INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Series Q

Supplement 4
(05/98)

SERIES Q: SWITCHING AND SIGNALLING

Number portability – Capability set 1 requirements for service provider portability (All call querry and Onward routing)

ITU-T Q-series Recommendations – Supplement 4

(Previously CCITT Recommendations)

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SUPPLEMENT 4 TO ITU-T Q-SERIES RECOMMENDATIONS

NUMBER PORTABILITY – CAPABILITY SET 1 REQUIREMENTS FOR SERVICE PROVIDER PORTABILITY (ALL CALL QUERRY AND ONWARD ROUTING)

Summary

This Supplement describes the additions required to support Service Provider Portability in a Signalling System Number No. 7 network for Number Portability Capability Set 1 (NPCS-1).

The Portability Number Call Control for Service Provider Portability (PNCC-SPP) in a Signalling System Number No. 7 network provides the core function to support portability for geographic numbers using the "onward routing" and "all call query" methods.

Source

Supplement 4 to ITU-T Q-series Recommendations was prepared by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 5 procedure on the 15th of May 1998.

FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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NUMBER PORTABILITY – CAPABILITY SET 1 REQUIREMENTS FOR SERVICE PROVIDER PORTABILITY (ALL CALL QUERRY AND ONWARD ROUTING)

(Geneva, 1998)

1 Scope

This Supplement describes the additions required to support Service Provider Portability in a Signalling System Number No. 7 network for Number Portability Capability Set 1 (NPCS-1). The definition for Service Provider Portability is defined in reference [1].

The Portability Number Call Control for Service Provider Portability (PNCC-SPP) in a Signalling System Number No. 7 network provides the core function to support portability for geographic numbers using the "onward routing" and "all call query" methods.

The signalling requirements for the support of NPCS-1 PNCC-SPP are contained in this supplement.

Annex A contains the additional requirements for the support of PNCC-SPP when Intelligent Network (IN) is involved.

2 References

[1] Supplement 3 to Q-series Recommendations, *Number portability – Scope and capability set 1 architecture*.

3 Terms and definitions

For a complete set of definitions and terms, see reference [1]. Any additional definitions and terms specific to this Supplement will be provided in this clause.

4 Abbreviations

For a complete set of abbreviations, see reference [1]. Any additional abbreviations specific to this Supplement are provided below:

CC	Country Code
FE	Functional Entity
ISC	International Switching Centre
ISDN	Integrated Services Digital Network
NDC	National Destination Code
NNA	National Numbering Activity Authority
PBX	Private Branch Exchange
PNCC-SPP	Portable Number Call Control – Service Provider Portability
POTS	Plain Old Telephone Service
ROA	Recognized Operating Agency

SDL Specification and Description Language

TCAP Transaction Capability Application Part

5 General

The PNCC-SPP network capability delivers the following information to each exchange in the call path, once routing information has been obtained:

1) the original dialled number;

2) the necessary routing information;

3) an indication that NP routing information has been obtained.

In addition, for calls originating from a ported numbers, PNCC-SPP delivers the portable number as the calling party number and location-related information about the calling party.

The capabilities of the PNCC-SPP build upon the existing SS7 capabilities. Backward compatibility is an important requirement. Only the new capabilities, not covered by existing ITU-T Recommendations, required for PNCC-SPP are described here.

Number portability affects any service that makes an assumption that an E.164 directory 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 (e.g. numbering plan).

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

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

a) database architecture;

b) exchange internal call processing;

c) network operations and administration.

These network capabilities and interfaces are outside the scope of PNCC-SPP.

The functions described in this Supplement support number portability within the national domain and therefore should not be invoked for outgoing international calls.

5.1 Purpose

Number Portability (NP) allows end users of public switched networks to retain their E.164 telephone numbers when they change their service provider (service provider portability), location within a specific geographical area (location portability), or network service (service portability).

Table 1 below shows the supported combinations between E.164 numbers and the types of number portability.

Table 1 – Scope of the Number Portability Service

E.164	Type					
	Location Portability		Service Portability		Service Provider Portability	
	Int'l	National	Int'l	National	Int'l	National
1) Country Code for geographic area						
a) NDC beginning with area code	Case 1	Case 2 (Note)	Case 3	Case 4	Case 5	**Case 6** (Note)
b) NDC beginning with service access code	Case 7	Case 8	Case 9	Case 10	Case 11	Case 12 (Note)
c) NDC beginning with destination network code	Case 13	Case 14	Case 15	Case 16	Case 17	Case 18
2) Country Code for global services	Case 19	Case 20	Case 21	Case 22	Case 23	Case 24
3) Country Code for Networks	Case 25	Case 26	Case 27	Case 28	Case 29	Case 30
NOTE – Case 6 is the focus of this Supplement. Some aspects of Cases 2 and 12 are also supported. Cases where portability is not possible or not supported by this Supplement are shaded in this Table.						

Examples:

1a) +81 3 XXXX XXXX (POTS/ISDN in Japan: "3" is area code of Tokyo);

1b) +81 120 XXXX XXXX (International Direct Dialling of Japan Domestic Freephone Number: "120" is service access code);

1c) +81 50XX XXXXX (Personal Handyphone System in Japan: 50XX is DN for Personal Handyphone System provider);

2) +800 XXXXXXXX (Universal International Freephone Number);

3) +881 X XX....X (Global Mobile Satellite System).

- The number beginning with "Country Code for geographic area" [1) in Table 1] is the number that ITU assigns to each country (or countries in an integrated numbering plan). The National Numbering Activity Authority (NNA) administers the number following the CC.
- The number beginning with the "Country Code for global service" [2) in Table 1] is the number that ITU assigns the global service.
- The number beginning with "Country Code for Networks" [3) in Table 1] is the number that ITU assigns the two or more international Networks (typically ROAs). The following digits identify each international Network.

5.2 Application

PNCC-SPP is to support the implementation of Service Provider Number Portability in the competitive local service environment.

6 Description

This clause provides general descriptions of the new SS7 capability for the support of service provider number portability call control. The NP methods for this capability set are the "onward routing" method and the "all call query method". These methods are described in the Number Portability – Scope and Capability Set 1 Architecture (see reference [1]). This capability may be used within a single network or across network-interconnect interfaces.

PNCC-SPP is a core NP capability which determines that the called number is portable, ascertains the routing information to route the call towards the recipient network/exchange, and incorporates additional information into the call request to enable the recipient network/exchange to connect the call to the called end user. For calls originating from a ported number, PNCC-SPP delivers the portable number as the calling party number and location related information about the calling party.

6.1 Overview of number portability SS7 capabilities

Geographic numbers encode an identifier of the exchange that is serving the end user, this is contained in the numbering plan. Number Portability (NP) permits an end user to move their E.164 number while retaining their same number from one exchange in a network to another exchange in the same or a different network. Networks will therefore require additional capabilities to determine the recipient network or recipient exchange for a 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.

6.1.1 Inter-exchange Portable Number Call Control (PNCC-SPP)

The PNCC-SPP capability:

– Step 1: determines whether or not the number dialled by the calling user is portable.

