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International operation – Numbering plan of the international telephone service

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The international public telecommunication numbering plan

Supplement 2: Number portability

Recommendation ITU-T E.164 – Supplement 2

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ITU-T E-SERIES RECOMMENDATIONS

OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

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Recommendation ITU-T E.164

The international public telecommunication numbering plan

Supplement 2

Number portability

Summary

Supplement 2 to Recommendation ITU-T E.164 defines standard terminology for a common understanding of the different aspects of number portability within an ITU-T E.164 numbering scheme. It identifies numbering and addressing formats, call flows, network architectures and routing approaches that will provide alternative methods of implementation. It also proposes some examples of the administrative and operational processes required for the successful implementation of number portability.

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Number portability

1 Scope

This supplement defines standard terminology for a common understanding of the different aspects of number portability within an ITU-T E.164 numbering plan. It identifies numbering and addressing formats, call flows, network architectures, database structures, and routing approaches that will provide alternative methods of implementation. It also proposes some examples of the administrative and operational processes required for the successful implementation of number portability.

2 References

[ITU-T E.101] Recommendation ITU-T E.101 (2009), *Definitions of terms used for identifiers (names, numbers, addresses and other identifiers) for public telecommunication services and networks in the E-series Recommendations*.

[ITU-T E.129] Recommendation ITU-T E.129 (2009), *Presentation of national numbering plans*.

[ITU-T E.164] Recommendation ITU-T E.164 (2010), *The international public telecommunication numbering plan*.

[ITU-T Q-Sup.3] ITU-T Q-series Recommendations – Supplement 3 (1998), *Number portability – Scope and capability set 1 architecture*.

[ITU-T Q-Sup.4] ITU-T Q-series Recommendations – Supplement 4 (1998), *Number portability – Capability set 1 requirements for service provider portability (All call query and Onward routing).*

[ITU-T Q-Sup.5] ITU-T Q-series Recommendations – Supplement 5 (1999), *Number portability – Capability set 2 requirements for service provider portability (Query on release and Dropback).*

[ETSI TR 101 698] ETSI TR 101 698 V1.1.1 (1999), *Number Portability Task Force (NPTF); Administrative support of service provider portability for geographic and non-geographic numbers.*

[ETSI TR 184 003] ETSI TR 184 003 V3.1.1 (2010), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Portability of telephone numbers between operators for Next Generation Networks (NGNs).*

[ETSI TS 184 011] ETSI TS 184 011 V3.1.1 (2011), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Requirements and usage of E.164 numbers in Next Generation Network (NGN) and Next Generation Corporate Network (NGCN).*

[IETF RFC 3761] IETF RFC 3761 (2004), *The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM).*

3 Definitions and abbreviations

3.1 Definitions

The following definitions and terms used in this supplement are to be used within the context of number portability.

3.1.1 address (taken from [ITU-T E.101]): An address identifies a specific network termination point and can be used for routing to this physical and logical termination point inside a public or private network.

3.1.2 central reference database (CRDB): A non-real time database that is used to store a country's number portability routing data. The data contained in the CRDB usually consist of a list of ported telephone numbers with associated domain names routing numbers and optionally further information of administrative nature required to support the processing of a ported telephone number from one service provider to another service provider. These data can directly provide routing information (i.e., routing number) or are stored in a format which request further processing in order to render routing information.

It is a national matter if a unique administrative CRDB exists and/or whether there is one physical CRDB system or a logical one, which may be distributed or replicated among the service providers involved.

3.1.3 directory number: See end user's number.

3.1.4 donor network: The initial network where a number was located before ever being ported.

3.1.5 donor service provider: The service provider from whom the number was initially ported.

3.1.6 end user's number: The E.164 number, also denominated telephone number from [ITU-T E.101] for telephony call, used by the calling party to establish a call/session to the end user. This number is also used for presentation services like calling line identification (CLI) and connected line identification presentation (COLP).

The end user's number is equivalent to a directory number.

3.1.7 ENUM query: Query made using ENUM in order to resolve a specific E.164 number to a routable URI.

3.1.8 geographic number (GN) (taken from [ITU-T E.101]): An E.164 number which corresponds to a discrete geographic area.

3.1.9 location portability: The ability of an end user to retain nationally the same national E.164 public telecommunication number when moving from one location to another.

3.1.10 network operator: An entity that operates a network infrastructure for call establishment and routing.

3.1.11 non-geographic number (taken from [ITU-T E.101]): An E.164 number which has no geographic significance.

3.1.12 E.164 numbering plan (taken from [ITU-T E.101]): The public numbering plan, that is defined in the ITU-T E.164 Recommendation, that specifies the format and structure of the numbers used within that plan. It consists of decimal digits segmented into groups in order to identify specific elements used for identification, routing and charging capabilities, e.g., to identify countries, national destinations and subscribers.

An E.164 numbering plan does not include prefixes, suffixes and additional information required to complete a call.

The national numbering plan (NNP) is the national implementation of the E.164 international numbering plan (also called the international public telecommunication numbering plan).

3.1.13 operational database (OpDB, also abbreviated in the following as "DB"): An OpDB, as defined in [ETSI TR 184 003], is a real time database, typically operated by each operator, that stores number portability (NP) data that are updated from a number portability database (NPDB, that is a non-real time database, that is the same as a Central Reference Database, CRDB), including in principle the number portability routing information (NRI) to be used for routing.

3.1.14 originating network: The network serving a calling end user.

3.1.15 portable number: A complete E.164 number identified by an appropriate authority which is subject to number portability.

3.1.16 ported number: An end user's E.164 number that has been subject to number portability.

3.1.17 recipient network: The network where a number is located after being ported.

