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Number Portability

A Report of the Industry Numbering Committee

Proposed Final Draft

EXECUTIVE OVERVIEW 6

1.0 INTRODUCTION 8

2.0 BACKGROUND 8

2.1 CURRENT GEOGRAPHIC PORTABILITY LIMITATIONS 9
2.2 THERE EXISTS CONSIDERABLE INTEREST IN NUMBER PORTABILITY 10
2.3 EXISTING CAPABILITIES 10
2.4 THE NUMBER PORTABILITY WORKSHOP 11

3.0 DEFINITIONS 11

3.1 NUMBER PORTABILITY 11
3.2 GEOGRAPHIC & NON-GEOGRAPHIC NUMBERS 12
3.3 PORTABILITY SCENARIOS 13

4.0 PORTABILITY PRINCIPLES 14

5.0 THE FOCUS OF NUMBER PORTABILITY 15

5.1 SERVICE PROVIDER PORTABILITY 15
5.2 IMPACT ON CALL ORIGINATIONS 16
5.3 IMPACT ON CALL TERMINATION 16

6.0 NUMBERING RESOURCE AND CALL ROUTING CONSIDERATIONS 17

6.1 THE USE OF NUMBERS IN A NON-PORTABLE ENVIRONMENT 17
6.2 THE USE OF NUMBERS IN A PORTABLE ENVIRONMENT 18

7.0 ARCHITECTURAL CONSIDERATIONS 18

7.1 A DATABASE ARCHITECTURE FOR NUMBER PORTABILITY 18
7.1.1 Network Switches 19
7.1.2 The Routing Database 20
7.1.3 The Database Record 20
7.1.4 The Network Address 20
7.1.5 The Service Management System 21
7.2 CALL PROCESSING 23
7.2.1 A Terminating Network Query 23
7.2.2 An Originating Network Query 23
7.2.3 A Query From the (N-1) Network 24
7.2.4 Other Alternatives 24
7.2.5 Call Flows - General 24

8.0 NUMBERING ADMINISTRATION 25

8.1 ADMINISTRATION OF PORTABLE NPA-NXXS 25
8.2 INDUSTRY NOTIFICATION 27

9.0 SERVICE PROVISIONING 27

9.1 NUMBER "POOLS" FOR GEOGRAPHIC AREAS 28
9.1.1 Provisioning of Ported Service 28
9.1.2 Provisioning of New Service 29
9.2 SERVICE PROVIDER-SPECIFIC NUMBER ASSIGNMENTS 29
9.2.1 Provisioning of Ported Service 29
9.2.2 Provisioning of New Service 29

10. RATING AND RECORDING 29

10.1 IMPACT ON BILLING INFORMATION 30
10.2 IMPACT ON TELEPHONE CALL ACCOUNTING SYSTEMS 31
10.3 THE IMPACT OF REGULATION 31

11.0 END USER IMPACTS 32

11.1 IMPACT UPON PORTABILITY SUBSCRIBER 32
11.2 IMPACT UPON PARTY CALLING PORTED NUMBER CUSTOMER 33
11.3 POST DIAL DELAY 33

12.0 TECHNICAL CONSIDERATIONS 34

12.1. IMPACT ON SS7 SIGNALING 34
12.2 INTERWORKING/MF SIGNALING 34
12.3 IMPACT ON SWITCHES/SERVICE SWITCHING POINTS 34
12.4 SIGNAL TRANSFER POINTS 35
12.5 ROUTING DATABASES 36
12.6 IMPACT ON OPERATIONS SYSTEMS 36
12.7 IMPACT ON SWITCH FEATURES 37
12.7.1 CALL FORWARDING 37
12.7.2 Caller ID/ Calling Number Delivery Blocking 37
12.7.3 Automatic Callback/Automatic Recall 37
12.7.4 Network Voice Messaging 38
12.8 IMPACT ON OPERATOR SERVICES 38
12.8.1 Busy Line Verification 38
12.8.2 Emergency Calls 38
12.8.3 0+, 0- Calls Made by the Ported Number User 38
12.8.4 0+, 0- Calls Made to Ported Numbers 39
12.8.5 Directory Assistance 39
12.8.6 Impacts on Directory Assistance/Call Completion 39
12.8.7 Impact on Public Telephones/Customer-Owned Coin-Operated Telephones (COCOTS) 40
12.9 IMPACTS ON 911/E911 40
12.10 IMPACTS ON (ADVANCED) INTELLIGENT NETWORK FEATURES 41
12.11 IMPACT ON WIRELESS NETWORKS AND SERVICES 41
12.11.1 Impacts On Wireless Mobile Station Registration and Call Delivery 41
12.11.2 Impacts On Wireless Switches For Call Origination 42
12.11.3 Impact On Wireless Anti-Fraud Mechanisms 42
12.11.4 Impact On Wireless Call Detail Recording Mechanisms 42
12.11.5 Impact On Wireless/Wireline Interconnection Arrangements 42

13. 0 ARCHITECTURAL ALTERNATIVES 44

13.1 THE LRN PROPOSAL 45

13.1.1 GENERAL DESCRIPTION 45
13.1.1.2 A Single Number Solution 45
13.1.1.3 Use of Numbering Resources 46
13.1.1.4 Types of Number Portability Supported 46
13.1.2 ARCHITECTURE DESCRIPTION 46
13.1.2.1 Functional Diagram 46
13.1.3 METHOD OF OPERATION 48
13.1.3.1 Signaling Assumptions 48
13.1.3.2 Terminating Switch Processing 48
13.1.3.3 Query Point 48
13.1.3.3 Call Flows 49
13.1.3.3.1 InterLATA Calls 51
13.1.3.3.2 Intraoffice Calls 51
13.1.3.3.3 Calls Involving Non-LNP Capable Switches 52
13.1.3.3.4 MF Interworking 52
13.1.3.3.5 Default Routing 52
13.1.4 NETWORK IMPACTS 52
13.1.4.1 Switching 53
13.1.4.2 Signaling 53
13.1.4.3 Database Requirements 53
13.1.4.4 Networks Involved 53

13.1.5 SERVICE IMPACTS 54
13.1.5.1 CLASS Services 54
13.1.5.2 Operator Services 54
13.1.5.3 Services Using Non-Geographic Numbers 55
13.1.6 END USER IMPACTS 55
13.1.6.1 Transparency 55
13.1.6.2 Ubiquity 56
13.1.6.3 Directory Assistance 56
13.1.6.4 Repair Services 56
13.1.6.5 Emergency Services 56
13.1.7 NUMBER ADMINISTRATION 56
13.1.8 CALL RATING 57
13.1.9 TIMING AND AVAILABILITY 57