– Step 2: obtains routing information for the initiating exchange to route the call towards the recipient network.

– Step 3: routes the call to the recipient exchange and completes call set-up to the portable end user.

6.1.2 Configuration models

The following three configuration models depict the more typical PNCC-SPP network scenarios. Other network scenarios are possible (see reference [1] for more information). The first configuration (Figure 1) shows separate originating and initiating networks/exchanges while the second figure (Figure 2) depicts a scenario in which the originating and initiating networks/exchanges are the same. The third scenario (Figure 3) shows a network scenario in which the donor and initiating networks/exchanges are the same.

Also, although not shown explicitly in these figures, there may be one or more Transit networks/exchanges between any of the originating, initiating, donor, and recipient networks/exchanges. The NP database may be internal to the initiating exchange or may be located at another node in the network[1]. In each of these configurations, the exchanges may be in different networks but in the same country.

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[1] When a call spans interconnecting networks, the configuration applicable for the call depends on bilateral agreements between the concerned networks.

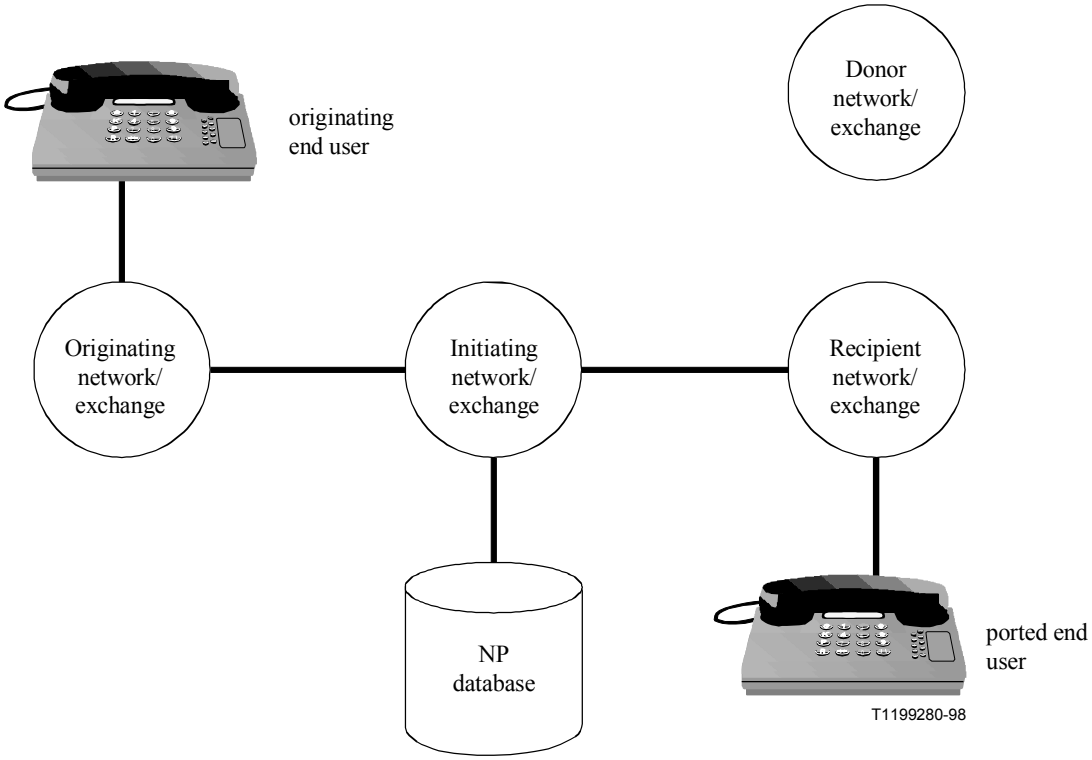


Figure 1 – PNCC-SPP configuration – Separate originating, initiating, donor networks/exchanges

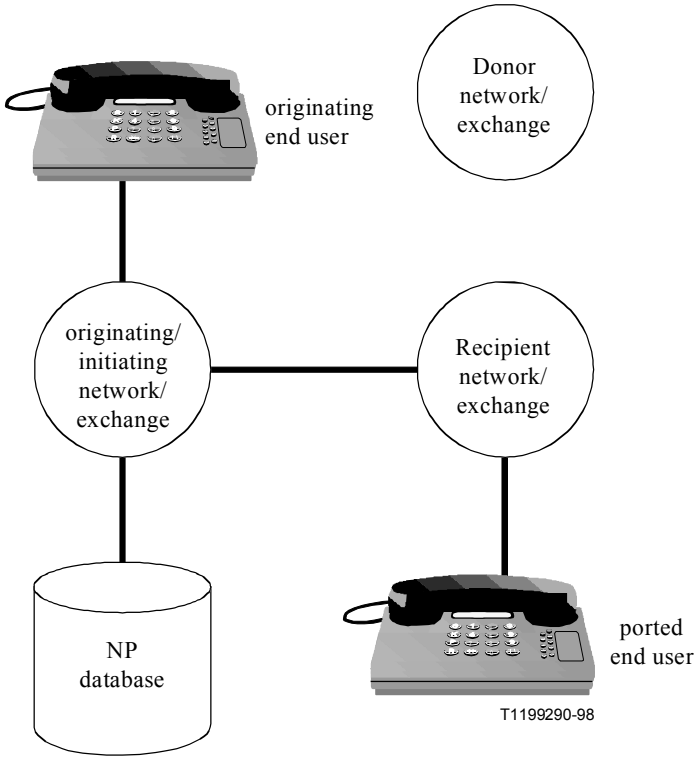


Figure 2 – PNCC-SPP configuration – Identical originating and initiating networks/exchanges

