Some specific examples of use of the network routing number are to invoke other number portability network capabilities such as Call Completion to a Portable Number (CCPN) or Number Portability Release to Pivot.

NP Query-Response applies principally to cases in which the query node and NP database are in different networks or operated by different entities. An individual network may optionally use NP Query-Response.

A.2.2   Procedures

A.2.2.1   Provisioning/withdrawal

End users do not subscribe directly to the NP Query-Response network capability. The operators of the query node and the NP database provide the capability at these nodes as part of the node configuration.

A.2.2.2   Activation/deactivation

None identified.

A.2.2.3   Normal procedures

A.2.2.3.1   Query node normal procedures

A requester invokes NP Query-Response after determining that an NANP number is a portable number and that the requester requires routing information to the serving switch for the portable number. NP Query-Response does not specify the means by which the requester

- obtains the NANP number that is the subject of the routing query.

- determines that the NANP number is a portable number.

The requester invokes NP Query-Response and provides the portable number. NP Query-Response formulates a query and transmits it to the NP database[9]. The response from the database contains the network routing number for the serving switch corresponding to the portable number.

A.2.2.3.2   NP database normal procedures

On receipt of a query the NP database uses the portable number provided in the query to access information that indicates whether the number has been ported to a serving switch different from its original destination switch. For ported numbers the NP database returns a network routing number that uniquely identifies the serving switch.

_____

[9]   The query can be routed from the query node to the number portability database using any valid SS7 routing scheme, including:
- MTP (DPC) routing
- SCCP primary/secondary GTT routing
- SCCP primary/multiple backups GTT routing
- SCCP equal load sharing routing of queries (not in ANSI T1.112).

If the provided portable number has not been ported from its original destination switch, the NP database returns the original portable number as the network routing number.

A.2.2.4 Exceptional procedures

A.2.2.4.1 Query node exceptional procedures

NP Query-Response will indicate to the requester that routing information for the serving switch is not available in any of the following cases:

- The NP database fails to respond to the query within a specified time-out period.

- The SS7 network returns the query sent to the NP database with an indication that the network cannot deliver the query to the database.

- The NP database indicates that it is unable to provide the routing information.

The action taken by the requester in response to this indication is outside the scope of NP Query-Response.

A.2.2.4.2 NP database exceptional procedures

If the NP database is unable to decode the received query message, the NP database will reject the query or abort the incoming transaction, in accordance with the procedures of ANSI T1.114.

If the NP database successfully decodes the received message but does not contain the requested information or is temporarily unable to access the requested information, the NP database will return reports of permanent or transient failures respectively.

A.2.2.5 Alternate procedures

None identified.

A.2.2.6 Interworking considerations

NP Query-Response requires SS7 signalling between the query node and the NP database. Lack of an SS7 signalling path between the query node and the NP database will either cause the network to return an indication that it cannot deliver the query or result in a failure to return a response within the time-out interval. The query node handles these outcomes according to the exceptional procedures in A2.2.4.1.

A.2.2.7 Network capabilities for charging

See 4.2.7.

A.2.2.8 Interactions with supplementary services

None identified.

A.3 Functional capabilities and information flows

This clause identifies a way for dividing the overall functionality for the NP Query-Response network capability into functional units, each located at a specific node in the network(s). The overall functionality of NP Query-Response results from communication between these functional units, called "functional entities," using information flows which are also identified in this clause.

An information flow is an abstraction of the communication protocol between functional entities that is realized through the additions to existing signalling system messages or new messages specified in clause A.4. A communication protocol is required only when functional entities are allocated to separate network nodes; the communication between functional entities allocated to a single network node is determined by the node implementation and is outside the scope of this American National Standard. Subclause A3.3 identifies possible allocations of functional entities to equipment.

The functional entity model defined in this clause refines the actions of FE2 as defined in 5.1.2. As such, functional entities and information flows defined in this Annex may be considered as taking place "inside" FE2.

A.3.1 Functional entity model

This clause identifies a set of functional entities that provides NP Query-Response and specifies the actions occurring in each functional entity. Functional entities abstract the elements of NP Query-Response for descriptive purposes and may not appear as separate components in actual implementations of the network capability.

Figure A.2 illustrates the three functional entities in the model for NP Query-Response. These are the requester (R), the query functional entity (Q), and the NP database functional entity (DB).
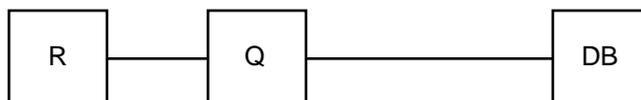

Figure A.2 – NP Query-Response functional entity model

A.3.1.1 Description of the requester functional entity (R)

R invokes NP Query-Response as a consequence of its need to identify the switch serving a portable number.

R obtains the subject number for the query in the course of providing an end user service or network capability. The nature of the end user service or network capability provided by R is outside the scope of NP Query-Response. NP Query-Response also does not specify the algorithm, if any, used by R to determine that the subject number is a portable number.

Having determined that a number is portable, R invokes the services of Q to obtain a network routing number for the switch that is serving the portable number. Q may provide either the network routing number, an indication that original destination switch still serves the portable number, or an error indication.

When Q provides the network routing number or an indication that the original destination node serves the portable number, R may use the network routing number or the original portable number respectively to communicate with the switch that is serving the portable number. The details of use of the number by R and the nature of any communication between R and functional entities located at the serving switch are outside the scope of NP Query-Response.

The action taken by R if Q returns an error indication is service dependent and falls outside the scope of NP Query-Response.

A.3.1.2 Description of the query functional entity (Q)

On invocation by R, Q accesses a database of number portability information represented by the DB functional entity. Q provides the portable number that is the subject to the query to DB. Q relays the response provided by DB back to R.

A.3.1.3 Description of the database functional entity (DB)

The NP database functional entity, DB, maintains information that associates portable numbers with network routing numbers for the nodes supporting these numbers. On receipt of a number portability query from the query functional entity, DB searches the database using the provided portable number as a key and indicates the search result to the query functional entity.

The possible database search results are as follows:

    a) An indication that the switch currently serving the identified number differs from the original destination switch for the number, i.e., a routing number for the serving switch.

    b) An indication that the original destination switch for the number serves that number. In this case the original portable number serves as the network routing number to the original destination switch.

    c) An error indication such as

        1) the number provided is an unallocated number.

        2) the number provided is outside the range of numbers for which the database contains information.

In order for a database to be able to return all of these responses to a query, the database must contain information that indicates the range of numbers that it serves. For each number in the served range, the database must contain information that indicates the switch currently serving this number or that the number is an unallocated number.

A database may optionally omit records corresponding to numbers still served by the original destination switch. In this case the database cannot distinguish between outcomes (b) and (c) above. Such a database will return the indication that the original destination switch serves the number in response to a query for a number for which the database does not contain explicit information.

A database may not contain explicit information about the range of numbers that it serves. In this case the database may return either of results (b) or (c) when the database does not have routing information corresponding to the subject number in a query.

A.3.2 Information flow model

Figure A.3 shows the sequence and types of information passed between functional entities and the actions performed by the functional entities to support NP Query-Response.
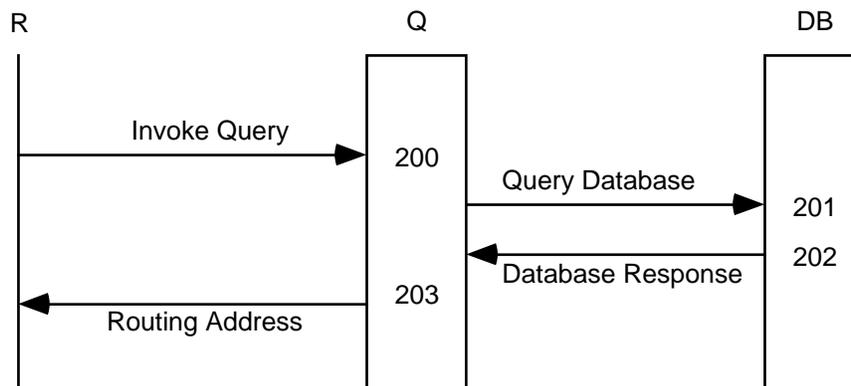

Figure A.3 – NP Query-Response information flow diagram

A.3.2.1 Normal procedures

200   Formulate routing query

201   Search NP database

202   Formulate routing response

203   Relay routing response

A.3.2.2 Exceptional procedures

None identified.

A.3.2.3 Alternate procedures

None identified.

A.3.3 Allocation of functions to equipment

Functional entities R and Q are always located in the same network node, the query node. The DB functional entity may be located either at the query node or at another network node, the NP database node.

A.4 Protocol and procedures

A.4.1 Protocol and procedural assumptions

NP Query-Response uses the SS7 Transaction Capabilities Application Part (TCAP) to transfer the NP query and response between the query switch and the NP database. For general information about TCAP message formats and procedures refer to ANSI T1.114.

NP Query-Response is not limited to the use of a single message set between the query node and the NP database. Generally a given query node will support a particular message set which it will use for all NP queries initiated by the node. An NP database serving several nodes may, however, support several message sets, thus allowing the served nodes to share use of the database while each using the node's "native" NP query message. Subclause A.4.2 defines the message sets used by this network capability.