13.2 LANP DESCRIPTION 59

13.2.1 GENERAL DESCRIPTION 59
13.2.1.1 Call Processing General Description 59
13.2.1.2 SS7/TCAP Message Processing General Description 61
13.2.1.3 Background 62
13.2.1.4 Network Node Address 63
13.2.1.5 Diversity of Serving Network/End-Office Functionality 64
13.2.1.6 Conservation of Numbering Resource 65
13.2.1.7 Comparison with Other Proposals 66
13.2.2 ARCHITECTURE DESCRIPTION 68
13.2.3 METHOD OF OPERATION 68
13.2.3.1 Signaling 69
13.2.3.2 Call Flows 69
13.2.3.2.3 IXC Call 72
13.2.3.2.4 Call to Mobile Subscriber using Dynamic Addressing 73
13.2.3.3 TCAP Message Flows 74
13.2.4 NETWORK IMPACTS 76
13.2.4.1 Switching 77
13.2.4.2 Signaling Standards 77
13.2.4.3 Signaling Networks 77
13.2.4.4 LNP Routing Database 78
13.2.4.5 Networks Involved 78
13.2.4.6 Operational Support Systems (OSS's) 78
13.2.5 SERVICE IMPACTS 79
13.2.6 END-USER IMPACTS 79

13.3 MCIMETRO CARRIER PORTABILITY CODE 80

13.3.1 GENERAL DESCRIPTION 80
13.3.2 ARCHITECTURE DESCRIPTION 80
13.3.3 METHOD OF OPERATIONS 83
13.3.3 (B) METHOD OF OPERATIONS BASED ON WHETHER THE PORTED NUMBER ORIGINATES OR TERMINATES THE CALL 86
13.3.3 (C) METHOD OF OPERATION FOR INTRASWITCH CALLS 87
13.3.4 NETWORK IMPACTS 88
13.3.4.1 Switch 88
13.3.4.2 Post Dial Delay 89
13.3.4.3 E911 Impacts 89
13.3.4.4 SMS Database 90
13.3.4.5 SCP Database Responses 90
13.3.4.6 Type of Number Portability Supported 90
13.3.4.7 Service Interactions 91
13.3.4.8 Number Administration 91
13.3.4.9 Operator Services Impact 92
13.3.4.10 Timing/Availability 94

13.3.4.11 SS7 Impacts *94*
13.3.4.12 Relative Cost *95*
13.3.4.13 Billing/Rating *95*
13.3.4.14 End User Impact *95*
13.3.4.15 Participating Carriers *96*

13.4 RTP PROPOSAL **98**

13.4.1 GENERAL 98
13.4.2 ARCHITECTURE DESCRIPTION 98
13.4.3 METHOD OF OPERATIONS 98
13.4.4 NETWORK IMPACTS 99
13.4.4.1 Switch *99*
13.4.4.2 Post Dial Delay *99*
13.4.4.3 E911 Impacts *100*
13.4.4.4 SMS Database *100*
13.4.4.5 SCP Database Responses *100*
13.4.4.6 Type of Number Portability Supported *100*
13.4.4.7 Service Interactions *100*
13.4.4.7.1 CLASS Services *100*
13.4.4.7.2 Operator Services Impact *100*
13.4.4.7.3 End User Impacts *101*
13.4.4.7.4 Repair Services *101*
13.4.4.8 Number Administration *101*
13.4.4.9 Timing/Availability *101*
13.4.4.10 SS7 Impacts *101*
13.4.4.11 Relative Cost *101*
13.4.4.12 Billing/Rating *102*
13.1.4.13 End User Impacts *102*
13.4.4.14 Participating Carriers *103*

13.5 NON-GEOGRAPHIC NUMBERING PROPOSAL **104**

13.5.1 GENERAL DESCRIPTION 104
13.5.2 ARCHITECTURE DESCRIPTION 104
13.5.3 METHOD OF OPERATIONS 105
13.5.4 NETWORK IMPACTS 106
13.5.4.1 Switching *106*
13.5.4.2 Originating switch *106*
13.5.4.3 Tandem *106*
13.5.4.4 Translations *107*
13.5.4.5 Signaling *107*
13.5.4.6 Database Requirements *107*
13.5.4.7 Post Dialing Delay *107*
13.5.4.8 Transmission Quality *108*
13.5.4.9 Blocking *108*
13.5.4.10 Network Reliability Impact *108*
13.5.4.11 Prevents "Looping" *108*
13.5.4.12 Limits Queries on Intraoffice Calls *108*
13.5.4.13 Avoids Redundant Queries *109*
13.5.4.14 E911 Impacts *109*
13.5.4.15 SMS Database *109*
13.5.4.16 SCP Database Responses *110*
13.5.4.17 Type of Number Portability Supported *111*
13.5.4.18 Service Interactions *111*
13.5.4.19 Switch Features *111*
13.5.4.20 ISDN Features *111*
13.5.4.21 Telephone Relay Services (TRS) *112*
13.5.4.22 Vertical Services *112*
13.5.4.23 Full Equal Access/Multiple PIC *112*

13.5.4.24 Automatic Callback / Automatic Recall *112*
13.5.4.25 Screening List Editing *112*
13.5.4.26 Caller ID and Privacy *112*
13.5.4.27 Caller ID with Name *113*
13.5.4.28 Call Forwarding *113*
13.5.4.29 Calls to Ported Service Access Code Numbers (500, 800, 900, etc.) *113*
13.5.4.30 ISDN Circuit Switched Voice *113*
13.5.4.31 ISDN Circuit Switch Data *113*
13.5.4.32 Selective Call Acceptance *113*
13.5.4.33 Selective Call Rejection *114*
13.5.4.34 Customer Originated Service Order Activation/Deactivation *114*
13.5.4.35 Number Administration *114*
13.5.4.36 Operator Services Impact *114*
13.5.4.37 Timing/Availability *115*
13.5.4.38 SS7 Impacts *115*
13.5.4.39 Capacity *115*
13.5.4.40 Relative cost *115*
13.5.4.41 Billing/Rating *115*
13.5.4.40 AMA recording *116*
13.5.4.41 Transparency *116*
13.5.4.42 LERG Impact *117*
13.5.4.43 Sent Collect *117*
13.5.4.44 800 Calls from Ported Number *117*
13.5.4.45 Access Record *117*
13.5.4.46 10-digit Number Recording *117*
13.5.4.47 Carrier Identification *117*
13.5.4.48 CMDS Message Clearing *118*
13.5.4.49 End User Impacts *118*
13.5.4.50 Directory listing *118*
13.5.4.51 Participating carriers *118*
13.5.4.52 Additional remarks / Summary *119*

14.0 INTERIM SOLUTIONS **120**

14.1 NEAR TERM ALTERNATIVES 120

GLOSSARY **123**

ACRONYMS **128**

Executive Overview

The Number Portability Workshop of the Industry Numbering Committee (INC) was formed in October, 1993 with a mission to develop a set of definitions, identify and describe p ntial network architectures, and assess the technical feasibility and implementation requirements, impacts and attributes of number portability. The Industry Carriers Compatibility Forum (ICCF) and all its subtending committees, including INC, are open to all interested parties. Participants in the INC Workshop have included representatives from most segments of the industry. The Workshop's initial focus was on one form of portability (Service Provider Portability) that had received a lot of attention and interest from regulators and competing local exchange carriers. This INC report attempts to capture the key elements of the discussion and presentations that took place within this Workshop to address this form of number portability. Some of the issues and concerns with other forms of number portability (i.e., Service Portability and Location Portability) are raised as well.