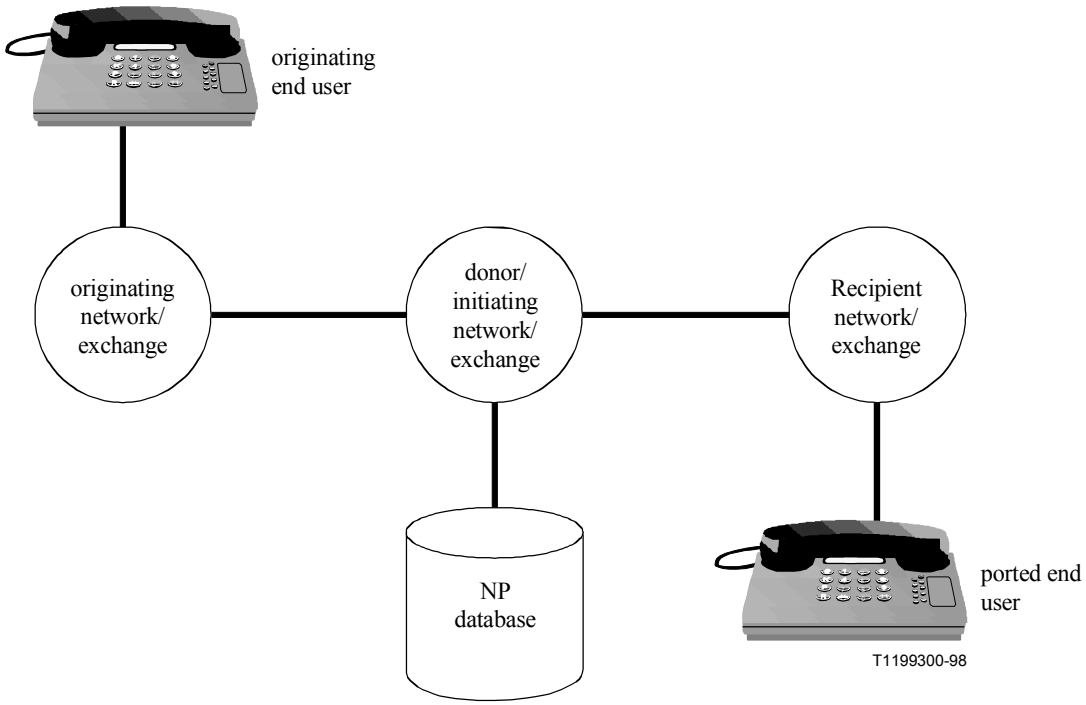


Figure 3 – PNCC-SPP configuration – Identical donor and initiating networks/exchanges

6.2 Procedures

6.2.1 Normal procedures

6.2.1.1 Portable Number Call Control for Service Provider Portability

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

When it is determined that the called number is portable, the initiating network/exchange determines whether the number is ported then uses the called end user's portable public number to obtain a Routing Number (RN). In addition, the initiating network/exchange may send an indication in the forward call set-up information that the NP database query of the portable number has been done. The RN is used by the initiating network/exchange and any Transit networks/exchanges to route the call.

As a minimum requirement, the address used as RN identifies either the recipient exchange or the recipient network serving the ported number. See reference [1] for information related to routing and addressing.

When the routing on RN of a call to a ported number applies, both the RN and the end user's number shall be transferred along with the call to accomplish a two-level addressing scheme. Transfer of the RN shall provide for backward compatibility in routing. The end user's number shall be conveyed transparently. Sending of the RN and optionally NP status indication between networks is optional and subject to bilateral agreements.

The recipient exchange uses the RN, NP status indication (optional), and the user's portable public number to route the call to the end user.

Specific actions shall be applied in the SS7 signalling in order to cope with the potential looping problem of calls to ported numbers.

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

The PNCC-SPP 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 incoming International Switching Centre (ISC) may provide the functions of the initiating exchange.

6.2.2 Exceptional procedures

PNCC-SPP requires call routing information in order to direct calls to portable numbers to the exchange serving the called end user. When an exchange normally serving as a PNCC-SPP initiating exchange is unable to obtain this routing information, its procedure depends on whether or not the exchange is the donor exchange for the call.

1) If the exchange is not the donor exchange for the call, it should route the call using normal procedures. As an option, the NP status indication may be sent indicating that the status of the portable number was not determined.
2) If the exchange is the donor exchange, it should always be able to determine if the called user's number is still located at this exchange or is not being served by this exchange.
   a) If the exchange still serves the called user, the call shall be completed.
   b) If the called user's number is not being served by this exchange, the call cannot be completed without the routing information. The call shall be released or connected to an appropriate tone or announcement.

6.2.3 Interworking considerations

PNCC-SPP uses the existing ISUP call set-up procedures and circuit selection procedures. PNCC-SPP assumes the use of ISUP between the initiating exchange and the recipient exchange to carry additional information, i.e. NP status indication (optional) and ported number.

In some interworking scenarios, the interworking exchange continues in-band call set-up using the end user's number. In this case, PNCC-SPP functions end at the interworking exchange.

6.2.4 Interactions with supplementary services

None of the supplementary services defined by ITU-T are affected by the PNCC-SPP network capability. The end user's number is unaffected by this network capability. Supplementary services relying on the end user's 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.

Since the calling party number of the subscriber is retained for both ported and non-ported numbers, the services are preserved through the following:

1) The calling party number of a ported calling party shall identify the end user's number (i.e. the ported number).
2) The Calling Line Identification Presentation (CLIP) supplementary service and Connected Line Identification Presentation (COLP) supplementary service shall work in the same way as for subscribers that are not ported.

3) The carrier selection functions of the originating end user are not influenced by Number Portability.

4) Calls to emergency services, courier services, taxis, and other services using a nationwide called party number shall work in the same way as for subscribers that are not ported.

In addition, additional information associated with the ported calling party will need to be transported. This information may include:

- Geographic location of the calling subscriber.
- Unique Identifier of the network point (at least exchange ID) of the calling subscriber.

