



ATIS-0700708.1998(\$2017)

PCS 1900 Service Provider Number Portability

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ATIS-0700708.1998 (R2013), PCS 1900 Service Provider Number Portability

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American National Standard
for Telecommunications –
**PCS 1900 Service Provider
Number Portability**

Secretariat

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Approved March 26, 1998

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Foreword (This foreword is not part of American National Standard T1.708-1998.)

This document titled *PCS 1900 Service Provider – Number Portability* describes a network capability in a PCS 1900 network that facilitates call completion to a portable number. This document has been developed for use by PCS 1900 networks to meet the anticipated needs of service provider portability, which is also referred to as Service Provider Number Portability in this document.

This standard is intended for use in conjunction with *American National Standard for Telecommunications - Signaling System Number 7 (SS7) - ISDN User Part (ISUP)*, ANSI T1.113-1995, *American National Standard for Telecommunications - Call Completion to Portable Number (CCPN)*, ANSI T1.660-1998,¹⁾ and *American National Standard for Telecommunications - Signaling System Number 7 (SS7) - Transaction Capabilities Application Part (TCAP)*, ANSI T1.114-1996.

Suggestions for improvement of this standard are welcome. They should be sent to Alliance for Telecommunications Industry Solutions, 1200 G Street, NW Suite 500, Washington, DC 20005.

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American National Standard for Telecommunications –

PCS 1900 Service Provider Number Portability

1 Scope

Number Portability (NP) allows subscribers to retain their Directory Number (DN) when they change their service provider (service provider portability), location (location portability), or service (service portability). The focus of this specification is to allow PCS1900 systems to support “service provider portability.” Location and service portability are outside the scope of this document. This specification addresses a basic voice call. The impact of number portability on Short Message Service, Intelligent-Network-based services, data services and other supplementary services is outside the scope of this document.

2 Normative References

The following standards contain provisions which, 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 T1.112-1996, *Telecommunications – Signalling system no. 7 (SS7) – Signaling connection control part (SCCP)*

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 capability application part (TCAP)*

ANSI T1.660-1998, *Telecommunications – Signalling system no. 7 (SS7) – Call completion to portable number – Integrated text*²⁾

ANSI, J-STD-023-1996, *Telecommunications – PCN to PCN intersystem operations based on PCS 1900*³⁾

North American Numbering Council (NANC) Functional Requirement Specification, *Number portability administration center – service management system (NPAC-SMS)*, Version 1.0, May 25, 1995; Version 2.0, June 2, 1997.

3 Definitions

3.1 Directory Number: Any North American Numbering Plan (NANP) 10-digit dialable number assigned to address a wireline or a wireless subscriber. DNs are inclusive of Mobile Station International ISDN Numbers (MSISDNs).

²⁾ This standard is currently in production. Please contact the Secretariat for more recent information.

³⁾ Please contact the Secretariat for further information on this document.

3.2 Donor: The term used to describe the switch or network from which the subscriber has ported. If the subscriber has ported more than once, the first switch or network to release the subscriber is referred to as the original donor switch or donor network. The original donor switch is the switch to which the call will be routed in the absence of number portability information, as it is the owner of the directory number.

3.3 End User: A consumer of telecommunications services.

3.4 Initiating MSC: The MSC (switch) that obtains routing information (i.e. LRN).

3.5 Mobile Station International ISDN Number: An E.164 dialable number and, in the context of this document, a 10-digit NANP directory number assigned to address a wireless service subscriber.

3.6 Portable Number: Any number within a block of NANP numbers identified to be involved in number portability by an appropriate (local, state, or federal) authority. Members of the block can be identified by their NPA-NXX. Finer granularity of the blocks may be possible.

3.7 Ported Number: A portable directory number that has been moved to a switch or network other than the donor.

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

3.9 Service Provider Portability: Allows an end user to retain the same directory number after changing from one service provider to another.

3.10 Recipient: The term used to describe the switch or network to which a subscriber's directory number has been ported.

4 Abbreviations

ACG	Automatic Code Gapping
ANSI	American National Standards Institute
CCPN	Call Completion to a Portable Number
CdPN	Called Party Number
CIC	Carrier Identification Code
DN	Directory Number
FCI	Forward Call Indicators
FRS	Functional Requirements Specification
GAP	Generic Address Parameter
GMSC	Gateway Mobile Switching Center
GSM	Global System for Mobile Telecommunication
GTT	Global Title Translation
HLR	Home Location Register
HON	Handover Number
IAM	Initial Address Message
ISUP	Integrated Services Digital Network (ISDN) User Part
LATA	Local Access Transport Area
LRN	Location Routing Number

LSMS	Local Service Management System
MAP	Mobile Application Part
MF	Multi-Frequency
MS	Mobile Station
MSC	Mobile Switching Center
MSISDN	Mobile Station International ISDN Number
MSRN	Mobile Subscriber Roaming Number
NANC	North American Numbering Council
NANP	North American Numbering Plan
NP	Number Portability
NPA	Numbering Plan Area
NPAC-SMS	Number Portability Administration Center - Service Management System
PCS	Personal Communication Services
PLMN	Public Land Mobile Network
PSTN	Public Switch Telephone Network
REL	Release Message
RN	Routing Number
SCCP	Signaling Connection Control Part
SK	Service Key
SRI	Send Routing Information
STP	Signaling Transfer Point
SS7	Signaling System Number 7
TCAP	Transaction Capability Application Part
TS	Technical Specification
VLR	Visitor Location Register

5 General Description

PCS 1900 will implement Number Portability according to the Location Routing Number (LRN) method. When the initiating Mobile Switching Center (MSC) determines that a call is to a portable number (the called party number lies within a portable range, e.g., NPA-NXX), it initiates a query to the NP database. If the subscriber has ported, the Query Response message returns an LRN to the initiating MSC. If the subscriber is not ported, the Query Response message returns the called party number (dialed number) to the initiating MSC.

The LRN identifies the serving switch to which the subscriber has ported and is used by all switches in the call path to route the call to the serving switch. The serving switch uses the LRN and the called party number to complete the call to the end user. The switch that obtains the LRN (initiating MSC) sends an indication in the forward call setup information that the NP status of the called party number has been determined, thus inhibiting subsequent queries at the succeeding switches/network. The call is routed using the called party number if the subscriber is not ported or error/time-out occurs.

For numbers ported into the Public Land Mobile Network (PLMN), the LRN will be used to route to at least one Gateway MSC (GMSC) of the PLMN. It may be necessary to assign multiple LRNs to the same GMSC or same set of GMSCs. All LRNs routed to a particular GMSC shall be recognized by that GMSC.

The NP database query may be made in either the terminating network or in a preceding network. Both cases are supported by this standard.