The North American Numbering Plan (NANP) utilizes a standard, 10-digit format comprised of a 3-digit area code (NPA), 3-digit central office code (NXX) and 4-digit line number. This NANP number is used by the public switched network for both routing and rating of calls between parties. Because the first six digits are used to uniquely identify a specific central office or carrier Point-of-Presence (POP), NANP numbers do not easily lend themselves to porting between several different carriers or serving switches.

The Workshop identified a set of objectives (i.e., Portability Principles) that needs to be considered in the development and implementation of any solution for (long term) number portability, including flexibility in implementation , transparency to both ported and non-ported customers, efficiency in routing and avoidance of adverse service impacts. All of the long-term architectures that have subsequently been discussed within the Workshop thus far have a common set of network components that include the following:

- Switches equipped with the capability to launch database queries
- A signaling network capable of routing database queries and responses and forwarding routing instructions
- One or more databases containing routing and rating information for ported numbers
- A regional Service Management System (SMS) comprised of the necessary software and hardware needed to maintain records of ported numbers and for downloading information to individual, network databases.
- Access links to the SMS to allow responsible organizations to create and update records contained therein.

Administration and provisioning of numbers within the regional SMS and individual network databases were found to follow one of two different alternatives: 1) management limited to previously-assigned numbers that have been ported; or 2) pooling of numbers within new codes (NXXs) and/or all unassigned numbers within an existing NXX. It was generally acknowledged that the latter alternative provides the best potential for conservation and efficient use of NANP resources, but the former introduces fewer complexities in service provisioning, default routing and intercept/disconnect treatment.

Routing and rating of calls, many operational support systems, and existing AMA record processing procedures are predicated upon information directly associated with an NPA/NXX. This association may no longer be possible with number portability. Therefore, a number of concerns must be addressed, such as:

1) Proper routing, rating and billing of calls

2) Potential for additional delay in connection time

3) Potential for customer confusion

4) Retention of subscriber features

5) Impact on service provisioning methods

There are a number of technical considerations that also need to be addressed when searching for a long-term architecture for number portability. Impact upon the various components of the network, including the SS7 signaling network, local and toll switches, routing databases and operational support systems are just a few. Potential adverse impacts on current features and services such as CLASS features, voice messaging, operator-assisted and coin calls, directory assistance, wireless roaming and E911 must also be identified and minimized.

Several proposals for a long-term, number portability architecture have been presented and discussed within the Workshop. They include:

1) The Location Routing Number (LRN) Plan, which maps (for routing purposes) a common routing address to each ported number terminating at the same switch. The first six digits of this address is comprised of an NPA/NXX traditionally assigned to (non-ported) lines on that switch.

2) The LANP Split Numbering Plan, which separates the customer dialable number from a unique network routing number, the latter of which is utilized to properly identify and route calls to the proper terminating switch.

3) The Carrier Portability Code (CPC) Plan, which replaces (for routing purposes) the dialed NPA of each ported number with a new 3-digit code which uniquely identifies the actual terminating carrier.

4) The Release-To-Pivot (RTP) Plan, which attempts to route calls based upon the dialed NPA/NXX, but in situations where the dialed number is subsequently determined to be ported, utilizes SS7 signaling capabilities to

return such calls back to a pivot switch for rerouting based upon new information provided by the original terminating switch.

5) The Non-Geographic Numbering Plan, which requires customers to accept a one-time number change to one using a non-geographic NPA (e.g., 333). This NPA, when dialed, would be easily recognized by the network and calling customers as one requiring special routing, thus possibly reducing customer confusion and network costs.

Proponents of each alternative provide a general description of the architecture's method of operation, followed by details regarding how it accommodates the aforementioned billing, customer and technical number portability concerns. Any and all claims as to the ability of a given alternative to fully address such concerns are offered only from the perspective of the proponent(s) and do not represent consensus by the Workshop as a whole. This report does not offer a recommendation regarding which might best meet the long term need for number portability.

Although the focus of the Workshop was on long-term solutions for providing number portability, several interim solutions utilizing existing technology were identified and discussed as well. Among them were use of switch-based features such as Remote Call Forwarding (RCF) and Direct Inward Dialing (DID) to reroute the call from the original terminating (donor) switch to the new (recipient) switch. Enhancements to these features to more easily accommodate number portability were also discussed. Because of several inherent concerns and limitations caused by the necessity of routing calls through the facilities of the donor switch carrier, these solutions are generally considered as interim measures until a long-term architecture is developed and deployed.

1.0 Introduction

In July of 1993, Ameritech introduced the issue of number portability to the Industry Carriers Compatibility Forum (ICCF). The issue was subsequently accepted and assigned to the Number Portability Workshop, a standing subcommittee under the newly-created Industry Numbering Committee (INC). The Workshop has provided a forum for identifying issues, discussing concerns and presenting proposals for number portability solutions since October of 1993. This first report documents and summarizes much of the activity that has taken place over that two-year timeframe. Since much of focus during this initial period has been on number portability among and between service providers, this report only touches upon some of the issues associated with other forms of number portability identified in Section 3.0. In addition, some issues and concerns with portability among wireless providers and between wireline and wireless networks are addressed. It is anticipated that as discussions continue on interoperability requirements, types of portability supported, roles of the number portability administrator and other related issues, additional reports and/or updates will be published.

2.0 Background

The citizens of the United States, Canada, and the Caribbean nations, the area historically referred to as World Zone One (WZ1), benefit from the most versatile, flexible, efficient and user friendly telephone numbering plan on earth - The North American Numbering Plan (NANP). This shared public resource provides a consistent 10-digit telephone number format allowing for maximum direct dial capabilities for user of the public switched telephone network in WZ1. The NANP was conceived, developed and implemented within the context of the old Bell System in the late 1940s to serve as a basis for dialing, addressing, routing and rating plan for the Bell System and the independent telephone companies operating in North America. It is a geographic numbering plan composed of the traditional combination of area codes, or Number Plan Areas (NPAs) followed by an exchange or central office code (NXX) composed of three digits, and a four digit line number. The full combination of digits equals the familiar 10 digit telephone number format of NPA-NXX-XXXX.

