CTIA
Building The Wireless Future
Cellular Telecommunications Industry Association

Michael F. Altschul
Vice President/General Counsel

EX PARTE OR LATE FILED

November 30, 1998

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Magalie Salas
Secretary
Federal Communications Commission
1919 M Street, N.W. 2nd Floor
Washington, D.C. 20554

Re: CC Docket No. 95-116
Ex Parte Presentation

Dear Ms. Salas:

On Wednesday, November 18, 1998, the Cellular Telecommunications Industry Association ("CTIA") and its Numbering Advisory Group met with Commission staff to discuss the wireless number portability issues raised in the above-referenced proceeding. During that meeting, Ms. Radley-Teicher asked CTIA to document the decision to adopt the separation of the mobile station's MIN from the CMRS customer's MDN as the wireless industry's approach for implementing CMRS number portability.

As requested, CTIA hereby resubmits the following materials to the Commission:

- CTIA's Petition for Clarification and/or Reconsideration, filed August 21, 1996, which describes the open industry forum and process that will be used to develop an architecture for CMRS number portability;
- CTIA's Petition for Extension of Implementation Deadlines, filed November 24, 1997, which includes the CTIA Report on Wireless Number Portability, Version 1.0;
- *Ex Parte* letter, filed July 20, 1998, which includes the CTIA Report on Wireless Number Portability, Version 2.0;[1]

[1] In addition to being filed with the Commission in this proceeding, CTIA's Report on Wireless Number Portability, Version 1.0 and Version 2.0, were also submitted to the NANC and the appropriate NANC working groups.

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In addition to these materials, CTIA hereby submits the report of its Number Portability Forum, held October 9-11, 1996, in Las Vegas, NV. The Forum Report in summary form describes the various proposals presented to the Forum, and provides an excellent overview of the discussion points raised by the Forum attendees. In particular, the Forum Report, and the ten written submissions (attached as Exhibits 1-10 of the Forum Report) demonstrates that the wireless industry carefully considered a variety of approaches to providing CMRS number portability and reached its conclusion through an open and consensus-driven process.

Exhibits 1-10 identify a wide range of alternatives for wireless number portability implementation. The Forum Report describes how the wireless industry, following reasoned consideration of all suggested implementation options, reached a consensus agreement to separate the MIN from the MDN. The decision to separate the MIN from the MDN was deemed to be the best alternative for a number of reasons, including its avoidance of the need to provide 10-digit Global Title Translation ("GTT") to complete CMRS calls, and the benefits associated with the industry's evolution towards the use of IMSI numbers.

The Telecommunications Resellers Association recently has proposed that the wireless industry adopt 10-digit Global Title Translation as a superior alternative to the MIN/MDN separation. At its 1996 meeting, the Number Portability Forum participants fully considered 10-digit GTT as a solution to wireless number portability. As noted in Exhibit 1 (the presentation of AT&T Wireless), technical approaches utilizing 10-digit GTT analysis would require extensive administrative overhead to manage data tables listing each and every subscriber. Additionally, 10 digit GTT would necessitate substantial modifications to CMRS billing systems.

While hindsight is said to be 20-20, CTIA continues to believe that the MIN/MDN separation is the best approach to implementing CMRS number portability. However, in response to Ms. Radley-Teicher's question, the salient point is that the wireless industry considered a broad range of technical solutions in an open forum and settled on a solution that would best enable CMRS providers to meet their obligations under the Commission's rules. Moreover, CTIA reported on its progress to the Commission at every major step in the process, even though the Commission had not sought to involve itself in the industry's decisionmaking process.

Pursuant to Section 1.1206 of the Commission's Rules, an original and one copy of this letter are being filed with your office. If you have any questions concerning this submission, please contact the undersigned.