Subclause A.4.2 contains the format and coding specifications for message sets that may be used between a query node and an NP database. Subclause A.4.3 contains procedures applicable to query node and database, including procedures specific to the individual message sets in A.4.2.

A.4.2 Formats and parameter coding

This subclause presents the formats and coding for TCAP components included in NP query and response messages. NP Query-Response uses the TCAP message format specified in ANSI T1.114, Chapter 3, incorporating the components specified in this clause in the component portions of TCAP query, conversation, and response messages according to the procedures in A.4.3.

This subclause uses the ASN.1 language specified in CCITT Recommendation X.208 to specify the component formats. When encoding components, a node shall use the basic encoding rules specified in CCITT Recommendation X.209 together with the additional formatting rules in ANSI T1.114.3 to serialize the ASN.1 data elements specified here for transmission.

This subclause uses a notation to indicate points at which the ASN.1 syntax may be extended. An ellipsis "…" indicates the possibility of extending the specified sequence by the addition of elements to a set or sequence type or alternatives to a choice type. In order to ensure forward and backward compatibility between applications using syntaxes specified in different versions of this standard:

– (Forward Compatibility) When the syntax used by a node indicates, by use of ellipsis, the possibility of extension:

  – the node should ignore additional elements received in a set.

  – the node should ignore additional elements received in a sequence provided that the additional values occur at the point where the ellipsis appears in the syntax.

  – the node should ignore an unrecognized alternative for a choice value whose type is defined with an ellipsis as one of its alternatives, provided that the choice value is optional or has a default.

- (Backward Compatibility) A node generating a message based on an extended version of the syntax may include additional set or sequence members or choice alternatives in the message, but should not depend[10] on the recognition and use of these elements by the node receiving the message.

- (Backward compatibility) A node using a syntax that has been extended by the definition of additional set or sequence elements should not require these elements to be received in an incoming message.

The notation used in this subclause to denote the values assigned to operations and errors conveyed by ANSI TCAP represents these values as a choice between nationally and privately assigned integer values. Since national and private operation codes use different operation code identifier values in the component coding[11], it's necessary to indicate the identifier to be used when specifying an operation value. Similarly, national and private error codes use different error code identifiers[12] Table A.1 gives the correspondence between the identifiers used in the operation and error value notation and the corresponding TCAP operation code identifier.

Table A.1 – Component value notation-identifier tag correspondence

Value Notation Identifier	TCAP Operation or Error Identifier
nationalOperation	[PRIVATE 16]
privateOperation	[PRIVATE 17]
nationalError	[PRIVATE 19]
privateError	[PRIVATE 20]

For example an operation value written as "privateOperation 5" in ASN.1 would be coded with a tag value "[PRIVATE 17]" (1101 0001), a length value of 1 (0000 0001), and content of 5 (0000 0101).

A.4.2.1 Message set A formats and parameters

```
NPQR-AIN-FORMAT{ iso memberbody usa t1.660(1 2 840 10057) modules(0) ainFormat(0) }
DEFINITIONS IMPLICIT TAGS
BEGIN

IMPORTS
    OPERATION, ERROR FROM TCAPPackage {iso memberbody usa t1-114};

infoAnalyzed OPERATION

    PARAMETER
        SEQUENCE{
            callSource              UserID,
            bearerRequested         BearerCapability,
            endUserNumber           CalledPartyID OPTIONAL, --Required for NP Q–R
```

_____

[10]   ANSI T1.114 provides a mechanism, the application context, for use by nodes that depend on recognition of an extended syntax by the receiving node.

[11]   See ANSI T1.114.3 5.8

[12]   See ANSI T1.114.3 5.11

```
            …
            }

    ERRORS {
        applicationError
        }

    LINKED {
        analyzeRoute
        }

::= privateOperation 25603   -- Family Name is "Request Instructions"

analyzeRoute OPERATION

    PARAMETER
        SEQUENCE {
            callerID                    CallingPartyID OPTIONAL,
            networkRoutingNumber        CalledPartyID OPTIONAL, --Required for NP Q–R
            …
            }

::= privateOperation 25857   -- Family Name is "Connection Control (Call Model)"

applicationError ERROR

    PARAMETER
        SEQUENCE {
            ApplicationErrorString
            }

::= privateError 1

AINDigits ::= OCTET STRING
    --The octet string is identical in content to the ISUP Calling
    --Party Number parameter specified in ANSI T1.113.3, §3.7.
    --For NP applications the numbering plan indicator is always coded
    --"ISDN (Telephony) numbering plan (Recommendation E.164)."

ApplicationErrorString ::= [55] IMPLICIT SEQUENCE {
                                        ErrorCause,
                                        FailedMessage OPTIONAL,
                                        UserID OPTIONAL
    }

BearerCapability ::= [13] IMPLICIT ENUMERATED {
    speech                          (0),
    3-1kHzAudio                     (1),
    7kHzAudio                       (2),          --Not applicable for NP
    b56kbps                         (3),
    b64kbps                         (4),
    packetModeData                  (5)           --Not applicable for NP
    }
```

CalledPartyID ::= [15] IMPLICIT AINDigits
      --For NP applications the nature of address indicator in the CalledPartyID is always coded
      --"national (significant) number."

CallingPartyID ::= [18] IMPLICIT AINDigits

Dn ::= OCTET STRING (SIZE (5))
      --The octet string contains a binary coded decimal NANP number with
      --the most significant digit sent first as follows:

--	Octet Number	Bits H…E	Bits D…A
--	1	2nd digit	1st digit
--	2	4th digit	3rd digit
--	3	6th digit	5th digit
--	4	8th digit	7th digit
--	5	10th digit	9th digit

ErrorCause ::= [56] IMPLICIT ENUMERATED {
      erroneousDataValue   (0),
      missingConditionalParameter   (1),
      responseMessageTimerExpired   (2),
      unexpectedCommunication   (3),
      unexpectedMessage   (4),
      unexpectedMessageSequence   (5),
      unexpectedParameterSequence   (6)
      }

FailedMessage ::= [57] IMPLICIT SEQUENCE {
      opCode   INTEGER,
      parameter   OCTET STRINGOPTIONAL,
      invParams   [1] EXPLICIT InvParms OPTIONAL
      }

InvParms ::= CHOICE {
      BearerCapability,
      CalledPartyID,
      CallingPartyID,
      UserID,
      …
      }

ISDNI ::= SEQUENCE {
      Spid,
      Dn
      }

PrivateFacilityGID ::= INTEGER (0..9999)

Spid ::= [49] IMPLICIT IA5String (SIZE(3..20))
      --The Service Profile ID (Spid) identifies an initialized terminal assigned to an ISDN interface.
      --The last two characters are required to be numeric in the range 00–62.

TrunkGroupID ::= INTEGER (0..9999)

```
UserID ::= [53] CHOICE {
    [1] IMPLICIT Dn,
    [2] IMPLICIT ISDNI,
    [5] IMPLICIT TrunkGroupID,
    [6] IMPLICIT PrivateFacilityGID
    }
```

END   --Of module NPQR-AIN-FORMAT

A.4.2.2 Message set B formats and parameters

NPQR-IN-FORMAT{ iso memberbody usa t1.660 (1 2 840 10057) modules(0) inFormat(1) }
DEFINITIONS IMPLICIT TAGS
BEGIN

```
IMPORTS
    OPERATION, ERROR FROM TCAPPackage {iso memberbody usa t1-114};

provideInstruction OPERATION

    PARAMETER SET {
        endUserNumber              [10]  ServiceKey,

        callingPartyANI13)             [4]  IMPLICIT Digits,
        originatingLATA                [4]  IMPLICIT Digits,
        oli               [PRIVATE 37]  IMPLICIT OriginatingStationType,
        cicSupport        [PRIVATE 72]  IMPLICIT CICExpansion OPTIONAL
        }

ERRORS {
    unexpectedComponentSequence,
    unexpectedDataValue,
    dataUnavailable
    }

LINKED {
    connectionControl
    }

::= nationalOperation -31999              --Family: Provide instructions,
                                          --Specifier: Start, reply requested

connectionControl OPERATION

PARAMETER SET {
    carrierID14)                   [4]  IMPLICIT Digits,
    networkRoutingNumber13)        [4]  IMPLICIT Digits,
    billingIndicators    [PRIVATE 33]  IMPLICIT Digits
```

_____

13)   Distinguishing the callingPartyNumber from the originatingLATA in the parameter set requires examination of the type of digits field which is coded "Calling party number (1)" or "Local Access and Transport Area (7)" respectively.