2.1 Current geographic portability limitations

The term "geographic number" has a literal meaning. In geographic numbers, the number identifies a specific physical location, province or country. The first three digits of a geographic number (the NPA) typically identifies a specific geographical area within a state. The second three digits (the NXX) identifies a switching entity, usually a central office switch. Given the fact that numbers have historically been assigned "geographically", there are communities with as few or fewer than 200 telephone stations that have entire 10,000 number NXX blocks assigned exclusively for their use, and conversely there are other communities in which one central office houses several NXXs because tens of thousands of station lines are required at that location. Assignment of a single NXX to serve more than one switch or geographic area is generally not recommended. As a result, multiple station lines remain unassignable in many instances.

In addition to the assignment and availability of "geographic numbers", the physical location of each end office switch also affects the routing and rating of telephone calls. Each end office switch has historically been identified by longitude and latitude (commonly called "V and H coordinates" for routing and rating purposes in order to determine a call's jurisdiction (inter/intra state, inter/intra LATA, etc.) Thus, with the existing method of routing and rating calls based on geographic locations of NXXs, the use of one NXX to serve more than one physical location is limited.

In summary, geographic numbers have provided two unique functions in telephone communications - allowing calls to progress from origination to termination and allowing applicable charges and jurisdiction to be generally known by consumers and determined by telephone switching equipment. In recent years, the increasing availability of new technology (cellular, paging, facsimile, etc.) as well as new competitive telecommunications local service providers have placed demands on the North American Numbering Plan that were not envisioned when the existing assignment criteria were developed. This system of telephone addressing was designed prior to the contemplation or actuality of multiple service providers operating in the same geography/jurisdiction. As a result, modifications to the current application of

geographic number assignments linked to single service providers require careful planning, as the paradigm shifts significantly. While these modifications to the current numbering plan are significant, they are not unresolvable. There are interim measures that can be employed to facilitate the paradigm shift to full local exchange competition. The Industry Numbering Committee (INC), as a standing committee under the Industry Carriers Compatibility Forum (ICCF), is analyzing and describing potential industry solutions to address the need for number portability in North America.

For the definition of, and further information on Geographic and Non-Geographic numbers, see Section 3.2.

2.2 There exists considerable interest in number portability

While the importance of retaining a telephone number was recognized in the early (1960s) exchange tariffs and became a significant issue associated with 800 service during the 1980s, the need for portability for local numbers was seldom cited until the NANP Administration's "Proposal on the Future of Numbering in World Zone 1" dated January 4, 1993. Since that time, substantial interest has been expressed and effort expended in addressing number portability. The parties involved in these efforts include both competitive and incumbent local exchange carriers, as well as interexchange carriers, commercial mobile radio service providers, regulatory representatives and other interested entities. Not surprisingly, views on this subject vary, concerning both the need for portability and the technical, public interest, cost, implementation and other attributes that surround deployment of the capability. Moreover and perhaps most importantly, this matter has been recognized and is being studied by both federal and state regulatory bodies, and is being embodied in recent proposed telecom legislation.

2.3 Existing capabilities

There exist certain capabilities deployed in networks which provide end users a measure of number portability (see the descriptions of remote call forwarding and Direct Inward Dialing (DID) in Section 14). The use of these capabilities as sufficient solutions to number portability issues is the subject of some discussion within the industry. Proponents view these existing capabilities as acceptable alternatives to other solutions being considered which may entail complex and costly enhancements to the public switched network. Others consider these capabilities of value only as interim arrangements, and consider them to be inefficient and not suited to a permanent solution for number portability.

As a matter of clarification, wireless providers do not currently offer location portability outside their home serving area, but generally do offer a temporary form of terminal/personal mobility known as roaming. Terminal/personal mobility is defined as the ability of a terminal or person to access a given telecommunications service from different locations and while in motion, and the capability of the network to identify and locate that terminal or person. Roaming permits wireless customers to make and receive calls throughout most of North America utilizing the NANP number assigned to the mobile terminal instrument by the home wireless provider. The customer will be billed by his/her home

provider but service during the roaming period is provided by the wireless provider located in the visited area.

2.4 The Number Portability Workshop

Because of the interest in number portability, and a desire to move beyond existing network capabilities, if technically and economically feasible and in the public interest, a number portability workshop was established under the Industry Numbering Committee (INC). The Workshop has developed the following Mission and Scope:

MISSION:

The Number Portability Workshop will develop a set of definitions for number portability scenarios, describe the possible network architectures and/or provisioning alternatives which could support it and assess the technical feasibility and implementation requirements impacts and attributes.

SCOPE:

The Number Portability Workshop will identify and examine the various types of number portability (e.g., local number portability, location portability, etc.) that are possible, explore the general implications of each, and decide upon standard definitions that will become the focal point for discussions on planning and provisioning. Once the terminology is defined, participants will work towards identifying any and all alternatives for providing number portability and assess the technical feasibility, target technology, service impact (both positive and negative), timing and relative complexities/benefits for each. These definitions, network architectures and implementation requirements will be documented. The documentation will include a set of baseline requirements, high-level capabilities, call flow diagrams, network performance expectations, etc., as appropriate.

3.0 Definitions

3.1 Number Portability

The Workshop has defined the term "Number Portability" as follows:

> Number portability refers to the ability of end users to retain their geographic or non-geographic telephone number when they change any of the following:
>
> a) their location
>
> b) their service provider
>
> c) their service

The three types of portability referenced in this general definition were further defined as follows:

Location Portability:

The ability of an end user to retain the same geographic or non-geographic telephone number (NANP) numbers as he/she moves from one permanent physical location to another. Location Portability will involve either of the following scenarios:

1) New permanent physical location is within the same serving wireline central office area.

2) New permanent physical location is within a different serving wireline central office or wireless serving area [1].

Service Provider Portability:

The ability of an end user to retain the same geographic or non-geographic telephone number (NANP number) as he/she changes from one service provider to another.

Service Portability:

The ability of an end user to retain the same geographic or non-geographic telephone number (NANP numbers) as he/she changes from one type of service to another (e.g., POTS to ISDN).

Regarding location portability, consideration of restrictions to (within) specific geographical boundaries (e.g., NPA, LATA, MSA, RSA, MTA, BTA) may be appropriate as an interim or long-term measure to minimize potentially adverse network and end-user impacts.

