



TECHNICAL REPORT

Network Technologies (NTECH); Options for Number Portability and actual use cases

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Foreword

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Modal verbs terminology

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Introduction

In voice and multimedia IP-based networks (NGN included), E.164 numbers are, and will continue to be used as the basic (primary) identifier that enables the originating party to establish a call/communication with an end-user or a service. In this context, infrastructure ENUM systems, being an effective mechanism for mapping E.164 numbers to URIs, that identify the network actually serving these E.164 numbers and that are usable inside DNS systems for routing purposes, are at the time of writing being implemented inside networks, or are expected to be implemented at some point in the near future.

On the other hand 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 done by the telecommunications operators within each country, and typically such NP solutions work, it is likely that the options to be selected for establishing ENUM mechanisms will be based on safeguarding the national investments already done, following progressive network technological evolutions towards NGN.

So it can be assumed that ENUM mechanisms, when used inside NGN IP-based networks, will in principle conform with the existing national number portability solutions already adopted and working within each country; therefore there will be a number of different options suitable for establishing ENUM mechanisms without necessarily changing or evolving existing NP technical solutions. It is important to remark that ENUM is, first of all, a hierarchical system that extends the DNS system, following in principle the same approach, and ENUM is also a standard "query" protocol to derive, based on E.164 numbers, the appropriate routing information, that is usable inside IP-based networks. These ENUM components are part of the ENUM system, also in the case of ENUM query mechanisms implemented inside existing NP solutions (referred as ENUM-like non-standard solutions).

Although around five years have passed since the first version of the present document was published in June 2014, in most countries, migration from PSTN to IP-based networks (NGN included) is not complete yet. This revised version introduces actual use cases of number portability in 7 countries towards all IP networks in order to verify the estimated direction of number portability described in the original version, which was expected to be "ENUM-like" technology with considerable degrees of variation among the possible solutions.

The present document introduces several use cases of current or proposed number portability solutions at this point toward all IP in 7 countries (Japan, US, Netherlands, Italy, Switzerland, Sweden, Finland) with the cooperation of experts from each country. They are newly described in Annex B.

Although these use cases may include indecisive area it can be said that there are other options than ENUM-like technology concerning all IP Number Portability so that the ENUM-based option may not necessarily be the target for some networks or countries.

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1 Scope

The present document aims to lay out and organize the various available options for establishing ENUM or ENUM-like mechanisms for number portability, and to establish a correspondence between these available options and actual use cases that are currently under implementation or are expected to be so in the near future.

Also the present document introduces several use cases of current or proposed number portability solutions at this point toward all IP in 7 countries (Japan, US, Netherlands, Italy, Switzerland, Sweden, Finland) with the cooperation of experts from each country. They are newly described in Annex B in the revised version.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TR 101 122 (V1.1.1): "Network Aspects (NA); Numbering and addressing for Number Portability".
- [i.2] Recommendation ITU-T E.164 Supplement 2 (2014): "Number portability".
- [i.3] 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 Recommendation".
- [i.4] IETF RFC 6116: "The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery System (DDDS) Application (ENUM)".
- [i.5] Recommendation ITU-T E.164 (2010): "The international public telecommunication numbering plan".
- [i.6] IETF RFC 5067: "Infrastructure ENUM Requirements".
- [i.7] ETSI TR 184 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Portability of telephone numbers between operators for Next Generation Networks (NGNs)".
- [i.8] GSMA IR.67 version 8.0 (23 November 2012): "DNS/ENUM Guidelines for Service Providers & GRX/IPX Providers".
- [i.9] Reference to a Dutch ENUM implementation public information.
(e.g.: <https://www.coin.nl/index.php/en/>).
- [i.10] Reference to a North American ENUM implementation public information.
(e.g.: http://www.itu.int/ITU-D/finance/work-cost-tariffs/events/tariff-seminars/Geneva-OriginID/pdf/Session2_Lind_ENUM_presentation.pdf).

- [i.11] Reference to a German ENUM implementation public information.
(e.g. <https://ripe64.ripe.net/presentations/93-e-wtklxc-RIPEGlobalVoix-003.pdf>).
- [i.12] GSMA NG.105 ENUM Guidelines for Service Providers and IPX Providers.
- [i.13] TTC standard JJ-90.31-v3: "Common interconnection interface for carrier ENUM".
- [i.14] TTC standard JT-E164_Supplement_2: "Number Portability".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

data base query function: function whereby a data base is accessed in order to ascertain whether a telephone number is ported, and if it is, a Routing Number or a domain name is obtained that can be used to route the call to a destination

donating network: network from which the number has been ported out in the last porting process

donor network: initial network where a number was allocated by the Numbering Plan Administrator before ever being ported

NOTE: Source ETSI TR 101 122 [i.1].