6 Functional Entities and Call Flows

6.1 Functional Entities

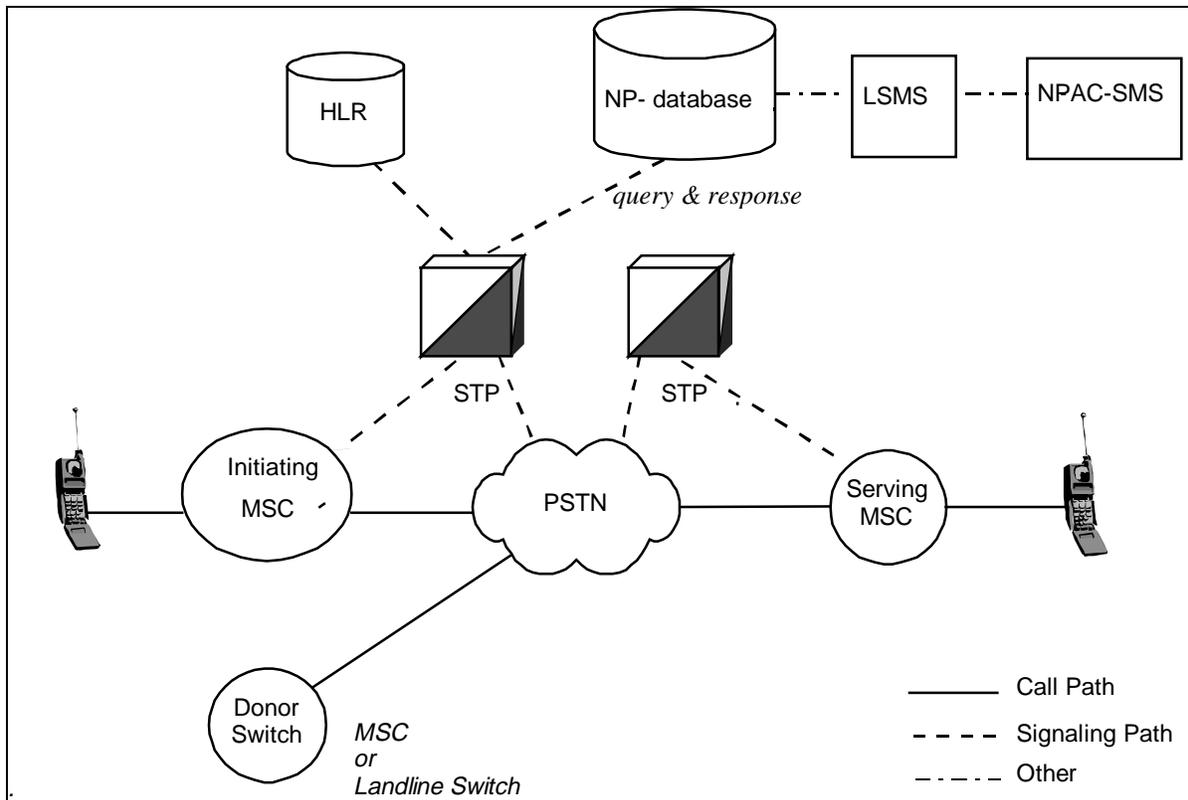


Figure 1 – Functional Architecture

Figure 1 depicts the functional architecture to support PCS 1900 service provider number portability.

6.1.1 Number Portability Administration Center Service Management System (NPAC-SMS)

The NPAC-SMS is a Service Management System responsible for storing and broadcasting to the Local Service Management System(s) NP data updates within a service provider's area.

6.1.2 Local Service Management System (LSMS)

The LSMS is responsible for distributing the NP data updates from the NPAC-SMS to the service provider's NP database.

6.1.3 Number Portability Database (NP database)

The NP database is the database accessed in real time by the MSCs (switches) to provide the LRN for a ported subscriber in order to correctly route a call. It contains the number portability information transmitted by the NPAC-SMS via the LSMS.

6.1.4 Mobile Switching Center (MSC)

The MSC performs all the switching functions for mobile stations. This includes the allocation of radio resources, call establishment and handover.

A Mobile Station (MS) roaming in an MSC area is assigned to a Visitor Location Register (VLR). A VLR is in charge of temporarily storing subscription data for the MSs registered in the MSC area. A VLR may be collocated with an MSC and may be in charge of one or several MSC areas.

In the case of incoming calls to the PLMN, if the delivering network(s) is unable to interrogate the Home Location Register (HLR), the call is routed to an MSC. This MSC will interrogate the appropriate HLR and then route the call to the MSC where the mobile station is located. The MSC that performs the interrogation and routing function to the actual location of the mobile is called the Gateway MSC (GMSC).

For the rest of this specification, the term, MSC, will denote either GMSC or MSC/VLR or both, unless explicitly stated.

6.1.5 Home Location Register (HLR)

The HLR is a database that maintains information for the management of mobile subscribers. It contains the subscription information and may contain the location of each mobile station.

6.1.6 Signaling Transfer Point (STP)

The STP provides the Signaling Connection Control Part (SCCP) functions such as Global Title Translation (GTT) and SCCP management. GTT is used for message delivery (e.g., queries) to application databases. SCCP management is used to manage and reroute traffic based on application availability.

6.2 Interfaces

6.2.1 NPAC-to-LSMS Interface

The NPAC-to-LSMS interface is an interface for providing the information to populate the LSMS database as specified in the *North American Numbering Council (NANC) Functional Requirement Specification* (see clause 2).

6.2.2 LSMS-to-NP-database Interface

The interface between the LSMS and the NP database has not been standardized and is not covered in this specification.

6.2.3 NP-database-to-MSC Interface

The interface between the NP database and the MSC is as specified in ANSI T1.660, Annex A, message set B. Relevant portions of ANSI T1.660, Annex A are included and expanded in Clause 8 of this specification.

6.2.4 MSC-to-HLR Interface

The interface between the MSC and HLR is as specified in ANSI J-STD-023.

6.2.5 MSC-to-PSTN Interface

The interface between the MSC and Public Switch Telephony Network (PSTN) supports the enhanced ANSI ISUP as specified in ANSI T1.660. ISUP is enhanced to carry the following information when the number is ported:

- The LRN in the Called Party Number (CdPN) parameter
- The called party number in the Generic Address Parameter (GAP). The Type of Address of the GAP is coded as "ported number";
- An indication in the Forward Call Indicators (FCI) bit M to indicate that a query to the NP database has been done, thus inhibiting subsequent queries at the succeeding switches.

6.3 Call Flows

The call flows presented in this clause only show scenarios pertaining to number portability. For example, the signaling from the HLR to the VLR currently serving the mobile subscriber (used to obtain the roaming number) is not shown.

6.3.1 Alternatives for Querying an NP database

When a mobile originating call or an incoming call arrives at an MSC and an NP database query has not been done, the MSC shall progress the call in one of two ways, as shown in Figure 2 and Figure 3.