The Workshop agreed that NANP numbers that are assigned for specific service applications (e.g., 800, 500, 555, 950) should not be service portable for applications outside of their respective industry-approved service definitions or guidelines.

3.2 Geographic & Non-Geographic Numbers

The "Central Office Code Assignment Guidelines" (ICCF 93-0729-010) helps define the terms geographic and non-geographic numbers in its classification of NPAs:

---

[1] Wireless serving areas (i.e., Basic Trading Areas (BTAs); Metropolitan Statistical Areas (MSAs); Rural Service Areas (RSAs); Metropolitan Trading Areas (MTAs); etc.) are generally much larger geographically than wireline central office serving areas. Thus wireless location portability would inherently involve different scenarios.

Scenario #2 may not apply depending upon the distance and ported area involved. Typically, a wireless service area (MSA, RSA, MTA, BTA, etc.,) encompasses several thousand square miles.

Geographic NPAs are NPAs which correspond to discreet geographic areas within the area served by the NANP.

Non-geographic NPAs are NPAs that do not correspond to discrete geographic areas, but which are instead assigned for services with attributes, functionalities, or requirements that transcend specific geographic boundaries. The common examples are NPAs in the N00 format, e.g., 800.

The focus of this Workshop has been on geographic numbers, since portability of non-geographic numbers has, or is being addressed, in other forums and proceedings.

3.3 Portability Scenarios

The three types of portability can be considered together with both geographic and non-geographic numbers to describe multiple portability scenarios. They are listed in the matrix below. A number (Scenario #) for each of the listed scenarios is provided for identification purposes only.

As stated previously, the primary focus of the workshop's efforts is that of portability of geographic numbers. Moreover, the initial focus has been to understand the network needs required to implement service provider portability of geographic numbers, the scenario identified as #4 in the matrix.

Scenario #	Numbering Resource	Location	Svc. Provider	Service
1	Geographic	Y	N	N
2	"	Y	Y	N
3	"	Y	Y	Y
4	"	N	Y	N
5	"	N	Y	Y
6	"	N	N	Y
7	"	Y	N	Y
8	Non-Geographic	Y	N	N
9	"	Y	Y	N
10	"	Y	Y	Y*
11	"	Y	N	Y*

*Note: NANP numbers assigned for specific service applications (e.g., 800, 500, etc.) should not be service portable outside of their respective industry-approved service definitions or guidelines.

4.0 Portability Principles

The Workshop has established a number of objectives that it believes should be taken into consideration in the development and implementation of any solution for number portability. While perhaps not exhaustive, the following list represents several key concepts that have been identified as desireable to ensure that number portability is deployed in an efficient and consistent manner.

Preamble

All service providers who participate in portability will adhere to the following principles which apply to network technical considerations. It is recognized that considerations involving the recovery of costs associated with the development and implementation of number portability are very important, as well as the consideration of the initial and subsequent economic effects on all impacted entities. In addition, any solution should not preclude the development of appropriate cost recovery mechanisms. However, such considerations are not included in these principles.

Architectural Flexibility Principle

To the extent possible, architectures proposed for the support of number portability should allow network providers reasonable flexibility in the manner in which the architecture is implemented. Specifically, architectures which require a database(s) solution should not preclude any carrier from incorporating the database(s) in their own network. In addition, proposed number portability solutions should consider service providers' networks that utilize existing, industry-approved standards.

Customer Transparency Principle

The mechanism by which portability is provided should, as an objective, be transparent to the ported and non-ported customer.

Efficient Routing Principle

Number portability should support the efficient and consistent routing of telephone calls to ported numbers. Service providers serving ported customers, and service providers routing to other service providers should be able to route those calls in as direct and efficient manner as is technically possible. The architecture should subject the call to minimal (if any) performance degradation relative to that incurred in today's non-portable environment.

NANP Number Principle

Where number portability is required, it applies to geographic ten-digit NANP numbers, except in situations where industry approved service definitions limit or preclude such portability (e.g., 555).

Participation Principle

At a minimum, each of the service providers (e.g., CMRS, ICs, CAPs, LECs, CLECs) participating in number portability should also participate in number portability development, deployment and associated administrative functions. In addition, other impacted entities are encouraged to participate.

Reciprocal Interconnection Principle

All service providers (e.g., CMRS, ICs, CAPs, LECs, CLECs) offering portability within the same specific geographic area should interconnect and allow for call completion. The method of interconnection (direct, tandem, hub, etc.) is a business decision for the service provider requesting interconnection.

Service Impact Principle

Regardless of the selection of the network provider, care should be taken to avoid any adverse impacts to customers who do not desire number portability.

Service Provider Principle

Customers should have the option of retaining their geographic telephone number as they change between service providers (e.g., CMRS, ICs, CAPs, LECs) serving the same specific geographic area. The obligation to provide number portability should be borne by all service providers as required by appropriate regulatory bodies with jurisdiction over a common geographic boundary area.

Technical Equity Principle

The technical characteristics of existing interconnection arrangements with non-participating networks should not be fundamentally changed as a result of number portability.

5.0 The Focus of Number Portability

5.1 Service Provider Portability

As described in Section 3, number portability is defined to include three major categories, is relevant to both geographic and non-geographic numbers, and can be considered in a multitude of scenarios. Although all types of number portability are described, early issues of this document will focus primarily on service provider portability; that is, the ability of an end user to retain their existing geographic telephone number when they change (local) service

provider. In addition, emphasis on service provider portability carries the added constraint of a fixed location, the assumption that the end user has not changed his/her permanent physical location or rate center.

Although it is believed that the primary number portability concern is that associated with a change of service provider, some of the network operational considerations necessary to accommodate location portability and service portability are described in various sections of this document. Moreover, although portability of non-geographic numbers was identified in the scenarios described in Section 3, the relevant network issues are being addressed in a separate industry workshop and are discussed only as related to a specific proposa o this workshop (see Section 13.4).

5.2 Impact on Call Originations

Some issues related to number portability that might be associated with call origination (e.g., call rating) are not addressed in detail within this document. However, provision of the basic signaling information necessary to support network operations such as billing. fraud detection/investigation, and services should be of concern.

