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Supplement 2

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SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

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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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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6.2	ITU-T E.164 Suppl. 1	1998-03-09	2	11.1002/1000/4510
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6.5	ITU-T E.164 Suppl. 3 (2004) Amd. 1	2009-11-24	2	11.1002/1000/10691
6.6	ITU-T E.164 Suppl. 4	2004-05-28	2	11.1002/1000/7393
6.7	ITU-T E.164 Suppl. 4 (2004) Amd. 1	2009-11-24	2	11.1002/1000/10692
6.7	ITU-T E.164 (2010) Amd. 1	2011-06-10	2	11.1002/1000/11025
6.8	ITU-T E.164 Suppl. 5	2009-11-24	2	11.1002/1000/10693
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The international public telecommunication numbering plan

Supplement 2

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. This Supplement 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 (2013), *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 NGN and NGCN*.

[IETF RFC 4694] IETF RFC 4694 (2006), *Number Portability Parameters for the "tel" URI*.

[IETF RFC 5067] IETF RFC 5067 (2007), *Infrastructure ENUM requirements*.

[IETF RFC 6116] IETF RFC 6116 (2011), *The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM).*

3 Definitions

The following terms used in this Supplement are to apply within the context of number portability.

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 address [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 geographic number [ITU-T E.101]: An E.164 number which corresponds to a discrete geographic area.

3.1.3 non-geographic number [ITU-T E.101]: An E.164 number which has no geographic significance.

3.1.4 E.164 numbering plan [ITU-T E.101]: A type of numbering plan that specifies the format and structure of the numbers used within that plan. It typically 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 international E.164-numbering plan (also called the international public telecommunication numbering plan).

3.1.5 routing number [ITU-T E.101]: An address/number, only used for routing purposes and not known by end users, that is derived and used by the public telecommunication network to route the call/session towards the network termination point. This address/number can also be used to route calls towards a ported number.

3.1.6 service number [ITU-T E.101]: A non-geographic E.164 number allocated to a specific category of services.

3.1.7 number portability (NP) query [ETSI TR 184 003]: Query using the data base query function.

3.2 Terms defined in this Supplement

This Supplement defines the following terms:

3.2.1 central reference database: A non-real time database that is used to store a country's number portability routing data. The data contained in the central reference database (CRDB) usually consist of a list of ported telephone numbers with associated domain names, routing numbers and optionally further information of an 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 requests further processing in order to render routing information.

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

3.2.2 directory number: See end user's number.

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

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

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

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

3.2.6 ENUM query: Query made using ENUM in order to resolve a specific ITU-T E.164 number to a routable uniform resource identifier (URI).

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

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

3.2.9 operational database (OpDB): 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.

NOTE – Based on the definition in [ETSI TR 184 003].

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

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

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

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

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

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

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

3.2.17 service provider portability: The ability of an end user to retain nationally the same ITU-T 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).

3.2.18 service provider portability for geographic numbers: The ability of an end user to retain nationally the same geographic ITU-T 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.

3.2.19 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.

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

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

ACQ	All Call Query
CC	Country Code
CLI	Calling Line Identification
COLP	Connected Line Identification Presentation
CRDB	Central Reference Database
DB	Database
DN	Directory Number
DNS	Domain Name System
ENUM	Telephone Number Mapping
IP	Internet Protocol
ISDN	Integrated Services Digital Network
NGN	Next Generation Network
NNP	National Numbering Plan
NP	Number Portability
NPDB	Number Portability Data Base
NPDI	Number Portability Database Indicator
NRI	Number Portability Routing Information
NTP	Network Termination Point
NW	Network
OpDB	Operational Data Base
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
QoR	Query on Release
RN	Routing Number
POI	Point of Interconnection
SIP	Session Initiation Protocol
URI	Uniform Resource Identifiers

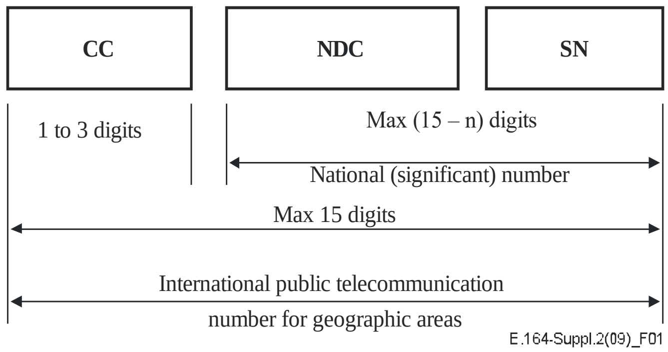
5 ITU-T E.164 number structures

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.

5.1 International public telecommunication number for geographic areas

Figure 1 depicts an international public telecommunication number structure for geographic areas.



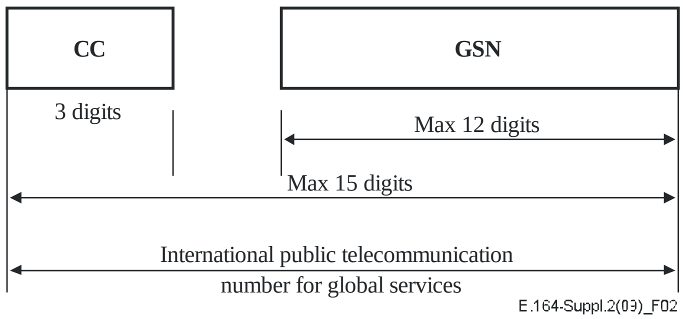
CC Country Code for geographic areas
NDC National Destination Code (optional)
SN Subscriber Number
n Number of digits in the country code

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

5.2 International public telecommunication number for global services

Figure 2 depicts an international public telecommunication number structure for global services.



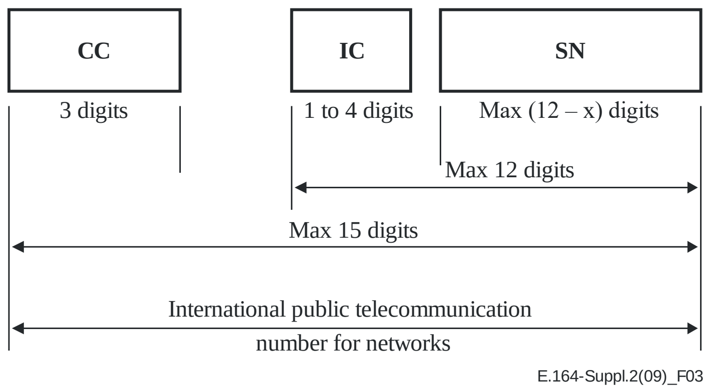
CC Country Code for global services
GSN Global Subscriber Number

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

5.3 International public telecommunication number for networks

Figure 3 depicts an international public telecommunication number structure 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

6 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.

7 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 limitations, as it is dependent on the ITU-T E.164 numbering plan requirements established by a country's administration.

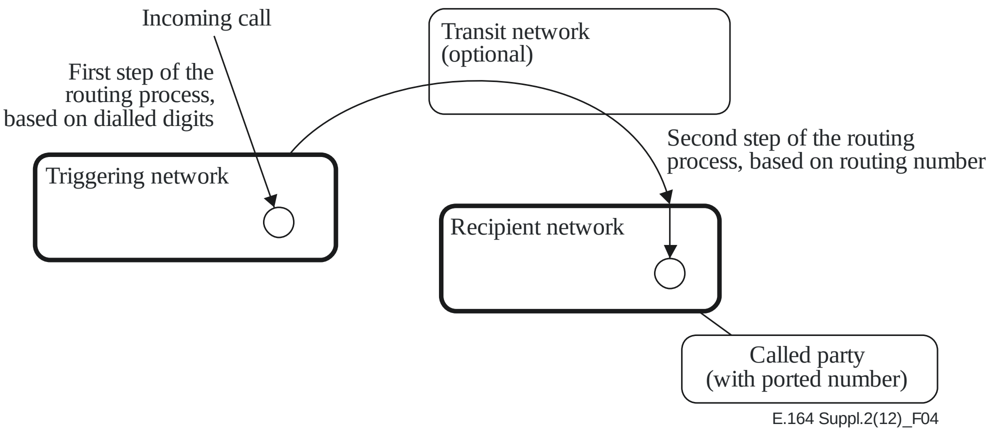


Figure 4 – Conceptual framework for number portability (NP) handling

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 main consecutive 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 a 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.

