The Challenge of Implementing Service Provider Portability

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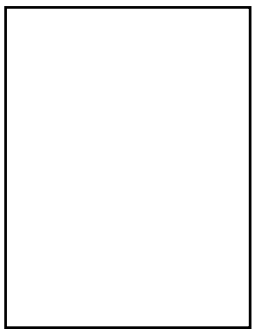

Mr. John C. Rollins is a Network Planning Manager for GTE with 25 years of experience in the telecommunications industry. For the past year, he has served on a number of state committees and subcommittees (California, Florida, Texas, and Washington) developing plans for the deployment of Local Number Portability. He represents GTE on the USTA Network Planning Subcommittee and is the Chairman of the Bellcore Advanced Voice Services User Group. He also represents GTE on the CO Code Transition Subcommittee (a subcommittee of the North American Numbering Council).

Unparalleled telecommunications changes are being planned for 1997 that will impact the communications infrastructure as never before. Although it is difficult to explain the extent of the changes, nothing in the history of the telephone industry will have as great an impact. Driven by the 1996 Telecommunications Act (the 1996 Act), these changes are extensive because they impact the basic operations of the communications network we know today. In addition, the changes are required to take place in a shorter timeframe than any other major change in recent history. This article will review the cause, extent, and impact of these changes on future telecommunications companies and subscribers.

Implementing Service Provider Portability

In February, President Clinton signed the 1996 Act into law. While this act addressed many different aspects of telecommunications, the following statement seems to have been overlooked by the public and news media: "Customers may retain their existing numbers at the same location while changing service providers." The term Service Provider Portability (SPP) is now being used to define the requirements of the act. Implementing SPP will require extensive changes to the basic design of the telephone network infrastructure. The nationwide financial impact of the changes required to implement SPP has been estimated to be in the $10 to $30 *billion* range. The recovery of the implementation cost alone may keep the communications companies, the legal community, and the utility commissions busy for years to come.

To explain why these telecommunications changes are so extensive, we first need to review some history associated with SPP. The discussion of number portability predates the 1996 Act, and began in 1995 with an order from the Illinois Commerce Commission (ICC). The ICC ordered the telecommunications companies operating in Illinois to determine a method for providing portability of telephone numbers. While number portability, in its broadest sense, can cover geographic and service portability, the ICC efforts concentrated on SPP. The broader geographic portability issues have been left as a topic for future discussions. Any customer movement was restricted to a small area identified as a rate center.[1] Under the guidance of the ICC, a Local Number Portability Taskforce was established, and a number of subcommittees were chartered. The requirement of three of the subcommittees was to select a method and develop standards sufficient to implement necessary changes. These subcommittees developed Generic Requirements documents for operator services, switching, and signaling control points.[2]

During this same period, the Washington State Commission and the New York Commission were also investigating different methods of providing portability. They discussed many methods with varying costs and complexity. Trials were performed in Washington and New York, but the methods used in these states were not recommended

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for wider deployment due to technical and operational reasons. GTE proposed a relatively simple method that would allow not only service provider portability, but also wide area geographic portability. The method was called the Non-Geographic Number (NGN) method. It had many advantages over the methods being deployed. However, NGN was never able to generate any vocal support outside GTE because it could require an initial one-time number change.

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In July 1996, the Federal Communications Commission (FCC) reacted to the 1996 Act by issuing an order (96-286) containing a review of the various methods being studied and a deployment timetable.[3] This order also established nine criteria that an acceptable method must satisfy. While stating that it would not mandate a particular method, the order did identify an approach developed and championed by AT&T. The method was called the Location Routing Number (LRN) method, and the FCC order stated it was acceptable.

While all parties do not currently agree that LRN is the most appropriate method, it is the only one to receive favorable mention in the FCC order. It is also the method chosen by the ICC for the initial roll-out in Chicago in July 1997. Numerous requests for reconsideration have been filed since the release of the order in attempts to reduce the cost and complexity of the SPP deployment. However, as of this writing, the FCC has made no official response to requests for approval of alternative methods. Since the order states that LRN is acceptable, and the FCC has not responded to the requests for reconsideration, the industry is attempting to implement LRN.