14)   Distinguishing the carrierID from the networkRoutingNumber in the parameter set requires examination of the type of digits field which is coded "Carrier (8)" or "Routing number (4)" respectively.

```
    }

::= nationalOperation 1025                    --Family: Connection control
                                             --Specifier: Connect, reply not requested


unexpectedComponentSequence ERROR
    PARAMETER SET {}
::= nationalError 1

unexpectedDataValue ERROR
    PARAMETER
        SET {
            unexpectedValue            ProblemData
            }
::= nationalError 2

dataUnavailable ERROR
    PARAMETER SET {}
::= nationalError 6

CICExpansion ::= ENUMERATED {
    expandedCICSupport            (1)
    }

Digits ::= OCTET STRING
    --The format of the octet string is specified in ANSI T1.114.5, §4.5

OriginatingStationType ::= OCTET STRING
    --The octet string is identical in content to the ISUP Originating Line Information
    --parameter specified in ANSI T1.113.3, §3.26A.

problemData                       [6]   IMPLICIT OCTET STRING
    --The octet string contains the tag, length, and value of a received parameter in which
    --an error was detected.

ServiceKey ::= CHOICE {
    [4] IMPLICIT Digits
    }

END            --Of module NPQR-IN-FORMAT
```

A.4.3   TCAP procedures

A.4.3.1   Normal procedures

A.4.3.1.1   Query node normal procedures

When NP Query-Response is invoked at a query node the node first determines the message set to be used. If the query node supports only one message set then that message set is used. A node supporting multiple message sets will require a mechanism to select one of them; this mechanism is outside the scope of NP Query–Response. As an example however, the mechanism could be based on the NPA–NXX digits of the end user public number.

Having chosen the message set, the query node formulates and transmits a TCAP Query with Permission message. The format of the transaction portion of the message is according to ANSI T1.114.3. NP Query-Response does not include a dialogue portion 4.4 in the message.

The component portion of the message contains a single invoke component. The general format of the component portion and of the invoke component conform to ANSI T1.114.3. For the message sets specified in A.4.2, Table A.2 identifies

  a) the value reference (and implicitly the type) of the component sent in the query message.

  b) the name of the parameter set or sequence element containing the end user's public number information.

The NP Query-Response application starts a timer, T_q (maximum value 5 sec.), to ensure that the database responds to the query within a reasonable period of time. The value of T_q is provisionable on a per node basis.

The database response will be received in a TCAP response message. The transaction portion of the message is formatted according to ANSI T1.114.3. It contains a responding transaction ID identical to the originating transaction ID transmitted in the query message.

The component portion of the response will contain a single Invoke (Last) component sent in response to the invoke component of the query message[15). The component will contain a correlation ID identical to the Invoke ID transmitted in the Invoke component of the query message.

For the message sets specified in A.4.2, Table A.2 identifies

  a) the value reference (and implicitly the type) of the invoke component.

  b) the name of the parameter set or sequence element containing the network routing number information.

If the end user is still served by the original destination switch, the end user's public number is returned as the network routing number. When the database indicates that the node currently serving the end user's network service access point differs from the original destination node for the address, the query node extracts the network routing number for the serving node from the response and returns it to the application invoking NP Query-Response.

Table A.2 – Query-Response protocol formats

	Protocol Format	
	Message Set A	**Message Set B**
Query component type	infoAnalyzed	provideInstruction
End user public number parameter element	endUserNumber	ServiceKey
Response component type	analyzeRoute	connectionControl
Network routing number parameter element	networkRoutingNumber	networkRoutingNumber
Protocol specific errors	applicationError	unexpectedComponentSequence unexpectedDataValue dataUnavailable

_____

[15)   The response message could contain additional components if there is a need to transfer additional information between the query switch and NP database. Such additional information transfer is outside the scope of NP Query–Response.

A.4.3.1.1.1 Message set A specific procedures

In addition to information specific to number portability, the infoAnalyzed operation parameters indicate the source of an associated call (callSource) and the bearer capability requested for the call (bearerRequested).

The call source indicates the facility from which the query node received the call. This may be any of the following:

1. an ISDN access facility. The query node indicates the DN and a service profile identifier associated with the terminal originating the call.

2. a non–ISDN access facility. The query node indicates the DN of the access.

3. a trunk group forming part of the PSTN. The query node indicates a trunk group number provisioned in the query node to identify the trunk group.

4. a trunk group dedicated to an individual subscriber. The query node indicates a trunk group number provisioned in the query node to identify the trunk group.

The bearer capability is determined from the request received from the access or in the User Service Information parameter of an incoming IAM.

The analyzeRoute operation received from the NP database may include a callerID parameter. If present, this information will be used as the calling party number for the call for the purposes of the Calling Line Identification Presentation and Restriction Supplementary Services (ANSI T1.625). The callerId should contain a network validated number.

A.4.3.1.1.2 Message set B specific procedures

In addition to information specific to number portability, the provideInstruction operation parameters include charge information (callingPartyANI and oli), the LATA in which the call originates, and the ability of the query node to deal with 4-digit carrier identification codes (cicSupport).

The query node determines charge information from stored information concerning the access originating a call or from charge information received in an incoming IAM. ANSI T1.113.4, §2.1.9.3A gives procedures for transmitting charge information in an IAM.

The originatingLATA parameter contains a 3-digit code identifying the LATA in which the call originates.

A query node includes the cicSupport optional parameter in the query message if the node has support for four-digit carrier identification codes.

In addition to number portability specific information the connectionControl operation may contain a 3- or 4-digit carrier identification code (carrierID parameter) indicating a carrier to be used for subsequent routing of the call. The billingIndicators parameter holds specific billing data to be collected for the call by the query node. The content of this parameter is outside the scope of NP Query–Response.

A.4.3.1.2 NP database normal procedures

When the NP database receives a query from a query node it must first determine the specific protocol used for the query. The specific method used by the database is outside the scope of NP query response, however examples of possible methods include

a) use of different SCCP called party addresses (i.e. sub–system numbers) for different protocols.

b) examination of a specific common field in the query message, such as the operation field of the invoke component, that takes different values for different protocols.

The protocol selected determines the information available from the query message. The NP database uses this information to determine a network routing number for the exchange serving the end user.

The NP database uses the retrieved routing information to generate a Response message to the query node. The NP database formats the transaction portion of the message according to ANSI T1.114.3. The Response message does not include a dialogue portion.

The component portion of the response message contains the routing information retrieved from the database. As indicated in A.4.3.1.1, the content of the component portion of the response method is mainly determined by the individual protocol specifications.

A.4.3.2 Exceptional procedures

A.4.3.2.1 Query node exceptional procedures

Occurrence of any of the following conditions indicates that routing information is unavailable, either temporarily or permanently.

a) Timer T_q expires before receipt of any response message from the NP database.

b) The query message sent by the query node is returned due to an SCCP detected error.

c) The query node receives a TCAP abort message containing a responding ID identical to the originating ID sent in the query message.

d) The query node receives a TCAP response message containing a responding ID identical to the originating ID sent in the query message and a reject component with a correlation ID identical to the invoke ID sent in the query message invoke component.

e) The database returns a protocol–specific error identified in Table A.2 indicating that it does not contain or is temporarily unable to access the requested routing information.

NP Query-Response will indicate that routing information is unavailable to its invoking application process. The subsequent action of the invoker is outside the scope of NP Query–Response.

A.4.3.2.1.1 Message set A specific procedures

The TC–user at the NP database transmits the error "applicationError" in a Response message to indicate a failure preventing interpretation of the received query. In the ApplicationErrorString parameter:

1. the ErrorCause indicates the specific cause of the problem.

2. the FailedMessage, if present, contains information about the specific component and parameter that caused the failure.

3. the UserID indicates the source of the associated call, reflected from the query message.

A.4.3.2.1.2 Message set B specific procedures

When the returned error concerns a specific received data value, i.e., the unexpectedDataValue error, the unexpectedValue parameter contains the tag, length, and value of the parameter in which the NP database detected an error.

A.4.3.2.2 NP database exceptional procedures

The NP database shall detect and respond to protocol and application errors according to the procedures of ANSI T1.114.4 Clause 4. The NP database response to TCAP user errors, such as incorrect or unreasonable information in the query, is determined by the individual protocol.

A.4.3.2.2.1 Message set A specific procedures

An NP database detecting an application error in the received query message may report the error to the query node by transmitting a Response message containing a single Return Error

component with value "applicationError." The format of the transaction portion of the message conforms to ANSI T1.114.3. The message does not contain a dialogue portion.

Subclause A.4.2.1 specifies the value of "applicationError" and the type of its parameter. In the ApplicationErrorString sequence type

- the ErrorCause value indicates the specific application error detected.

- the FailedMessage sequence value contains

  - the opCode value of the received component, i.e., infoAnalyzed.

  - if the application error relates to a particular received parameter value, the invParms value is a reflection of the received value.

- the UserID value reflects the UserID value received in the Query message.

A.4.3.2.2.2   Message set B specific procedures

When the database reports an error concerning a specific received parameter, i.e., the unexpectedDataValue error, it returns the tag, length, and value of the incorrect parameter as the content of the unexpectedValue element of the error parameter set.

Annex B
(informative)

Number Portability Release to Pivot Network Capability

B.1   Scope, purpose, and application

This annex describes the use of a Release to Pivot (RTP) network capability in support of Number Portability (NP). The result is the optional Number Portability RTP (NP RTP) network capability.