6.2.5 SDL

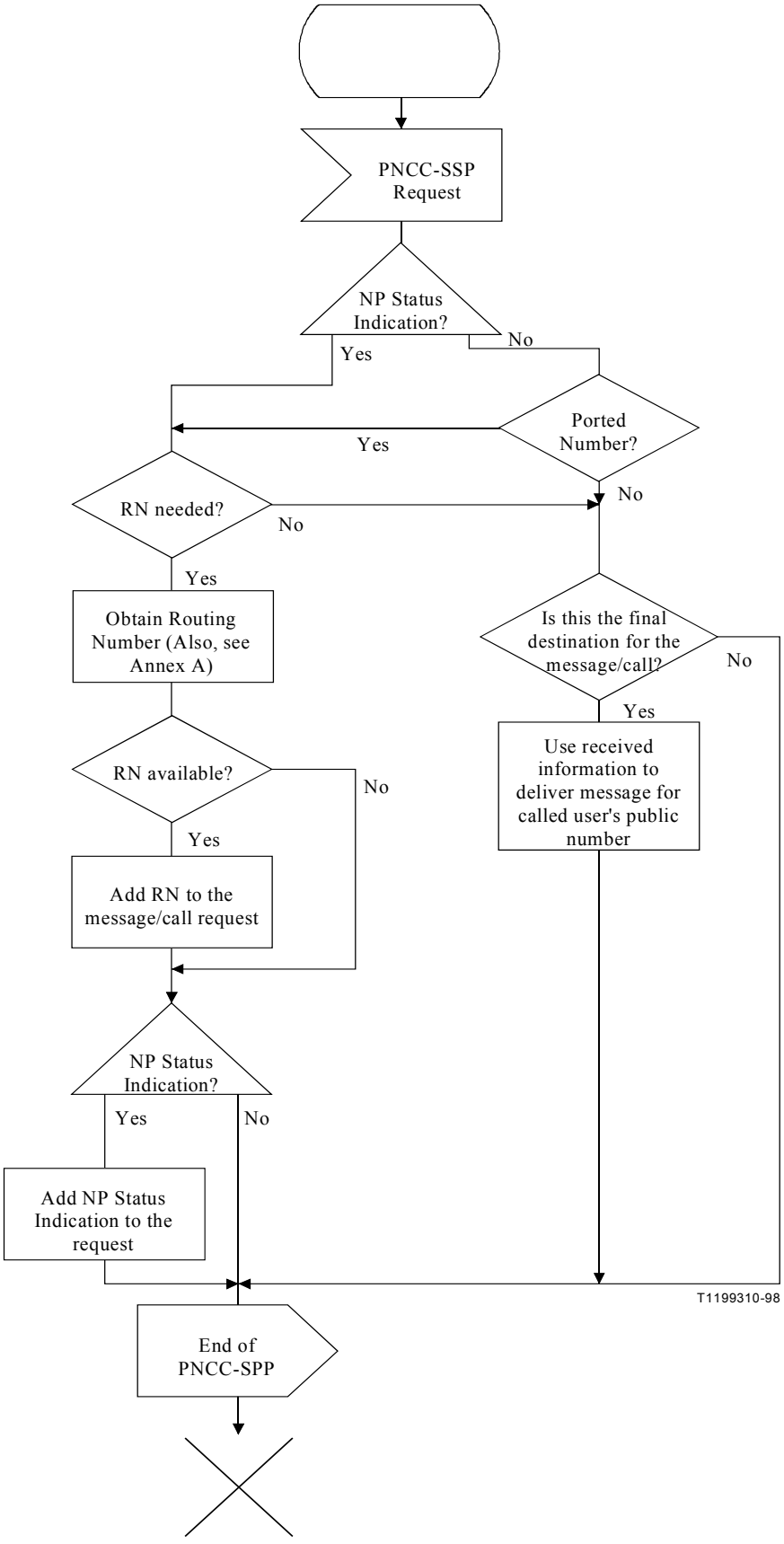


Figure 4 – PNCC-SPP procedures

7 Functional capabilities and information flows

7.1 Functional entity model

A Functional Entity (FE) is a group of functions that cannot be split across multiple exchanges. Multiple functional entities can be implemented in a single exchange. Figure 5 shows the functional entity model for PNCC-SPP.

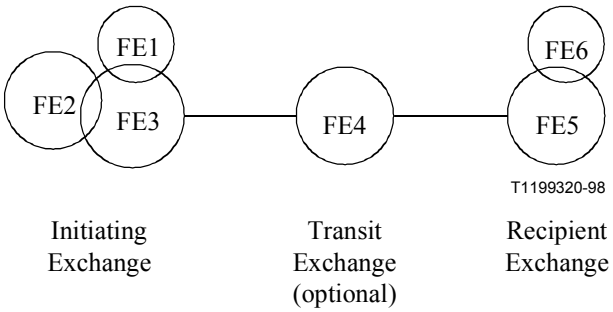


Figure 5 – FE model for PNCC-SPP

Below is a list of the functional entities:

– FE1: portable number detection functional entity.

– FE2: portable number query functional entity.

– FE3, FE4, and FE5: basic call functional entities.

– FE6: recipient exchange functional entity.

7.1.1 Description of portable number detection functional entity (FE1)

The portable number detection functional entity (FE1) determines whether the call set-up 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 toward the recipient exchange. Otherwise, this functional entity shall return the call to FE3 for further call processing.

7.1.2 Description of portable number query functional entity (FE2)

The portable number query functional entity (FE2) obtains the routing information based on the end user's number to route a call toward the recipient exchange. This information is used by FE3 to route toward the recipient exchange.

NOTE – FE2 may require internodal communication. Therefore, it may be necessary to distribute functionality equivalent to FE2 across multiple functional entities. Annex A (subclauses A.2.4.1 and A.2.4.2) provides a functional entity model when Intelligent Network functions are invoked to obtain the routing information. This Annex expands FE2 to include additional IN functional entities in the context of the other functional entities.

7.1.3 Description of FE3, FE4, and FE5

FE3, FE4, and FE5 represent the basic call functional entities. On instruction from FE2, FE3 modifies the call set-up information to include the routing information to access the recipient exchange, the called number, and as an option, the NP status indication.

7.1.4 Description of recipient exchange functional entity (FE6)

The recipient exchange functional entity (FE6) recognizes that the call can be completed at this exchange. FE6 will use the call set-up information to complete the call to the portable number.

7.2 Information flow model

Figure 6 shows the information flow model between the functional entities for PNCC-SPP. The initiating exchange will use the routing information to route the call through the network or networks to the recipient exchange. In addition, the initiating exchange will send the end user's ported public number along with the call set-up information. The recipient exchange will identify itself as the recipient exchange and use the call set-up information to connect to the correct end user.

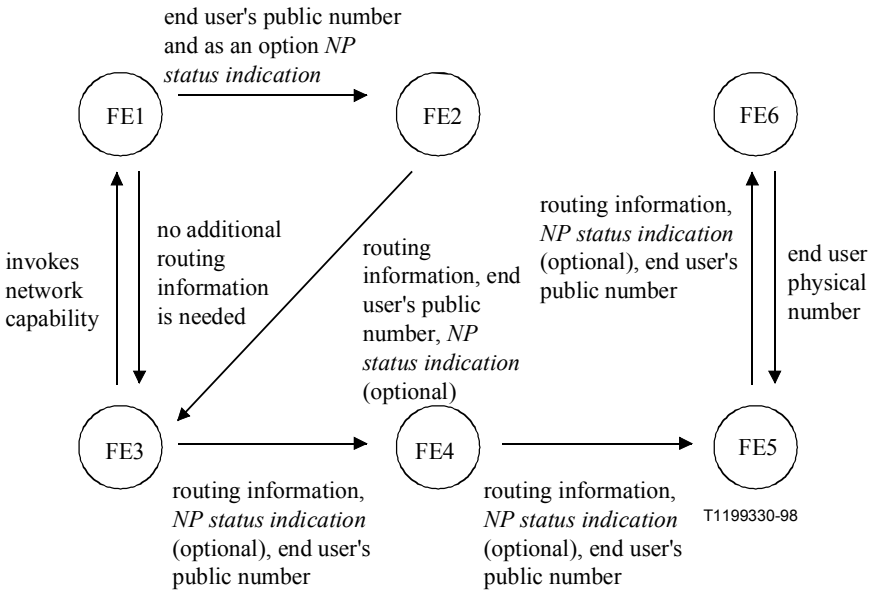


Figure 6 – Information flow diagram

7.2.1 Invoking the portable number detection functional entity (FE1)

FE3 invokes FE1 as part of basic call processing.

7.2.2 Invoking the portable number query functional entity (FE2)

At the initiating exchange, on detection of a portable number, FE1 invokes FE2. FE2 can invoke additional functional entities in order to obtain the routing information. Annex A (subclauses A.2.4.1 and A.2.4.2) provides a functional entity model when Intelligent Network functions are invoked to obtain the routing number.

7.2.3 Invoking the recipient exchange functional entity (FE6)

FE5 invokes FE6 on receipt of PNCC-SPP information in an incoming call.

7.2.4 Activation and deactivation of PNCC-SPP network capability

Activation and deactivation of PNCC-SPP is done on a per exchange or per network basis.

7.2.5 Exceptional procedures

If FE2 cannot 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 exchange is the donor exchange for the called number, then the call cannot be routed to any other exchange and shall be released after appropriate treatment (tone or announcement).

2) At any exchange other than the donor exchange, the call should be routed on toward the donor exchange using the original called party number and optionally, with an NP status indication designating that the status of the portable number was not determined.