Under some conditions it may be desirable to generate information about the geographic origin of a call at the originating switch and provide it in the Initial Address Message (IAM). This may include information about the switch and rate center where the call originated and/or an explicit indication that the call originates from a ported number. This information can be of assistance in:

1. Properly rating the call. For example, if a caller has a ported number, if the caller's rate center is not associated with the calling party number, and if billing records are made at some location other than the originating switch, then it may be desirable to include switch/rate center and ported number information in the IAM generated by the originating switch. This information may be used to support billing.
2. Supporting fraud detection, investigation, and prevention measures. Many fraud detection measures rely on the geographic location of the calling party. For example, many fraud perpetrators tend to cluster in a geographic area (e.g., a city block) and geographic information is used to target detection in those areas. If the calling number is ported, the availability of information about the geographic origin of the call in the IAM could facilitate this type of detection.
3. Efficient operation of network services. For example, operation of services in the terminating switch might be made more efficient by the availability of additional information, such as the ported number or the switch where a call originated, in the incoming IAM.

Note that the generation of this information may require changes in applicable standards, and the use of this information may require changes to a variety of billing and operations systems.

5.3 Impact on Call Termination

Network issues associated with number portability relate primarily to call terminations; specifically, call processing required for the routing and rating of calls. Issues dealing with access of a local service provider to its customer (i.e., the availability of a local loop), although arguably complementary to the subject of number portability and clearly essential to the understanding of local exchange competition, are often considered a separate and distinct matter and are not covered herein.

Specific items related to this competitive concern might involve:

- The existence of multiple loops to an end user's premises (e.g., EC and CATV)
- The unbundling of the local network infrastructure by the dominant local service provider and the availability of these network components through lease arrangements
- The provision of "equal access" for local service, allowing a customer to presubscribe and to "dial around" to access a local service provider
- The availability of network and/or end user premises equipment that allows an end user to efficiently use the services of any one of several available local service providers.

Although clearly of significance, because these issues are not directly related to number portability, they will not be discussed further here.

6.0 Numbering Resource and Call Routing Considerations

Critical to an understanding of the potential impacts of number portability is an awareness of the current format of dialable telephone numbers and how that format is used by network providers.

6.1 The Use of Numbers in a Non-Portable Environment

Today, a geographic North American Numbering Plan (NANP) telephone number (of the form NPA-NXX-XXXX) and, most often, specifically the first six digits of that number (NPA-NXX), can be used to identify the service provider as well as the network location from which services are offered and to which calls dialed with that number should be routed. The use of these numbers and their meaning is pervasive in all phases of call processing, in all (CAP, CLEC, CMRS, IC and LEC) networks. NANP numbers are inherently linked to routing the call to its destination, to rating the call for charging, and to the support of the call and the associated transport networks for operational purposes such as provisioning and network management.

Assignments of central office codes (NPA-NXX) are made not only to established LECs, but also to wireless carriers and competitive exchange carriers (CLECs). Accordingly, calls dialed with numbers asigned to all local exchange providers are routed based upon NPA-NXX. The information associating NPA-NXX with service provider and location is disseminated throughout the industry via the

Local Exchange Routing Guide (LERG), published by the Traffic Routing Administration Group (TRA) within Bellcore.

6.2 The Use of Numbers in a Portable Environment

In a number portability environment, it is likely that call processing (e.g., routing and rating) based upon NPA-NXX (6 digits) of the dialed number will no longer be viable. Rather, in many instances, some phase of call routing will require analysis of all ten digits. Consequently, it is likely that network infrastructures will have to be modified to accommodate these changes. Moreover, because number portability will impact all types of calls, both intraLATA and interLATA alike, the necessary modifications will, over time, have to be made in all carriers' networks.

In today's environment, the dialed number serves not only as a customer address, but also identifies the network address (and in wireless networks, the specific mobile terminal) to which the call must be routed for completion. This "multiple use" of the dialed number demands that any customer who might choose to change their location, service or provider and therefore, the network address from which he/she is served, must, in most cases, also change his/her telephone number. Accordingly, this arrangement precludes any implementation of number portability.

Clearly, in order to provide number portability, the dialed number must be separated from its associated network address. This separation will allow a new network address, to be associated with a customer's existing telephone number.

7.0 Architectural Considerations

Network arrangements which support number portability must provide an effective means through which all carriers can complete calls in the most direct and efficient manner. The architecture should support all of the portability principles listed in Section 4 of this document, and there should be general consensus that the potential benefits derived by all end users outweigh the costs of its deployment. The underlying methodology should be "user-friendly" to both carriers and customers alike in that it facilitates an easy transfer of customer service from one carrier to another, accommodates location and service portability, and allows both called and calling customers full use of their subscribed features. This section contains an overview of the fundamental components needed to support many of the solutions proposed thusfar for number portability.

7.1 A Database Architecture for Number Portability

It is proposed that the association of customer number and network address be located in network (number portability) databases.

It is generally acknowledged that the architecture required to support these network databases includes the following hardware components (for ease of understanding, these components are shown in Figure 7.1-1):

- switches (e.g., end offices, tandems) equipped with a capability to launch database queries

- a signaling network capable of routing database queries and responses and providing the necessary routing information to all switch points in the call path

- one or more databases containing sufficient information to rate and route calls to ported numbers

- a Service Management System (SMS) comprised of the necessary software and hardware needed to create and maintain records of ported numbers and to download such information to the individual databases owned and operated by various carriers and contractors.

- access links to the SMS to allow responsible organizations to create and update the records contained therein

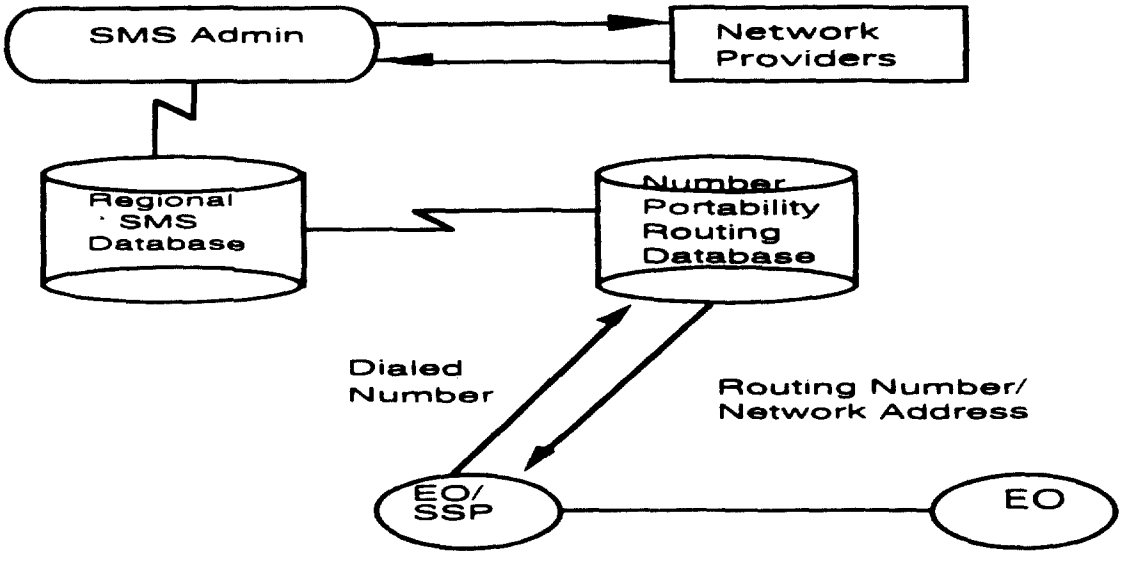

Figure 7.1-1

These components and supporting functionalities are further described in the sections that follow.