8 Entities addressed by routing

Entities which need to be addressed by a routing number (RN) or number portability routing information (NRI), the definition of which 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 and 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.

9 Number portability mechanisms

9.1 Assumptions

Internal assumptions that have been made are listed below:

a) calling line identification (CLI) is required to be transported unchanged along with a possible presentation supplementary service 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.

9.2 General description

9.2.1 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.

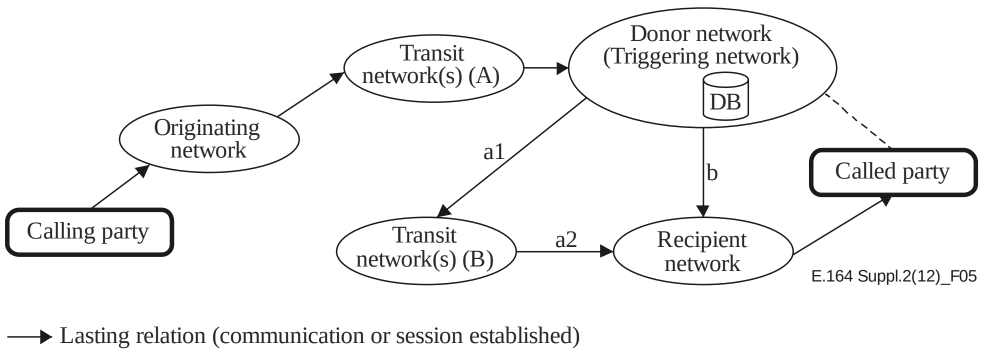


Figure 5 – Call delivering to recipient network by onward routing principles from donor network

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.

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

9.2.2 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. In addition, in this scenario, only the donor network maintains NP routing information, i.e., the RN associated with the recipient network for ported out numbers.

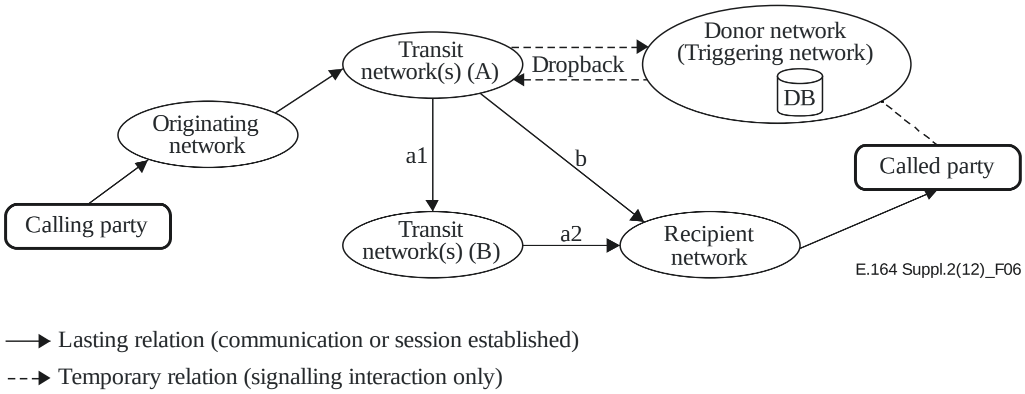


Figure 6 – Dropback with re-routing information and onward re-routing performed by a transit network

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 if it determines that the preceding network has "dropback" capability. The originating network, at reception of the release, re-routes the call towards the recipient network.

It should be noted 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) between the onward routing (transit or originating) network and the recipient network.

9.2.3 Call re-routing initiated by "query on release" 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 signal indicating 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.

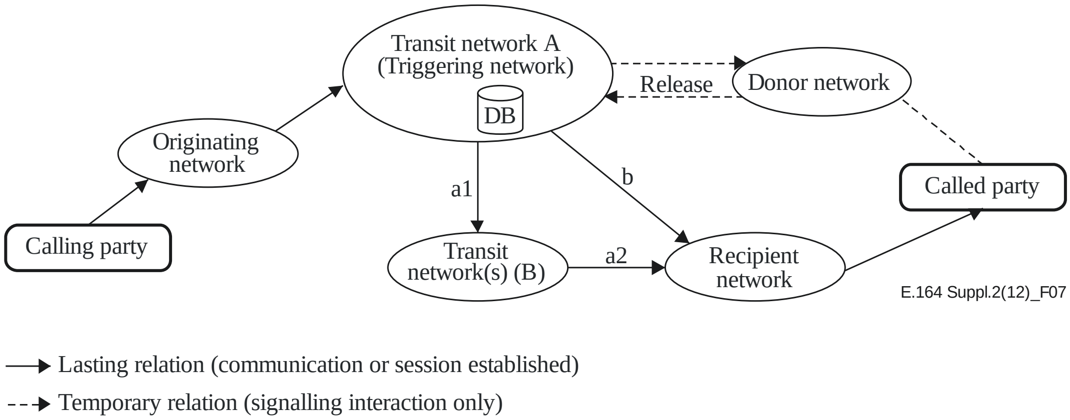


Figure 7 – Query on release by transit network

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 Figure 7 as transit network A).

9.2.4 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 with the recipient network.

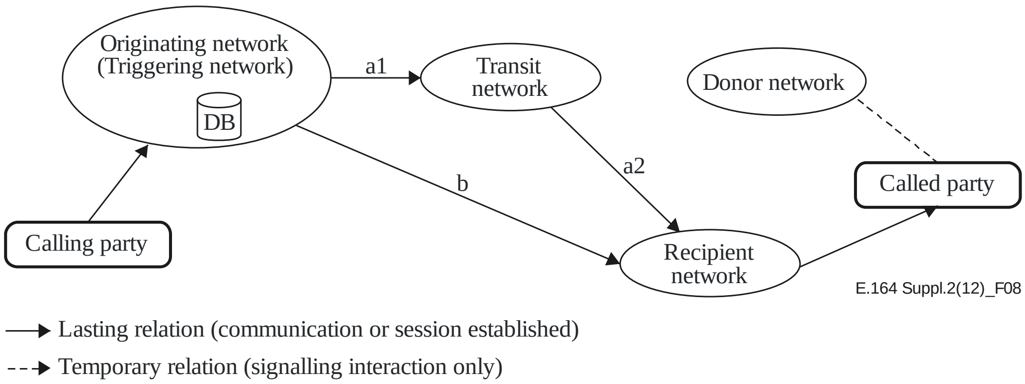


Figure 8 – All call query by originating network

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) might be transiting the call to the recipient network.

9.2.5 Next generation network 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 6116], 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.

10 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 10.1);

– separated address (see clause 10.2);

– RN only, i.e., a plain network address, suppressed ITU-T E.164 number (see clause 10.3);

– DN only, i.e., a plain ITU-T E.164 number (see clause 10.4).

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

10.1 Concatenated address

10.1.1 Description of concatenated address

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, see Figure 9.

RN	DN

Figure 9 – A concatenated address

RN is a routing number prefixed for a routing purpose. The length of the 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 nationally spare hexadecimal values in the Signalling System No. 7. RN is used to route the call to the addressed entity.

10.1.2 Brief analysis

Case 1

Advantages:

This solution does not waste any numbering resources 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.

Disadvantages:

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

Advantages:

As for case 1, this solution can also be accommodated in the existing signalling. In contrast 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.

Disadvantages:

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

Advantages:

This solution does not waste any resources 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.

Disadvantages:

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).

10.2 Separated addresses

10.2.1 Description of separated addresses

In this address type, the RN and the directory number are carried in two different fields in the signalling messages, see 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.