Sincerely,

Michael F. Altschul

Cc: David Furth
Janice Jamison
Clint Odom
Charlene Lagerwerff
Blaise Scinto
Gail Radley-Teicher
Jeannie Grimes
Patrick Forster

CTIA
STAMP & RETURN

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

AUG 2 1 1996

In the Matter of	)	
	)	
Telephone Number Portability	)	CC Docket No. 95-116
	)	RM 8535

PETITION FOR CLARIFICATION AND/OR RECONSIDERATION OF THE CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION

The Cellular Telecommunications Industry Association ("CTIA"), by its attorneys, respectfully submits its petition for clarification and/or reconsideration of the Commission's *First Report and Order* in the above-captioned proceeding.[1]

I. THE COMMISSION SHOULD CLARIFY THE EXTENT TO WHICH CMRS PROVIDERS ARE OBLIGATED TO PROVIDE NUMBER PORTABILITY

In its Order in this docket, the Commission adopted separate number portability implementation schedules for local exchange carriers ("LECs") and commercial mobile radio service ("CMRS") providers. LECs must offer long-term service provider portability in the 100 largest Metropolitan Statistical Areas ("MSAs") commencing on October 1, 1997, and concluding by December 31, 1998, according to a phased

[1] Telephone Number Portability, *First Report and Order* in CC Docket No. 95-116 (rel. July 2, 1996) ("Order").

deployment schedule.[2] After December 31, 1998, each LEC must make long-term number portability available in smaller MSAs within six months after a specific request by another telecommunications carrier in the areas in which the requesting carrier is operating or plans to operate.[3] In contrast, all cellular, broadband PCS, and covered SMR carriers must have the capability to deliver calls from their networks to ported numbers throughout the country by December 31, 1998. Moreover, CMRS providers must offer service provider portability in every one of their markets, both urban and rural, by June 30, 1999.[4]

Under the Commission's implementation schedule, CMRS providers are subject to a much broader obligation than the LECs. Just six months after LECs are required to implement number portability in the 100 largest MSAs, CMRS providers are required to implement number portability in all markets -- including those in which the LEC has not received a request to provide number portability. As CTIA previously advised the Commission in its comments in this proceeding,

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[2] Order at 42. Under the phased deployment schedule, the Commission requires deployment in one MSA in each of the seven BOC regions by the end of fourth quarter 1997, 16 additional MSAs by the end of first quarter 1998, 22 additional MSAs by the end of second quarter 1998, 25 additional MSAs by the end of third quarter 1998, and 30 additional MSAs by the end of fourth quarter 1998. Id.

[3] Id. at 43.

[4] Id. at 88-89.

CMRS carriers have interconnected their switches using IS-41 facilities to support roaming on a nationwide basis, and thus require a nationwide solution to support CMRS roaming capabilities. However, the need to support CMRS roaming on a national basis is very different from a requirement to support local number portability on a market or region-specific basis. Therefore, CTIA seeks clarification as to whether the Commission intended to require CMRS providers to implement full local number portability in every market throughout the United States -- in addition to supporting nationwide roaming of CMRS customers with ported numbers -- by June 30, 1999, or whether CMRS providers are obliged to support roaming of CMRS customers with ported numbers on a nationwide basis and provide full local number portability in only the largest 100 markets and any market where the LEC has received a request to provide portability.

If CMRS providers are required to provide full number portability in all markets, the Commission, on reconsideration, should revise the obligations imposed on CMRS providers to more closely mirror those imposed on LECs. In the absence of a regional data base created to support LEC number portability, CMRS providers may not have the technical capability to provide number portability by the date specified in the Order.

In the largely rural Western United States, and in rural areas not included in the Department of Commerce MSA's, as well as the smaller MSAs, it is possible that the LECs will not received a specific request to provide number portability. In that event, the LECs are not required to provide number portability, and a regional database for that particular area may not exist. CMRS providers in that area, therefore, would be required to establish their own database in order to route calls to ported CMRS numbers. CMRS providers, however, may not have a sufficient level of caller volume requesting ported numbers to justify establishing individual databases. Moreover, requiring CMRS carriers to deploy individual databases would place a disproportional burden on CMRS carriers, and would result in the deployment of multiple number portability databases over various geographic areas, an outcome the Commission seeks to avoid.[5]

The Commission should therefore conform the implementation requirements of CMRS providers to that of LECs such that CMRS providers are required to provide number portability only to the 100 largest markets by December 31, 1998.[6] Thereafter, CMRS providers should be required to

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[5] See Order at 49.

[6] CMRS carriers would also be expected to support nationwide roaming of customers with ported numbers.

provide number portability in smaller markets upon creation of a regional database that includes both LEC and CMRS numbers. This uniform implementation schedule will ensure that number portability is implemented in an efficient and competitively neutral manner, consistent with a national number portability policy.

