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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Network Aspects (NA).

1 Scope

The present document is to analyse the impact of Service Provider Portability on Geographic and non-geographic numbers and number formats used at the Network Termination Point (NTP) and also at the Point Of Interconnection (POI) between networks in a multi-vendor environment. Routeing requirements are analysed and numbers and number formats are derived as a consequence.

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

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[1] ITU-T Recommendation E.164: "International Telecommunication Numbering plan".

[2] TR NA 010063: "High level Description of Number portability".

[3] TR NA 010064: "High level Architecture and solutions to support Number Portability".

3 Definitions and abbreviations

3.1 Definitions

addressed entity: Any entity identified by an address in the routeing process (e.g. called party, serving exchange, point of interconnection, IN-element - depending on the routeing method).

directory number: The number that is dialled by the users to reach the called customer (potentially with prefix and/or with suffix).

routeing number: A specific number that is added and used by the networks to route the call. The Routeing Number conveys information usable by the network. If the digits dialled by the user match the digits of a routeing number, the dialled digits should not be interpreted as a routeing number.

ported number: A number that has been subject to number portability.

routeing information: Information needed to complete the call. It consists of Routeing Number (RN), Directory Number (DN) or RN + DN.

service provider: An entity that offers services to users involving the use of network resources. The "Service Provider" is understood in the present document in a generic way and may have different status according to the service provided. For example, "Service Provider" refers to a local loop operator in the case of Geographic Numbers, or to a mobile operator in the case of Mobile Numbers, or to a service operator / reseller in the case of Service Numbers.

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

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

serving network: The network that determines whether a number has been ported, and, if so, provides an appropriate routeing number. This functionality may be distributed.

transit network: A network between two networks, e.g. . the recipient network and the donor network.

donor exchange: The initial Exchange where a number was located before ever being ported.

recipient exchange: The new Exchange where a number is located after being ported.

serving exchange: A Serving Exchange) is, within this document, an exchange within a Serving network (SN) that makes a data base (Exchange internal or external) access to retrieve a Routeing Number for a call to a portable number.

database query function: The function whereby a database is accessed in order to ascertain whether a number is ported, and if it is, a Routeing Number is obtained that may be used to route the call to a destination. The database could form part of an IN implementation, could be embedded within the switch, or could be some form of other off-switch database.

national numbering plan: A national Numbering Plan is a scheme that structures the numbers used and the numbers space available in a country.

network termination point: The point where a call is delivered.

point of interconnection: An access point between two networks.

3.2 Abbreviations

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

CC	Country Code (E.164)
CgPN	Calling Party Number
COLP	COnnected Line identification Presentation
DN	Directory Number
NNS	National Numbering Scheme
NP	Number Portability
NPA	Numbering Plan Administrator
N(S)N	National Significant Number (E.164)
NTP	Network Termination Point
POI	Point Of Interconnection
RN	Routeing Number
SP	Service Provider

4 General assumptions and guidelines

4.1 General guide-lines

The main purpose of the present is to describe types of numbers/addresses to be used by the callers and also by network operators in order to set-up calls to ported numbers.

The main routeing problem to solve when Number Portability (NP) is involved is to be able to route the call to the correct exchange in the correct network and select the access line of the subscriber with the ported number in the recipient exchange

4.1.1 General Assumptions

The present document deals with call set-up and analyses what types of numbers/addresses should be used at various reference points in the overall call path between calling and called party in order to establish calls. It also generally considers addressing and numbering in the context of number portability at SCCP level.

4.1.2 Guide-lines for number types specification

1) All numbers identifying a network termination point are ITU-T Recommendation E.164 [1] numbers (i.e. comply with ITU-T Recommendation E.164 [1] requirements), this may not be the case for numbers only carried within a network or transferred from one network to another (e.g. these numbers may use non-decimal digits or may have other formats).

2) A number which can be dialled by a caller is a disable number. This category includes numbers normally used to set-up calls and also any number format which can be received by a local exchange and trigger a routeing process. Signalling protocols may provide an indicator to distinguish disable numbers from others.

3) If the digits dialled by the user match the digits of a routeing number, the dialled digits should not be interpreted as a routeing number.

4.2 Assumptions made as regards routeing

The following general routeing scheme is assumed as the routeing model for calls routed to a ported customer.