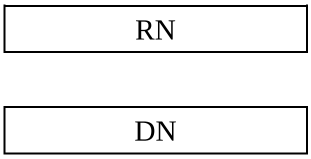


Figure 10 – A separated address

10.2.2 Brief analysis

Advantages:

The RN can either be an ITU-T E.164 number or a national-only number and therefore numbering resources belonging to the national numbering plan (NNP), and it is usable only inside a specific country. In addition, 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.

Disadvantages:

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

10.3 RN only sent between networks

10.3.1 Description of routing number only

In this case, the routing number is the only information being sent between networks, see 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.

Figure 11 – Routing number only

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

10.3.2 Brief analysis

Advantages:

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

Disadvantages:

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

10.4 DN only (normally across network boundaries)

10.4.1 Description of DN only

In this case, the directory number is the only information that is being sent between networks, see Figure 12.

Figure 12 – A directory number only

10.4.2 Brief analysis

Advantages:

This is the usual 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.

Disadvantages:

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

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

Previous clauses 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 each other, 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 the economical and technical parameters of each individual situation. For this reason, this Supplement does not recommend one solution over another.

12 Examples of locations of OpDBs and CRDBs for number portability

12.1 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 may possibly even be located 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 DB 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 the 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 to 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.

12.2 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.

Descriptions 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 number portability data base (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 (the 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 (the 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 five options above, 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. Examples of ENUM-like technology utilization for these solutions are described in clause 12.2.1. 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.

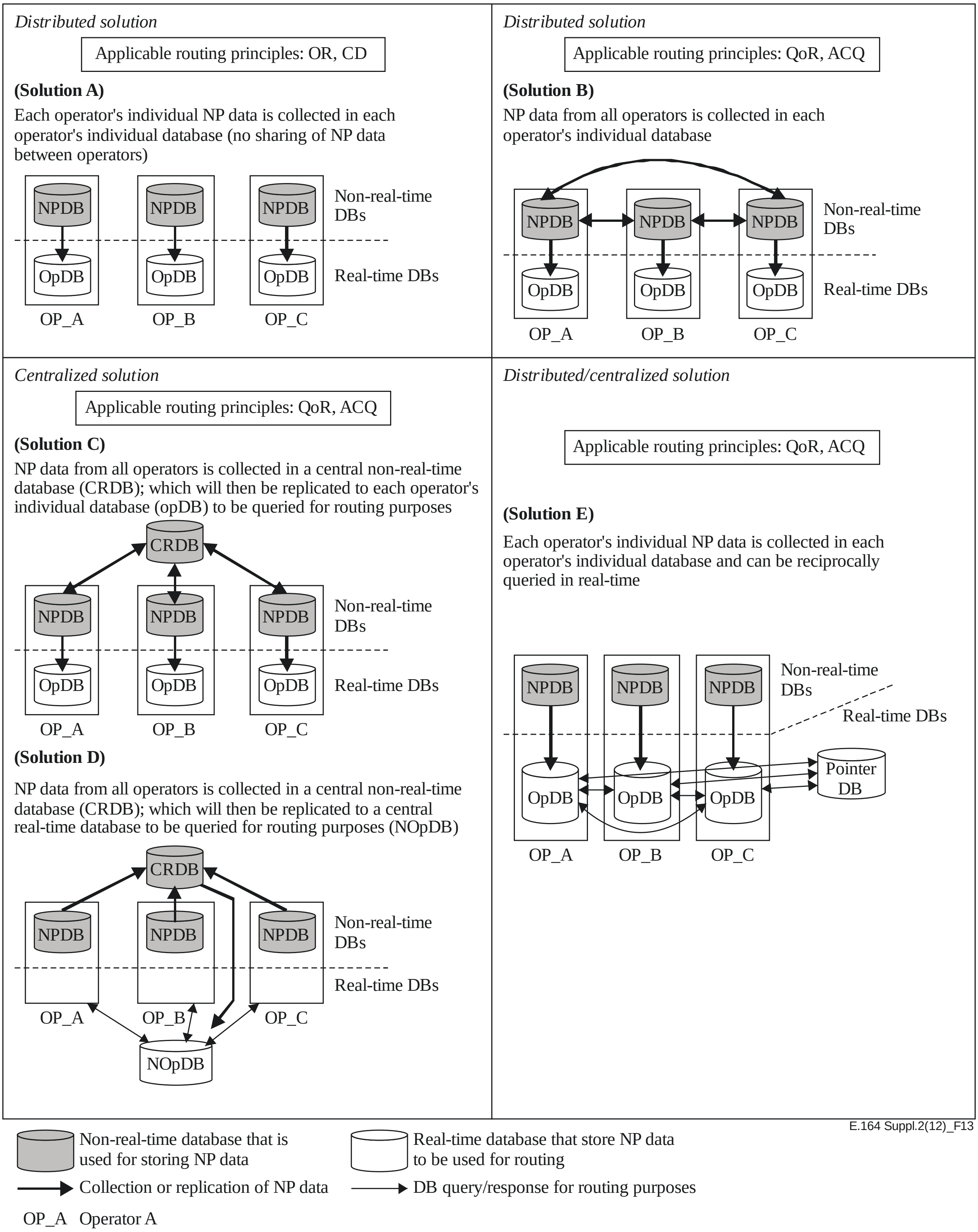

Figure 13 – Examples of number portability databases solutions

12.2.1 Examples of ENUM-like technology utilization

ENUM, based on the IETF definition [IETF RFC 6116], is 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. However, implementation of number portability and routing of calls differ from country to country, based on national requirements and mandates and therefore there is no single solution that suits all countries. Consequently, implementation examples of utilizing ENUM-like technology (see Note) for existing number portability systems in several ways can be considered, among other possible implementation solutions, as applicable to IP address-based networks such as NGN.

NOTE – An ENUM-like technology here means a technology providing capabilities similar to those provided by the standardized infrastructure ENUM. In addition, infrastructure ENUM is defined in [IETF RFC 5067] as an ENUM system that is technically based on [IETF RFC 6116] and is defined and used only inside a network and among networks for routing purposes.

The four examples of an ENUM-like technology utilization for the solutions in clause 12.2 are listed below. Overview diagrams of those examples are shown in Figure 14.

- Example of an ENUM-like technology utilization for Solution A:
  Local ENUM with no sharing of NP data among operators
- Example of an ENUM-like technology utilization for Solutions B & C:
  Local ENUM with common/shared NP data among operators
- Example of an ENUM-like technology utilization for Solution D:
  National ENUM with collective NP data from all operators
- Example of an ENUM-like technology utilization for Solutions C & E:
  Hierarchical ENUM