II. THE COMMISSION SHOULD DELEGATE AUTHORITY TO THE CHIEF, WIRELESS TELECOMMUNICATIONS BUREAU, TO WAIVE OR STAY ANY OF THE DATES OF THE IMPLEMENTATION SCHEDULE FOR AN UNLIMITED PERIOD OF TIME

In its Order, the Commission recognized that "additional technical issues may arise as the industry begins to focus on provision of portability by CMRS carriers."[7] The Commission therefore delegated authority to the Chief, Wireless Telecommunications Bureau, to waive or stay any of the dates in the implementation schedule, as the Chief determines necessary to ensure the efficient development of number portability, for a period not to exceed nine months (*i.e.*, no later than September 30, 1999 for the first deadline, and no later than March 31, 2000 for the second deadline).[8]

The nine month period within which the Chief of the Wireless Bureau may waive or stay the implementation schedule is totally arbitrary. It was established without

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[7] Order at 49.

[8] Id. at 89-90.

any support from the record, it is not predicated on any analysis of the wireless industry's ability to comply with the mandated implementation schedule, and given the technical complexity of the issues likely to be raised by the wireless petitioners, nine months may not provide the Wireless Bureau sufficient time to conduct a reasoned decisionmaking.

Next week CTIA will issue a request for information ("RFI") with respect to the implementation of number portability by CMRS carriers. Based on the responses to this RFI from interested hardware, software, and operating system vendors, CTIA will hold an open forum (in October, 1996) where its members will explore the technical issues associated with meeting the Commission's implementation schedule.

In a matter of this complexity, the statutory filing date for seeking review of the Commission's Order does not provide CTIA with the time it requires to determine CMRS carriers' ability to comply with the aggressive implementation schedule established in the Order. Unfortunately, it will be many months before CTIA can provide meaningful comment on the feasibility of the number portability requirements the Commission has imposed on the wireless industry. However, through CTIA's RFI and Open Forum, as well as through the ongoing efforts of its members

who are participating in the Association's Number Advisory Group, CTIA has begun to obtain the number portability implementation information required by both CMRS carriers and the Commission.

CTIA will provide the Commission with the information it obtains through its Open Forum and from its Number Advisory Group, and intends to supplement the record in this proceeding as additional information concerning implementation of number portability is obtained. Moreover, implementation issues are likely to continue to develop long after this proceeding is closed.

Therefore, as part of this Petition, CTIA asks the Commission to reconsider its limited grant of only nine months discretion given to the Chief, Wireless Telecommunications Bureau, be broadened. The Chief of the Wireless Bureau should be given delegated authority to waive or stay any of the dates of the implementation schedule for

an unlimited period of time based on the requisite showing by the CMRS industry that the schedule established by the Commission in the Order is not achievable.

Respectfully submitted,

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Staff Attorney

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Vice President and
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Randall S. Coleman
Vice President,
Regulatory Policy & Law

CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION
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August 21, 1996

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

BEFORE THE
Federal Communications Commission
WASHINGTON, D.C.

In the Matter of	)	
	)	
Telephone Number Portability	)	CC Docket No. 95-116
	)	

TO: CHIEF, WIRELESS TELECOMMUNICATIONS BUREAU

PETITION FOR EXTENSION OF IMPLEMENTATION DEADLINES OF THE CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION

The Cellular Telecommunications Industry Association ("CTIA")[1] submits its Petition for an extension of the implementation deadlines applicable to wireless carriers in the above-captioned proceeding.

INTRODUCTION

In the First Report and Order[2] the Commission established rules mandating number portability for both LECs and CMRS providers. A separate time-table was established for CMRS providers, requiring them to implement service provider number portability by June 30, 1999. The Commission noted that although

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1 CTIA is the international organization of the wireless communications industry for both wireless carriers and manufacturers. Membership in the association covers all Commercial Mobile Radio Service ("CMRS") providers, including 48 of the 50 largest cellular and broadband personal communications service ("PCS") providers. CTIA represents more broadband PCS carriers and more cellular carriers than any other trade association.