3.1.18 recipient service provider: The service provider to whom the number is ported and which typically operates the recipient network.

3.1.19 routing number (taken from [ITU-T E.101]): An address/number, only used for routing purposes and not known and usable by end users, that is derived and used by the public telecommunication network to route the call/session towards the recipient network also in the NP context.

3.1.20 triggering network(s): The network(s) that have the role to determine the status of a number in an environment capable of supporting number portability and, if necessary, obtains the routing information for ported numbers. The functionality to provide these capabilities may reside in either the originating, donor or recipient network or in a transit network.

3.1.21 service number (taken from [ITU-T E.101]): A non-geographic E.164 number allocated to a specific category of services.

3.1.22 service provider: An entity that offers services to users involving the use of network resources.

3.1.23 service provider portability: The ability of an end user to retain nationally the same E.164 national number when changing from one service provider to another inside the same location and service category, as it is defined in the national numbering plan (NNP).

3.1.24 service provider portability for geographic numbers: The ability of an end user to retain nationally the same geographic E.164 national number when changing from one service provider to another without changing their location and without changing the nature of the service offered.

3.1.25 service provider portability for non-geographic numbers: The ability of an end user to retain nationally the same non-geographic E.164 national number when changing from one service provider to another without changing the nature of the service offered.

3.1.26 transit network: A network between two networks that handles transparently the call/session.

3.1.27 number portability (NP) query (taken from [ETSI TR 184 003]): A query to OpDB.

3.2 Abbreviations

This supplement uses the following abbreviations:

CC Country Code

CCBS Completion of Calls to Busy Subscriber

CRDB Central Reference Database

DB Database

DDI Direct-Dialling-In

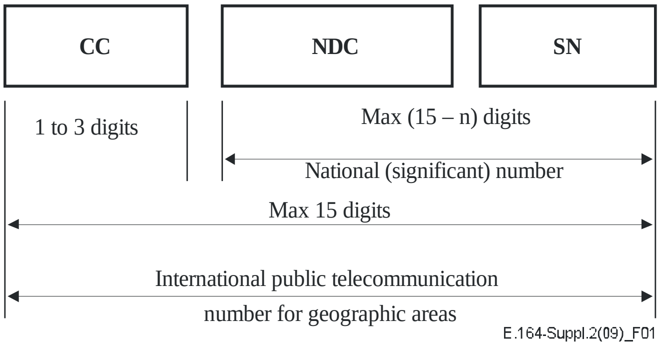
DN	Directory Number
ENUM	Telephone Number Mapping
IN	Intelligent Network
IP	Internet Protocol
ISDN	Integrated Services Digital Network
MSN	Multiple Subscriber Number
NGN	Next Generation Network
NNP	National Numbering Plan
NP	Number Portability
NPDB	Number Portability Data Base
NRI	Number Portability Routing Information
OpDB	Operational Data Base
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
RN	Routing Number
SP	Service Provider
TN	Transit Network

4 ITU-T E.164 number structures

This clause identifies three different structures for the international public telecommunication number that, as national numbers following specific national numbering plans, may be subjected to number portability inside a specific country:

- international public telecommunication number for geographic areas;
- international public telecommunication number for global services;
- international public telecommunication number for networks.

4.1 International public telecommunication number for geographic areas

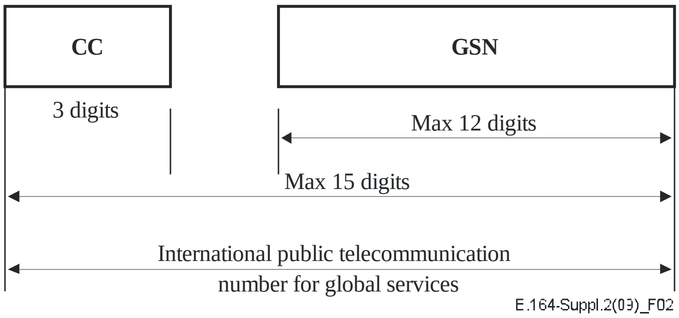


CC Country Code for geographic areas
NDC National Destination Code (optional)
SN Subscriber Number
n Number of digits in the country code

NOTE – National and international prefixes are not part of the international public telecommunication number for geographic areas.

Figure 1 – International public telecommunication number structure for geographic areas

4.2 International public telecommunication number for global services

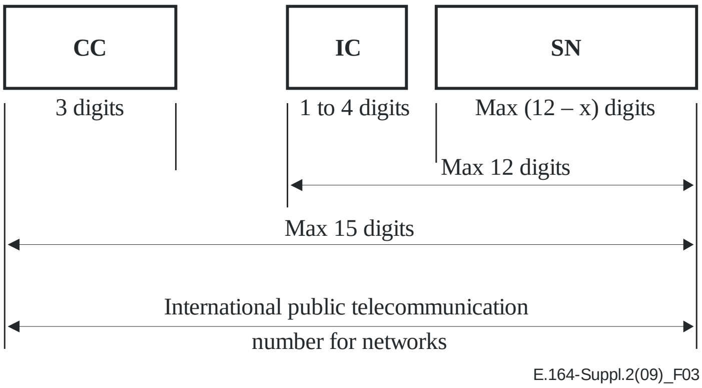


CC Country Code for global services
GSN Global Subscriber Number

NOTE – National and international prefixes are not considered to be part of the international public telecommunication number for global services.

Figure 2 – International public telecommunication number structure for global services

4.3 International public telecommunication number for networks



CC Country Code for networks
IC Identification Code
SN Subscriber Number
x Number of digits in Identification Code (IC)

NOTE – National and international prefixes are not part of the international public telecommunication number for networks.