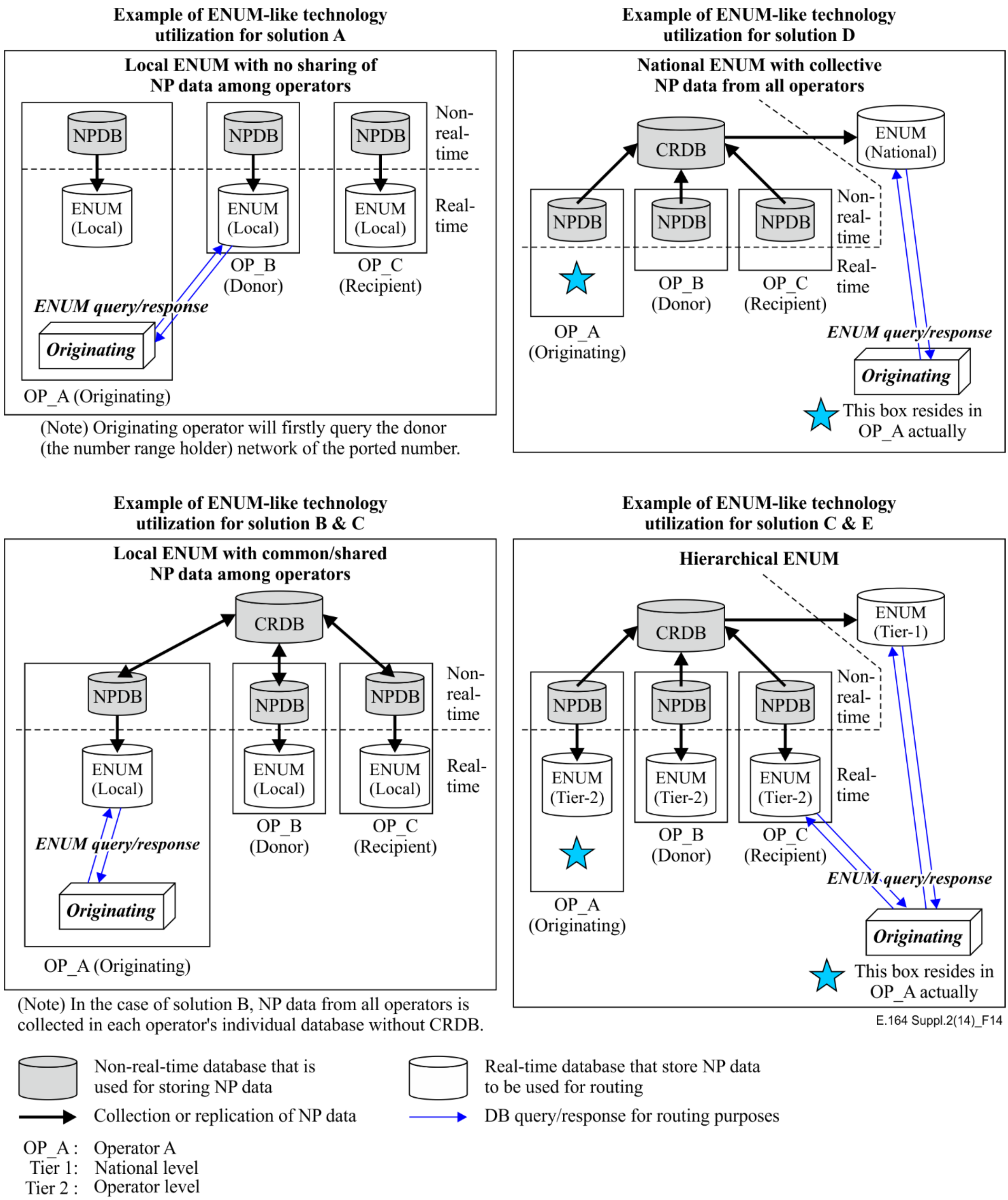

Figure 14 – Examples of ENUM-like technology utilization

12.3 Use cases of number portability solutions toward all IP

Use cases of estimated number portability solutions toward all IP in 11 countries are introduced in Appendix I. The study of these use cases is thought to be very useful for future works, while there may be some remaining ones for further study. Concerning some background information for each country on the reasons that led to the choice described, the following description may be applicable to most countries of non-ENUM-like solution.

Number portability (NP), has now for some time operated within each country based on standard technical solutions (usually NP mechanisms defined by ITU-T and ETSI on traditional telephone technology), nationally adapted and implemented with country-specific characteristics. Since large investments towards implementing and operating number portability have already been spent by the telecommunications operators within each country, and typically such NP solutions work, it is likely that the options to be selected toward all IP will be based on safeguarding the national investments already done, following progressive network technological evolutions towards NGN.

[ETSI TR 103 282]

other countries introducing enum-like solution will be aiming to upgrade np functions (e.g., to have all call query (ACQ)) or to realize additional services, or certain countries might have a plan to introduce innovative solution such as block-chain other than the existing solutions.

13 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, 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
Fault and repair handling	
Directory number information	Directory entries Operator assistance Emergency service Number plan administration Law enforcement agencies
Billing	

Appendix I

Use cases of number portability solutions toward all IP

I.1 Categorization of use cases

Use cases of number portability solution toward all IP collected from 11 countries are categorized in Table I.1 by mapping to an appropriate option in non-ENUM-like options list (Figure I.1) or in ENUM-like options list (Figure I.2). The options for both lists are extracted from Figure 13 and Figure 14.

Table I.1 – Categorization of use cases

Options (described in Figure I.1 and Figure I.2)		Japan	US	Netherlands(*1) Option 1	Netherlands(*1) Option 2	Italy fixed	Italy mobile	Switzerland	Sweden	Finland	UK	France	Germany fixed	Germany mobile	Spain
non-ENUM like	[A]	○				○●					○				
	[B]						○●						○●		
	[C]		○●	○	●			○●	○●	○		○●		○●	○●
ENUM like	[A]	●													
	[C]			○						◉					
	[D]				◉										
Other Options											◉ [*2)				

(*1)
In the Netherlands operators can use non-ENUM like [C] and ENUM like [C] optionally. Also as a future option, operators will be able to use non-ENUM like [C] and ENUM like [D] optionally.

(*2)
Introduction of the brand-new technology might be one of the possible number portability solution depending on the consultation on key questions including the utilization of new technology such as block-chain for the future of numbering published in April 2019.

○ :current option
● :future option
◉ :future option(foreseen)