In the NP environment, network switches require routing information of the ported end user to process the call. The network can reduce query load on the NP database by only querying the database for calls to the ported numbers. The calls to portable numbers are routed to the original destination switch identified by the NPA-NXX (NPA and CO code) of the dialed number according to Local Exchange Routing Guide. The original destination switch then determines whether it currently serves the called party. Once the original destination switch determines that the called party is ported, the routing information about the ported number is retrieved. The RTP network capability allows the original destination switch to release the call to a pivot switch.

When the pivot capable switch receives the routing information in the Release message from the original destination switch, the following items should be forwarded in the subsequent call path:

 − Original dialed number.

 − Routing information for the serving switch.

 − An indication that an NP query has occurred.

The call completion procedure is as if the pivot switch had itself obtained the Network Routing Number. It is documented in the main body of this standard.

This annex applies to the Integrated Services Digital Network (ISDN) User Part (ISUP) and is intended to supplement the signalling functions and call procedures described in ANSI T1.113. This annex should be used in conjunction with other American National Standards related to supplementary services for a complete understanding of the interactions between the NP RTP network capability and other services. This network capability will normally be used only within a single service provider's network. However, it may be used between networks on an internetwork agreement basis.

B.2   Description of Number Portability Release to Pivot

B.2.1   General description

The optional NP RTP network capability supports Call Completion to Portable Number (CCPN) in obtaining routing information. After CCPN has detected at the initiating/pivot switch that a public number is portable, it determines whether to invoke NP RTP for this call. Once invoked, NP RTP routes the call to the original destination switch which determines if it serves the called public number or not. If the public number is ported (i.e., is not served by the original destination switch), NP RTP returns the appropriate network routing number (NRN) to CCPN using the RTP network capability. If the public number is not ported (i.e., is served by the original destination switch), normal call processing procedures complete the call.

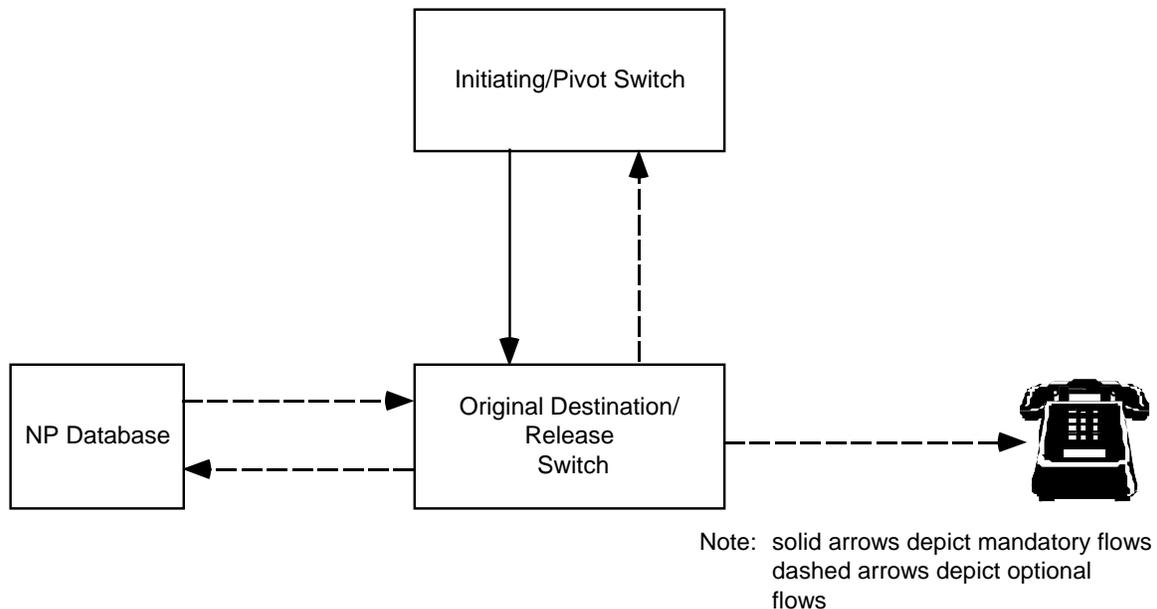Call routing with the NP RTP option is shown in Figure B.1.

Note: solid arrows depict mandatory flows
       dashed arrows depict optional
       flows

Figure B.1 – NP RTP routing flow

B.2.2 Procedures

B.2.2.1 Provisioning/withdrawal

NP RTP is a network capability transparent to the end users that is invoked when calling a portable number.

NP RTP shall be provisionable. This network capability might, for example, be provisionable per NPA-NXX (NPA and CO code) or per outgoing trunk.

B.2.2.2 Activation/deactivation

None identified.

B.2.2.3 Normal procedures

In the process of establishing a connection to the release switch, the pivot switch will determine if a specific call is eligible for NP RTP processing. The switch shall not invoke its own pivot function for NP when the incoming call request indicates that there is a previous switch with NP RTP active in the call path, but should forward the indication. In other respects, the method of determination is implementation dependent and outside the scope of this standard. The pivot switch includes the capability information in an NP RTP-eligible call to the original destination/release switch.

Once the original destination/release switch receives a call including capability information, it will attempt to complete the call. If the called number has been ported, the release switch will retrieve the NRN identifying the serving switch from an internal or external NP database. The release switch will invoke the NP RTP network capability and release the call back to pivot switch with NP Redirection information. The NP Redirection information will include NRN.

Upon receipt of the Release message, the pivot switch will route the call to the serving switch based on NRN. The pivot switch will include the original dialed public number, NRN and an indication that NP query has been done in the subsequent forward call connection.

The pivot switch shall not invoke NP RTP if an NP query has already been done for an incoming RTP-eligible call.

B.2.2.4 Exceptional procedures

If the release switch is unable to obtain the NRN, the call cannot be completed and shall be released or connected to an appropriate tone or announcement.

In those cases where an originating network contains the initiating switch for NP RTP, the call progresses into another network, and the call is released back, care must be taken to ensure that call recording data is properly interpreted.

B.2.2.5 Alternate procedures

B.2.2.5.1 Pivot switch

A call released to a pivot switch without NP redirection information, does not invoke the NP pivot function and therefore will not use CCPN for call completion. Such a call may invoke the basic RTP pivot function.

B.2.2.5.2 Release switch

If a call arrives at the original destination/release switch with no indication that there is a switch earlier in the call path capable of acting as the NP RTP pivot switch, the original destination/release switch shall attempt to route the call using normal procedures which may include CCPN.

B.2.2.6 Interworking considerations

NP RTP network capability will interwork with existing ISUP call setup and network routing procedures.

NP RTP requires SS7 signalling between release and pivot switches. Should a call encounter interworking between release and pivot switch, the call will lack the indication that the pivot switch exists on arrival at the original destination/release switch. The release switch handles the call according to the alternate procedures in B.2.2.5.2.

B.2.2.7 Network capabilities for charging

See 4.2.7.

B.2.2.8 Interactions with supplementary services

If user network interaction[16] is encountered after NP RTP invocation, the switch where the user network interaction occurs (or a later switch in the call path) must act as the CCPN initiating switch.

See also 4.2.8.

Interactions with other supplementary services using RTP are for further study.

B.2.2.9 SDLs

Figures B.2, B.3, and B.4 provide the SDL for the NP RTP option:

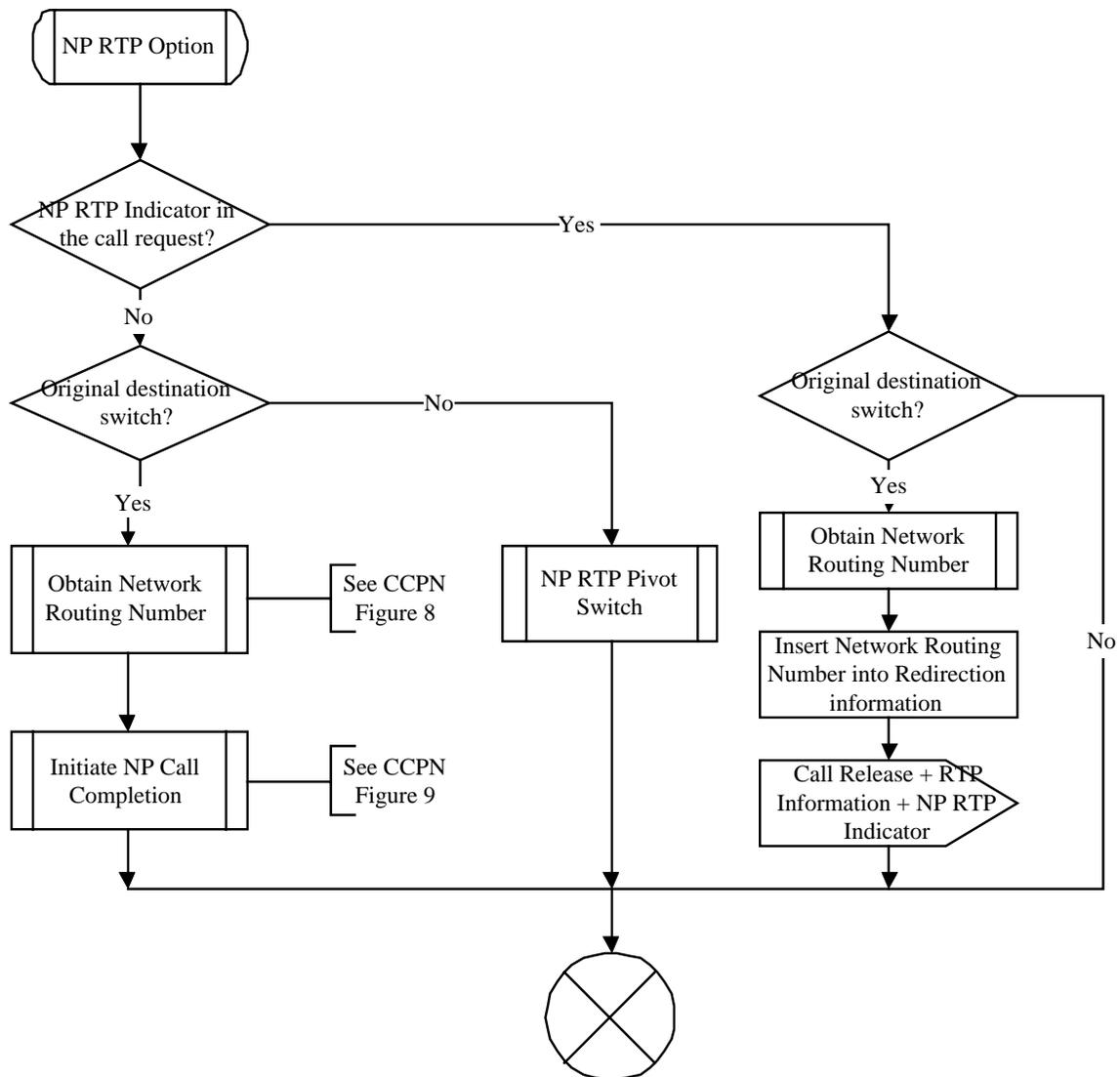_____

[16] See ANSI T1.113.4, chapter 4, A.6

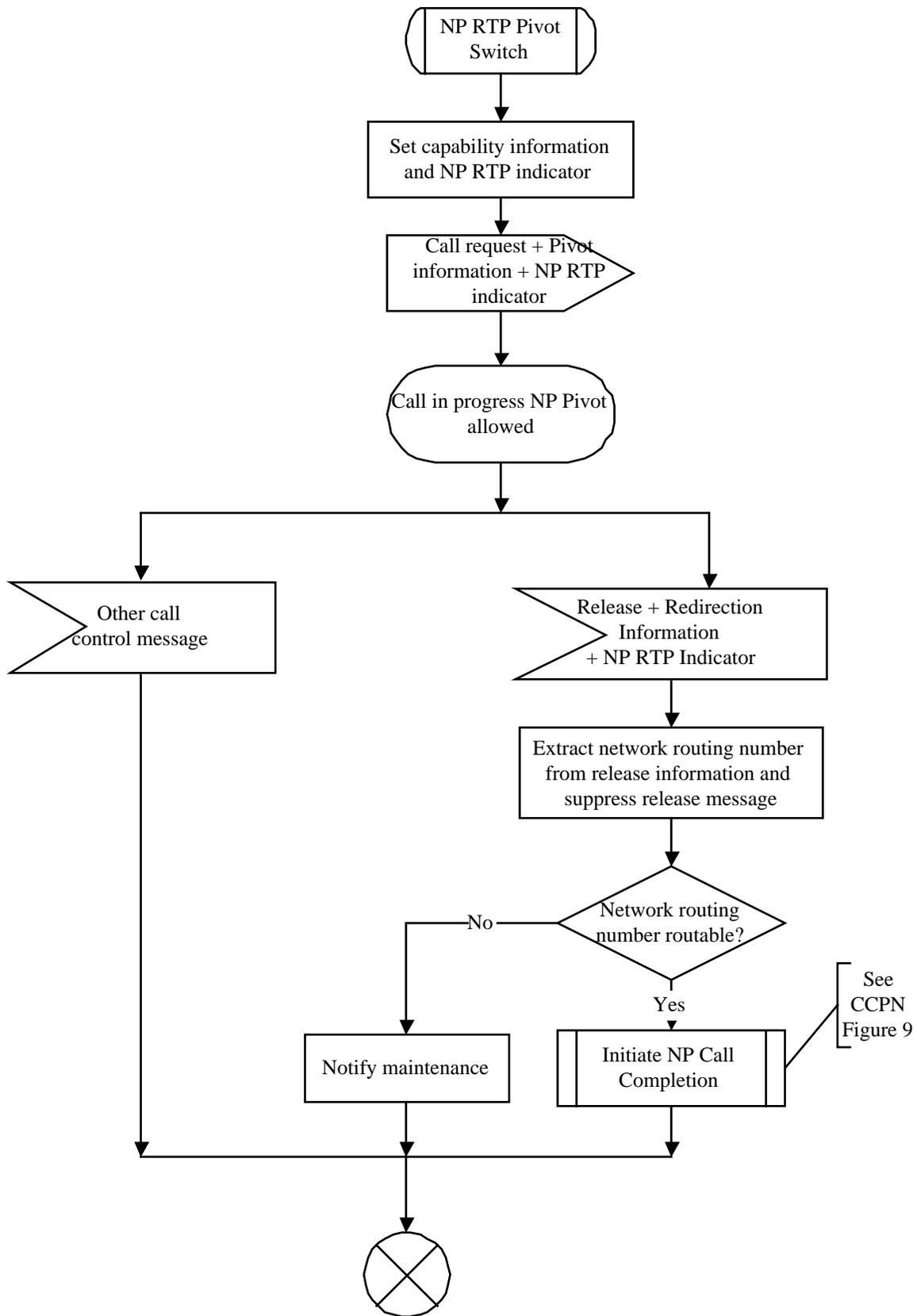**Figure B.2 – Initiate optional NP RTP network capability**

Figure B.3 – NP RTP pivot switch

B.3 Functional capabilities and information flows

B.3.1 Functional entity model

A functional entity (FE) is a group of functions that cannot be split across multiple switches. Multiple functional entities can be implemented in a single switch. The functional entity model defined in this clause refines the actions of FE2 as defined in 5.1.2. As such, functional entities and information flows defined in this Annex may be considered as taking place "inside" FE2.

Figure B.4 - NP RTP FE model

Below is a list of functional entities:

- BC_p represents basic call functions at the pivot switch.

- NP_p implements the optional NP RTP version of the CCPN Portable Number Query functional entity (FE2).

- P represents the pivot functional entity described in Release to Pivot network capability.

- BC_r represents basic call functions at the release switch.

- NP_r is the number portability functional entity at the release switch.

- R represents the release functional entity described in Release to Pivot network capability.

B.3.1.1 Description of basic call functional entities (BC_p and BC_r)

BC_p and BC_r provide basic call functions at the pivot, release and serving switches respectively. These functional entities detect calls incoming to their respective switches and relay information from call control messages to the number portability and pivot or release functional entities on the same switch. The basic call functional entities also relay information from the number portability and pivot or release functional entities to adjacent basic call functional entities.

B.3.1.2 Description of number portability functional entity at the pivot switch (NPp)

NP_p provides functionality specific to NP RTP at the pivot switch. BC_p informs NP_p of a new call, whether the call originates from the pivot switch or is incoming to the pivot switch from another network switch. NP_p examines the call set up information and determines whether or not to offer to act as an NP RTP pivot point.

NPp offers to act as the pivot point for calls passing through the pivot switch, based on its examination of call set up information. If the call set setup information includes capability information and the NP RTP indicator, NPp does not modify the received information and NPp shall not offer NP RTP network capability for the call. Otherwise, the algorithm used by NPp to

select the calls for which it offers to act as a pivot is determined by the operator of the pivot switch; it is outside the scope of NP RTP network capability.

When NPp determines that it should offer to act as a pivot point, it instructs P to include capability information in the call set up message indicating that the current switch will act as a pivot point up to receipt of an ACM. NPp also instructs BCp to include the NP RTP indicator in the call request.

If NPr releases the call to pivot, P will inform NPp of the release to pivot and provide the NRN contained in the Redirection Information to NPp. The Release message also contains a specific indication, provided by NPr that the release is to support number portability. In these circumstances, NPp returns the NRN to the CCPN network capability to complete the call.

B.3.1.3 Description of number portability functional entity at the release switch (NPr)

NP_r provides functionality specific to NP RTP at the release switch. BC_r informs NP_r of a new call, incoming to the release switch from another network switch. NP_r examines the called party number for the call and determines:

- that the called party number has been ported,

- using the indication provided by NP_p, that there is a switch capable of acting as an NP RTP pivot point earlier in the call path, and

- the NRN for the ported user's serving switch (NP_r may invoke NP Query-Response to obtain the NRN).

NP_r provides the NRN obtained for the serving switch to R as the new destination for the call. In accordance with RTP procedures, R will return the NRN to the pivot switch in the Redirection Information. NP_r also instructs BC_r to include an indication that the call is released in support of number portability in the Release message.

If the called party number has not been ported, NP_r instructs BC_r to complete the call using basic call procedures.

If the incoming call request has no indication of a prior switch capable of acting as an NP RTP pivot point, NP_r invokes CCPN to complete the call.