Figure 3 – International public telecommunication number structure for networks

5 Number portability types for national ITU-T E.164 numbers

Number portability is classified into two implementation types:

1) Service provider portability;

2) Location portability.

An ITU-T E.164 number is classified into the following three types of country codes (CCs) that, as national numbers following specific national numbering plans, may be subjected to number portability inside a specific country:

1) beginning with CC for geographic areas;

2) beginning with CC for global services; and

3) beginning with CC for networks.

Tables 1 and 2 provide an overview of the applicability of each type of portability, when considered against the three ITU-T E.164 number types.

Table 1 – Service provider portability

Scope	**Only within the same country (CC)**	
CC type (Note 1)	Porting	Standards (Note 3)
Geographic	Applicable	Not required (Note 2)
Global services	Not applicable	Not required

Table 2 – Location portability

Scope	**Only within the same country (CC)**	
CC type (Note 1)	Porting	Standards (Note 3)
Geographic	Applicable	Not required (Note 2)
Global services	Not applicable	Not required

Notes to Tables 1 and 2:

NOTE 1 – Portability not applicable between CC types and different country.

NOTE 2 – International standardization not required but could be of use.

NOTE 3 – For purposes of Tables 1 and 2, "Standards" means ITU-T Recommendations.

6 Generic implementation of number portability

The following general routing scheme is assumed as the routing model for calls routed to a ported customer regardless of the network (PSTN, ISDN, PLMN, NGN and IP) being used to provide the transport.

NOTE 1 – The number portability solution chosen for implementation by a country's Administration is, in principle, independent from a specific technology. This applies even if it has to respect the specific technology characteristics and limitation, as it is dependent on the ITU-T E.164 numbering plan requirements established by a country's Administration.

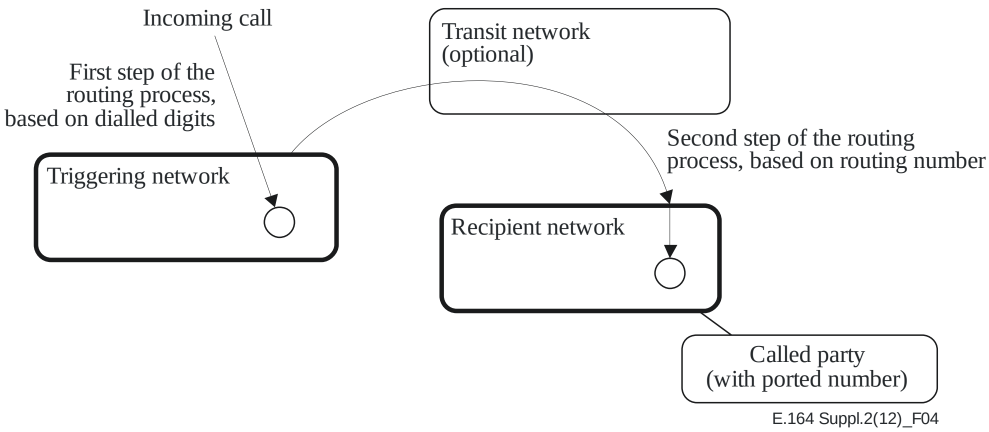


Figure 4 – Conceptual framework for number portability (NP) handling

NOTE 2 – The caller sets up the call by dialling the end user's number which, in this case, is a ported number. The end user's number is enough to initiate the routing process. Furthermore, number portability, by definition, implies that the callers should continue to dial the same end user's number and nothing more to set up a call to a ported customer.

NOTE 3 – The routing process is split into two consecutive main steps:

a) Normal routing based on the end user's number towards a donor or triggering network:

As a first step in the routing process, the originating network typically routes the call up to a donor or triggering network clearly identified by the analysis of a certain number of leading digits of the end user's number. In some number portability (NP) solutions, i.e., the so-called direct routing or all call query technical solution, the originating network can also assume the role of triggering network.

b) Routing to the recipient network based on routing number(s) (RNs) obtained by donor or triggering network:

NOTE 4 – The recipient network has the responsibility to terminate the call to the customer's network terminating point.

NOTE 5 – If a number is ported subsequently from service provider No. 1 to service provider No. 2, then to service provider No. 3, etc., this will change the number portability routing information (NRI) but not the routing principles.

7 Entities addressed by routing

Entities which need to be addressed by a routing number (RN or NRI), whose definition is a national matter, are identified in this clause.

According to the structure of the RN that is delivered to the recipient network, one or a combination of the following entities should be addressable:

– A recipient network and/or a point of interconnection (POI) with the recipient network: in this option, the RN identifies the network where the customer is now located. Therefore, the routing process will need additional information (i.e., directory number (DN)) to be completed.

– Network termination point (NTP): In this option, the RN identifies the subscriber's access. The ported customer identified by the RN is unique. Therefore, the routing process, in terms of number portability, can be completed without any additional information. In normal cases, also for more efficient use of numbering resources, the NTP is identified by the internal RN which is determined by the recipient network using received RN and DN information.

8 Number portability mechanisms

8.1 Assumptions

The following documents internal assumptions that have been made:

a) calling line identification (CLI) is required to be transported, with possible presentation supplementary service, unchanged to the recipient network;

b) initial routing arrangements have been defined and implemented prior to the introduction of routing based on a routing number;

c) number portability is not allowed to influence the carrier selection function.

8.2 General description

8.2.1 Call re-routed from donor network by use of onward routing principles

The first step/solution discussed for number portability is often that the donor network maintains the portability information, i.e., the complete address to the recipient network for ported out numbers, and delivers incoming calls to ported out numbers onward towards the recipient network, according to onward routing principles outlined in Figure 5.