7.3 Allocation of functions to equipment

FE1, FE2, and FE3 could reside in the originating, transit, or donor exchange. FE4 resides in the transit exchange. FE5 and FE6 reside in the recipient exchange.

8 Signalling requirements

Based on the preceding subclauses of this Supplement, the following are requirements for signalling systems relevant to circuit-related and non-circuit-related signalling:

1) The signalling mechanisms that support number portability should not place any restrictions on the PSTN and ISDN services, including basic, supplementary and non-circuit-related based services.

2) Number Portability solutions shall allow that Transit Network(s) be used between Originating and Donor/Initiating Networks.

3) Number Portability solutions shall allow that Transit Network(s) be used between Donor/Initiating and Recipient Networks.

4) Number Portability solutions shall not interfere with Carrier Selection.

5) Interoperability of the various methods must be provided. e.g. the signalling must be capable of providing interworking between onward routing and other methods.

6) NP should not result in the looping of calls or messages.

7) Outgoing international calls or messages shall be unaffected.

8) It shall be possible to signal an indication that the NP status, if available, of the portable number has been determined. The indication may be included for either ported or non-ported numbers.

9) Only the E.164 number (not including prefixes, etc.) should be considered eligible to be ported.

10) The entire E.164 number and not only part of it should be ported.

11) Single numbers within a MSN can only be ported if a different access is provided to the ported number.

12) Groups of contiguous numbers (e.g. DDI/multiline groups) can be ported.

13) Porting of single numbers within a DDI range is not allowed.

14) The privacy of the user which has ported his/her number should be guaranteed. That means that the calling/called party should not be informed that the called/calling party has ported his number.

15) Number portability should not affect the dialling procedures for calls incoming to the ported number.

16) The dialling procedures for calls outgoing from the ported customer should be the same as those of non-ported customers served by the same Service Provider.

17) Introducing service provider portability must not adversely affect conformance with national or international propagation and echo standards.

18) Calling Line Identification Presentation (CLIP) supplementary service and Calling Line Identification Restriction (CLIR) supplementary service shall work in same way as for subscribers not porting the number. For the CLIP supplementary service, if the call is originated by a calling user which has been ported, the calling line identification is the ported number. This is valid for both PSTN and ISDN subscribers.

19) Connected Line Identification Presentation (COLP) supplementary service and Connected Line Identification Restriction (COLR) supplementary service shall work in same way as for subscribers not porting the number. For the COLP supplementary service, if the called user's number has been ported, the connected line identity presented to the calling user is the ported number. This is valid for both PSTN and ISDN subscribers.

20) Calls from a ported number to the emergency services should be supported by the same functionality as calls from non-ported numbers to the emergency services.

21) Variable number length must be supported.

22) Overlap signalling must be supported before and after obtaining the routing number.

23) The redirection counter, used for the Diversion services, must not be stepped at redirection by a Number Portability procedure.

24) There shall be transparent support for NP at transit nodes.

25) It shall be possible to transfer both an Unchanged Called Party Number (CdPN) and a Routing Number (RN) unambiguously.

26) It shall be possible to indicate one or all of the following destinations with the Routing Number (RN):

    i) Recipient Network ID (RNID) or/and;

    ii) Point of Interconnection (POI) or/and;

    iii) Recipient Exchange (REX).

    (NOTE – This list is not exhaustive.)

27) An indication in the forward direction to indicate a call to a ported number.

28) In an environment of number portability, calls from ported numbers must convey both logical and physical calling party information.

29) RN need not be in E.164 format.

30) For incoming international calls, the incoming gateway in the network should be considered as the originating network for Number Portability.

31) The Number used to route the call is constructed as one of the following:

    i) Concatenated Address = Routing Number + DN (as a single piece of information).

    ii) Separated Address = Routing Number and DN (as two separate pieces of information).

    iii) DN only.

32) SCCP addressing based on RN for the called party should be supported.

33) The sum total of the networks involved in addressing and routing non-circuit-related messages pertaining to a ported number shall be able to detect the number has been ported and drive the identity of the appropriate destination of the message. The division of responsibilities of this among the networks depends on the architecture chosen.

34) Number Portability solutions should be backward compatible with nodes and services not updated for NP.

ANNEX A

Intelligent Network support for PNCC for Service Provider Portability

A.1 Scope

Annex A covers Intelligent Network (IN) requirements, taking account of current and emerging Intelligent Network Standards, to support number portability for geographic numbers as defined in PNCC-SPP. This Annex defines an approach for an IN solution for obtaining the routing number for Number portability. The IN Capabilities may exist in the Originating, Donor, Transit or Recipient Networks or Exchanges. This Annex identifies and defines functions that may be needed by IN to support PNCC-SPP. Additional mechanisms for obtaining the routing number are not excluded by this Annex.

Intelligent Network (IN), with respect to Number Portability, provides the capability to obtain routing information for ported/portable numbers to support routing of incoming calls to the recipient network and to the recipient exchange. Specifically, this Annex addresses the IN capabilities needed to support the "all call query" and "onward routing" principles.

See the Q.12xx-series of Recommendations for the general IN definitions, terms, and functions.

A.2 General description

This subclause describes the functions for IN support of Portable Number Call Control for Service Provider Portability (PNCC-SPP) for geographic numbers. For general information related to the definitions, terms, and architecture, see reference [1].

A.2.1 General assumptions

The following list outlines the assumptions for the IN requirements:

a) Support for overlap signalling before and after the routing number is obtained.

b) Triggering on number blocks or individual end user numbers.

c) Triggering can be initiated from Originating, Transit, Donor, and Recipient networks.

d) IN queries from the exchanges access a real-time database system which responds with the routing information back to the exchange.

A.2.2 Number Portability data

PNCC-SPP requires additional information in order to route the call from the originating network to the recipient network. Signalling protocols used by IN already support the transfer of the called party's end user number but separate transfer of routing information (i.e. Routing Number) require signalling enhancements. This subclause outlines additional information that may need to be transferred between an exchange and a number portability database.

A.2.2.1 Calling Party information

In order to obtain the location of the calling party, e.g. for emergency calls or for a local weather forecast, there is a need to transfer Geographic Location information together with the Calling Party Number.

A.2.2.2 Routing Numbers

In addressing the Recipient Network or/and Recipient Exchange, the following addressable entities, depending on the structure for the Routing Number, are identified:

1) *Recipient Network*

   Here, the routing number identifies the network where the customer is now located.

2) *Point of Interconnection*

   Here, the routing number identifies a gateway or Point Of Interconnection (POI) to the next network in the routing process.

3) *Recipient exchange*

   Here, the routing number identifies the exchange where the customer's number is now being served.

A.2.3 IN support for Service Provider Portability of Geographic Numbers

The requirement for IN support of PNCC-SPP incorporates triggering of called end user in a portable number range and performing an IN number portability database query. If the number has been ported, the response will be a routing number and an indication that the number has been ported. INAP (Intelligent Network Application Protocol) is the protocol used between the switching network and database.

Special functions are needed to support the cases where:

a) Number ranges have variable length.