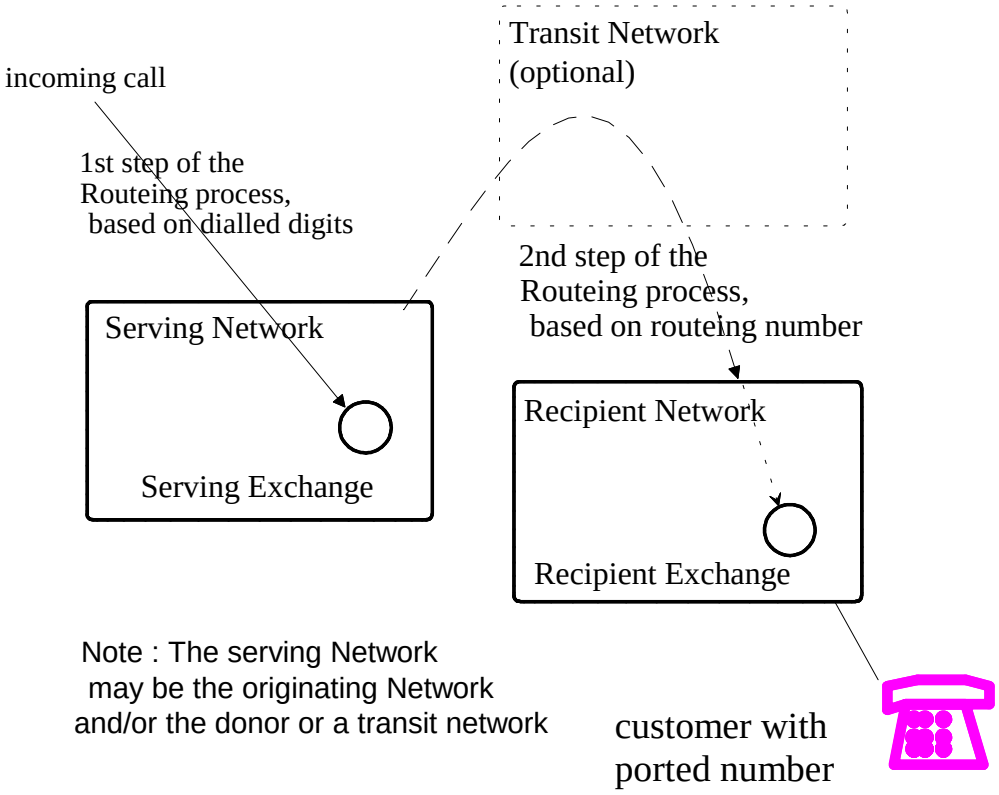

Figure 1: Conceptual framework for incoming calls

1) The caller sets-up the call by dialling the DN as usual. The DN is enough to initiate the routeing process. Furthermore, number portability, by definition implies that the callers should continue to dial the same DN and nothing more to set up a call to a ported customer.

2) The routeing process is split into 2 consecutive main steps:

   a) normal routeing based on DN towards a serving exchange.

      As a 1st step in the routeing process, the originating network routes the call up to a serving exchange clearly identified by the analysis of a certain number of leading digits of the DN.

   b) routeing to customer's interface based on number(s) obtained by this serving exchange.

      It should be noted that this step might be subdivided into sub-steps (e.g. the serving exchange could provide information to route to a database - within the recipient network or accessed by the recipient network - which provides subsequent routeing information identifying the recipient exchange, information used for a following sub-step in the routeing process).

3) If only the recipient network is identified, then it is the responsibility of the recipient network to obtain the subsequent RN to terminate the call at the recipient exchange.

4) In any case the internal routeing process in the recipient exchange shall unambiguously terminate at the called customer's interface.

5) If a number is ported subsequently from Service Provider #1 to Service Provider #2, then to Service Provider #3, etc., this will change the Routeing Number but not change the routeing principles.

4.3 Assumptions made as regards the numbers

1) Incoming calls to a ported number are set-up by callers dialling DN in either the local or the national format. For incoming international calls, the caller abroad dials +CC National Significant Number (N(S)N), the DN format handled in the national network is the national format N(S)N.

2) Outgoing calls set-up by a customer with a ported number benefit from the CLI function i.e. the calling number is optionally forwarded up to the called party and may be used by the called party or by any involved network for various purposes (e.g. by a transit network for carrier selection billing). The calling number indicated should therefore be the DN of this customer in any case.