6.3.1.1 Interrogating the HLR before querying the NP database

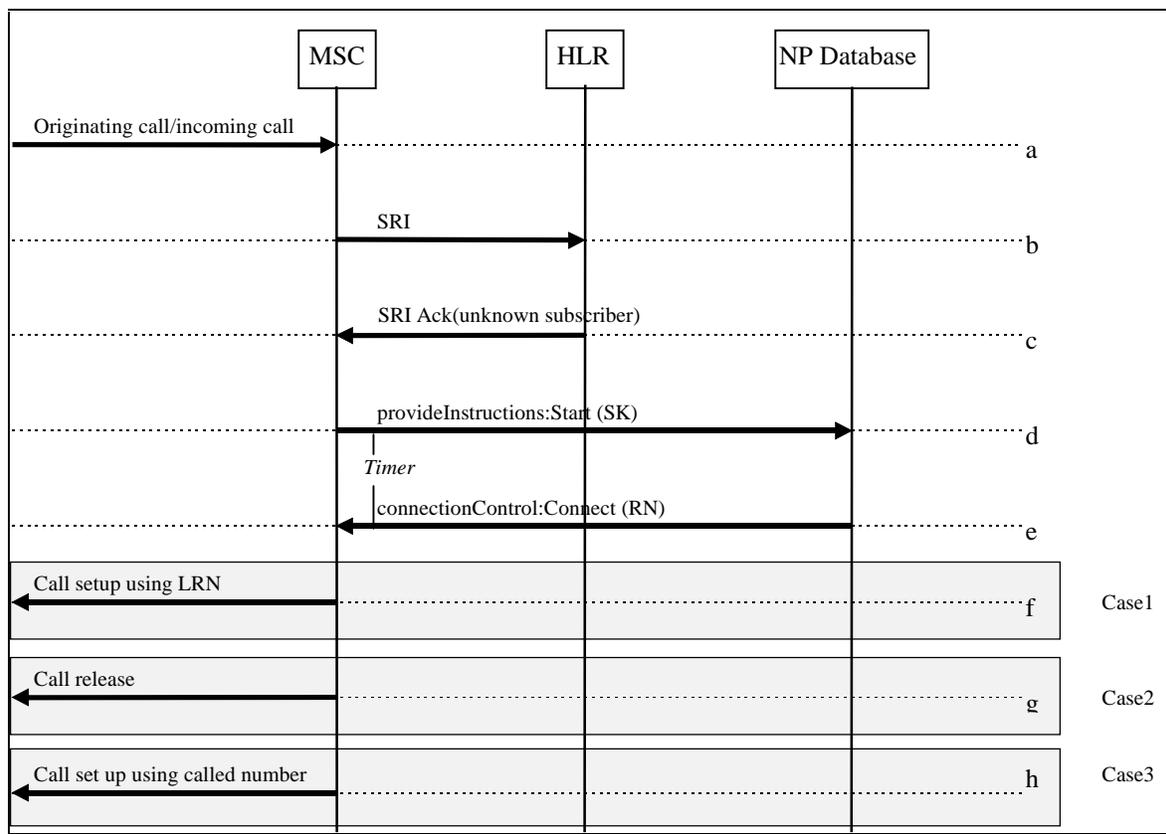


Figure 2 – Interrogating the HLR before querying the NP database

- Originating call or Incoming call with called party number is received by the MSC;

- b) The MSC detects that the called party number may be served by this PLMN. The MSC sends SRI to the HLR with the called party number.
- c) The HLR returns “unknown subscriber” in the SRI Ack.
- d) The MSC sends provideInstructions:Start query to the NP database if the DN is within a portable NPA-NXX range. The Service Key (SK) parameter contains the called party number.
- e) The NP database returns connectionControl:Connect response. The Routing Number (RN) parameter contains either the 10 digit LRN for the called party number or the actual called party number.
- f) Case 1: If the NP database returned the LRN, then the MSC will setup the call using the LRN if the LRN is not owned by the PLMN. Otherwise, the MSC will release the call using normal call release procedures.
- g) Case 2: If the NP database returned the called party number and the PLMN is the donor network for the portable NPA-NXX, then the MSC will release the call using normal call release procedures. This is the case when the called number is portable but unallocated.
- h) Case 3: If the NP database returned the called party number and the PLMN is not the donor network for the portable NPA-NXX, then the MSC will setup the call using the called party number. This is the case when the called party number is within a portable NPA-NXX, but not ported and not served by this PLMN.

6.3.1.2 Querying the NP database before interrogating the HLR

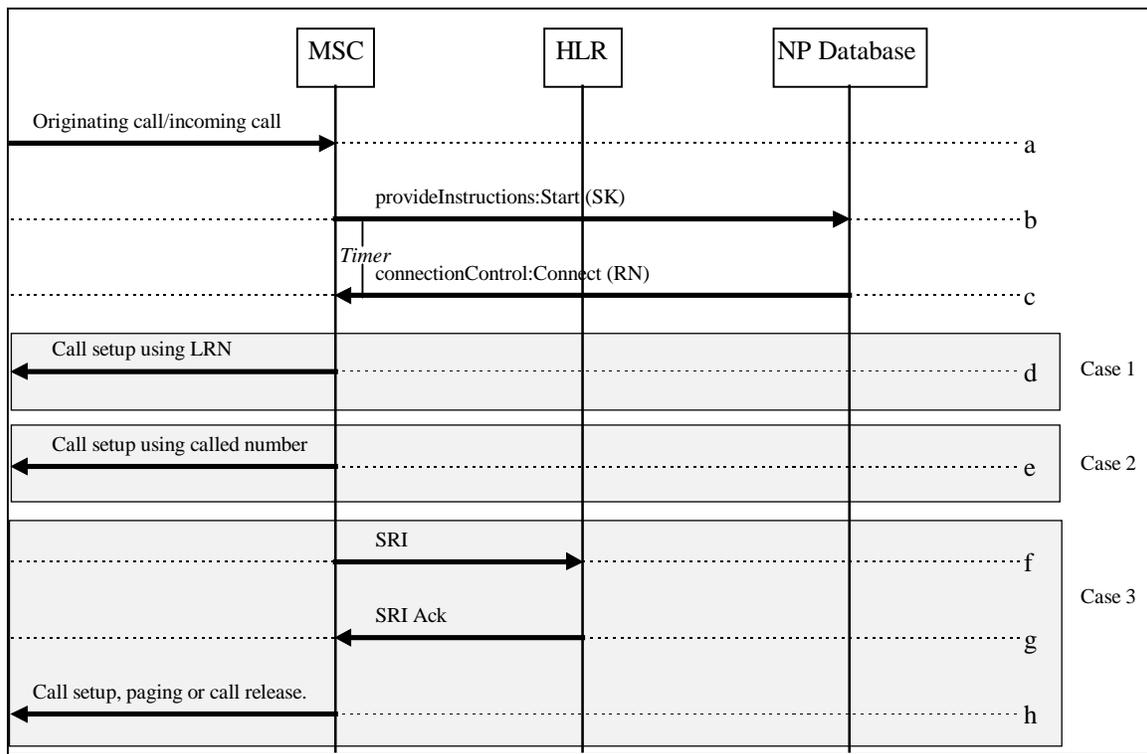


Figure 3 – Querying the NP database before interrogating the HLR

- a) Originating call or Incoming call with called party number is received by the MSC;

- b) The MSC detects the called party number is within a portable NPA-NXX and sends provideInstructions:Start query to the NP database. The Service Key parameter contains the called party number;
- c) The NP database returns connectionControl:Connect response. The Routing Number parameter contains either the 10-digit LRN for the called party number or the actual called party number;
- d) Case 1: If the LRN is returned by the NP database and does not belong to this MSC, then the MSC uses the LRN to route the call;
- e) Case 2: If the called party number is returned by the NP database and the PLMN is not the donor network for the portable NPA-NXX, then the MSC uses the called party number to route the call;
- f) Case 3: If the LRN belongs to the MSC or when the NP database returns the called party number and the PLMN is the donor network for the portable NPA-NXX, then the MSC sends SRI to the HLR with the called party number;
- g) Case 3: The HLR returns SRI Ack with either a routing number (e.g., MSRN) or “unknown subscriber”;
- h) Case 3: If a routing number is returned by the HLR, the MSC will complete the call normally (e.g., either route the call with MSRN or initiate paging). If “unknown subscriber” is returned by the HLR, then the MSC will initiate a normal release (as for an unallocated number).