   This might require multiple IN NP DB queries, e.g. by request for more data, depending on number length knowledge in SSP.

b) DDI ranges have variable length (within a number range).

   This requires overlap signalling even after number translation all the way to the PBX, since the number length (per unique number) is controlled by the PBX owner.

The IN queries, to obtain a routing number, is applicable both for circuit-related signalling (call set-up) and for non-circuit-related signalling (TCAP based services).

NOTE – Options a) and b) are only applicable for circuit-related signalling, since the complete destination must be reached (i.e. all digits received) before the calling subscriber is able to activate e.g. CCBS and CCNR services.

A.2.3.1 IN trigger conditions for circuit-related signalling to Geographic Numbers

Triggering of an IN NP DB query, during call set-up, can in principle be due to:

1) an end user's number being identified as ported-out, i.e. a "ported or vacant number" based trigger;

2) a received call to "portable number" with a "number block" based trigger.

This Annex addresses two types of number portability architectures (see reference [1]):

1) Onward routing: This solution could incorporate IN triggering based on a "ported number" based trigger or based on a "number block" based trigger.

2) All Call Query NP solution: This solution could incorporate IN triggering based on a "number block" based trigger.

The triggers are applicable to Originating, Donor, Transit, and Recipient exchanges.

A.2.3.2 IN trigger conditions, non-circuit-related signalling to Geographic Numbers

Triggering of an IN DB query, during non-circuit-related signalling, can in principle be due to:

a) an end user's number being identified as ported-out, i.e. a single number based trigger or a number block based trigger;

b) a received call to "portable number", i.e. a number block based trigger.

The triggers are applicable to Originating, Donor, Transit, and Recipient exchanges in addition to the Signalling Relay Points.

A.2.4 Information flows for PNCC-SSP using the IN architecture

The following descriptions give some examples of possible scenarios for Geographic Number Portability Solutions where IN architecture is used to support NP-related number translation and call control. The examples/solutions focuses on actions required by IN functional/physical entities.

The special actions required for variable number length and variable DDI length is shown in some scenarios only but is applicable to all scenarios.

The location of NP database is not the critical issues in the figures; instead, the point where query is made and what caused the IN triggering are the important issues.

The variations of interconnections are only examples since the actual interconnection is network dependent.

Transit networks are optional and included for depict interconnection topologies when routing calls/services towards ported/portable geographic numbers.

High-level network models for service provider portability of geographic numbers are described in reference [1].

A.2.4.1 Onward Routing by donor LE combined with a second query in Recipient Network

The high-level scenario addressed in this subclause is the case where the call is first routed to the Donor Network, optionally via Transit Network(s) A and from there onward routed towards the recipient Network, optionally via Transit Network(s) B, as outlined in Figure A.1.

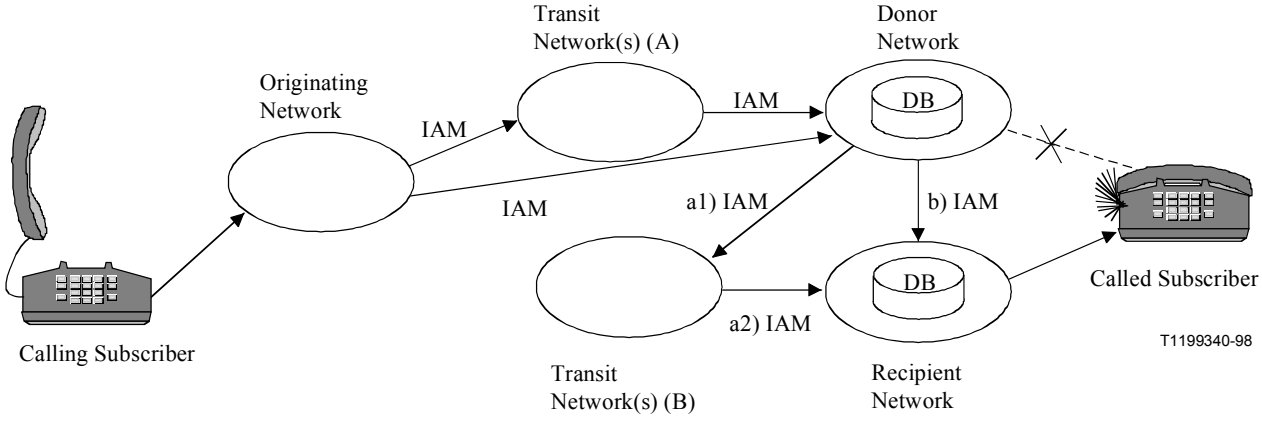


Figure A.1 – Onward routing by Donor and Recipient Model

Figure A.1 could be expanded since the required NP tasks could be performed within both the Donor Network and Recipient Network, see reference [1]. For simplicity reasons the Originating and

Transit Networks are not expanded, since this does not give any additional value with regard to IN structured aspects in Donor and Recipient.

Figure A.2 provides an information flow diagram between functional entities (not network elements) where the functional entities from PNCC-SPP are used in conjunction with the functional entities from the IN functions to obtain the routing number. The simple case, where the donor invokes IN functions, is portrayed in Figure A.2, flow a). The elements in the figure are as follows:

- Invoke: When call is initiated incoming to the donor, FE3 determines that the PNCC-SPP capability is to be invoked for this call. FE3 provides the end user's number.
- Request: FE1 determines that the number is portable and sends a request to FE2 to obtain the routing information.
- IN_req: FE2 invokes the IN functions to obtain the routing information. FE2 makes a request to FE2A (IN function on another network node).
- Search: FE2A (IN specific FE) sends a request using IN protocols to request an operation at the NP database (FE2B) to retrieve the necessary routing information.
- Result: FE2B (IN specific FE) processes the Search request which includes the end user's number to retrieve the routing number and responds with the Result.
- IN_res: FE2A is an IN function on the exchange that interprets the Result and returns the IN_res with the RN.
- Route: FE2 has completed the function of obtaining the RN and returns the information to FE3 so the call can be routed.
- rn_info: FE3 routes the call using the routing number through the basic call functions FE4 and FE5. FE6 interprets the NP information to determine the end user's physical location. If an additional query is needed, FE6 returns control to FE5. Note FE5, FE4, and FE3 are basic call functional entities. If an additional query is needed, FE4 or FE5 would begin the functions as FE3.

NOTE – In Figure A.2, the FE1 could determine that no routing number is needed and return this indication back to FE3. For this case, FE3 would continue to route towards the called user's network or exchange using the called user's number. In addition, FE2 could determine that the called end user's number is not ported and return an indication back to FE2 which could optionally provide the NP status indication to FE3 for proper call routing. This flow is depicted as case b) in Figure A.2.