2 Telephone Number Portability, First Report and Order and Further Notice of Proposed Rulemaking in CC Docket No. 95-116, 11 FCC Rcd 8352 (1996) ("First Report and Order").

the Communications Act of 1934 ("Act") does not expressly mandate CMRS number portability, it would be an important service to promote competition between CMRS providers.[3]

Even before the release of the First Report and Order the wireless industry was taking steps to solve the unique difficulties CMRS providers face in implementing number portability.[4] Consistent with the First Report and Order, industry working groups had set June 30, 1999 as their deadline.[5] The process, however, has proven more complex than originally anticipated. Among other things, the industry has had to develop a means of allowing subscribers to keep their telephone number and separate the Mobile Identification Number ("MIN") in the handset. This is critical to meeting the Commission's directive

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3 See First Report and Order at ¶ 157 ("[T]he inability of customers to keep their telephone numbers when switching carriers also hinders the successful entrance of new service providers into the cellular, broadband PCS, and SMR markets.") Although this may be true in a wireline model, it is not clear that these principles apply in a wireless context as evidenced by the success of all CMRS carriers.

In addition, the Commission stated that "service provider portability will promote competition between existing cellular carriers, as well as facilitate the viable entry of new providers of innovative service offerings, such as PCS and covered SMR providers." First Report and Order at ¶ 157. This too may go too far in applying a wireline paradigm to wireless competition. On a cost/benefit basis, CMRS licensees may be more interested in devoting their resources to improving network coverage.

4 Declaration of Arthur L. Prest at ¶ 5.

5 Id.

and the industry's support for nationwide roaming.[6] Industry working groups agreed that this could best be accomplished by splitting the MIN from the Mobile Directory Number ("MDN"). Creating a second ten-digit number, which must be treated separately in all network functions, however, is a complex task. The industry is now in the process of developing standards so that all carriers will operate efficiently and consistently in this new network architecture. Once standards have been developed and tested, every CMRS provider will have to change both its calling networks and customer service/back office support systems to distinguish between the MIN and the MDN.

In addition, CMRS providers are dependent upon the implementation of wireline number portability to develop compatible systems between wireless and wireline carriers. Until wireline number portability standards are established, the wireless industry cannot complete certain final provisions that are critical to its deployment of number portability.

The industry recognizes today that it will not be able to provide service provider number portability by June 30, 1999. While the MIN/MDN separation has been agreed to, the industry has not yet arrived at final standards. Once this is resolved, the standards must endure extensive testing and then be implemented by every carrier nationwide. CTIA therefore requests that the

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6 First Report and Order at ¶ 166 (requiring all CMRS providers to maintain nationwide roaming in a number portability environment).

WTB invoke its authority immediately and extend the deadlines for wireless number portability.

I. THE WIRELESS TELECOMMUNICATIONS BUREAU SHOULD STAY THE EFFECTIVE DATES OF THE IMPLEMENTATION SCHEDULE FOR WIRELESS NUMBER PORTABILITY BY NINE MONTHS.

When the Commission mandated wireless number portability it expressly delegated to the Chief of the Wireless Telecommunication Bureau ("WTB") authority to delay the implementation deadlines of the First Report and Order for nine months.[7] The Commission recognized that the wireless industry faced unique technical obstacles in developing the necessary standards and protocols as well as the challenges of supporting nationwide roaming.[8] On reconsideration, the Commission maintained the implementation deadlines, while also reiterating its intention that the Bureau have the flexibility to stay the deadlines "[i]f it becomes apparent that the wireless industry is not progressing as quickly as necessary to meet the deadlines for providing querying capability and service provider portability."[9]

It has become apparent that the industry cannot meet the June 30, 1999 deadline for service provider number portability.[10] As demonstrated by the attached declaration, a series of

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7 First Report and Order at ¶ 167.

8 Id. at ¶ 166.

9 Telephone Number Portability, First Memorandum Opinion and Order on Reconsideration in CC Docket No. 95-116, 12 FCC Rcd 7236 at ¶ 134 (1997) ("First Memorandum Opinion and Order").

10 See Declaration of Arthur L. Prest at ¶¶ 6, 15.

important issues concerning standards, nationwide roaming, and customer service/back office support remain unresolved.