6.3.2 Call Scenarios for NP database query before HLR interrogation

In the following cases (Figures 4 to 7), the NP database is queried before interrogating the HLR. In general, depending on the configuration of the MSC, the NP database may be queried either before or after interrogating the HLR. The Time Out scenario is shown as a separate case, as illustrated in Figure 7.

6.3.2.1 Call to a Ported Number

This scenario describes call setup to a party whose directory number is ported. The NP database returns the LRN to the requesting MSC.

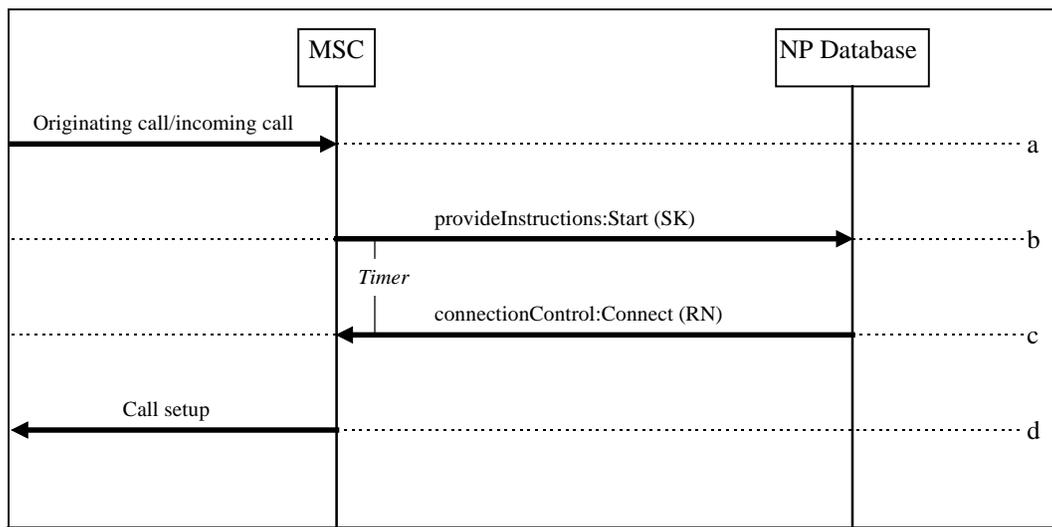


Figure 4 – NP Query - LRN returned

- a) Originating call or Incoming call with the called party number is received by the MSC. The called party number may correspond to either a wireline or a wireless subscriber;
- b) The MSC determines that the called party number lies within a portable NPA-NXX range, and sends a TCAP message `provideInstructions:Start` to the NP database. The Service Key parameter contains the 10-digit called party number;
- c) The NP database sends a connectionControl:Connect message back to the MSC. The Routing Number parameter contains a 10-digit LRN;
- d) The MSC routes the call using the LRN.

If the selected outgoing trunk group uses ISUP signaling, then, in addition to the existing ISUP optional parameters, the Initial Address Message (IAM) will be populated as follows:

- The CdPN parameter is populated with the LRN;
- The GAP is populated with the called party number and the Type of Address of the GAP is coded as “ported number”;
- The FCI parameter bit M is set to “number translated” to indicate to succeeding switches that a query to the NP database has been done.

If the selected outgoing trunk group uses MF signaling, then the LRN and FCI information is not outpulsed. Only the called party number is sent.

If the LRN is owned by the PLMN, then normal call setup procedures apply (refer to Figure 8 for details of the HLR query).

6.3.2.2 Call to a Nonported Number

This scenario describes call setup to a party whose directory number is not ported. The NP database returns the called party number to the requesting MSC.

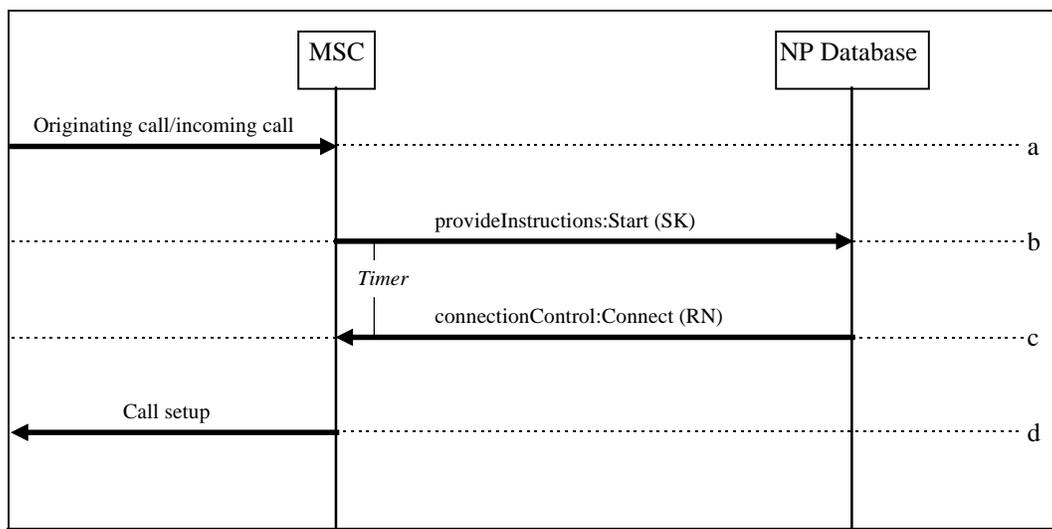


Figure 5 – NP Query - Dialed Digits Returned

- a) Originating call or Incoming call with the called party number is received by the MSC. The called party number may correspond to either a wireline or a wireless subscriber;
- b) The MSC determines that the called party number lies within a portable NPA-NXX range, and sends a TCAP message `provideInstructions:Start` to the NP database. The Service Key parameter contains the 10-digit called party number;

- c) The NP database sends a `connectionControl:Connect` back to MSC. The Routing Number parameter contains the called party number. This indicates that the called party number is not ported;
- d) The MSC routes the call using the called party number.

If the selected outgoing trunk group uses ISUP signaling, then, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN parameter is populated with the called party number, and
- The FCI parameter bit M is set to “number translated” to indicate to succeeding switches that a query to the NP database has been done.

If the selected outgoing trunk group uses MF signaling, then the FCI information is not outpulsed. Only the called party number is sent.

If the called party number is served by the PLMN, then normal call setup procedures apply.

6.3.2.3 Response other than `connectionControl:Connect`

This scenario describes call setup to a party whose directory number may have been ported and the NP database returns any response other than `connectionControl:Connect` (e.g., Return Error, Reject message, `callerInteraction:Play_Announcement`).