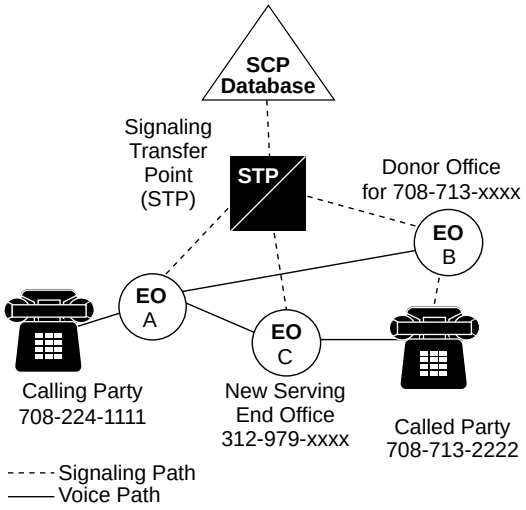
The FCC order also provides a timeline for deployment. SPP must be deployed by the end of 1998 in the top 100 Metropolitan Statistical Areas (MSAs). The initial MSAs scheduled for fourth quarter 1997 include Chicago, Philadelphia, Atlanta, New York City, Los Angeles, Houston, and Minneapolis. The remaining 93 MSAs are distributed by quarter during 1998. All other areas outside of the top 100 MSAs must have SPP deployed within six months of the receipt of a bonafide request for portability.

Local Routing Numbers

A Location Routing Number (LRN) is a 10-digit number that mimics a current local telephone number. It is used to ensure proper routing to a specific central office. The LRN method uses Signaling System 7 (SS7) and Advanced Intelligent Network (AIN) functionality to change the normal routing of calls. In this case, the LRN acts much like an SS7 point code to assist in setting up a path to the correct central office. The major complexity of the LRN method, once deployed, is that it requires a Service Control Point (SCP) database query to identify the proper routing for all inter-office calls. The following basic call flow diagram is provided to describe the technical interworking of LNP.

In Figure 1, line 708-224-1111 located in End Office (EO) "A" dials 708-713-2222. Prior to the deployment of Service Provider Portability (SPP) hardware and software, all calls to phone numbers beginning with 708-713 would terminate at EO "B." The network was designed in this manner to simplify routing. With the advent of SPP, the network can no longer depend upon the first six digits of the telephone number to uniquely define an EO. In Figure 1, the customer associated with telephone number 708-713-2222 is no longer connected to EO "B" as is signified by the dash line from the called party to EO "B" and the solid line from EO "C" to the called party. Office "B" is now known as the Donor office because they have donated a customer number to another office and that number is no longer available for assignment out of office "B." The customer has now been moved to office "C" (new serving office). This new serving office can be operated by the same company as office "B" or by a new company. The interconnection from the new office to the customer could be through the lease of the original end office facility or through the use of a new local connection. The originating office, with SPP capability, has a table that lists all NPAs (area codes) and NXXs

Figure 1
Basic LNP Call Flow Diagram



Source: J. C. Rollins

(central office codes) within which at least one number has switched to a new service provider (a portable number).

After the number has been dialed, the originating switch analyzes the dialed number to determine how to route the call. If it determines that 708-713 is a portable NPA/NXX and the line has not been moved (ported) into office "A," a query is made from office "A" through the Signal Transfer Point (STP) to a SCP database to determine if the 10-digit telephone number is in fact a portable number. (If the number had been ported into office "A," the office would recognize that an intraswitch call had been placed and could complete the call without a query.) Once the first number is ported out of an NPA/NXX, all calls to that NPA/NXX will need to first go to a database to determine if the number dialed is the ported number. If the dialed number is a portable number, the database will find a match and send the LRN associated with the dialed telephone number back to office "A."

Office "A" uses SS7 to store the actual called number in a special call record (the Generic Address Parameter [GAP]), and processes the LRN as if it were the actual dialed number. The originating office will then route the call as if the dialed number was the LRN number it received from the database. The originating office will also set an indicator (Forward Call Indicator [FCI]) to alert future switches that a query has been performed on this call. As far as intermediate networks are now concerned, the call will be routed based on the first six digits of the LRN. The call will arrive at EO "C" based on the LRN for that switch.

Switch "C" receives the call, analyzes the call messages, determines the call is to a portable number, recognizes that the LRN belongs to the switch, and retrieves the original dialed number from the GAP. It then analyzes the number retrieved to determine if it is a working number on the switch or a vacant number. If it is a vacant number, the call will be routed to a recording: "The number you have dialed is not in service, please check your number and dial again." If the retrieved number is a working number on switch "C," the call will then be completed to the correct customer.

It is important to note that this is much different from the normal call routing that takes place in the network today. In today's network, the first six digits of a telephone number are unique, and no two offices are assigned numbers out of the same NPA/NXX.

Change is Expensive

Network Hardware and Software

The main reason for the extent of the changes involves the impact to network switching components from a hardware and software perspective. As LRN is deployed and the number of NXXs containing portable numbers increases, a large percentage of the numbers being dialed will require a database query. As the volume of queries increases, the number of SCP databases will also increase to handle the volume. The porting in of numbers and the initiation of queries will also require additional switch memory and real-time capacity. Finally, the implementation also requires that all offices within the portability area be AIN-, SS7-, and LRN-capable from a software and hardware perspective.