If NP_r cannot obtain an NRN corresponding to the ported number, the call fails.

B.3.1.4 Descriptions of pivot functional entity (P) and release functional entity (R)

These two functional entities are described in the RTP network capability.

B.3.2 Informational flow model

Figure B.5 shows the information flows between functional entities when using NP RTP.
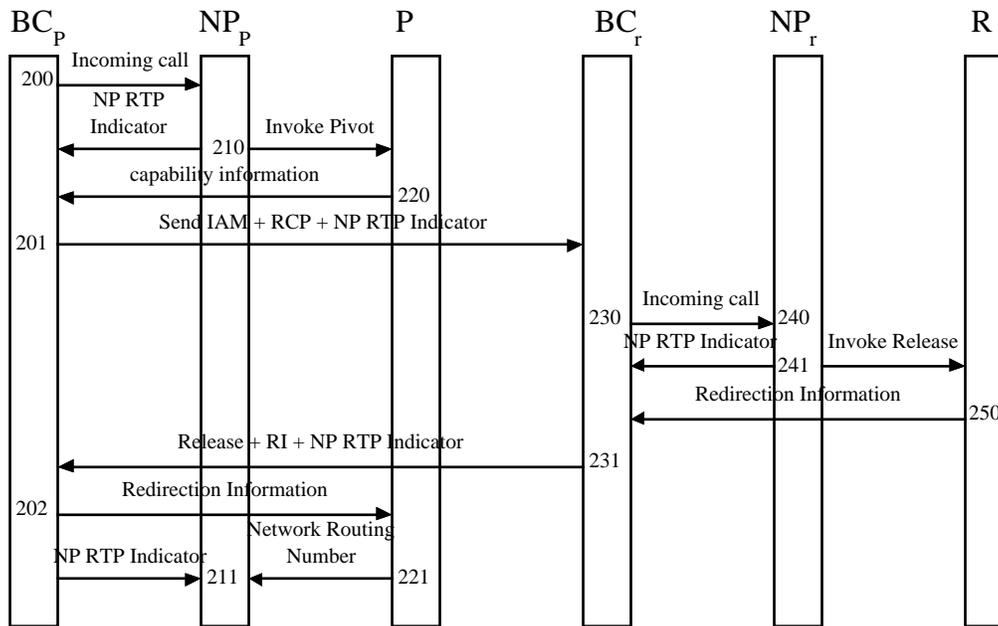
Figure B.5 – Information flow diagram

B.3.2.1   Normal procedures

The functional entity actions referenced in Figure B.5 are as follows.

200   Detect incoming call and provide call set up information to NP_p and P functional entities.

201   Route call using called party number. Incorporate the NP RTP indicator and capability information provided by NP_p and P respectively into call set up information.

202   Detect call released with Redirection Information and NP RTP indicator. Provide call Redirection Information to NP_p and P.

210   Examine set up information and determine whether to offer pivot capability for number portability. Invoke P to provide capability information for the call. Provide NP for RTP indicator for the call.

211   On receipt of the NP for RTP indicator from BC_p and the destination address from P, invoke CCPN using the original called party address from the call set up as the portable address and the destination address as the NRN.

220   On invocation by NP_p provide capability information to BC_p.

221   On receipt of Redirection Information, provide the destination address to NP_p.

230   Detect the incoming call and provide call set up information to NP_r.

231   Release the incoming call incorporating the NP RTP indicator and Redirection Information, provided by NP_r and R respectively, into the Release message.

240   Examine call set up information. Determine that the called party number is portable and that a pivot point is available. Obtain the NRN for the portable user's serving switch and determine that the call should be released to the available pivot point.

241   Invoke the release capability, providing the NRN as the new destination. Provide the NP RTP indicator to BC_r.

250   On invocation by NP$_r$, formulate Redirection Information and instruct BC$_r$ to release the call, including the Redirection Information in the Release message.

Figure B.5 does not show information flows between the pivot switch and the called portable user's serving switch. These information flows are part of CCPN.

B.3.2.2 Exceptional procedures

None identified.

B.3.2.3 Alternate procedures

When an original destination/release switch receives a call set up message from another switch and the set up message does not indicate the presence of a switch capable of performing the NP pivot function earlier in the call path, the original destination/release switch may not invoke the release function of NP RTP. The original destination/release switch will attempt to route the call using normal routing procedures. If the number is ported, the release switch will then determine the NRN for the called ported user's serving switch and invoke CCPN to deliver the call to the called party.

When a pivot switch receives a Release message that does not include the Redirection Information specified by ANSI T1.661 for the basic RTP network capability, the pivot switch does not invoke NP RTP. The pivot switch shall use basic call control procedures to release the call.

When a pivot switch receives a Release message that includes Redirection Information but not the NP RTP indicator, the pivot switch does not invoke NP RTP. The Release message may still cause invocation of the pivot function of basic RTP network capability at that switch. Provision of the function is outside the scope of NP RTP, see ANSI T1.661 for a description of the operation of the pivot function in this case.

B.3.3 Allocation of functions to equipment

NP$_p$, BC$_p$, and P could reside in an originating or an intermediate switch. NP$_r$, BC$_r$, and R reside in a destination switch.

B.4 Protocol and procedures

B.4.1 Protocol and procedural assumptions

None identified.

B.4.2 Formats of the ISUP parameters supporting Number Portabilty Release to Pivot

NP RTP makes use of additional signalling information defined in ANSI T1.661.

B.4.2.1 Format of the NP RTP indicator

The NP RTP indicator is a Service Activation Parameter (ANSI T1.113.3, subclause 3.29A) containing a feature code of "NP RTP."

This feature code is encoded as follows:

    1011 1111   NP RTP

For brevity, the subsequent sections refer to a Service Activation Parameter that contains this feature indicator value (possibly among others) as an "NP RTP indicator."

B.4.3 Procedures for Number Portability Release to Pivot

The exchange should follow the existing ISUP procedures with the following modifications.

B.4.3.1 Procedures for an originating exchange

The exchange determines that the called number is portable and the call will proceed to an NP original destination/release exchange. The pivot switch will formulate an IAM containing:

1) a Redirect Capability Parameter (RCP). For NP RTP the default RCP value is "Redirection Possible Before ACM." Other supplementary services or network capabilities may, in accordance with procedures of ANSI T1.661, set the RCP to permit pivoting at a later call state. This is outside the scope of NP RTP.

2) an NP RTP indicator.

The originating exchange forwards the IAM toward the original destination/release exchange and RTP stores the IAM information; this information may be necessary to complete the NP RTP pivot function.

Having sent the RCP and NP RTP indicator, if the originating exchange receives an REL with cause value "Reroute to New Destination," Redirection Number parameter, and an NP RTP indicator, the exchange provides NP pivoting for the call. The exchange extracts the NRN value contained in the received Redirection Number parameter and uses it, together with the original called party number, to invoke the basic CCPN network capability and route the call to the called user's serving exchange for completion.

B.4.3.2 Procedures for an intermediate exchange

An intermediate exchange that is NP pivot capable follows the same procedures as a pivot capable originating exchange with one exception.

If the incoming IAM for a call includes an NP RTP indicator, the intermediate exchange shall not activate its pivot capability for the call for NP. The exchange does not alter any NP RTP specific information in the IAM.

B.4.3.3 Procedures for a destination exchange

When the destination exchange determines that the called party has been ported to another serving exchange, it obtains an NRN for the called party. The destination exchange may invoke NP Query-Response to obtain the NRN, then

– If the incoming IAM contains the RCP and NP RTP indicator, the destination exchange invokes the basic RTP network capability to release the call to the pivot exchange, prior to sending ACM to the call. The destination exchange uses the NRN as the new destination number for the call and includes an "NP RTP" indicator in the REL.

– If the incoming IAM does not contain both the RCP and the NP RTP indicator, the destination exchange uses the NRN to route the call using the CCPN network capability.

B.4.4 Exceptional procedures

If, on receipt of an REL containing Redirection Number parameter the pivot switch can not route the call toward the serving exchange based on the NRN, the call will be released back using existing ISUP Procedure.