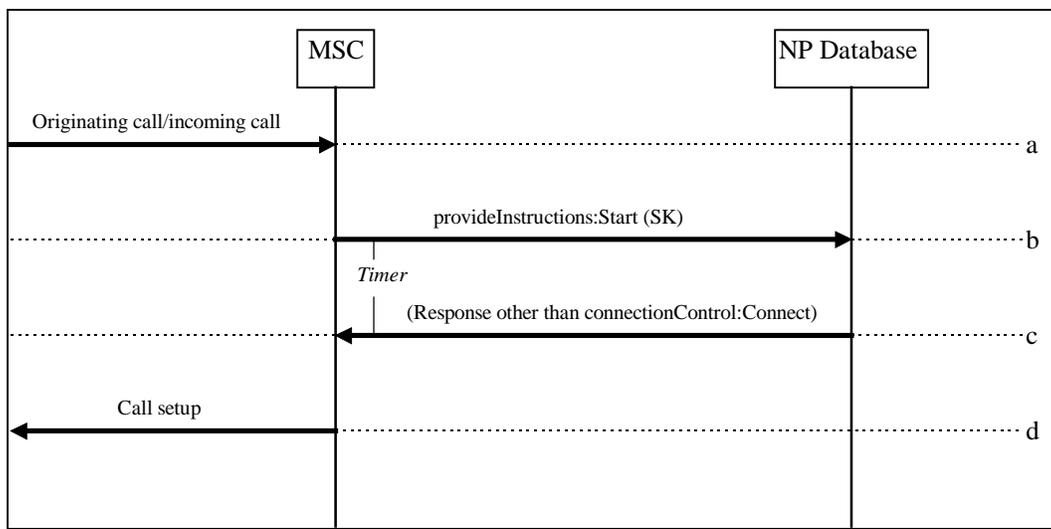


Figure 6 – NP database Query - Response other than `connectionControl:Connect`

- a) Originating call or Incoming call with the called party number is received by the MSC. The called party number may correspond to either a wireline or a wireless subscriber;
- b) The MSC determines that the called party number lies within a portable NPA-NXX range, and sends a TCAP message `provideInstructions:Start` to the NP database. The Service Key parameter contains the 10-digit called party number;
- c) A response other than `connectionControl:Connect` is sent back to MSC;
- d) The MSC routes the call using the called party number.

If the selected outgoing trunk group uses ISUP signaling, then, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN parameter is populated with the called party number, and
- The FCI parameter bit M is set to “number not translated” to indicate to succeeding switches that a query to the NP database has not been done.

If the selected outgoing trunk group uses MF signaling, then the FCI information is not outputted. Only the called party number is sent.

If the called party number is owned by the PLMN, then normal call setup procedures apply.

6.3.2.4 Time-out

This scenario describes call setup to a party whose directory number may have been ported. The response from the NP database is not received at the requesting MSC before the operation timer expires.

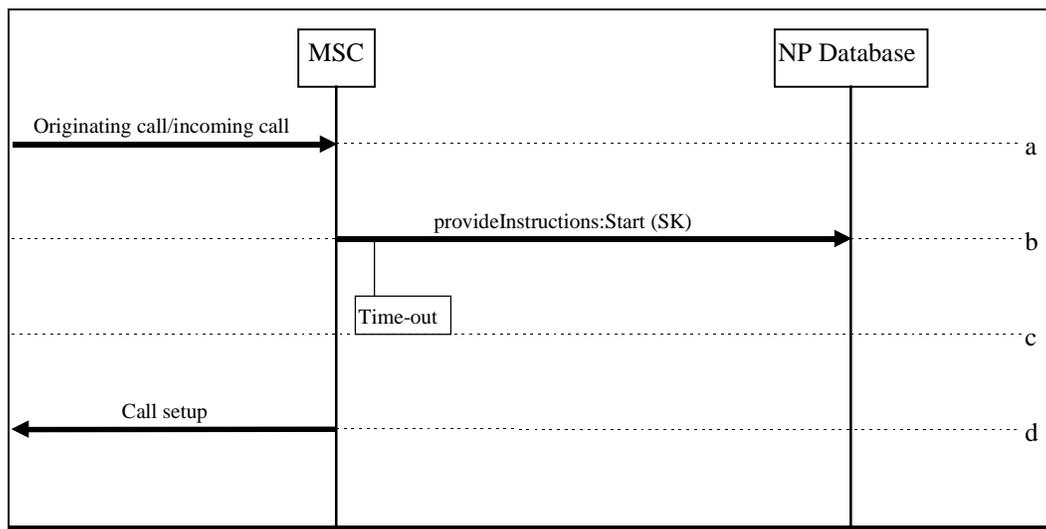


Figure 7 – NP database Query - Time-out

- Originating call or Incoming call with the called party number is received by the MSC. The called party number may correspond to either a wireline or a wireless subscriber;
- The MSC determines that the called party number lies within a portable NPA-NXX range, and sends a TCAP message `provideInstructions:Start` to the NP database. The Service Key parameter contains the 10-digit called party number;
- The Timer expires before a response from the NP database is received by the MSC;
- The MSC routes the call using the called party number.

If the selected outgoing trunk uses ISUP signaling, then, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN parameter is populated with the called party number, and
- The FCI parameter bit M is set to “number not translated” to indicate to succeeding switches that a query to the NP database has not been done.

If the selected outgoing trunk group uses MF signaling, then the FCI information is not outputted. Only the called party number is sent.

If the called party number is owned by the PLMN, then normal call setup procedures apply.

6.3.3 Call Scenarios for Incoming calls with NP database query previously performed

6.3.3.1 Incoming Call to a Ported Number belonging to a Serving MSC within the PLMN

This scenario (Figure 8) describes a call setup to a party whose directory number is ported to a Serving MSC within a PLMN, and NP database query has been done. In this case, the Serving MSC refers to the network or switch to which the subscriber has been ported.

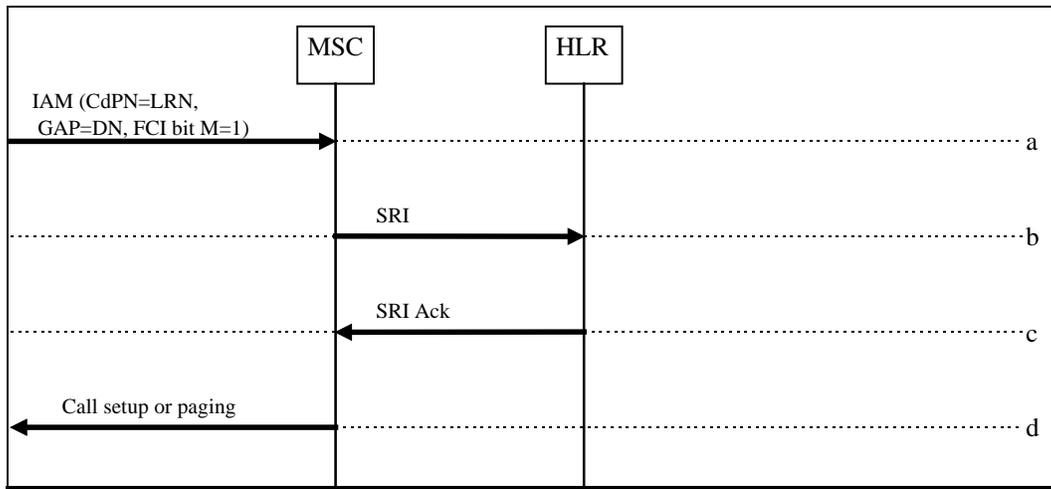


Figure 8 – Incoming Call to Ported Number at a PLMN serving MSC

- The MSC receives an IAM with the FCI bit M set to “number translated”, GAP equal to “ported number,” and CdPN equal to its own LRN;
- The MSC sends SRI to the HLR with the MSISDN populated with the “ported number” contained in the GAP. The SCCP global title may be populated with the LRN contained in the CdPN;
- The HLR returns SRI Ack with the routing number (e.g., MSRN);
- The MSC completes the call by applying normal procedures.