The fact that the Commission's deadline is not technically feasible creates something of a dilemma for wireless licensees by confronting them with regulatory obligations that cannot be accomplished, despite their best efforts. Although the Commission imposed deadline is more than a year away, the WTB can ameliorate this conflict by establishing a new implementation date for March 31, 2000.

The uncertainty created by the conflict affects various aspects of carriers' activities, most notably in their capital budgeting. Prompt WTB decision-making would assure carriers that they do not need to presently allocate funds for a number portability solution that is not attainable until at least 2000. As long as a difference persists between regulatory requirements and technical feasibility for implementing wireless number portability, carriers will not be able to efficiently allocate their resources. This problem is most significant for PCS licensees who are in the process of constructing their networks and need to devote substantial resources to building-out and extending system coverage. Prematurely dedicating resources for number portability implementation before a fully vetted and documented solution exists unnecessarily diverts available funds from network build-out plans. Thus, WTB action extending the deadline is urgently required.

II. THE WIRELESS INDUSTRY IS WORKING TO OVERCOME THE OBSTACLES TO NUMBER PORTABILITY.

As evidenced by the attached declaration of Arthur L. Prest, the CMRS industry has been working to meet the Commission's June 30, 1999 deadline for wireless service provider number portability. The industry has reached a consensus on the general architecture and is now in the process of developing the necessary standards and protocols to be used by all carriers. The standards setting process, however, is not yet complete. These processes are complicated by the fact that the MIN, which today is also the MDN, is used for a variety of other functions, including roaming and customer services. Once standards are developed, it will take additional time to implement them in every carrier's network.[11]

Not surprisingly, one of the most important issues for both the Commission and CMRS providers is maintaining nationwide roaming in a number portability environment. By separating the MIN from the MDN, the industry has ensured that nationwide roaming will remain in effect. When a subscriber is roaming, the MIN is used by the visiting carrier to identify the user. The MIN permits the carrier in the visiting market to identify the subscriber's home market and to communicate with the subscriber's carrier for validation and fraud prevention purposes. Today, the

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[11] Although the First Memorandum Opinion and Order requires that number portability only be deployed in the largest 100 MSAs, every carrier nationwide will have to upgrade its systems to support roaming and distinguish between the MIN and the MDN. Without this upgrade ported subscribers will not be able to roam outside of the 100 largest MSAs.

MIN and the MDN are the same number and therefore both are associated with a particular carrier. In a number portability environment, however, every MIN will be associated with a carrier but the MDN will move with the ported user. Once they are separated, subscribers will be generally unaware that such a distinction exists. Carriers, on the other hand, must be acutely aware of this change and implement protocols to distinguish between the two numbers.[12]

The MIN/MDN split will also require carriers to make extensive changes to their customer service/back office support architectures. Carriers currently utilize the MIN as a means of identifying subscribers for a variety of purposes including billing and caller identification. Once the MIN can no longer be used for this purpose, carriers must implement new software and other changes to accommodate the split.

By separating the MIN from the MDN, the industry has developed a number portability solution that will be transparent to subscribers and still permit them to use their wireless telephones everywhere. It is, however, incumbent upon the Commission to accord the wireless industry sufficient time to implement the solution in an orderly manner.

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12 See Declaration of Arthur L. Prest at ¶¶ 9-11.

IV. CONCLUSION

For these reasons CTIA respectfully requests that the Chief, Wireless Telecommunications Bureau, stay the implementation schedule for wireless number portability for nine months.

Respectfully submitted,

CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION

Michael F. Altschul
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Vice President for
Regulatory Policy and Law

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(202) 785-0081

Its Attorneys

November 24, 1997

CERTIFICATE OF SERVICE

I, Rosalyn Bethke, hereby certify that a copy of the foregoing Petition for Extension of Implementation Deadlines of The Cellular Telecommunications Industry Association was served by hand delivery upon the following:

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Secretary
Federal Communications Commission
1919 M Street, N.W.
Room 222
Washington, DC 20554

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Rosalyn Bethke

Rosalyn Bethke

Dated: November 24, 1997

DECLARATION OF ARTHUR L. PREST

ON BEHALF OF THE CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION

1. I, Arthur L. Prest, do hereby declare as follows:

2. My name is Arthur L. Prest. My business address is 1250 Connecticut Avenue, N.W., Suite 200, Washington, D.C. 20036. I am employed by the Cellular Telecommunications Industry Association ("CTIA") as Vice President of Science and Technology. I have served in my current role since 1994.