3) the structure and the format of the RN should be, in a given country, independent of the network architecture to support NP. The structure and format of RN are unique in one country if passed between networks.

4.4 Assumptions made as regards the numbering scheme management

Some objectives may be assumed as regards the management of the national numbering plan:

1) minimize the impact on the National Numbering Scheme (NNS) (e.g. minimize the amount of additional numbers needed by the networks);

2) provide a clear distinction between the non-directory numbers and directory numbers of the NNS , to help their management;

3) if a number is ported several times (i.e. from Service Provider #1 to Service Provider #2, then to Service Provider #3, etc.), the subsequent portability should not increase the amount of routeing numbers needed beyond what is needed for the initial portability.

4.5 Other considerations

Ported numbers are assigned a routeing number in their new Service Provider's domain. In a general case there is a many-to-one mapping between DN and RN, but in special cases there may be a one-to-one relationship.

5 Addressable entities for routeing purposes.

Entities which need to be addressed by a RN in one or more routeing solutions are identified in this clause.

According to the structure of the routeing number, one or a combination of several of the following entities should be addressable.

Recipient Network: in this option, the routeing number identifies the network where the customer is now located. Therefore the routeing process will need an additional information (i.e. DN) to be completed.

Point Of Interconnection (**POI)**: in this option, the routeing number identifies an interface to the next network in the routeing process. Therefore the routeing process will need an additional information (i.e. DN) to be completed.

Recipient exchange: in this option, the routeing number identifies the exchange the customer is now located. Therefore the routeing process within the recipient exchange will need an additional information (i.e. DN) to be completed.

Network Termination Point (NTP): in this option, the routeing number identifies the Subscriber/Access line/service. The ported customer identified by the RN is unique. Therefore the routeing process, in terms of Number Portability, can be completed without any additional information.

Combined entities: In this option, we may use RN to identify any combination of the above entities.

6 Types of addresses and numbers — within networks and across network boundaries

With service provider portability it is no longer possible to use the Directory Number, dialled by the calling party, to route the call to the customer. An additional information, the RN, is needed to be able to route the call. The Routeing Information may have one of the following :

- concatenated address (subclause 6.1);
- separated address (subclause 6.2);
- partly separated address (subclause 6.3);
- only RN, i.e. plain network address, suppressed ITU-T Recommendation E.164 [1] number (subclause 6.4);
- only DN, i.e. plain ITU-T Recommendation E.164 [1] number (subclause 6.5).

It shall be taken into account that in case of the concatenated and partly separated addressing schemes limitations can be present on the maximum numbers of digits being supported by the signalling system and the exchanges in the different networks involved.

6.1 Concatenated address

6.1.1 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 2).

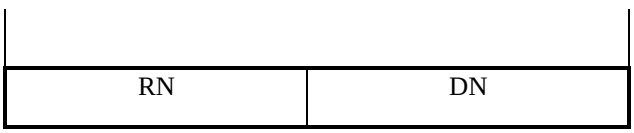

Figure 2: Concatenated address

RN is a Routeing Number prefixed for routeing 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 to have somewhere a signalling field which indicates "Routeing information for a ported number", otherwise routeing 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 which are not used as first digits in the national numbering plan and which indicates that the call is to a ported number. The value could be one of the digits 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 N°7. RN is used to route the call to the addressed entity.

6.1.2 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 exchange). This solution can be accommodated in the existing standards for signalling.

Cons:

This solution requires to use a specific identifier to qualify the Routeing Number as an address used for a ported call, requiring special treatment . The routeing mechanisms in exchanges 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.

Case 2 :

Pros:

As for case 1, this solution can also be accommodated in the existing signalling standards. 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 Routeing Number is dedicated to ported calls.

Cons:

This solution makes use of a part of the national numbering scheme.

To be able to handle the prefix, routeing mechanisms in the exchanges 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 (i.e. one of the 6 values A, B, C, D, E and F). 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 cost any resources from the National Numbering Plan, it does take up numbering resources (it uses a spare value from the Signalling System N°7).

6.2 Separated addresses

6.2.1 Description

In this address type, the Routeing Number and the Directory Number are carried in two different fields in the signalling messages (figure 3). The address identifying the destination of the ported call, Routeing Number, is used to route the call. DN is transparently carried in a separate signalling parameter and is only used at the called side to set up the call.