6.3.3.2 Incoming Call to a Ported Number not served within the PLMN

This scenario (Figure 9) describes a call setup to a party whose directory number may be ported but the number is not served within the PLMN, and NP database query has been done.

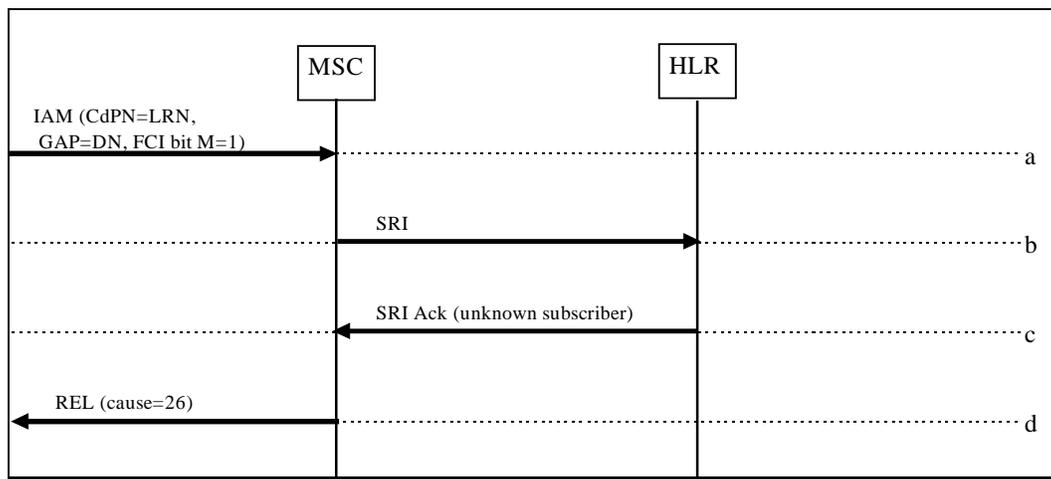


Figure 9 – Incoming Call to Ported Number not served within PLMN

- a) The MSC receives an IAM with the FCI bit M set to “number translated”, GAP equal to “ported number,” and CdPN equal to its own LRN;
- b) The MSC sends SRI to the HLR with the MSISDN populated with the “ported number” contained in the GAP. The SCCP global title may be populated with the LRN contained in the CdPN;
- c) The HLR returns SRI Ack with “unknown subscriber”;
- d) The MSC initiates a release of the call with ANSI cause value 26 “Misrouted call to a ported number.”

6.3.3.3 Incoming Call to a Nonported Number Assigned to the PLMN

This scenario (Figure 10) describes a call setup to a nonported directory number within a portable NPA-NXX assigned to the PLMN. In this case, a database query has been performed by a previous network, and the NP database has returned the original called party number.

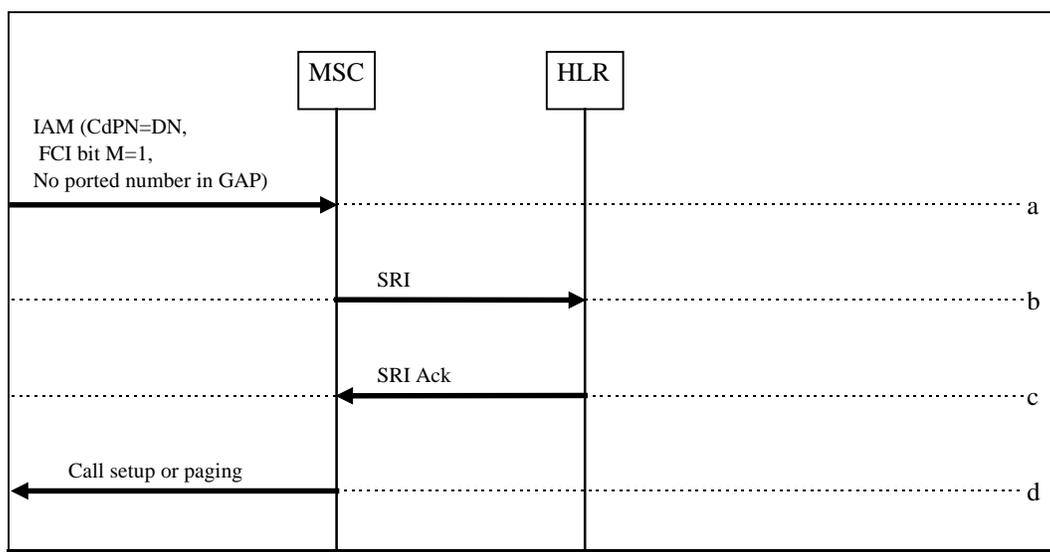


Figure 10 – Incoming Call to a Nonported Number Assigned to the PLMN

- a) The MSC receives an IAM with bit M set to “number translated” in the FCI, no ported number in GAP and CdPN equal to the called party number;
- b) The MSC sends SRI to the HLR with the MSISDN populated with the called party number contained in the CdPN. The SCCP global title may be populated with the same called party number;
- c) The HLR responds with an SRI Ack;
- d) The MSC completes the call by applying normal procedures.

7 Procedures

7.1 Call Processing

7.1.1 Originating Call

When an MSC determines that the called party number does not lie within a portable NPA-NXX range, normal call handling procedures will apply.

When an MSC determines that the called party number lies within a portable NPA-NXX range, the call may be progressed in one of two ways, as specified in 7.1.1.1 or 7.1.1.2.

7.1.1.1 Querying the NP database before interrogating the HLR

When an MSC determines that the called party number lies within a portable NPA-NXX range, it will send a TCAP message provideInstructions:Start to the NP database with the Service Key (SK) parameter populated with the 10-digit called party number and will start a timer (see Figure 3). Upon receiving a connectionControl:Connect message, the MSC will determine that the Routing Number (RN) parameter contains the LRN if the content of the RN is not the same as the called party number.

Depending on the outcome of the query, one of the following cases will arise:

Case 1: Called Party Number is a ported number

The NP database will send a connectionControl:Connect message back to the MSC with the 10-digit LRN populated in the RN (see Figure 4). If the LRN is owned by the PLMN, then the MSC will apply normal mobile terminating call procedures; otherwise, the MSC will use the LRN to route the call to the serving switch. The MSC may route the call using ISUP or MF signaling. If the call is routed using ISUP signaling, in addition to the existing ISUP optional parameters, the Initial Address Message (IAM) will be populated as follows:

- The Called Party Number (CdPN) parameter is populated with the LRN,
- The Generic Address Parameter (GAP) is populated with the called party number and the Type of Address of the GAP is coded as “ported number”, and
- The Forward Call Indicators (FCI) parameter bit M is set to “number translated” to indicate to succeeding switches that a query to the NP database has been done.

If the call is routed using MF signaling, the LRN and FCI information is not outpulsed. Only the called party number is sent.

Case 2: Called Party Number is not a ported number

The NP database will send a connectionControl:Connect back to the MSC with the 10-digit called party number populated in the RN (see Figure 5). If the called party number is owned by the PLMN, then the MSC will apply normal mobile terminating call procedures; otherwise, the MSC will route the call using the called party number. The MSC may route the call using ISUP or MF signaling. If the call is routed using ISUP signaling, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN parameter is populated with the called party number, and
- The FCI parameter bit M is set to “number translated” to indicate to succeeding switches that a query to the NP database has been done.