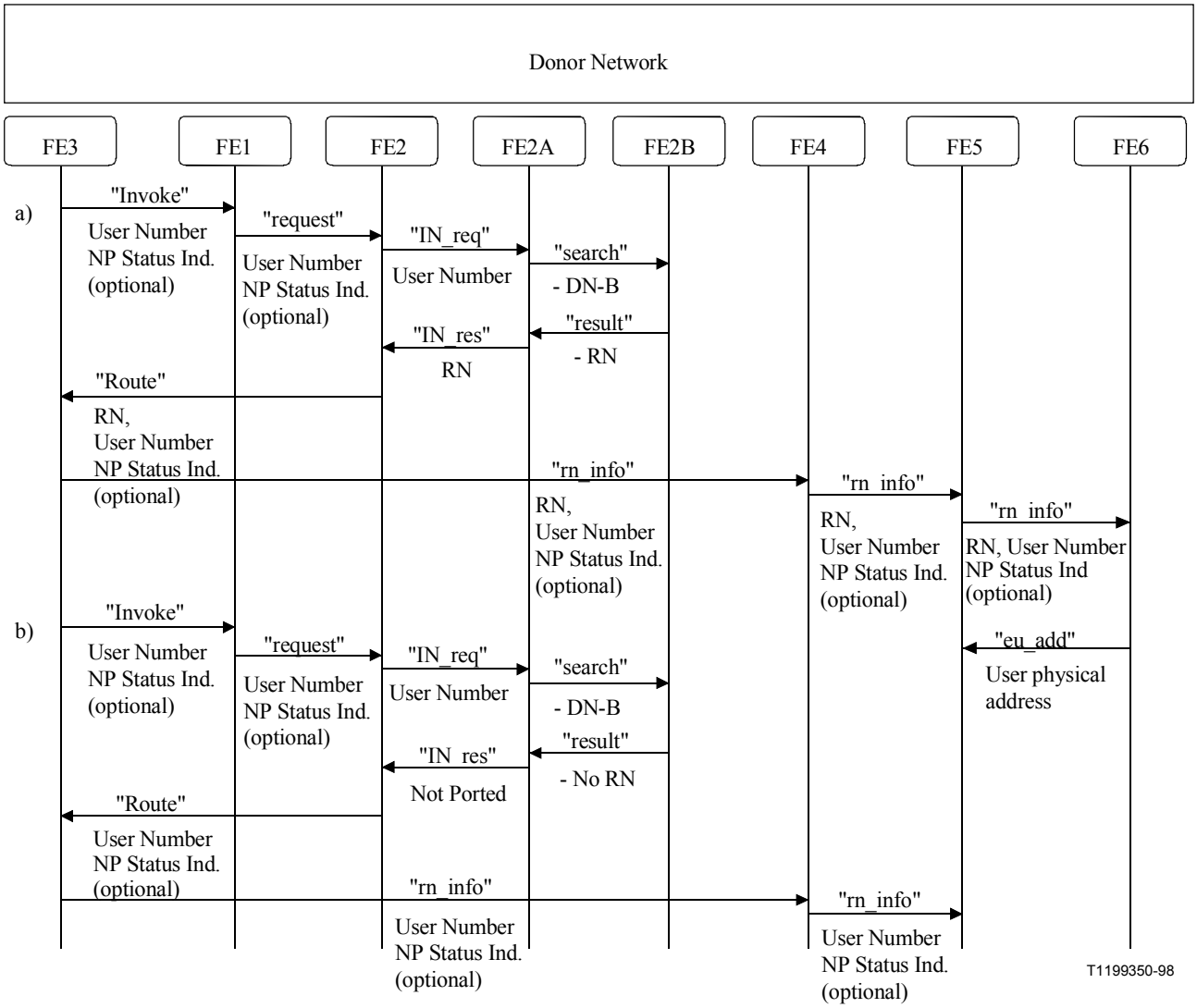
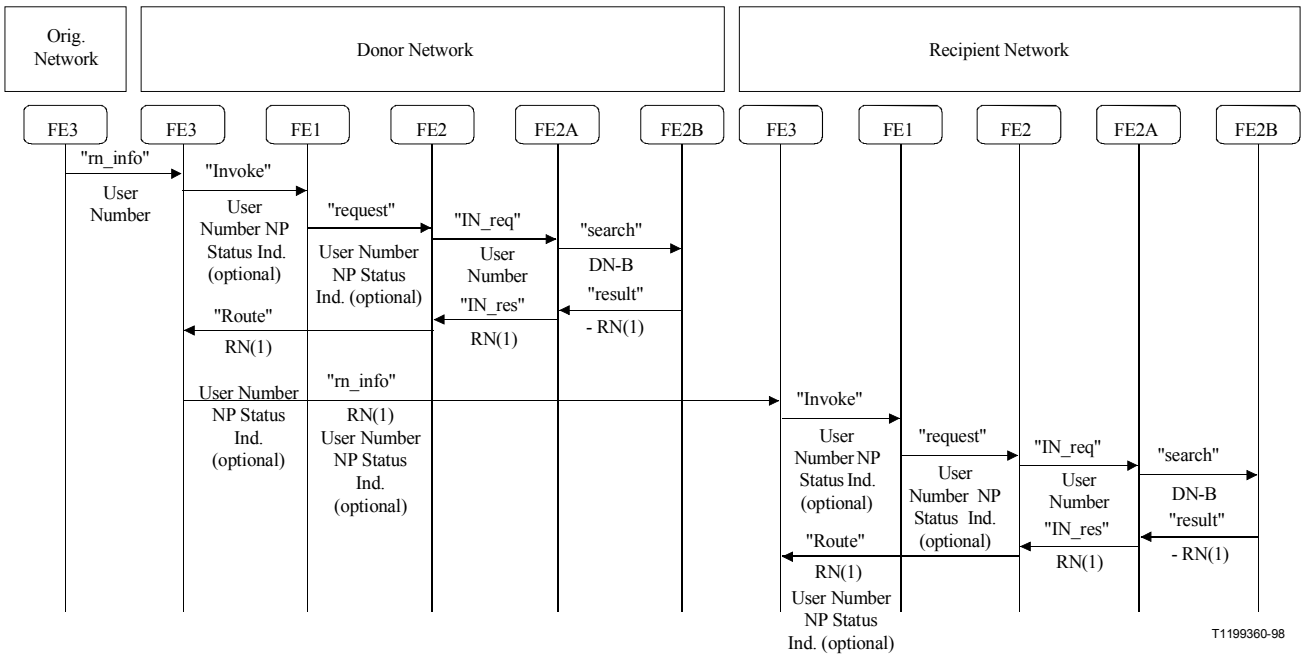


Figure A.2 – Information flow diagram

In the network element information flows in Figure A.3, the Originating network routes the call to the network based on the called Directory Number (DN). The Donor network has armed a "line based" trigger or "number block based" trigger, stating the number has been ported-out. It then makes a NP DB query, using IN components, to retrieve a routing number. The routing number is then used by the donor network to route the call onward towards the recipient network. When the call is received in the recipient network, a new query is performed, in similar way, to obtain a routing number to address the recipient exchange.

From the network element flows in Figure A.3, the Donor Network is considered as the Initiating Network since it performs both NP trap functions and obtains the RN to route towards Recipient Network. The second query, in Recipient Network, is not required in the case that the first step obtains the complete address to the Recipient Exchange.