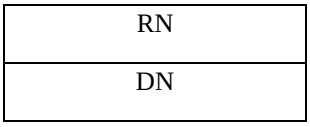

Figure 3: Separated address

6.2.2 Brief analysis

Pros :

If the routeing number is a plain ITU-T Recommendation E.164 [1] number from the range usually handled by the addressed exchange, no specific addressing scheme (for identifying the exchanges) is needed. this solution does not waste any numbering resources since the dialled number and routeing number are carried in separate fields. The numbering space for routeing numbers will always be sufficient, as all numbers from the national numbering plan can be used as routeing numbers. Contrary to prefix based solutions, no special treatment of Routeing Numbers needs to be provided by the routeing mechanism of the exchange.

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.

6.3 Partly separated addresses

6.3.1 Description

This address type (figure 4) is a combination of concatenated address and separate address information regarding recipient network and point of interconnection, e.g. a separate field for the part of the Routeing Number that is used for routeing to the right network, and the part of the routeing number that consist of information regarding recipient exchange or/and access line for internal network routeing is concatenated with the Directory Number in a concatenated field.

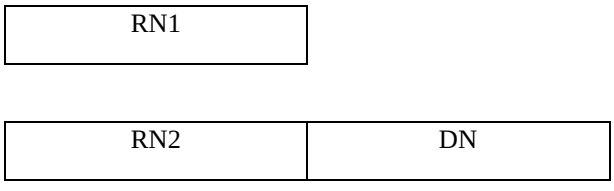

Figure 4: Partly separated address

NOTE: RN1 and RN2 may be identical.

6.3.2 Brief analysis

Pros :

This addressing method might be a way to migrate from a concatenated address solution to a separated address solution.

Cons :

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

6.4 Only RN

6.4.1 Description

In this case the Routeing Number is the only information that is being sent between exchanges/networks (figure 5). The Directory Number, ITU-T Recommendation E.164 [1] number, is not sent between exchanges but is translated into a Routeing Number. The Routeing Number points out the access line to which the called party is connected.

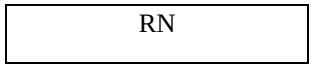

Figure 5: RN only used

6.4.2 Brief analysis

Pros:

The advantages of this addressing method are that it is internationally available today because the RNs are ITU-T Recommendation E.164 [1] numbers and it does not require any changes in the signalling systems.

Cons:

To be able to provide information regarding the DN, in services like COLP, a second query in the recipient exchange (or in the last transit exchange) is needed. This solution can waste numbering resources (depending on solution).

6.5 Only DN (only possible across network boundaries)

6.5.1 Description

In this case the Directory Number is the only information that is being sent between networks, the same information is sent as before introduction of NP (figure 6).

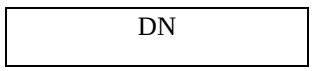

Figure 5: Only DN used

6.5.2 Brief analysis

Pros :

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 routeing information with ported calls inside their networks, regardless which number portability solution is chosen. There are multiple options to transport this routeing information. Separation or concatenation of routeing information and directory number is the main characteristic.

Internal routeing is not dependent on information given by other networks (no network interdependence).

Cons :

Use of this addressing method requires the use of all call query all networks architecture at the network interface. Implications of this architecture are noted in TR NA 010064 [3] subclause 6.7.

7 Addressing at SCCP level

To facilitate numbering portability, it is suggested that SCCP traffic should use the same number translation capability to determine the routeing data for ported numbers, as this reduces investment and operational cost for number portability and avoids problems with database inconsistency. It implies that addressing at SCCP level may use similar addresses and numbers as used for ISUP calls. The use of these addresses requires further consideration.

8 Combinations of addressing types and addressed entities

This section describes how the different addressing types, described in section 6, can be used to address different parts in the network, described in section 5.1.

The following table sets out which entities may practically be addressed for each format of routeing information.

Routeing inf. → **Entity identified by the whole RN (c)** ###	Concatenated Address	Separated Address	Partly separated Address	Only RN	Only DN
Recipient Network	YES	YES	YES	NO	NO without a query to a Database
POI	YES	YES	YES	NO	
Recipient Exchange	YES a)	YES a)	YES a)	NO	
NTP	YES a), b)	YES a)	YES a)	YES a)	

Remarks :

a) the solution will cause lack of network privacy;

b) the quantity of addressed entities may be restricted due to limited number length;

c) this relates to the entity addressed by the totality of the RN, not, for example, entities identifiable by the significant digits of the RN.

History

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