If the call is routed using MF signaling, the FCI information is not outpulsed. Only the called party number is sent.

Case 3: Exceptions

If the NP database sends a response other than connectionControl:Connect (see Figure 6), or the MSC timer expires before a response is received (see Figure 7), the call is routed using the called party number. If the called party number is owned by the PLMN, then the MSC will apply normal mobile terminating call procedures as specified in ANSI J-STD-023. If the called party number is not owned by the PLMN, the MSC may optionally interrogate the HLR to determine if the called party number has been ported into the PLMN. If the HLR is interrogated and the number is not found, or if the HLR is not interrogated, the call is routed using the called party number. If the HLR is interrogated and the number is found, normal call procedures are used to complete the call. This avoids “hairpinning” the call through the donor network. If the call is routed using ISUP signaling, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN parameter is populated with the called party number, and
- The FCI parameter bit M is set to “number not translated” to indicate to succeeding switches that a query to the NP database has not been done.

If the call is routed using MF signaling, only the called party number is outpulsed.

7.1.1.2 Interrogating the HLR before querying NP database

The MSC sends SRI to the HLR (see Figure 2). If the MSC receives an SRI Ack with “unknown subscriber” and the called party number lies within a portable NPA-NXX range, the MSC will send TCAP message provideInstructions:Start to the NP database with the Service Key parameter populated with the 10-digit called party number and will start a timer.

If the HLR does not respond, and the called party number lies within a portable NPA-NXX range, then the MSC may optionally behave as if the HLR had returned an “unknown subscriber” and query the NP database rather than release the call.

Depending on the outcome of the query, one of the following cases will arise:

Case 1: Called Party Number is a ported number

The NP database will send a connectionControl:Connect message back to the MSC with the 10-digit LRN populated in the RN (see Figure 4). If the LRN is owned by the PLMN, then the MSC will release the call using normal call release procedures; otherwise, the MSC will use the LRN to route the call to the serving switch. The MSC may route the call using ISUP or MF signaling. If the call is routed using ISUP signaling, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN parameter is populated with the LRN,
- The GAP is populated with the called party number, and
- The FCI parameter bit M is set to “number translated” to indicate to succeeding switches that a query to the NP database has been done.

If the call is routed using MF signaling, the LRN and FCI information is not outpulsed. Only the called party number is sent.

Case 2: Called Party Number is not a ported number

The NP database will send a connectionControl:Connect back to the MSC with the 10-digit called party number populated in the Routing Number parameter (see Figure 5). If the called party number is owned by the PLMN, then the MSC will release the call using normal release procedures, as described in ANSI J-STD-023; otherwise, the MSC will route the call using the called party number. The MSC may route the call using ISUP or MF signaling. If the call is routed using ISUP signaling, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN is populated with the called party number, and
- The FCI parameter bit M is set to “number translated” to indicate to succeeding switches that a query to the NP database has been done.

If the call is routed using MF signaling, the FCI information is not outpulsed. Only the called party number is sent.

Case 3: Exceptions

If the NP database sends a response other than connectionControl:Connect (see Figure 6), or the MSC timer expires before a response is received (see Figure 7), and the called party number is not owned by the PLMN, the call is routed using the called party number. If the called party number is owned by the PLMN, then the MSC will apply normal call release procedures. If the call is routed using ISUP signaling, in addition to the existing ISUP optional parameters, the IAM will be populated as follows:

- The CdPN is populated with the called party number, and

- The FCI parameter bit M is set to “number not translated” to indicate to succeeding switches that a query to the NP database has not been done.

If the call is routed using MF signaling, only the called party number is outpulsed.

7.1.2 Incoming Call

7.1.2.1 No prior NP database query done

If the incoming trunk is MF or the FCI parameter bit M is set to “number not translated,” the incoming call to the MSC is handled in the same way as in 7.1.1 and associated subclauses.

7.1.2.2 Prior NP database query done

If the FCI parameter bit M is set to “number translated”, and the GAP is included in the incoming ISUP message, the MSC will determine if the LRN in the CdPN belongs to it. If it does, the MSC will complete the call by sending SRI to the HLR with the MSISDN populated with the called party number contained in the GAP. The SCCP global title may be populated with the LRN contained in the CdPN. If the HLR returns successful SRI ACK (see Figure 8), the MSC will complete the call to the ported number using normal call procedures. If the HLR returns SRI ACK with “unknown subscriber” (see Figure 9), the MSC will release the call with ANSI cause value 26 “Misrouted call to a ported number”. If the MSC determines that the LRN in the CdPN does not belong to it (tandem case), it will route the call using the LRN to the serving switch without modifying the GAP and FCI parameters.

The MSC will complete the call normally using the called party number if the incoming ISUP message (see Figure 10) has the FCI parameter bit M set to “number translated” and the GAP is not included or the GAP does not include the ported DN.

7.1.3 Call Delivery and Handover

For call delivery at an MSC following interrogation of the HLR and receipt of a NANP Mobile Subscriber Roaming Number (MSRN), the CdPN in the ISUP IAM is populated with the MSRN and, as an option, the FCI bit “M” is set to “number translated”. Setting the FCI bit “M” avoids unnecessary NP database queries when the MSRN lies within a portable NPA-NXX range.

For inter-MSC handover from an anchor MSC following receipt of a handover number (HON) from the serving MSC, the CdPN in the ISUP IAM is populated with the HON and, as an option, the FCI bit “M” is set to “number translated”. Setting the FCI bit “M” avoids unnecessary NP database queries when the HON lies within a portable NPA-NXX range.

7.1.4 Receipt of ANSI cause value 26

When an MSC receives an ANSI cause value 26 it will follow the procedures specified in 7.3.1 of ANSI T1.660.

7.2 NP Database Interaction

7.2.1 LRN NP database Query

The MSC initiates NP database query with the TCAP message provideInstructions:Start. The translation type for the global title in the SCCP called party address of the NP database Query is as defined in ANSI T1.112.

Network-specific SSNs will be used to identify the querying application and the queried application (NP database).

The global title address will contain the 10-digit called party number.

The reader should refer to 8.2, “TCAP Signaling”, for the Message set B formats and parameters coding and procedure information.

7.2.2 LRN NP database Response

Any response other than connectionControl:Connect message will lead to exception handling as specified in 7.3). If the number is ported, the RN will contain the LRN; otherwise, the RN will contain the called party number that was sent in the query message.

7.3 Exceptions

Automatic Code Gapping (ACG) procedure is an optional procedure and its impact on number portability is for further study.

For all the exceptional conditions listed below, the MSC will route the call using the called party number as specified in 7.1.1.1, Case 3 and 7.1.1.2, Case 3.

- Unable to launch a NP database query (e.g., congestion);
- NP database rejects the query;
- NP database does not respond within a predefined time;
- NP database returns the result message connectionControl:Connect with “type of digits” not equal to “routing number”;
- The returned “routing number” is not 10 digits;
- NP database returns a response message other than connectionControl:Connect.

8 SS7 Signaling and Protocols

The NP processing in the MSC may be encountered from an originating mobile subscriber or originating trunk (e.g., MF, ISUP). The signaling from the originating terminal, including non-NP, capable MSCs, is not modified by this feature.

From a signaling perspective, the mobile subscriber or trunk-originated signaling is the same for a call to a ported number as for a call to a nonported number.

8.1 ISUP

For NP-related modifications to ISUP signaling, see ANSI T1.660.