E.164 number: A string of decimal digits that satisfies the three characteristics of structure, number length and uniqueness specified in Recommendation ITU-T E.164 [i.5]. The number contains the information necessary to route the call to the end user or to a point where a service is provided.

NOTE: Source Recommendation ITU-T E.101 [i.3].

ENUM data: data for mapping an E.164 number to an URI

NOTE: Mapping can be done directly or by providing pointers to other ENUM DBs according to ordinary DNS procedures.

ENUM system: real time hierarchical and distributed system that stores ENUM data and used to resolve E.164 numbers to URIs at session initiation

ENUM query: query adhering to the ENUM query protocol in order to resolve a specific E.164 number to a domain name for routing purposes (e.g. a routable URI)

infrastructure ENUM: ENUM system defined in IETF RFC 5067 [i.6] and technically based on IETF RFC 6116 [i.4]

NOTE: The infrastructure ENUM is defined and used only inside a network and among networks for routing purposes.

Location portability: ability of an end user to retain the same telephone number when moving from one location to another, without changing his service provider

NP Routing Information (NPRI): information needed to complete a communication request to a ported telephone number

Numbering Plan Administrator (NPA) data: off-line data published by the Numbering Plan Administrator (NPA) which provide the number block assignments to operators that provide services within the jurisdiction of the NPA

NOTE 1: If the telephone numbers are subject to number portability the actual operator serving a specific telephone number can differ from the one provided by these data, if these data are not kept aligned with NP data. In cases where telephone numbers are assigned directly to end users, the operator chosen by the end user to provide services is due to spread information that he is serving that telephone number.

NOTE 2: Source ETSI TR 184 003 [i.7].

Numbering Plan Administrator (NPA) DB: non-real time administrative data base that stores NPA Data

Number Portability Data (NPD): off-line data linked to ported telephone numbers as they are stored in and retrieved from the NPDB

NOTE 1: This data consist of a list of ported telephone numbers with associated domain names or routing numbers and optionally further information of traffic and/or administrative nature. Normally these data are provided in a format which requests for further processing in order to render routing information.

NOTE 2: Source ETSI TR 184 003 [i.7].

Number Portability Data Base (NPDB): non-real time data base that is used to store NP Data

NOTE 1: As an option the NPDB may contain information for all telephone numbers (i.e. also non-portable telephone numbers). Such additional information would be based on NPA Data.

NOTE 2: Source ETSI TR 184 003 [i.7].

Number Portability (NP) query: query function whereby a data base is accessed in order to ascertain whether a telephone number is ported, and if it is, a Routing Number or a domain name is obtained that can be used to route the call to a destination

Operational Data Base (OpDB): real time data base that store data from the NPDB to be transformed to NRI used for routing

NOTE: Source ETSI TR 184 003 [i.7].

operator: entity providing public telecommunications networks and/or public telecommunication services

NOTE: Source ETSI TR 184 003 [i.7].

ported number: number that has been subject to number portability

NOTE: Source ETSI TR 101 122 [i.1].

recipient network: current serving network where a number is located after being ported

NOTE: Source ETSI TR 101 122 [i.1].

Reference Number Portability Data Base (RefNPDB): non-real time reference NPDB

NOTE 1: It is national matter whether there is one physical RefNPDB or a logical one, which may be distributed over the operators involved.

NOTE 2: Source ETSI TR 184 003 [i.7].

NOTE 3: In some places the term "RefNPDB" is replaced with the term "CRDB".

service portability: ability of an end user to retain the same telephone number when changing from one type of service to another

Service Provider Portability (SPP): ability of an end user to retain the same telephone number when changing from one service provider to another

NOTE: Source ETSI TR 184 003 [i.7].

telephone number; directory number: number adhering to the national E.164 numbering plan, used by the originating party to establish a call/communication to an end user or a service

NOTE: Source Recommendation ITU-T E.101 [i.3]. The E.101 definition has been modified here to be independent of the network technology, e.g. NGN, PSTN/ISDN and other technologies. The E.101 original definition is:

"4.22 telephone number; phone number; directory number (DN): The number, derived from the E.164 numbering plan, used by the calling party to establish a call to an end user or a service. The number may also be used for presentation services like calling line identification presentation (CLIP) and connected line identification presentation (COLP) and may also be published in different directories and/or directory enquiry services".