B.4.5 SDLs

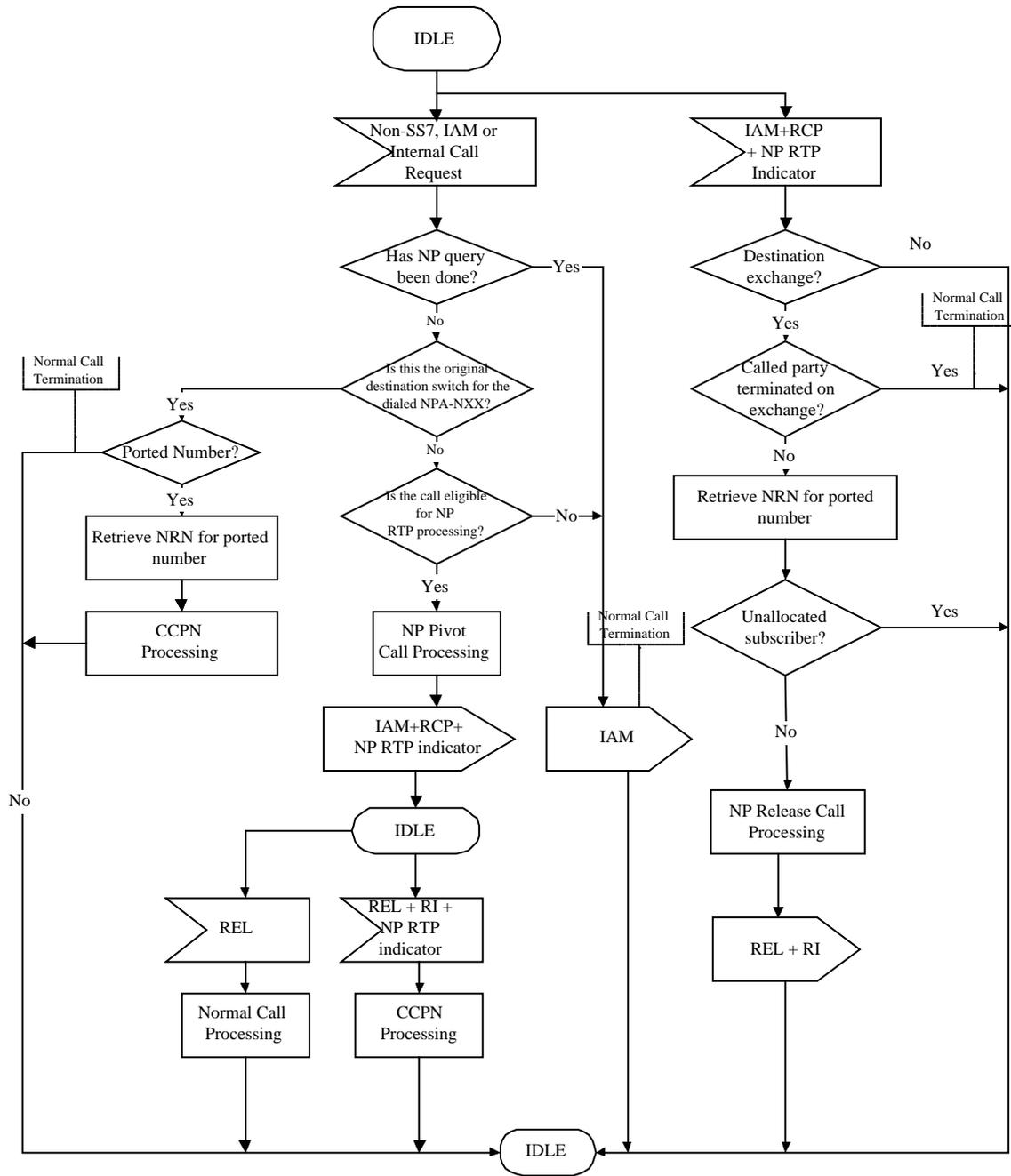Figure B.6 illustrates NP RTP functionality.

Figure B.6 – SDL of NP RTP

B.4.6 Interaction with other supplementary services

None identified.

B.5 Specifications for protocol interworking

None identified.

Annex C
(informative)

NP Query on Release Capability

C.1   Scope, purpose, and application

This annex defines the optional NP Query on Release (QoR) network capability that complements the Call Completion to a Portable Number (CCPN) capability. Specifically, it allows the initiating switch, after determining that the called party number is portable, the option to check for the presence of the subscriber not only in its own data, but in one other switch. This capability will normally be used only within a single service provider's network. However, it may be used between networks on an internetwork agreement basis.

This annex applies to the Integrated Services Digital Network (ISDN) User Part (ISUP) and is intended to supplement the signalling functions and call procedures described in ANSI T1.113. This annex should be used in conjunction with other ANSI standards related to supplementary services for a complete understanding of the interactions between the NP QoR capability and other services.

C.2   Description of Query on Release capability

C.2.1   General description

The optional NP QoR capability supports call completion to a portable number (CCPN). After CCPN has detected, at the initiating switch, that a public number is portable, it determines whether to invoke NP QoR for this call. Once invoked, NP QoR routes the call to the original destination switch which determines if it serves the called public number or not. If the public number is ported (i.e., is not served by the original destination switch), NP QoR returns an indication to the initiating switch which obtains the appropriate network routing number (NRN) using CCPN. If the public number is not ported (i.e., is served by the original destination switch), normal call processing procedures complete the call.

Call routing with the NP QoR option is shown in Figure C.1.
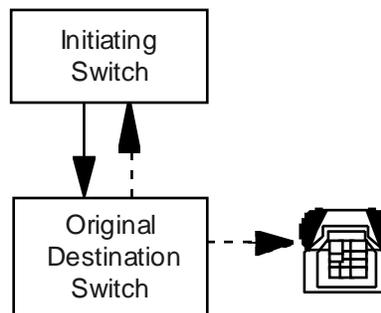
Note: solid arrows depict mandatory flows
dashed arrows depict optional flows

Figure C.1 – NP QoR routing flow

C.2.2   Procedures

C.2.2.1   Provisioning/withdrawal

NP QoR is a network capability transparent to the end users that is invoked when calling a portable number.

NP QoR shall be provisionable. This capability might, for example, be provisionable per NPA-NXX (NPA and CO code) or per incoming/outgoing trunk group.

C.2.2.2   Activation/deactivation

None identified.

C.2.2.3   Normal procedures

If invoked, NP QoR at the initiating switch sets a QoR attempt indicator and routes the call to the original destination switch.

The original destination switch determines whether it serves the called user. If the original destination switch does not serve the called user and the call request contains the QoR attempt indicator, it releases the call back to the initiating switch with an indication that the user is no longer served on the original destination switch. The original destination switch handles all other calls using existing procedures.

Based on the release information, the initiating switch obtains a network routing number for the called user's serving switch, clears the QoR attempt indicator, and completes the call as provided for in the CCPN capability.

C.2.2.4   Exceptional procedures

If the initiating switch cannot obtain the routing number, the QoR attempt indicator is cleared, and the call progressed towards the original destination switch so that a subsequent switch may successfully complete the query and route the call.

In those cases where an originating network contains the initiating switch for NP QoR and the call progresses into another network, and the call is released back, care must be taken to ensure that call recording data is properly interpreted.

C.2.2.5   Alternate procedures

None identified.

C.2.2.6   Interworking considerations

This capability requires the use of ISUP between the initiating and original destination switches, in order to carry the additional information required, i.e., the QoR attempt indicator.

C.2.2.7   Network capabilities for charging

See 4.2.7,

50

C.2.2.8 Interactions with supplementary services

If user network interaction[17] is encountered after NP QoR invocation, the switch where the user network interaction occurs (or a switch later in the call path) must act as the CCPN initiating switch.

See also 4.2.8

C.2.2.9   SDLs

Figure C.2 shows the SDL for the NP QoR capability at all switches.

Figure C.2 – SDL diagram for NP QoR capability

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[17]   See ANSI T1.113.4, Chapter 4, A.6

Figure C.3 shows the additional NP QoR functionality specific to the initiating switch.
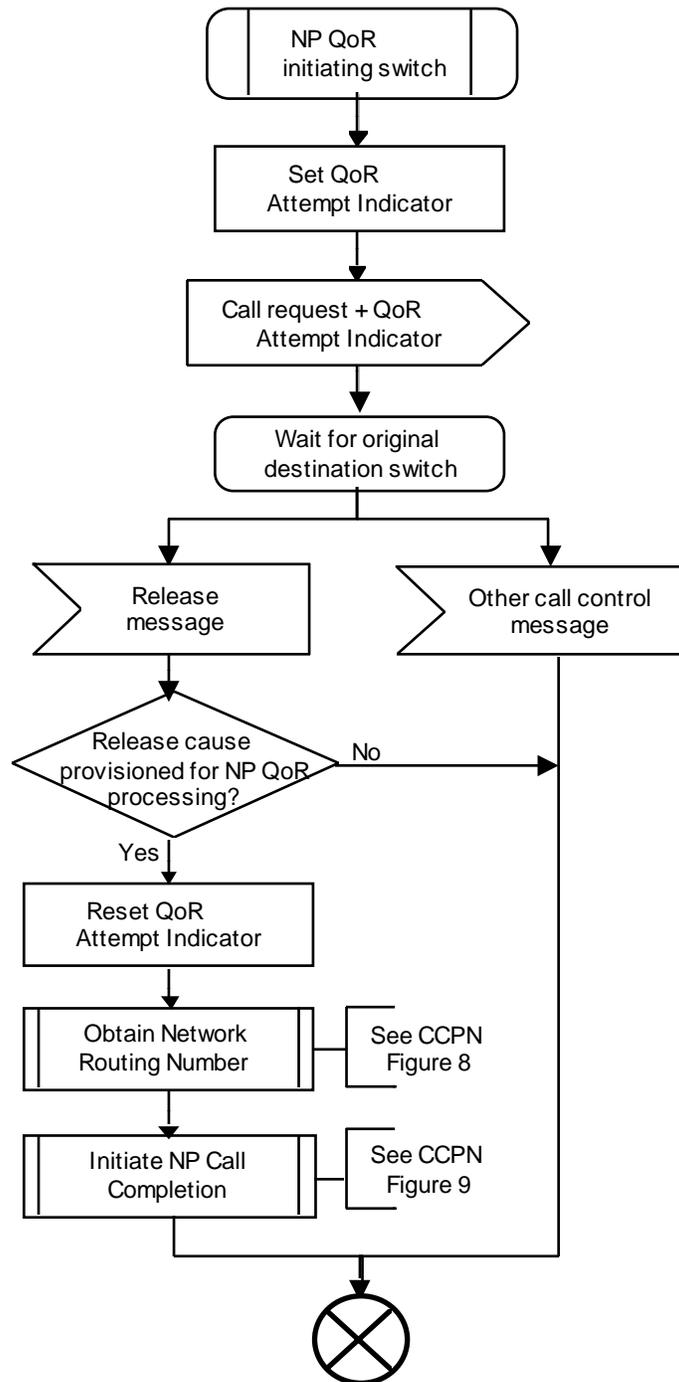