8.2 TCAP Signaling

8.2.1 NP database Query Message

Table 1 shows the parameters of the provideInstruction:Start message that are relevant to PCS 1900 service provider number portability.

Table 1 – Provide Instruction Message Parameters

Parameter	Type	Number of Octets	Contents
Package Type Identifier	M	1	Query with Permission
Component Type Identifier	M	1	Invoke (last)
Operation Code Identifier	M	1	National TCAP
Operation Code	M	2	provideInstruction:Start (reply required)
Service Key	M	11*	10-digit called party number digits
Digits (calling party number)	M ¹	6-9	3, 6, or 10 ANI digits
Digits (LATA)	M ¹	6	LATA ID
Originating Station Type	M ¹	1	Binary value of ANI II digits
Note:	M = Mandatory Parameters * = Value specific for number portability ¹ = This mandatory parameter is required for the message, but the content is not essential for number portability. No procedures are specified for this parameter in this specification.		

Table 2 shows the complete TCAP message structure for the NP database query.

Table 2 – Complete TCAP Message Structure for the NP Database Query

Parameter	Type	Number of Octets	Encoding ¹⁾
Package Type Identifier = Query with permission	M	1	T1.114.3
Total TCAP Message length	M	1	T1.114.3
Transaction ID Identifier	M	1	T1.114.3
Transaction ID Length	M	1	T1.114.3
Originating Transaction ID	M	4	T1.114.3
Component Sequence Identifier	M	1	T1.114.3
Component Sequence Length	M	1	T1.114.3
Component Type Identifier = Invoke(last)	M	1	T1.114.3
Component Length	M	1	T1.114.3
Component ID Identifier	M	1	T1.114.3
Component ID Length	M	1	T1.114.3
Component ID = Invoke ID	M	1	T1.114.3
Operation Code Identifier = National TCAP	M	1	T1.114.3
Operation Code Length	M	1	T1.114.3
Operation Code = ProvideInstruction:Start (reply required)	M	2	T1.114.5
Parameter Set Identifier	M	1	T1.114.3
Parameter Set Length	M	1	T1.114.3
Service Key Identifier	M	1	T1.114.5
Service Key Length	M	1	T1.114.5
Digits Identifier	M	1	T1.114.5
Digits Length	M	1	T1.114.5
Digits: Type of digits = Called party number (dialed), Nature of Number = National, No Presentation Restriction, Numbering Plan = E.164, Encoding Scheme = Binary Coded Decimal, Number of digits = ten, Digits = Actual ten digits of the called party number.	M	9	T1.114.5
Digits Identifier	M	1	T1.114.5
Digits Length	M	1	T1.114.5
Digits: Type of digits = Calling party number, Nature of Number = National, No Presentation Restriction, Numbering Plan = E.164, Encoding Scheme = Binary Coded Decimal, Number of digits = three, six, or ten, Digits = Actual three, six, or ten ANI digits.	M	6, 7, 9	T1.114.5
Digits Identifier	M	1	T1.114.5
Digits Length	M	1	T1.114.5

(continued)

Table 2 – Complete TCAP Message Structure for the NP Database Query (concluded)

Parameter	Type	Number of Octets	Encoding ¹⁾
Digits: Type of digits = Local Access and Transport Area (LATA), Nature of Number = National, No Presentation Restriction, Numbering Plan = Unknown or Not Applicable, Encoding Scheme = Binary Coded Decimal, Number of digits = three, Digits = Actual three LATA digits.	M	6	T1.114.5
Originating Station Type Identifier Private TCAP Originating Station Type Identifier	M	2	11011111 01000101
Originating Station Type Length	M	1	00000001
Originating Station Type	M	1	N/A
¹⁾ Where T1.114.x is indicated, refer to the appropriate sections in ANSI T1.114. N/A indicates not applicable. The other values are shown in absolute binary. Note – The ordering of the parameters within the parameter set is not relevant, except the digits identifier for the called party number must follow the service key identifier.			

8.2.2 NP Database Response Message

Table 3 shows the parameters of the connectionControl:Connect message that are relevant to PCS 1900 service provider number portability.

Table 3 – Connection Control Message Parameters

Parameter	Type	Number of Octets	Contents
Package Type Identifier	M	1	Response
Component Type Identifier	M	1	Invoke (last)
Operation Code Identifier	M	1	National TCAP
Operation Code	M	2	connectionControl:Connect (no reply required)
Digits (Carrier)	M ¹	6	3- or 4-digit CIC
Digits (Routing Number)	M	9*	10-digit LRN or Dialed Number
Billing Indicators	M ¹	4	Unspecified
Note: M = Mandatory Parameters * = Value specific for number portability ¹ = This mandatory parameter is required for the message, but the content is not essential for number portability. No procedures are specified for this parameter in this specification.			

Table 4 shows the complete TCAP message structure for the NP database query.

Table 4 – Complete TCAP Message Structure for NP Database Response

Parameter	Type	Number of Octets	Encoding ¹⁾
Package Type Identifier = Response	M	1	T1.114.3
Total TCAP Message length	M	1	T1.114.3
Transaction ID Identifier	M	1	T1.114.3
Transaction ID Length	M	1	T1.114.3
Responding Transaction ID	M	4	T1.114.3
Component Sequence Identifier	M	1	T1.114.3
Component Sequence Length	M	1	T1.114.3
Component Type Identifier = Invoke(last)	M	1	T1.114.3
Component Length	M	1	T1.114.3
Component ID Identifier	M	1	T1.114.3
Component ID Length	M	1	T1.114.3
Component ID = Invoke ID, Correlation ID	M	2	T1.114.3
Operation Code Identifier = National TCAP	M	1	T1.114.3
Operation Code Length	M	1	T1.114.3
Operation Code = Connection:Control:Connect (no reply required)	M	2	T1.114.5
Parameter Set Identifier	M	1	T1.114.3
Parameter Set Length	M	1	T1.114.3
Digits Identifier	M	1	T1.114.5
Digits Length	M	1	T1.114.5
Digits: Type of digits = Carrier, Nature of Number = National, No Presentation Restriction, Numbering Plan = Unknown or Not Applicable, Encoding Scheme = Binary Coded Decimal, Number of digits = three or four, Digits = Actual three or four digits identifying the carrier.	M	6	T1.114.5
Digits Identifier	M	1	T1.114.5
Digits Length	M	1	T1.114.5
Digits: Type of digits = Routing Number, Nature of Number = National, No Presentation Restriction, Numbering Plan = E.164, Encoding Scheme = Binary Coded Decimal, Number of digits = ten, Digits = Actual ten routing digits.	M	9	T1.114.5
Billing Indicators Identifier Private TCAP Billing Indicators Identifier	M	2	11011111 01000001
Billing Indicators Length	M	1	00000100
Billing Indicators	M	4	N/A
¹⁾ Where T1.114.x is indicated, refer to the appropriate sections in ANSI T1.114. N/A indicates not applicable. The other values are shown in absolute binary. Note – The ordering of the parameters within the parameter set is not relevant.			

8.3 MAP Signaling

8.3.1 Use of SCCP

When sending the SRI message to the HLR, the PLMN may use the LRN or the MSISDN as the global title in the SCCP called party address. In either case, the translation type remains as defined in ANSI T1.112.

8.3.2 MAP Message and Parameters

All MAP messages and parameters are as defined in ANSI J-STD-023.