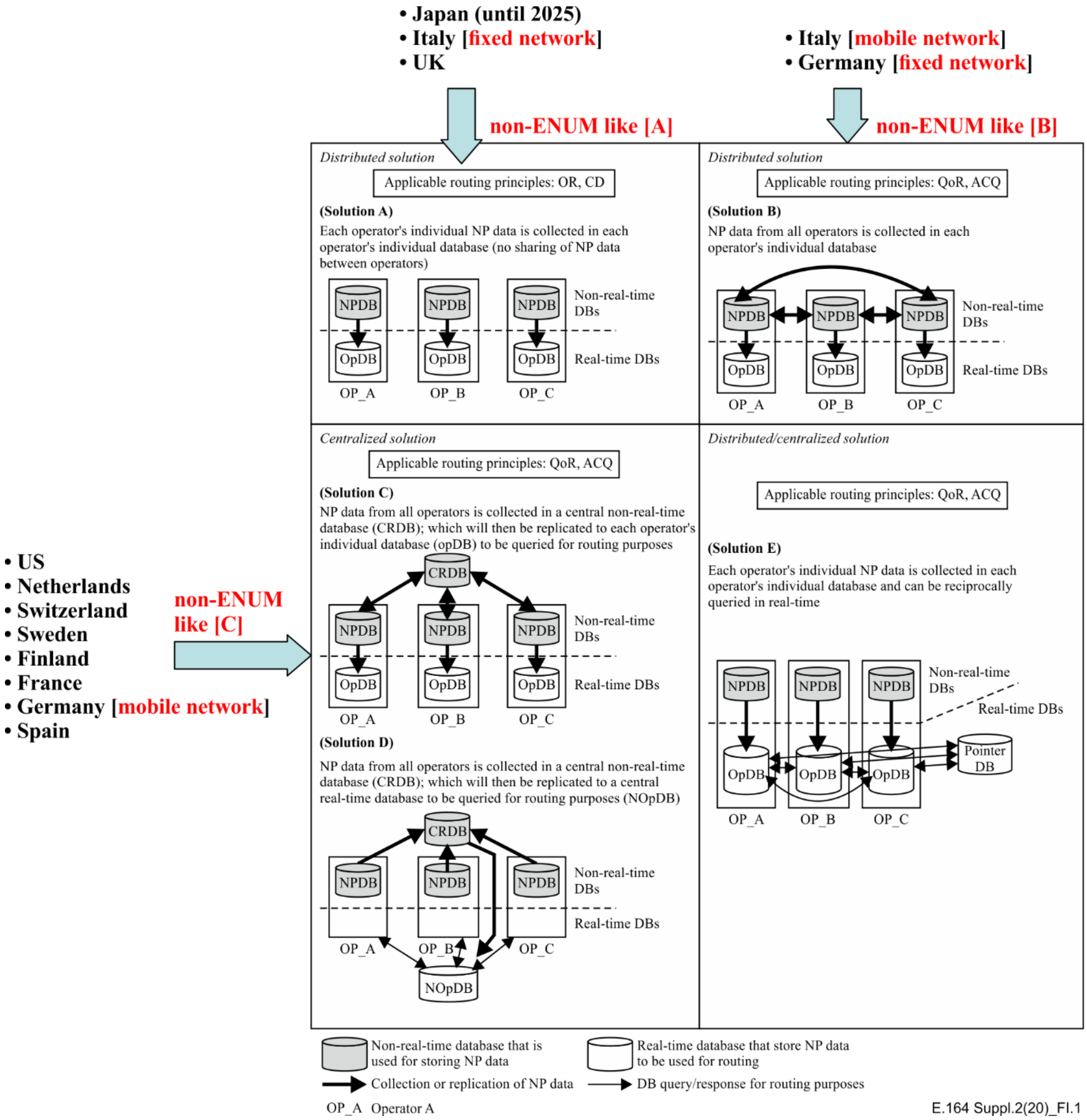

Figure I.1 – Mapping of use cases to non-ENUM-like technology utilization

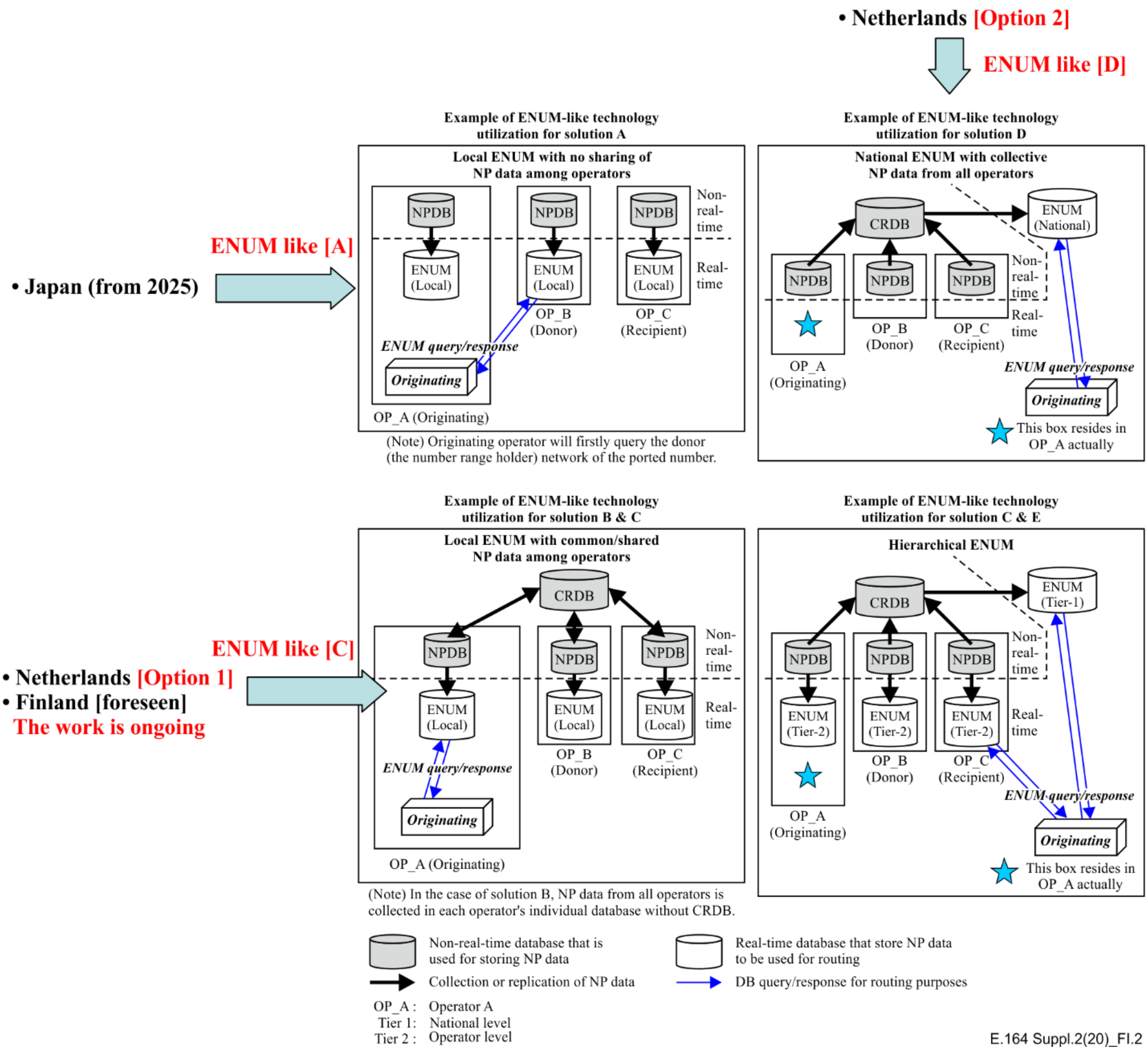

Figure I.2 – Mapping of use cases to ENUM-like technology utilization

I.2 Use case in Japan (ENUM-like)

In Japan ENUM like option [A] categorized in Table I.1 was selected as the solution for IP networks (see also Figure I.3). Based on this, the national standard of number portability architecture was created in August 2015 (*1).

The operators in Japan will start implementation following the national standard in the near future.

(*1) JT-E164_Supplement_2 by TTC of Japan (TTC: The Telecommunication Technology Committee)

JJ-90.31-v3 (Common interconnection interface for carrier ENUM)

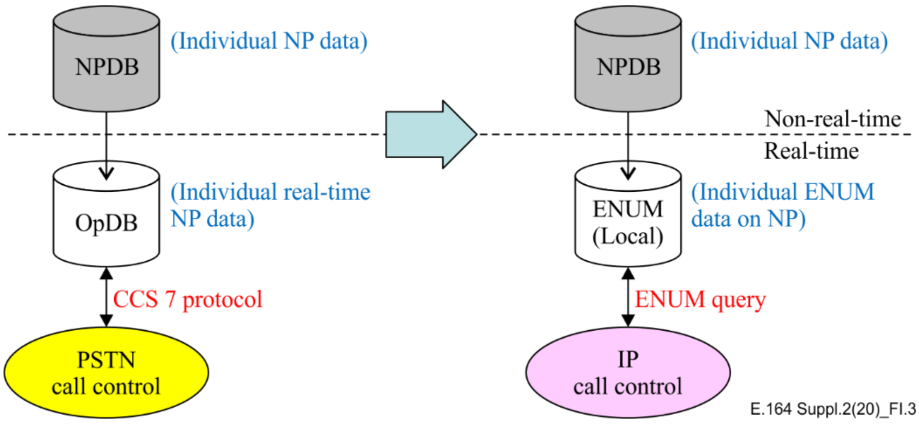

Figure I.3 – Use case in Japan (ENUM-like)

I.3 Use case in the US (non-ENUM like)

It can be considered that in the US, for the time being, the existing CRDB and NPDB will be used toward all IP although the direction might not be decisive yet. It is non-ENUM like option [C] categorized in Table I.1.

ENUM-like technology might be partially used inside of IP call control domain depending on the selection by individual operators in the future (see Figure I.4).