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACQ	All Call Query
CD	Call Dropback
CLIP	Calling Line Identification Presentation
COLP	Connected Line Identification Presentation
CRDB	Central Reference Data Base
DB	Data Base
DN	Directory Number
DNS	Domain Name System
ENUM	tElephone NUMber mapping
GSMA	Global System For Mobile Communications Association
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IPX	Internet Packet eXchange
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
NAPTR	Naming Authority Pointer
NGN	Next Generation Network
NopDB	National Operational Data Base
NP	Number Portability
NPA	Numbering Plan Administrator
NPD	NP Data
NPDB	Number Portability Data Base
NPRI	NP Routing Information
NS	Name Server
NW	Network
OP	Operator
OpDB	Operational Data Base
OR	Onward Routeing
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
QoR	Query on Release
RefNPDB	Reference Number Portability Data Base
SG	Study Group
SIP	Session Initiation Protocol
SIP-I	SIP with encapsulated ISUP
SNPAC	Sweden Number Portability Administrative Center
SPP	Service Provider Portability
TLD	Top Level Domain
TTC	Telecommunication Technology Committee
URI	Uniform Resource Identifier

4 Basic concept of the present document

4.1 Original meaning of ENUM and Number portability

The ENUM system is defined as bound to a distributed, decentralized, hierarchical organization of numbers, in which every provider makes available the numbers, at the time of writing handled, in principle, through a local ENUM system that is part of an infrastructure ENUM hierarchy.

On the one hand if a Central Reference Data Base exists, it is not in principle involved in the real-time handling of the calls, but it can be used as a national repository. For this reason this Administrative Central Reference Data Base is considered technically distinct from the ENUM system; in addition it will not in principle be a pre-requisite for the ENUM system implementation and will not influence nor change the intrinsic characteristics of the ENUM system itself, which is defined in international and ETSI normative and technical specifications.

Thus it is not a requirement for the ENUM implementation to change or evolve existing NP models, since the infrastructure ENUM system can be just integrated inside existing NP solutions; in other cases the ENUM system implementation at national level can deeply impact or change existing NP solutions.

4.2 Background for ENUM-like mechanisms

In IP-based networks telephone numbers are still being used as the basic (primary) identifier. In this context ENUM mechanisms are currently being implemented, or are expected to be implemented at some point in the near future, as a tool for mapping E.164 numbers to URIs. With ENUM system in the present document it is referred only the case of the infrastructure ENUM [i.6]; as a consequence, it uses a "technical" TLD other than the "e164.arpa", which is used for public or User ENUM. An ENUM-like system is a system providing capabilities similar to those provided by the standardized infrastructure ENUM. It should be noted that ETSI TR 184 003 [i.7] describes the opportunity to use also other technologies than ENUM for providing NP in NGN mainly for coping with a very heterogeneous network environment.

4.3 Incorporating NP mechanisms into ENUM-like mechanisms

If ENUM or ENUM-like mechanisms are to be used as a tool for call establishment, giving adequate consideration for Number Portability (NP) would be indispensable.

Since large investments towards NP implementation/operation have already been spent within each country, a reasonable form of implementing ENUM-like mechanisms would be to implement them adhering to the existing NP mechanisms varying from one country to another, based on the NP models and mechanisms that have been standardized by ETSI and ITU-T.

4.4 Actual use cases, studies by other SDOs or other organizations

For example, an ENUM-like mechanism applicable for NP operation is under development by a Dutch ENUM implementation [i.9], based on an approach that utilizes the existing NP mechanism.

GSMA IR.67 [i.8], as another example, sets out the different methods for establishing ENUM-like mechanism, depending on whether the existing NP operation is based on a centralized database approach or a distributed database approach.

NOTE: GSMA undertook a review of IR.67 [i.8], which lead to two separate documents: the newly revised IR.67, which only deals with DNS guidelines and for which enum is out of scope, and a new NG.105 ENUM Guidelines for Service Providers and IPX Providers [i.12], which focuses on enum.

4.5 Target of the present document

Target of the present document is to organize and provide a conceptual overview of the available options for implementing/establishing ENUM-like mechanisms, using as a basis the actual use cases (for instance a Dutch ENUM implementation [i.9]) and studies undertaken by other organizations (for instance GSMA IR.67 [i.8]). Preferable options for establishing ENUM-like mechanisms would be those by which existing NP mechanisms (already in operation within each country) could be utilized to a maximum extent.

Each of the options is brought under review. Important items to be studied include issues related with the "co-existence/combination" phase of the existing NP mechanism and the newly implemented ENUM-like mechanism.

5 Options for number portability solution

5.1 Overview

It is assumed that the selection of ENUM/ENUM-like mechanisms as required by the transition of networks to an all-IP infrastructure, will be significantly affected by the existing number portability solutions; in particular by the previously adopted number portability database solutions. Based on this perspective, this clause aims to go over the various options for number portability solution, using the below listed existing documents as source:

- ETSI TR 184 003 [i.7]; and
- Recommendation ITU-T E.164 Supplement 2 [i.2].

Figure 5.1, excerpted from Recommendation ITU-T E.164 Supplement 2 [i.2], provides a graphic explanation on the examples of number portability database solution. All of the options shown in figure 5.1 maintain consistency with ETSI TR 184 003 [i.7], in terms of terminology as well as concept.

NOTE: In some places the term "RefNPDB" is replaced with the term "CRDB".

Figure 5.1 is intended to cover the main number portability database solutions that are implemented in various countries around the world.