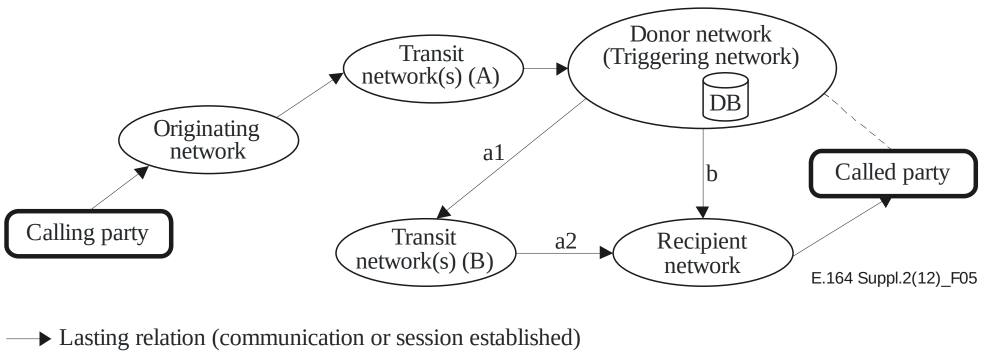


Figure 5 – Call delivering to recipient network by onward routing principles from donor network

In Figure 5, the donor network receives an incoming call by the originating network. It then detects that the called number has been ported out to another network and makes a database (DB) query to retrieve an RN. It thereafter delivers the call onward towards the recipient network using the retrieved routing information.

Please note that the transit network(s) is (are) optional (see options a1 and a2 in Figure 5 above), i.e., direct interconnections between the originating network and the donor network might exist and the same also between the donor network and the recipient network (see option b above).

8.2.2 Call re-routed by dropback principles from donor network

One possible enhancement of the previously described onward routing solution is that the donor network initiates the re-routing of the call towards the recipient network according to "dropback" principles outlined in Figure 6. Also, in this scenario, only the donor network maintains NP routing information, i.e., the RN associated to the recipient network for ported out numbers.

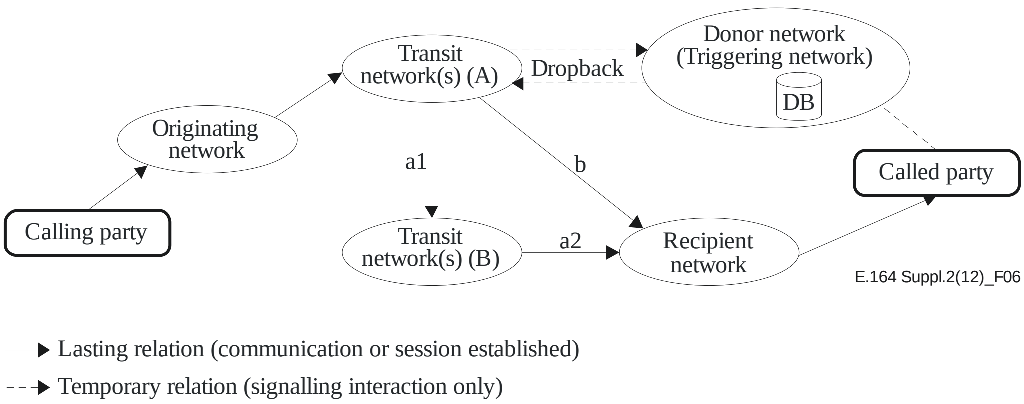


Figure 6 – Dropback with re-routing information and onward re-routing performed by a transit network

Option b is valid when direct interconnection exists between transit network A and the recipient network.

A further evolution is that the dropback indication is sent back to the originating network. This is mainly of interest if the originating network has direct interconnections to other networks than the transit network used in the call attempt to the donor network.

The dropback indication is also passed through to the originating network if either the transit network A has no "dropback" capability or determines that the preceding network has "dropback" capability. The originating network, at reception of the release, re-routes the call towards the recipient network.

Please note that transit networks are optional (i.e., direct connections between the originating network and the donor network might exist), but might exist (see options a1 and a2 in Figure 6 above) between the onward routing (transit or originating) network and the recipient network.

8.2.3 Call re-routing initiated by "query on release (QoR)" principles from donor network

A similar case, as the previously described "dropback" principle, is when the originating (or transit) network initiates an NP DB query at the reception of a release message. This case is often referred to as "Query on Release (QoR)".

In Figure 7, the donor network receives an incoming call from the originating network. It then detects that the called number has been ported out to another network. It then determines that the originating (or an intermediate triggering network) has QoR capability by looking at the received signalling information. It thereafter releases the call with a special indication telling that the called number is ported out. The originating network, or the intermediate triggering network, then traps the release, makes an NP database query, and delivers the call onward towards the recipient network. In this scenario, the originating or, an intermediate triggering network, has access to an NP operational DB (OpDB) with the complete address to the recipient network.

In Figure 7, options a1 and a2 are valid when either the triggering network (depicted as transit network A), functioning also as the triggering network, has no direct interconnection to the recipient network, or when overflow traffic could be placed via transit network B.