3. I oversee all of CTIA's number portability activities and am personally an active participant in industry standards groups developing wireless number portability standards. In addition, I am involved in developing standards relating to network interworking, interoperability, and reliability.

4. The purpose of this declaration is to provide input to the Chief of the Wireless Telecommunications Bureau on the status of the wireless industry's ability to meet the June 30, 1999 number portability implementation deadline established by the Federal Communications Commission ("FCC"). I will discuss the efforts that the industry has already made and the obstacles which remain for wireless number portability implementation.

5. The wireless industry began working on number portability prior to the release of the FCC's First Report and Order in CC Docket No. 95-116. The order mandates that all CMRS providers establish the capability to deliver calls from their network to ported wireline telephone numbers anywhere in the United States by December 31, 1998. In addition, the

order mandates that these providers offer wireless number portability, including support for roaming, by June 30, 1999.

6. From a technical perspective, it is clear today that the wireless industry will not be able to meet the CMRS number portability deadline. As an industry, wireless carriers and vendors have been working in standards committees, open fora facilitated by CTIA, and North American Numbering Council working groups and task forces. Provisioning our systems for national roaming and separating the Mobile Identification Number (MIN) from the Mobile Directory Number (MDN) have proven to be among the most complicated issues for wireless number portability. These issues are also unique to CMRS providers.

7. CTIA maintains a Numbering Advisory Group (NAG) comprised of wireless service providers from all wireless technologies which seeks consensus positions and solutions for wireless numbering issues. Soon after the release of the First Report and Order, in August 1996, CTIA NAG released a Request for Information (RFI) to the wireless industry. The goal of the RFI was to solicit potential methods to implement wireless number portability consistent with the First Report and Order. CTIA received several substantive responses serving as the basis for a Number Portability Forum held in October 1996. This forum was open to both wireless and wireline participants and was used to discuss the wireless number portability implementation strategy.

This forum resulted in industry consensus agreements on issues critical to the wireless industry. Most importantly, the wireless industry agreed in this forum that the best method of realizing wireless number portability would be to separate the MIN from the MDN.

8. The CTIA NAG subsequently created a Number Portability Sub Task Group, open to both members and non-members of CTIA, to facilitate and promote the development of wireless number portability standards. The Sub Task Group was charged with drafting a *Wireless Standards Requirements Document,* providing the appropriate committees with an initial look into the requirements of wireless number portability on current and future standards. On January 22, 1997, CTIA released to both TIA and Committee T1 standards committees this document. The Sub Task Group also drafted the *CTIA Wireless Number Portability Report*, attached hereto, which characterizes the network architecture and operational procedures necessary to support wireless number portability. This report was submitted to industry standards bodies in April 1997 and the North American Numbering Council in May 1997.

9. As noted above, the separation of the MIN from the MDN raises significant challenges to the implementation of wireless number portability. In North America, the MIN is generally used as the MDN. However, in order to support wireless number portability and minimize impacts on the existing wireless network infrastructure, the wireless

industry determined that it is necessary to separate the MIN from the MDN. This separation will significantly affect the wireless industry. Service providers use this single MIN for such tasks as performing registration, call processing, provisioning, customer care, and billing.

10. In a number portability environment, the MDN will be portable while the MIN will remain in the phone as a 10 digit non-dialable number associated with a specific service provider and unique to the mobile station. This separation represents a significant departure from the current wireless call structure. Every ported subscriber will require a new MIN from the new carrier which will require reprogramming the subscriber's wireless unit with every move. The subscriber, however, will retain the MDN, the ported telephone number.

11. While this method will be transparent to the subscriber and provides benefits in the long-term, numerous details still must be resolved by the industry standard setting bodies for this structure to work effectively. For example, many older analog cellular phones display their MINs but have no ability to display or recognize their own directory number. This means that after a subscriber ports the ten-digit telephone number, the newly displayed ten-digit MIN is not the subscriber's telephone number, and might actually be another subscriber's telephone number. In addition to customer confusion, the separation of the MIN from the MDN will require modification to all network and back office

systems. Most network elements (i.e., Mobile Switching Center (MSC), Home Location Register (HLR), Visiting Location Register (VLR), Signal Transfer Point (STP), etc.) will need to have the capability to support both the MIN and MDN parameters where appropriate.