RN(1)	Routing Number (e.g. Recipient Network ID)
RN(2)	Routing Number (e.g. Recipient Network and Exchange ID)
DN-B	Directory Number, called party
NP Status	An indication of NP number translation
Route	An operation from SSF storing a new routing number in CCF

Figure A.3 – Network element flow for two-step onward routing

A.2.4.2 All call query in Originating Network combined with a new query in Recipient Network

The high-level scenario, as outlined in Figure A.4 shows a NP solution where the Originating Network traps all calls to portable numbers, makes a DB query on the CdPN to retrieve a partial routing information to address the Recipient Network, routes the call towards the Recipient Network, optionally via Transit Network(s). Further alternatives and explanation of the figures is found in reference [1]. The examples/solutions focuses on actions required by IN functions. The IN functions could, based on the IN application, provide the routing information sufficient to route to the recipient exchange.

Figure A.4 is expanded in network element information flow (Figure A.5) to see how IN components can be used to perform the required NP tasks within both the Originating and Recipient Network. For simplicity reasons the Transit Network(s) are not expanded since this does not give any additional value with regard to IN structured aspects.

As in "onward routing", the functional entity call flows for the query functions outlined in Figure A.4 can be portrayed with the base functional entity modes with the additional IN functional entity models. This is depicted in Figure A.2 – Information Flow Diagram and not repeated here.

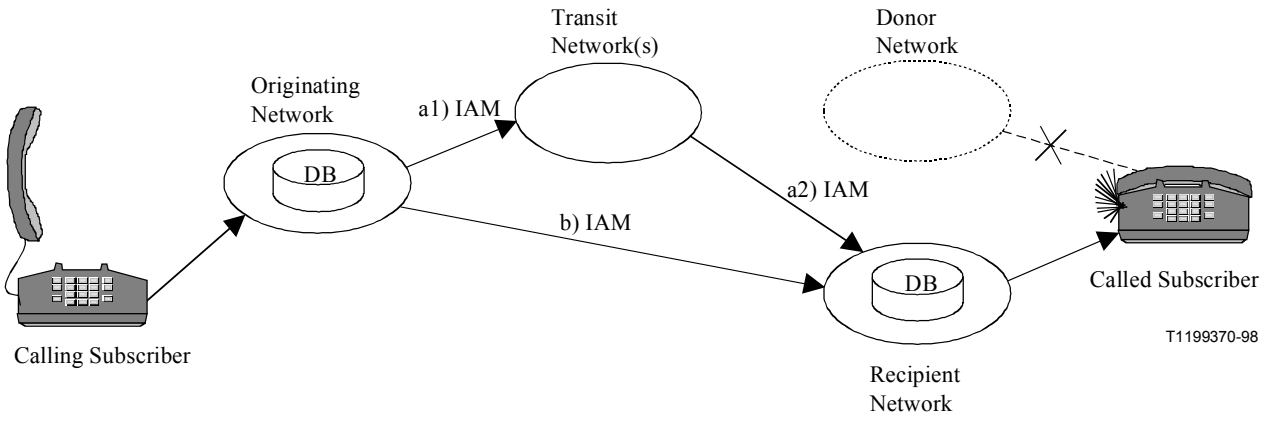
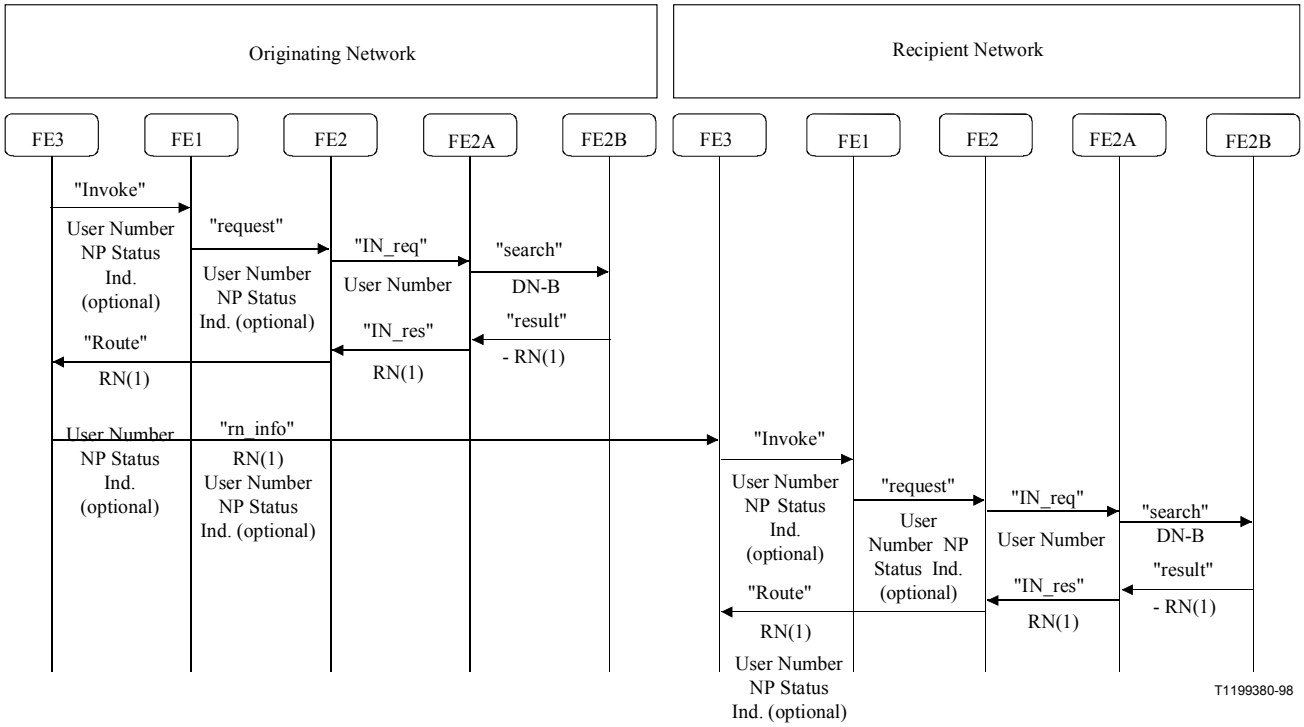


Figure A.4 – "All Call Query" two-step IN model

In the network element flow outlined in Figure A.5 below, the Originating network has armed a "number block" based trigger, i.e. all outgoing calls with a called party number being part of this number block will lead to a NP DB query INAP to retrieve a routing number. The query is performed using IN functional components. The routing number is then used to route the call towards Recipient Network.



RN(1) Routing Number (e.g. Recipient Network ID)
RN(2) Routing Number (e.g. Recipient Network and Exchange ID)
DN-B Directory Number, called party
NP Status An indication of NP number translation
Route An operation from SSF storing a new routing number in CCF

Figure A.5 – Network element information flow for "All Call Query" two Step IN Query

In reference to the network element flow (Figure A.5), the Originating Network is considered as the Initiating Network since it performs the NP trap functions, obtains the RN, and routes towards Recipient Network. The second query, in Recipient Network, is not required in the case that the first step obtains the complete address to the Recipient Exchange.

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Geneva, 1999