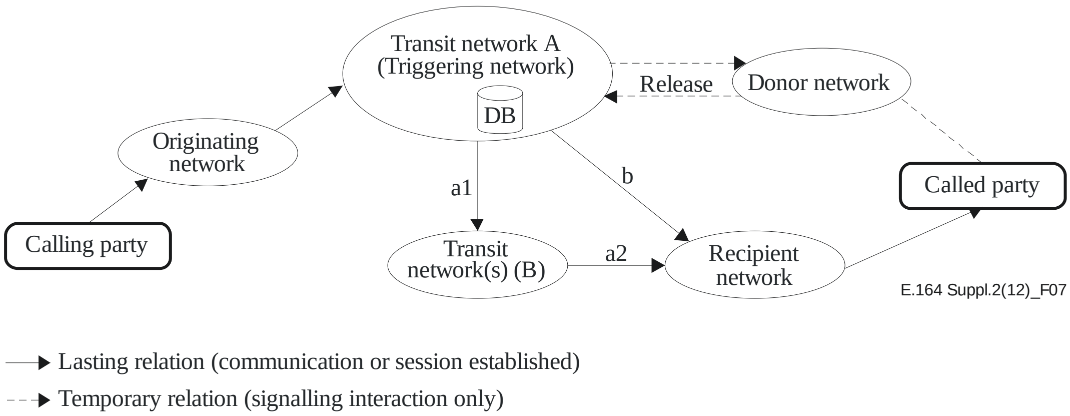


Figure 7 – Query on release by transit network

In Figure 7, option b is valid when direct interconnection exists between the triggering network, which may or may not function as the originating network, and the recipient network. The triggering function can be performed either by the originating network or by the intermediate triggering network (this latter case is depicted in the above figure as transit network A).

8.2.4 Routing initiated by "direct routing" or "all call query" principles

In the scenario shown in Figure 8, the originating network has access to an operational DB with the RN associated to the recipient network.

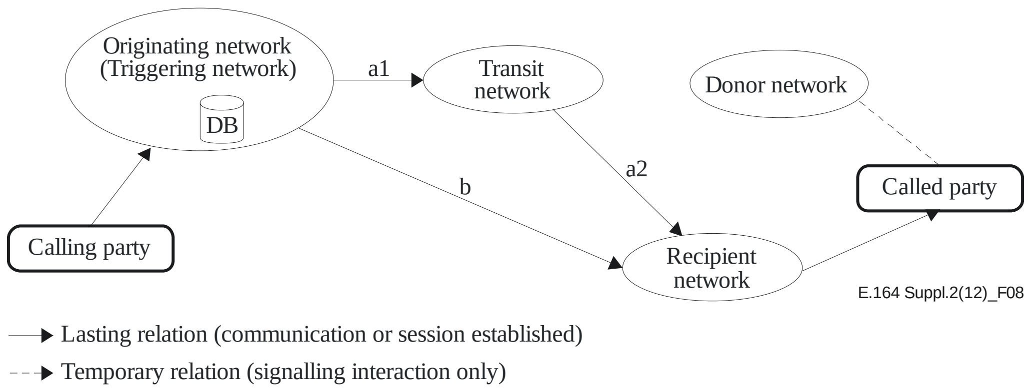


Figure 8 – All call query by originating network

As can be seen in Figure 8, the donor network is not involved in the call set-up at all; however, optionally the transit network (see cases a1 and a2 above) might be transiting the call to the recipient network.

8.2.5 Next generation network (NGN) number portability issues

Implementation of number portability and routing of calls differ from country to country, based on national requirements and mandates and consequently there is no single solution that suits all countries. Next generation networks (NGNs) are typically based on IP technology, according to NGN ITU-T Recommendations or ETSI standards. A nationally defined DB system and query mechanism, for instance an ENUM-based system, is then used to map an ITU-T E.164 number into a uniform resource indicator (URI) or domain name, or another national database system providing the appropriate mapping functionalities between ITU-T E.164 numbers and URI and/or domain name and/or IP address.

Factors that may influence national decisions on NGN number portability implementation include, but are not limited to:

- capabilities of the NGN architecture;
- service-oriented IP service interconnection requirements;
- interoperability with existing number portability solutions;
- ability to make number portability routing data available to all networks:
  - As an example of a capability that can be used to support number portability routing, ENUM, based on the IETF definition [IETF RFC 3761], is, among various technical alternatives, a DB hierarchical system and a query protocol for mapping an ITU-T E.164 number into a domain name that is understandable in IP networks. The result of an ENUM look-up is a uniform resource indicator (URI), e.g., **SIP: user@domain.com**, which may include an ITU-T E.164 number or a national routing number as user components. The domain name system (DNS) is used to map domain names to IP addresses. By constructing a routable address from the ITU-T E.164 number, the ENUM and the DNS system can be used to map ITU-T E.164 numbers into IP addresses, or another database system can be used to route to other network addresses or routing numbers. The implementation of ENUM can make use of this mechanism to provide routing information for NP. The NP solution inside NGN context is a national issue.

9 Types of addresses and numbers – within networks and across network boundaries

With service provider portability, it may no longer be possible to use an end user's number, dialled by the calling party, to route the call to the customer. If a customer changes the service provider, an RN is needed to be able to route the call. The routing information may have one of the following:

– concatenated address (see clause 9.1);

– separated address (see clause 9.2);

– RN only, i.e., a plain network address, suppressed ITU-T E.164 number (see clause 9.3);

– DN only, i.e., a plain ITU-T E.164 number (see clause 9.4).

For the use and support of ITU-T E.164 numbering in the NGN context also refer to [ETSI TS 184 011].

9.1 Concatenated address

9.1.1 Description

In this type of address, two numbers are concatenated in the same signalling field (the called party number) which is used to route the call (Figure 9).

RN	DN

Figure 9 – Showing a concatenated address

RN is a routing number prefixed for a routing purpose. The length of RN may vary from country to country.

If some non-ported numbers have DN leading digits identical to the RN, this may imply that a signalling field indicating "routing information for a ported number" exists; otherwise, the routing would be ambiguous.