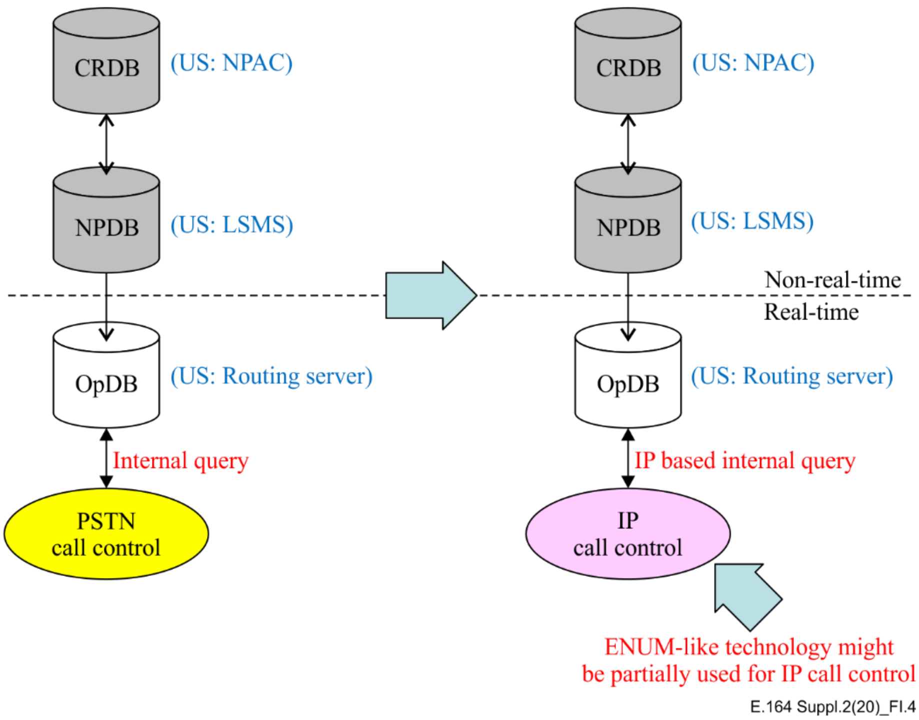

Figure I.4 – Use case in the US (non-ENUM like)

I.4 Use case in the Netherlands (both non-ENUM-like and ENUM-like could be used optionally)

In the Netherlands, two options were considered as is categorized in Table I.1. The operators can use non-ENUM like [C] and ENUM like [C] optionally. Also, as a future possibility, the operators will be able to use non-ENUM like [C] and ENUM like [D] optionally (see Figure I.5).

Specifically, in the Netherlands, the central number porting platform of COIN (CRDB) supports the number porting process for all network types (fixed, mobile, TDM and IP). ENUM data can be centrally stored in CRDB and distributed to the operators in addition to number porting reference data. The operators process the COIN reference data in their IT systems and the routing platforms for performing all call query (ACQ) based routing in the NL; using COIN ENUM reference data is optional. It is expected that in future an ENUM like reference data solution will be available in the NL for telephone number reference data. Current COIN NP solution/reference data supports clean routing in the NL for both TDM and IP based networks.

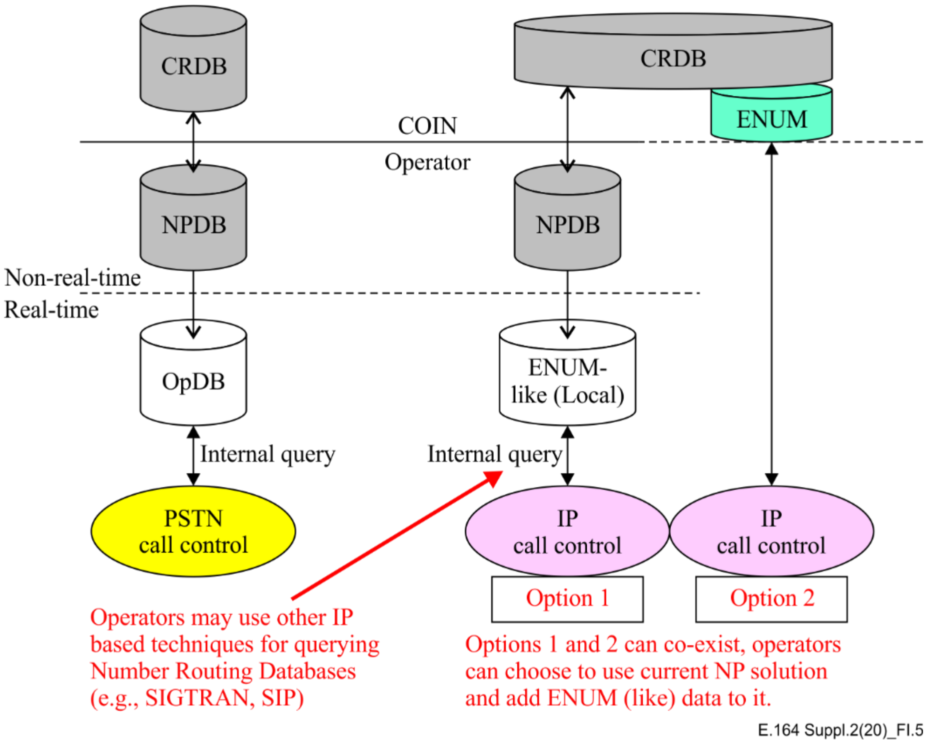

Figure I.5 – Use case in the Netherlands
(both non-ENUM-like and ENUM-like could be used optionally)

I.5 Use case in Italy (non-ENUM like)

In Italy, the solution used for fixed networks (NWs) is different from the one for mobile networks. The solution for fixed NW is non-ENUM like option [A] and the solution for mobile NW is categorized option [B] as shown in Table I.1. For fixed networks currently onward routing is used. There is at the time of writing on-going work to consider whether it is necessary to change this. For mobile networks currently the NP data of all mobile numbers are synchronised and all call query (ACQ) is used (see Figure I.6). All DBs contain the same global information. No change for this mechanism for all IP NW is foreseen. In this case IP call control will use IP based internal query. The operator DB is organised in two levels as follows:

- First level: the information is exchanged among all the mobile operators
- Second level: the single mobile operator exchanges (fixed network operator receives) the routing information only with (from) one mobile operator of the first level

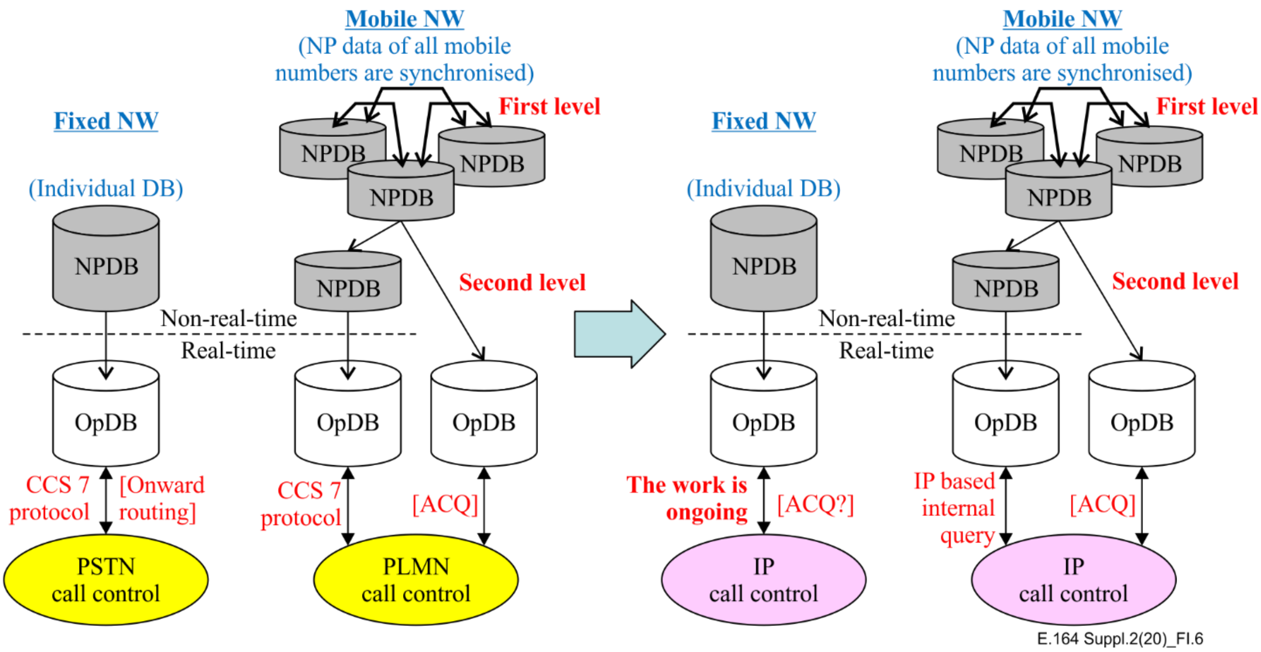

Figure I.6 – Use case in Italy (non-ENUM like)

I.6 Use case in Switzerland (non-ENUM like)

In Switzerland, non-ENUM like option [C] categorized in Table I.1 is in operation (see also Figure I.7). However, while migrating towards an All-IP environment each operator is free to choose and implement the preferred technology of the NPDB/OPDB, as far as numbering administrators are aware operators do not prefer ENUM-like solutions.