7.1.1 Network Switches

Network switches which support number portability must be able to receive and analyze the digits of the called party number, recognize the need for a database query, if required, identify if the dialed number is within a portable code (NPA/NXX), launch the database query, analyze the response and route the call. If the switch isn't capable of performing these tasks itself, it must route the call to

another switching node that can. Such a capability generally requires that the switch be equipped with Service Switch Point (SSP) functionality, and have Intelligent Network (IN) or Advanced Intelligent Network (AIN) software loaded within. Existing IN and AIN triggers (to generate the database query) may need to be augmented to allow proper interaction with all existing features and service types.

The wireless industry does not generally have an IN/AIN trigger capability equivalent to the wireline telecommunications industry. Although work in this area is underway, it is unclear whether the wireless IN triggers would provide a capability equivalent to the IN/AIN triggers or be compatible with a number portability architecture based upon an IN/AIN architecture. See Section 12.11.2 for further detail.

7.1.2 The Routing Database

Number portability routing databases will contain information that allows for proper rating and routing of dialed numbers. It is likely that there will not be one single database containing information on all ported numbers, but rather a number of databases. Depending upon the number of queries needed, each database may contain the same information or, alternatively, each may be limited to information for a specific area. This area may be defined by a geographic boundary or some other commonly recognized criteria. Moreover, in contrast with the architecture deployed for 800 portability, where 800 access databases are only located in access providers' networks, these number portability databases could be located in any carrier's network, or offered by an independent, non-carrier provider. For those carriers who choose not, or are unable to deploy databases in their own networks, other methods of accessing this information will be necessary.

7.1.3 The Database Record

For each customer record in the database, the related information will contain, at minimum:

- a network address or terminating service provider identifier which will uniquely identify either the specific network switch or (at minimum) the service provider's network to which the call must be routed.

- information which can be used to properly rate and bill the call

The database record might contain additional elements optionally populated by certain carriers or commonly populated by all. For example, it might be necessary to include the destination point code (DPC) of the terminating switch, to assist in routing non-call setup, i.e., (SS7) signaling messages, as further discussed in later sections of this document.

7.1.4 The Network Address

Essential to the implementation of LNP is the ability to associate a network destination with a (dialed) ported number. This information will identify either the specific network node termination (address), the terminating switch or

simply the terminating carrier's network. Clearly, such information is a key element in the number portability database.

A unique identity must be given to each carrier or switching entity which terminates calls to subscriber numbers. Although the use of a unique identity may significantly impact call processing in all networks, it is desireable if its use:

- minimizes modifications to the existing network infrastructure
- allows for the continued use of current network routing methods
- permits the use of existing signaling protocols
- minimizes the need for new technical standards

Most of the alternatives proposed in Section 13 use some form of the 10-digit NANP number as the switch address. However, any number of formats might be considered for use as the switch entity identifier. For example, a simple five digit numeric code would allow for the unique identity of up to 100,000 end offices. Alternatively, the code could be designed to include routing information indicating, for example, a region of the country in which the end office was located; or the code could be designed to include the identity of the service provider. Some have suggested there is no need to always identify the actual serving switch, but simply the terminating network provider. In such instances, a service provider ID (SPID) would permit the call to simply be handed off to the terminating provider's nearest access point (e.g., point of presence).

It should be recognized, however, that addresses that fail to meet all of the previously-listed criteria may introduce added costs and complexities to any solution deployed for number portability. Today, routing is based upon the geographic information contained in NANP numbers - specifically, the first six digits of those numbers (NPA-NXX). Accordingly, the use of an identifier in a format different than that associated with the NANP would create the need to develop routing based upon the new code. It appears appropriate, therefore, that the code retain the NANP format used to identify offices today.

Several variations of a terminating switch/network termination identifier have been proposed thus far and are described in detail in Section 13.

7.1.5 The Service Management System

Within a given area, individual number portability network routing databases will be administered and maintained by a master database or Service Management System (SMS). The SMS is the vehicle in which service providers will create and update records through which numbers will be "ported" from one service provider or location to another. In addition, the SMS, will act as a central clearinghouse for administrative and operations related functions necessary to provide the efficient and consistent management of data required to support number portability in a given area.

The SMS will contain listings of, at minimum, all ported customer numbers. For each listed number the database record will provide the associated network address and possibly rating information and the service status as well. Records

created or modified within the SMS will be simultaneously downloaded to individual network routing databases at regular intervals, thereby providing accurate and consistent information to all these databases, and therefore, to all service providers. Interconnection between the SMS and each service provider's network will either be directly between the SMS and the network routing databases or via a network interface to a specific SMS established by the service provider to administer its own network routing databases. It should be recognized that the SMS provides only a data administration function and is not involved in real time call processing. Database queries launched during call processing are received by network routing databases which respond to network switches. An overview of the SMS architecture is shown in the figure 7.1.5 below.