The RN could take one of the following values:

Case 1: RN represents the first digits of a number block usually handled by the addressed entity to which the call has to be routed. In this case, specific information carried by the signalling protocol is needed to indicate that it is a call to a ported number.

Case 2: One or more of the first digits of the RN are digits not used as first digits in the national numbering plan used to indicate that the call is to a ported number. The value of the digits could be between 0 and 9 (spare in the national numbering plan). The rest of the RN identifies the addressed entity to which the call has to be routed and is used for this purpose.

Case 3: This case is similar to case 2, but the first (or first two) digit(s) of the RN field is (are) one of the hexadecimal values nationally spare in the Signalling System No. 7. RN is used to route the call to the addressed entity.

9.1.2 Brief analysis

Case 1

Pros:

This solution does not waste any numbering resource since the RN value is formed by the first digits of the number block usually handled by the addressed entity.

This solution does not need a specific addressing scheme (for identifying the addressed network) and can be accommodated in the existing signalling.

Cons:

This solution requires the use of a specific identifier to qualify the RN as an address used for a ported call which requires special treatment. The routing mechanisms in networks have to be adapted to be able to provide this special treatment. As there is a constraint on the maximum length of the complete concatenated address, the numbering space available for RN may be insufficient; limitations can be present on the maximum numbers of digits being supported by the signalling system and in the different networks involved.

Case 2

Pros:

As for case 1, this solution can also be accommodated in the existing signalling. In opposition to case 1, this solution does not require any additional information to qualify the call as a ported call since one of the first digits of the RN is dedicated to ported calls.

Cons:

This solution makes use of a part of the national numbering plan. To be able to handle the prefix, routing mechanisms in the networks will have to be changed. As there is a constraint on the maximum length of the complete concatenated address, the numbering space available for RN may be insufficient.

Case 3

Pros:

This solution does not waste any resource from the national numbering plan since the first digit(s) is (are) hexadecimal[1]. The advantages are similar to those already mentioned for case 2.

Cons:

The drawbacks are similar to those already mentioned for case 2. However, since this solution makes use of hexadecimal character(s), it requires changes (e.g., in signalling systems, switches and support systems). Although the solution does not require any resources from the national numbering plan, it does take up numbering resources (it uses a spare value from the Signalling System No. 7).

9.2 Separated addresses

9.2.1 Description

In this address type, the RN and the directory number are carried in two different fields in the signalling messages (Figure 10). The address identifying the destination of the ported call, routing number, is used to route the call. The DN is carried transparently in a separate signalling parameter and is only used at the called side to complete the call.

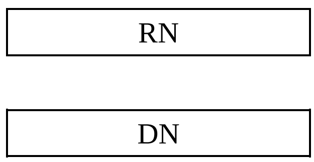


Figure 10 – Showing a separated address

[1] That is, one of the 6 values A, B, C, D, E or F.

9.2.2 Brief analysis

Pros:

The RN can either be an ITU-T E.164 number or a national-only number, therefore numbering resources belonging to the NNP, and it is usable only inside a specific country. Also RNs that are not part of NNP can be nationally defined. If ITU-T E.164 numbers are used, numbers within the national numbering plans must be identified and assigned only for routing purposes.

Cons:

Such a separated address solution requires, by definition, that signalling systems used are able to carry both RN and DN in separate signalling parameters.

9.3 RN only

9.3.1 Description

In this case, the routing number is the only information being sent between networks (Figure 11). The directory number, ITU-T E.164 number, is not sent between networks but is translated into an RN. The RN must point out the access line to which the called party is connected as no other method is available.

RN

Figure 11 – Showing a routing number only

9.3.2 Brief analysis

Pros:

The advantages of this addressing method are that it can be internationally used today when the RNs are ITU-T E.164 numbers and that it cannot require any changes in the signalling systems.

Cons:

This solution wastes numbering resources (depending on the solution) and it is not generally used inside a country.

9.4 DN only (normally across network boundaries)

9.4.1 Description

In this case, the directory number is the only information that is being sent between networks.

DN

Figure 12 – Showing a directory number only

9.4.2 Brief analysis

Pros:

This is the normal technical solution at international boundaries. It is not mandatory to introduce RN transfer between networks, i.e., this solution does not affect existing network interfaces. It allows different addressing options of different operators to work together. Operators will have to transport routing information with ported calls inside their networks, regardless of which number portability solution is chosen. There are multiple options to transport this routing information. Separation or concatenation of routing information and directory number is the main characteristic.

Cons:

Use of this addressing method requires the availability of technical solution inside each national network to solve NP, for instance through a common NP DB system with all ported number.

10 Combinations of addressing types, addressed entities and mechanisms: general signalling requirements

The previous clauses above have identified that there are three components that must be determined in any implementation of service provider number portability:

1) the entity addressed by the routing number;
2) the method of transporting the routing number;
3) the architecture used to determine the routing number.

Addressed entity: Assuming a routing number is utilized (see below), there are three possible entities that can be identified by the routing number:

1) network termination point;
2) recipient network;
3) point of interconnection.

Transport of routing number: There are four transport methods described:

1) concatenated;
2) separated;
3) no routing number used;
4) routing number only.

Architectures: There are four architectures described:

1) onward routing;
2) dropback;
3) query on release;
4) direct routing/all call query.

With the exception of the "no routing number used/routing number only" transport mechanisms, the three components are independent of one another, allowing a multitude of theoretically possible solutions by combining the components. An example of implementation could be:

– Routing number identifies the recipient network, is transported concatenated with dialled digits, and is derived using an onward routing architecture.

Or, an alternate implementation could be:

– Routing number identifies the recipient network, is transported in a separate field to the dialled digits, and is derived using an all call query architecture.