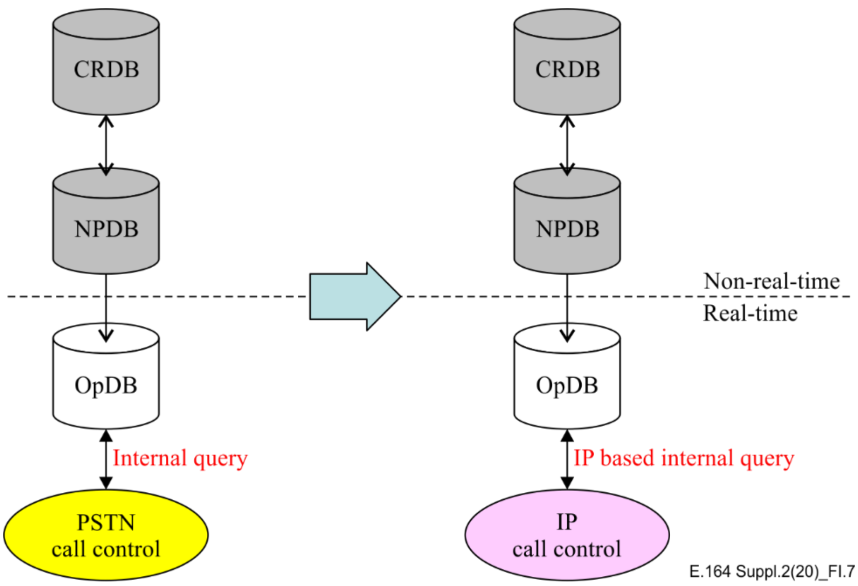

Figure I.7 – Use case in Switzerland (non-ENUM like)

I.7 Use case in Sweden (non-ENUM like)

In Sweden, the Swedish Number Portability Administrative Center (SNPAC) manages the administrative reference database CRDB (see Figure I.8). The Telecom Operators manages the AdmDBs (NPDBs) and operational databases (OpDBs) themselves.

The porting information is completed with routing information by the network operator. Therefore, itis not guaranteed that SNPAC would know if the network operators recently did some work to create a NOpDB from the porting information delivered by CRDB. However, no such work is being done at present.

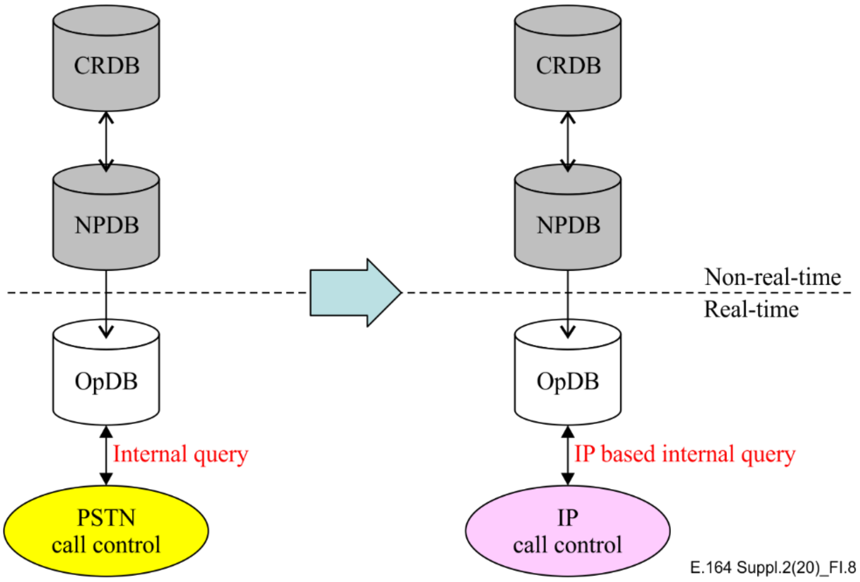

Figure I.8 – Use case in Sweden (non-ENUM like)

I.8 Use case in Finland (ENUM like is foreseen)

Currently the work is ongoing, and the scenario based on ENUM-like technology is foreseen (see Figure I.9).

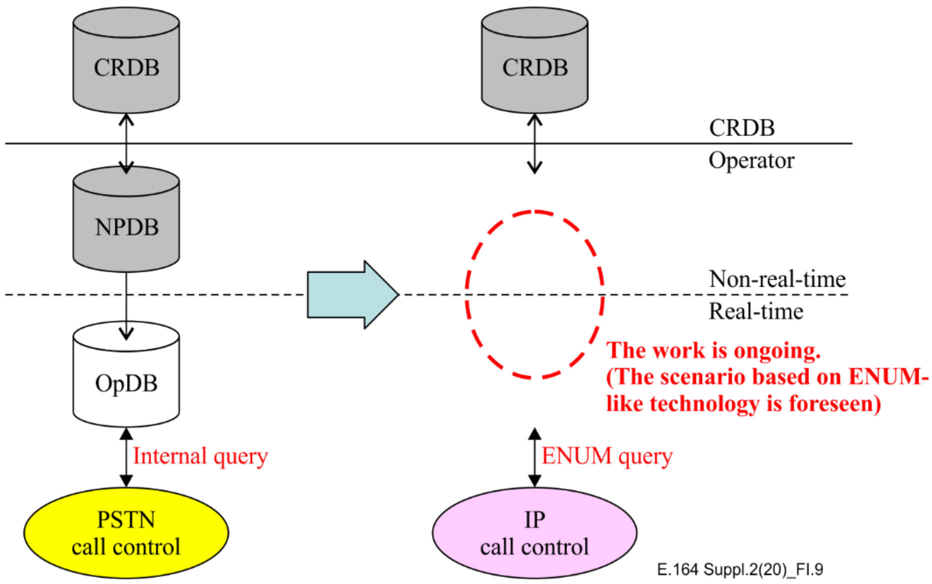

Figure I.9 – Use case in Finland (ENUM like is foreseen)

I.9 Use case in the UK (non-ENUM like)

Currently number portability in the UK is non-ENUM like option [A] as shown in Table I.1 (see also Figure I.10), while it is considered that the introduction of the new technology might be one of the possible number portability solution. The recent consultation includes questions of the utilization of new technology such as block-chain for the future of numbering published in April 2019.

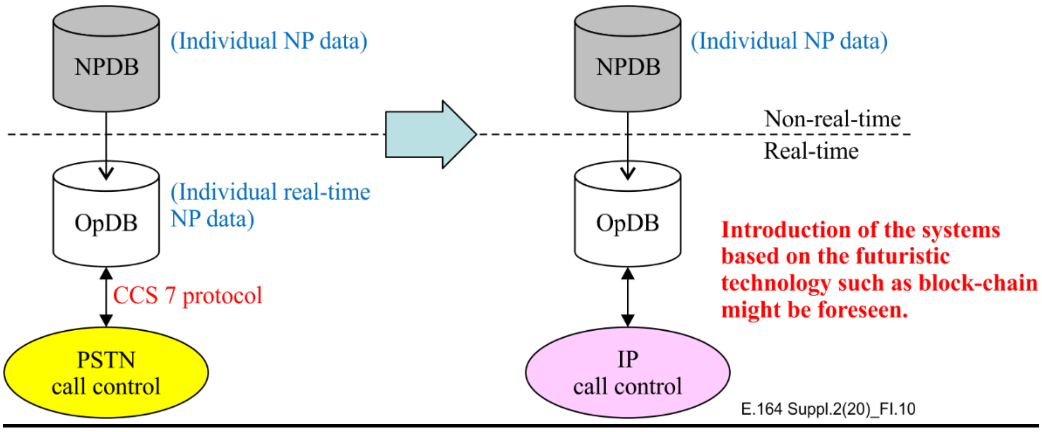

Figure I.10 – Use case in the UK [Other option]

I.10 Use case in France (non-ENUM like)

In the use case for France, Figure I.11 shows the current direction towards PSTN migration. There is no foreseen impact in France for number portability for a migration from PSTN to IP although ENUM-like technology might be used for IP call control individually by some operators.