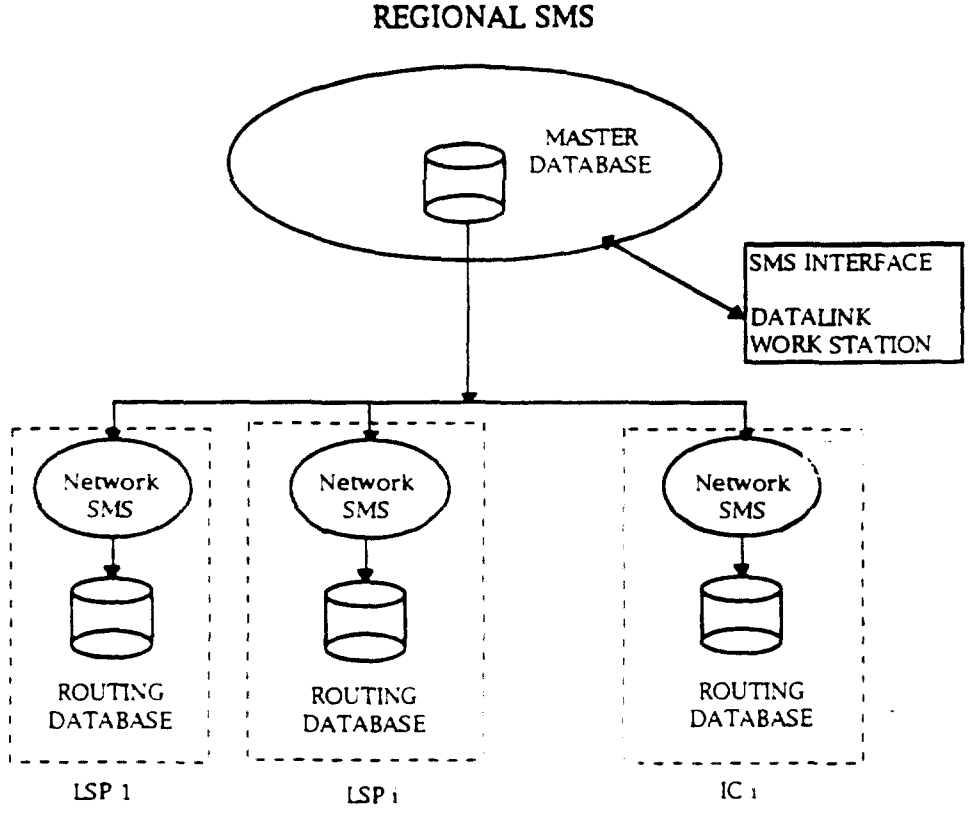

Figure 7.1.5

It is assumed that the data downloaded from the master database/SMS will be in a standard format, allowing the local service providers (LSPs) and/or Interexchange Carriers (ICs) - the SMS users, to maintain the data in that standard format or customize the data format to satisfy its specific needs. Moreover, it is necessary that the interfaces and associated protocols used to effect interconnection of the SMS with network routing databases be standard and consistent to all SMSs, for all carriers. Finally, it is further assumed that the primary arrangement through which service providers will access the SMS to create or modify records will be through a mechanized interface, established through permanent datalink. In addition, it is likely that SMS access will also be available via a dial-up connection, assuming the necessary security concerns can be satisfied.

It may be preferable that there exist several distinct SMSs, each containing and administering records for a given geographic area, rather than a single nationwide implementation. Although a single, national SMS is theoretically conceivable, the volume of records that will ultimately need to be stored suggest a more practical implementation of regional SMSs. Moreover, with the possible exception of wireless roaming, there appears to be no service related need for a single, national SMS as number portability will initially be confined to a more localized area and, therefore, within wireline networks, implementation of number portability does not require an instant, nationwide deployment. Accordingly, an SMS may contain records for a set of specific, geographic areas (e.g., an NPA or set of NPAs).

Finally, and most importantly, it is suggested that the SMS be administered by a neutral, independent entity, without any affiliation with any local service provider.

7.2 Call Processing

With number portability, processing of calls which involve a ported number will include a database query and its associated response. The information obtained from the database response will provide routing information necessary to complete the call, and the data required to accurately rate the call. The necessary database query could, in theory, be launched from any network involved in the call. Consider, for example, an interLATA call which transits an IC's network and includes the use of both originating and terminating switched access. Accordingly, upon recognition that the NPA-NXX of the dialed number is a "portable" code, the database query could be made by the orignating access provider, the IC, or the terminating access provider. To avoid redundant database queries at multiple points during the same call, it may be desireable that the process allow for the provisioning of a "dip indicator" in the call setup signaling message to inform subsequent switching nodes in the call path that the needed database query has already been performed.

7.2.1 A Terminating Network Query

The provision of the database query in the network of the service provider originally assigned the NPA-NXX of the dialed number -- the terminating network – allows calls to be transported from the originating carrier's network and across the IC's network with normal call routing, and therefore requires no change in the manner in which the originating and intermediate networks handle the call. However, this type processing demands the call be routed to the "wrong" service provider, results in inefficient routing, and potentially causes increased call set-up time. It is acknowledged, however, that for an undetermined amount of time, the ability to launch a query and reroute the call from the donor switch may be necessary to handle situations in which calls are misdirected as a result of a failure or inability of the originating or intermediate carrier to launch the query. In the event that number portability impinges on toll calling areas (e.g., location portability), after the query is performed, the donor switch may be required to determine the presubscribed carrier of the billable party to route the call appropriately.

7.2.2 An Originating Network Query

The provision of the database query in the network of the originating access provider (the carrier that serves the calling party) immediately provides the proper network address or terminating carrier to which the call must be routed, and therefore minimizes call set-up time. This arrangement, however, mandates database queries on many calls in which the originating access provider has no need to make such a query. Specifically, on calls which can be clearly identified as interLATA calls, for example, if a simple examination of calling and called party NPAs is sufficient to make this determination, the originating carrier need only forward the call to the interexchange carrier presubscribed to the calling line. Moreover, if the originating access provider were to make these queries, it would need knowledge of all NPA-NXXs throughout the country which were "portable" and access to the necessary routing databases where information on 10 digit numbers contained within these NPA-NXXs was stored. Accordingly, these carriers would require copies of all network databases in their networks, or the ability to launch signaling messages to the appropriate database located in another carrier's network. It is recognized, however, that absent some limits on the boundaries for provisioning location portability (e.g., restriction to within a LATA boundary) originating network queries may be required to determine the proper category of the call (e.g., intra vs. interLATA).

7.2.3 A Query From the (N-1) Network

Alternatively, in a connection that consists of "n" (number of) networks, the query to the routing database could be launched from the (n-1) or "next-to-last" network in that call path. For a call which transits an IC's network and, therefore, uses three networks -- an originating access provider, the IC, and a terminating access provider -- the (n-1) carrier is the IC. An intraLATA call which does not use the facilities of an IC can be considered to route the calls through two "networks", that is, the networks of the originating and terminating local service providers. In this case, the (n-1) network would be that associated with the originating network or, in fact, the originating switch. A query from the (n-1) network provides that network with the necessary routing information allowing efficient, direct routing of traffic to the appropriate terminating end office with minimal call set-up time.

7.2.4 Other Alternatives

Some have suggested a modified approach to the Originating and "N-1" query options by employing use of a "look-ahead" signaling capability to first determine whether the dialed number is actually ported before performing the database dip. Using SS7 call setup signaling messages, an attempt is made to first establish a call path to the switch assigned the NPA/NXX of the dialed number, as reflected in the LERG. If a release message is returned from this office (the donor switch), indicating that the dialed number is ported, the reserved call path will be dropped and a query will be launched by the originating or N-1 carrier. Others have suggested that the donor switch actually perform the database query and return <u>both</u> the release message <u>and</u> new routing instructions.

7.2.5 Call Flows - General