The various combinations provide flexibility of implementation to take into account economical and technical parameters of each individual situation. For this reason, this supplement does not recommend one solution over another.

11 Examples of locations of OpDBs and CRDBs for number portability

11.1 General description

Depending on the evolutionary level in a particular network, the NP databases, either real-time OpDBs or non-real-time central reference databases (CRDBs), will be located in different places of the network, or possibly even external to the network. The following principles of NP data storing have been identified, described and evaluated:

a) network-based real-time DB solutions, so called operational DBs (OpDB);

b) network external non real-time DBs solutions.

The following options for NP data query places have been identified, described and evaluated:

1) originating local network;

2) transit (triggering) network(s);

3) donor network(s).

Regardless of data storing place, the network can act according to different NP principles, e.g., onward routing the call, dropping back the re-routing information or even acting as a database and responding a query with re-routing information.

In some cases, a central reference database (CRDB) is used to store a country's number portability routing data. The data contained in the central database may include a list of ported telephone numbers with associated domain names, RNs, or optional information required to support the processing of a ported telephone number from one service provider to another service provider. The management and maintenance of the central reference database is a national matter.

11.2 Examples of a number portability database solution

Five options can be identified as potential solutions that address the implementation of a number portability database. The five solutions are listed below. Overview diagrams for each of the solutions are shown in Figure 13.

- **Solution A** (distributed database approach):

  Each operator's individual NP data is collected in each operator's individual database (no sharing of NP data among operators).

- **Solution B** (distributed database approach):

  NP data from all operators is collected in each operator's individual database.

- **Solution C** (centralized database approach):

  NP data from all operators is collected in a central non-real-time database; which will then be replicated to each operator's individual database to be queried for routing purposes.

- **Solution D** (centralized database approach):

  NP data from all operators is collected in a central non-real-time database; which will then be replicated to a central real-time database (also referred to as "National OpDB" or NOpDB) to be queried for routing purposes.

- **Solution E**: (distributed/centralized database approach):

  Each operator's individual NP data is collected in each operator's individual database and can be reciprocally queried in real time.

  Explanations for each of the solutions are shown below.

- **Solution A**: Each operator's individual NP data is collected in each operator's individual database (no sharing of NP data between operators):

  In this architecture, each operator holds/manages a non-real-time database and a real-time database separately on its own. Database management does not involve any transfer of database information between operators.

- **Solution B**: NP data from all operators is collected in each operator's individual database:

  In this architecture, NP data stored within each operator's individual non-real-time database (the NPDB according to [ETSI TR 184 003]) are reciprocally exchanged between operators. This reciprocal exchange of database information enables each operator's individual non-real-time database and individual real-time database (the OpDB according to [ETSI TR 184 003]) to hold NP data of all operators.

- **Solution C**: NP data from all operators is collected in a central non-real-time database; which will then be replicated to each operator's individual database to be queried for routing purposes:

  In this architecture, a central non-real-time database is established to be shared by all the operators. NP data stored within each operator's individual non-real-time database (NPDB) is transferred to this central non-real-time database (CRDB); as a result the central non-real-time database will hold NP data from all operators. Each operator then downloads data from this central non-real-time database, thereby enabling each operator's individual non-real-time database (NPDB) and individual real-time database (OpDB) to hold NP data of all operators.

- **Solution D**: NP data from all operators is collected in a central non-real-time database; which will then be replicated to a central real-time database to be queried for routing purposes:

  In this architecture, a central real-time database, together with a central non-real-time database, is established to be shared by all the operators. NP data stored within each operator's individual non-real-time database is transferred to this central non-real-time database; as a result the central non-real-time database will hold NP data from all operators. This data will then be downloaded (from the central non-real-time database) to the central real-time database. Each operator directly refers to this central real-time database in order to perform real-time processing.

- **Solution E**: Each operator's individual NP data is collected in each operator's individual database and can be reciprocally queried in real time:

  In this architecture, each operator's individual NP data is collected in each operator's individual database (no sharing of NP data between operators). However, the operators are able to refer, in real-time, to the NP data that is stored within each operator's respective real-time databases (OpDB) by utilizing a DB query technology (e.g., ENUM-like technology).

Of the above five options, solutions A, B, and C are currently adopted in many countries as they are deployable on the legacy PSTN environment. Solution D requires the implementation of a central real-time database, (NOpDB according to [ETSI TR 184 003]), in which ensuring high reliability will become a major issue.

ENUM-like technology can be used by the above solutions, especially in the case of solution E, as a way of implementing a NP database among other possible implementation solutions, mainly in the context of NGN IP-based networks. An example of ENUM-like technology utilization for Solution E is shown in Figure 14. In this case, Solution E will be able to have a high affinity for the IP-based NGN environment, since it will be possible to leverage the assets and know-how of DNS technology.