Figure C.3 – SDL Diagram for NP QoR capability initiating switch

C.3 Functional capabilities and information flows

C.3.1 Functional entity model

A functional entity (FE) is a group of functions that cannot be split across multiple switches. Multiple functional entities can be implemented in a single switch. The following functional entity model, shown in Figure C.4, is an optional extension of the CCPN capability, see 5.1.
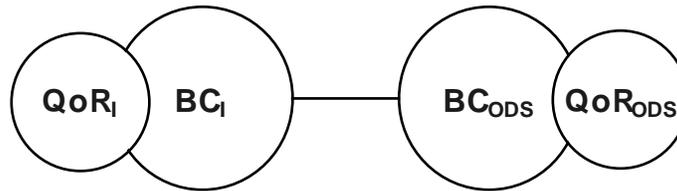
Figure C.4 – FE model for NP QoR

Below is a list of the functional entities required by the QoR model.

_ QoR_I implements the optional NP QoR version of the CCPN Portable Number Query functional entity (FE2). This functional entity initiates NP QoR, sets the QoR indicator, and sends the call to the original destination switch. If an appropriate release cause is returned, then QoR_I determines the network routing number, and returns it to CCPN, allowing CCPN to complete the call to the ported user.

_ BC_I and BC_{ODS} represent the basic call functional entities associated with the initiating and original destination switches, respectively.

_ QoR_{ODS} implements the NP QoR release function at the original destination switch.

C.3.1.1 Description of QoR initiating switch functional entity (QoR_I)

QoR_I implements the optional NP QoR version of the CCPN Portable Number Query functional entity. QoR_I determines whether the call setup information (specifically, the first six digits of the called public number) specify a connection request to a portable public number, and checks that NP QoR has not been initiated by a previous switch. If the call is to a portable number, and NP QoR has not been previously initiated, this functional entity initiates the NP QoR capability on a per call basis, sets the QoR attempt indicator, and invokes BC_I to initiate a connection request to the called public number using default routing. If QoR_I receives a number not served indication or another appropriate cause value, then QoR_I determines the routing information needed by CCPN for delivery of the call to the serving switch, and passes this information back to CCPN.

C.3.1.2 Description of the basic call functional entities (BC_I & BC_{ODS})

BC_I and BC_{ODS} represent the basic call functional entities associated with the initiating and original destination switches, respectively.

C.3.1.3 Description of NP QoR original destination switch functional entity (QoR_{ODS})

QoR_{ODS} is invoked by BC_{ODS} if the original destination switch does not serve the portable public number. If the QoR attempt indicator is set for the call, then QoR_{ODS} specifies that a "NP QoR-Number Not Found" indication should be returned by BC_{ODS} for the call. Otherwise, QoR_{ODS} performs no function and BC_{ODS} progresses the call using existing procedures.

C.3.2 Information flow model

Figure C.5 shows the proposed information flow model for the NP QoR capability when used in conjunction with the CCPN capability.
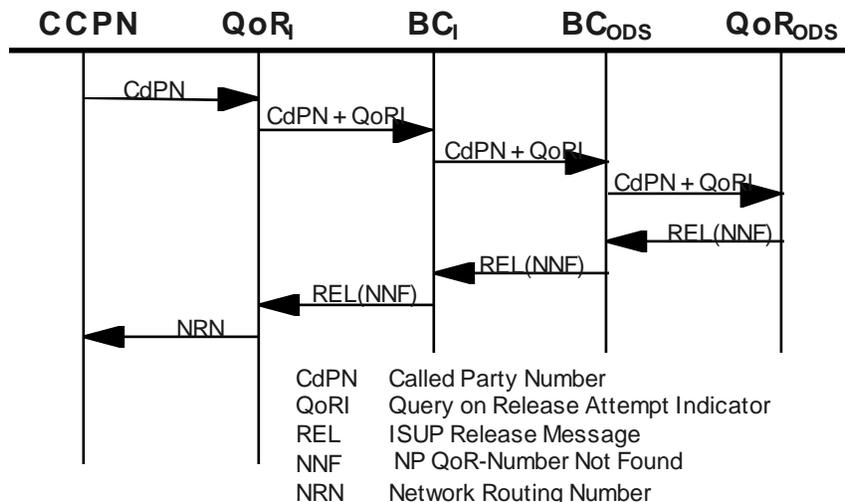

Figure C.5 – Information flow diagram

C.3.2.1 Invoking QoR$_I$

QoR$_I$ is invoked by the CCPN Portable Number Detection functional entity.

C.3.2.2 Invoking QoR$_{ODS}$

QoR$_{ODS}$ is invoked by a destination switch's normal call processing when the called public number is not served by that switch.

C.3.2.3 Activation and deactivation of the NP QoR capability

Activation and deactivation of the NP QoR capability is done on a functional entity basis.

C.3.2.4 Exceptional procedures

If QoR$_I$ cannot identify the network routing number for a given call in a timely manner, QoR$_I$ will clear the QoR attempt indicator, and route the call using the original called party number information.

C.3.3 Allocation of functions to equipment

QoR$_I$ and BC$_I$ can reside in the originating, intermediate or terminating switch. QoR$_{ODS}$ and BC$_{ODS}$ reside in the original destination switch.

C.4   Protocol and procedures

C.4.1   Protocol and procedural assumptions

None Identified.

C.4.2   Formats of the ISUP parameters supporting NP QoR

C.4.2.1 Signalling information

QoR Attempt Indicator: Information sent in the forward direction to indicate that a previous switch is NP QoR Capable.

C.4.2.2 Format of the forward call indicators (see ANSI T1.113, 3.20)

NP QoR defines a new indicator in the forward call indicator parameter.

	8	7	6	5	4	3	2	1
1	H	G	F	E	D	C	B	A
2	P	O	N	M	L	K	J	I

    bit   N: QoR Attempt Indicator
     0   no QoR routing attempt in progress
     1   QoR routing attempt in progress

Figure C.6 – Forward call indicators

C.4.2.3   ANSI cause value

An ANSI cause value is needed to inform the initiating exchange that the original destination exchange does not serve the called public number. When this case is detected, the call shall be released using normal ISUP procedures with the following REL cause value:

> Cause 27 - *NP QoR-Number Not Found.* This cause indicates that called public number is not served on the original destination exchange. This cause is only used when the incoming IAM contains an indication that a QoR routing attempt is in progress.

C.4.3   Procedures for NP QoR

The exchange should follow the existing ISUP procedures with the following modifications.

C.4.3.1   Action required at the originating exchange

The originating exchange, acting as the initiating switch, determines if the network routing number is to be derived using NP QoR. If so, then the call is routed to the original destination exchange with the QoR attempt indicator – bit "N" – set to indicate that a QoR routing attempt is in progress for this call.

If the first backward message received by the originating exchange is a REL message with an appropriate cause value[18], then this originating exchange will discard the REL message,

_____

[18]   e.g., ANSI cause 27, NP QoR–Number Not Found.

determine the routing information, clear the QoR attempt indicator, and route the call using the CCPN capability.[19]

C.4.3.2 Action required at the intermediate exchange

When an exchange receives an IAM containing the forward call indicator set to "number translated" or "QoR routing attempt in progress", it shall not act as an initiating switch.

C.4.3.3 Action required at the destination exchange

When a destination exchange receives a call with a QoR attempt indicator set to indicate "QoR routing attempt in progress", and the exchange does not serve the end user, it shall release the call with an ANSI Cause value 27, "NP QoR–Number Not Found".

C.4.3.4   Specifications for protocol interworking

C.4.3.4.1   SS7/DSS1

None identified.

C.4.3.4.2 SS7/inband

The NP QoR optional capability requires the use of SS7 between the initiating switch and the original destination exchange. If an inband circuit is used for this portion of the call, then the first CCPN capable exchange after the inband circuit must reinitiate the CCPN capability. Any QoR attempt indicators set are lost.

C.4.3.4.3 ISDN/non-ISDN

None identified.

C.4.3.5 Error conditions

None identified.

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[19]   Note that if the called number is unallocated, this results in a second call attempt towards the original destination switch. However, in this case, the QoR attempt indicator is not set for the second attempt, and the original destination switch will provide standard unallocated number treatment.