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The requirement to add additional hardware and software to existing sites will accelerate the replacement of some older technology offices. As the network stands today, it is composed of equipment of varying ages and technological capability. Electromechanical, analog electronic, and digital electronic switches will all be impacted by the required changes. Obviously, with newer equipment, fewer changes will be required. Some switches cannot have the new capability added to the existing hardware and will need to be replaced. Many companies will find it more economical to replace equipment than to expend funds to upgrade older technology. This could force the replacement of some electronic analog switches and the older vintage digital switches. Some existing digital switches may be downgraded to remotes to reduce the ongoing impact of software upgrades.

Whether it is from the increased number of queries being required or the increased number of network components being deployed, the network will become significantly more complex.

Operational and Administrative Requirements

In addition to the changes in switch hardware/software and the new requirements to administer the porting in and out of calls, modification will be required in the normal operational and administrative processes. This is caused, in part, by the current network design that makes efficient use of the current numbering plan. Historically, the first six digits (NPA/NXX) of the 10-digit telephone number have been used to identify the location of network components. As such, the NPA/NXXs are used to:

- Direct test messages to the proper test head.
- Route queries to Calling Name databases.
- Route calls to Line Information Data Bases (LIDBs).
- Identify which unused numbers are available for assignment to new customers.
- Set up paths to a specific central office in the processing of calls.
- Identify companies serving specific customers.
- Assist the operator services systems in performing third number billing and busy line verification.
- Enable companies to correctly allocate bills for mutual compensation agreements.
- Identify specific geographic location of equipment directly serving a customer.

The first six digits will no longer have unique site-specific meaning once local number portability is introduced into a network. With SPP, the first six digits can reside in any switch serving a rate center within a portability area. In addition to routing, the existing systems will need to utilize the LRN to identify offices. If the LRN is not readily available, the system would need to be able to perform a database query in real time to identify specific companies and locations. Companies located in the top 100 MSAs are working to analyze their existing operating systems to determine what changes are necessary.

Complexity

The network will also be impacted from the perspective of complexity. Whether it is from the increased number of queries being required or the increased number of network components being deployed, the network will become significantly more complex.

One example of an operational issue being discussed in various state Operations Subcommittees is the issue of SS7 looping. When the network has inaccurate SS7 Global Title Translation (GTT) data, messages that require GTT processing may end up in a circular routing scheme (looping) between networks (e.g., each network believes the message is destined for a location in the other network). This can increase network signaling loads (messages endlessly moving through the signaling network) and, in extreme cases, result in call failure. Although SS7 looping conditions can occur today, the increased number of databases required for SPP will result in an increase in the probability of looping. As the network becomes more complex, it also becomes less

redundant. In fact, from a network reliability perspective, LRN will make an increasing number of calls dependent upon a small number of local databases. Many within the industry are concerned that the standards being developed for deployment of LNR do not address network reliability. That is in part because the LRN standards do not require the same mean time between failure (outage per year) as other previously deployed database services such as 800 number calling. When systems were deployed to allow for the portability of 800 numbers between service providers, the down time per year for the system was defined as three minutes per year. The current specifications for SPP in the ICC standards call for outage requirements of 20 hours per year.[4]

The industry is already aware that computerized networks can cause problems. It is hoped that important lessons were learned from the SS7 outages that occurred in Los Angeles and Washington, D.C. in 1991. The cause of those outages was traced to software problems within a network that was much less complex than what exists today. The changes being deployed for SPP need to be carried out in a measured manner to ensure such problems do not occur.

It is hoped that this article has provided a view into changes in the network currently being deployed. While the idea of allowing customers to change providers without changing numbers seems like a simple concept, this article has shown that the technical changes to accomplish this goal are far from simple. It should also be understood that the achievement of portability should be viewed as a challenge that can be accomplished and, in the long run, will provide customers with heretofore unattainable flexibility in their choice of service providers.

The quickest way to ensure competition in the local exchange market is to deploy reliable technology and procedures. Careful attention to the issues raised in this article will ensure that all customers benefit from the changes. The issues have not been raised to slow competition, but rather to educate the readers to the opportunities and risks of current network activity. ntq

[1] Typically, the rate center is the smallest geographic area that must be identified to ensure proper billing. It is the lowest rate element as defined by state tariffs in a Metropolitan Statistical Area (MSA) defined by the FCC. These rate elements could be defined by the toll rate center, wire center, switch, or down to the area code and central office code (first six digits of a telephone number) level.

[2] Copies of these generic documents are available at http://www.bell-labs.com/user/jlichter.

[3] Web Site address—http://www.fcc.gov/Bureaus/Common_Carrier/Orders. To view the document, see fcc96286.txt; to download a word processing document, see fcc96286.wp.

[4] ICC Generic Requirements for SCP Applications and GTT Function for Number Portability, Issue 0.99, January 6, 1996, Section 4.10.

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