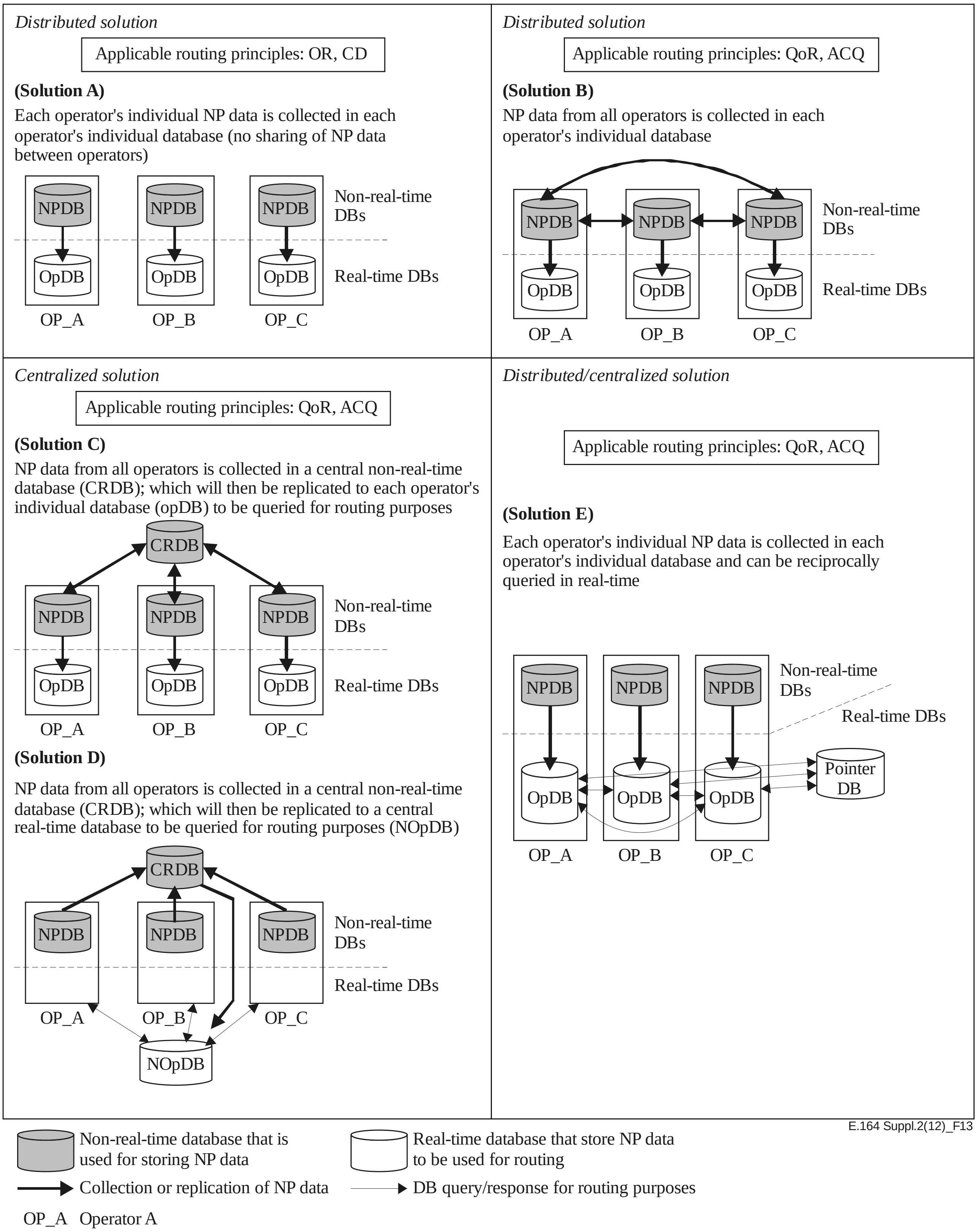


Figure 13 – Examples of number portability databases solutions

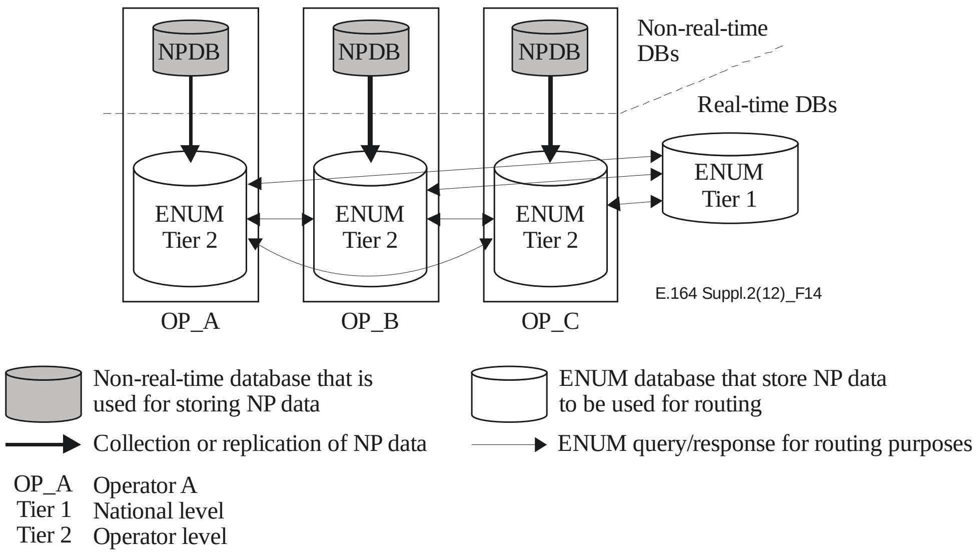


Figure 14 – Example of an ENUM technology utilization for Solution E

12 Administrative processes

In establishing number portability, processes that underpin its introduction and management are a key requirement. The following list provides top-level guidance on specific areas of activity and the steps that need to be covered. For more details on administrative support, please refer to [ETSI TR 101 698].

Process activity	Steps to be covered
Service establishment	*Initial contact between operators* Planning stage Implementation planning Network implementation and testing
Service maintenance	Introduction of a new switch Introduction of a new numbering block Number change New routing number
Service ordering	*Request* Validation Scheduling Contingency plans Hours Subsequent portability Change of account name Reasons for rejection Installation Cancellation

Process activity	Steps to be covered
Fault and repair handling	
Directory number information	Directory entries Operator assistance Emergency service Number plan administration Law enforcement agencies
Billing	

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