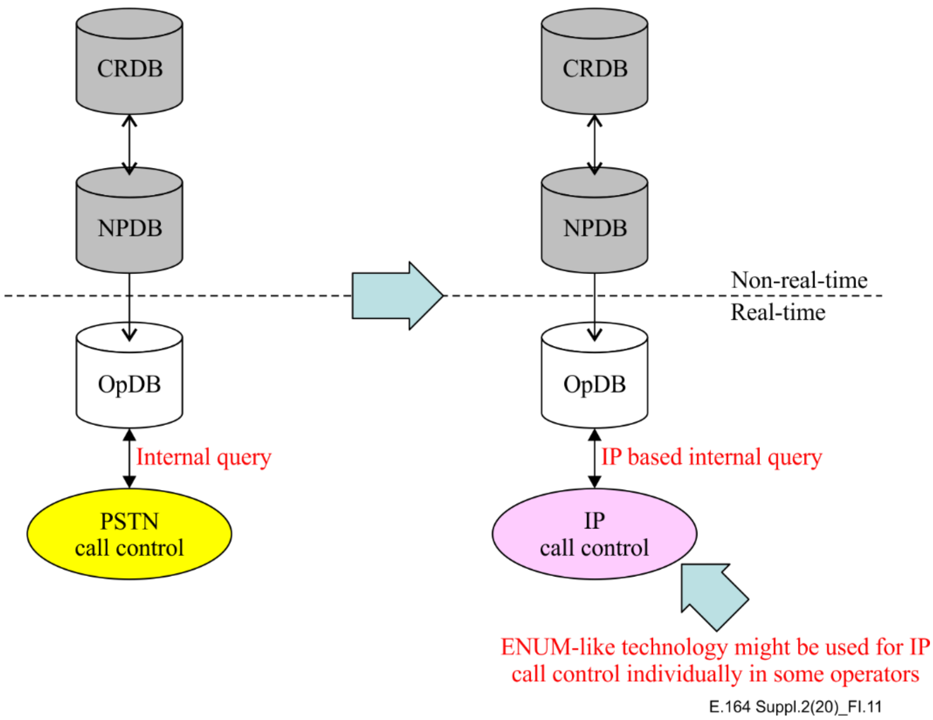

Figure I.11 – Use case in France (non-ENUM like)

I.11 Use case in Germany (non-ENUM like)

In Germany, the solution for fixed NW is non-ENUM like option [B] and the solution for mobile NW is non-ENUM like option [C] as shown in Table I.1 (see also Figure I.12).

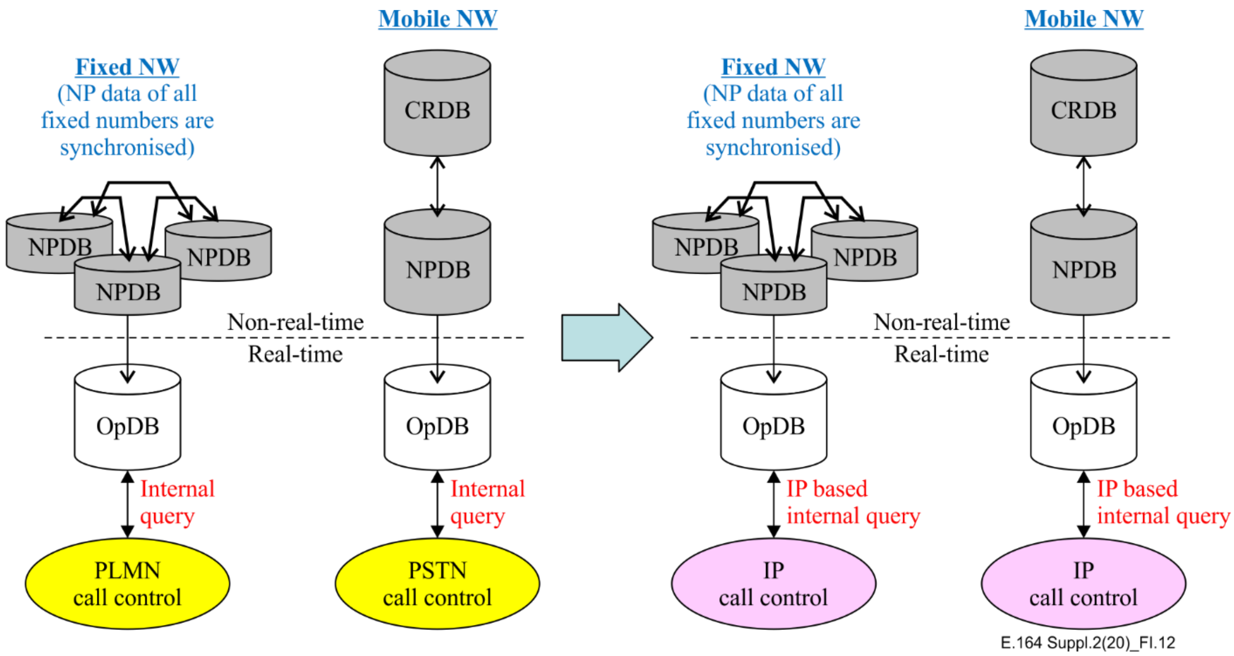

Figure I.12 – Use case in Germany (non-ENUM like)

I.12 Use case in Spain (non-ENUM like)

In Spain, non-ENUM like option [C] categorized in Table I.1 is in operation (see also Figure I.13). There are operators that use ENUM internally in their networks. However, the architecture deployed by the operators for the migration of PSTN to IP does not affect the operation of the centralized portability platform. The operators continue to use the same interfaces and procedures with the central portability platform. The migration to IP has only affected the interconnection. In the IP interconnection the session initiation protocol (SIP) is used and the portability information is exchanged following RFC 4694. The parameters exchanged are:

- RN (Routing Number): equivalent to NRN
- NPDI (Number Portability Database Indicator): indicates whether a portability database has already been queried, to avoid recursive queries.

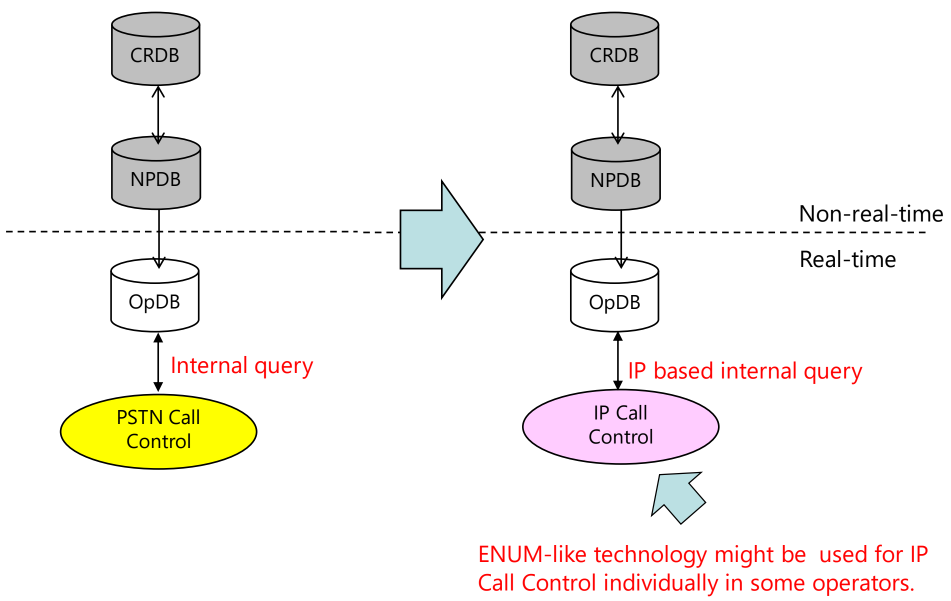

Figure I.13 – Use case in Spain (non-ENUM like)

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