12. While the benefits of this method will be realized in the long term, resolving the details for this structure to work effectively have taken longer than anticipated. The Standards Requirements Document released in January 1997 by CTIA has resulted in one standard currently in the ballot process. However, additional work is incomplete for Phase II wireless number portability implementation. In addition to the technical standards, the separation of the MIN and MDN will cause many older analog cellular phones to display their MINs but will not display or recognize their own directory number. Industry groups are working to ease subscriber confusion by resolving this matter as well.

13. In addition to customer confusion, the separation of MIN and MDN impacts all network and back office systems. Customer care and billing systems must be redesigned to recognize this change, and, in large part, are dependent upon the output of the standards bodies. In a large distributed network environment it can take up to 24 months to integrate new applications from the planning through roll-out phases. Considering the standards that remain to be agreed upon, a highly compressed delivery schedule is unlikely to be achieved without adversely affecting current subscribers.

14. Concurrent with addressing the impacts of the MIN and MDN split, the wireless industry is also developing guidelines to manage the assignment of MINs among all carriers nationwide. This, too, is a complicated process because MIN management has both domestic and global implications. MINs must be unique for international roaming to work properly. The industry has written an initial draft proposal which still must be adopted as an industry consensus practice.

15. The wireless industry has worked steadfastly and continues to work with the June 30, 1999 deadline in mind. However, the implementation obstacles faced by the wireless industry are unique and require additional time to reach industry consensus on critical items which will maintain the integrity and interoperability of the wireless networks in a national and international roaming environment. It is very clear today that the implementation of number portability by the CMRS industry is not attainable by June 30, 1999.

ARTHUR L. PREST
Vice President of Science
and Technology

Cellular Telecommunications
Industry Association

CTIA-Building the Wireless Future

CTIA
Report on
Wireless Number Portability

Created by the Number Portability Sub-task Group

on behalf of the

Cellular Telecommunications Industry Association

Number Advisory Group

TABLE OF CONTENTS

1. INTRODUCTION 5
   1.1 Purpose and Scope 5
   1.2 Solution Goals 5
   1.3 Definitions 6
   1.4 Background 8
      1.4.1 The FCC Order 8
      1.4.2 Wireless Industry Studies 10
   1.5 Assumptions 11
   1.6 Aspects of Wireless Number Portability 11
      1.6.1 Differences between Wireless and Wireline 11
      1.6.2 Geographic Boundaries 12
      1.6.3 Porting To and From 14
   1.7 Critical Dates 15
      1.7.1 Regulatory Mandates 15
      1.7.2 Implementation 16
2. WIRELESS NUMBER PORTABILITY 19
   2.1 Solution Overview 19
   2.2 Location Routing Number Call Routing 20
   2.3 Separation of the Mobile Directory Number from the Mobile Station Identifier 22
   2.4 Global Title Translation for Number Portability 23
3. THE WNP NETWORK REFERENCE MODEL AND PROCEDURES 24
   3.1 Network Configuration 24
      3.1.1 Number Portability Service Control Point 25
      3.1.2 Mobile Switching Centers 25
      3.1.3 Signaling Transfer Points 26
      3.1.4 Signaling 26
      3.1.5 WNP Trigger and Query Types 28
      3.1.6 Trigger Conditions 30
      3.1.7 Global Title Translation 30
      3.1.8 Home Location Register and Authentication Center 32
      3.1.9 Abnormal Procedures 32
   3.2 Call Flows 33
      3.2.1 Registration and Authentication 33
      3.2.2 Call Routing To a Ported Directory Number 33
   3.3 Feature Interactions 42
      3.3.1 Operator Services 42
      3.3.2 Roamer Access Port 42
      3.3.3 Emergency Services 43
      3.3.4 Short Message Service 43
4. BUSINESS SYSTEMS, OPERATION SYSTEMS AND BILLING 58
   4.1 Service Order and Provisioning 58
      4.1.1 Process Flow Overview 58
      4.1.2 Provisioning a Number Block Open for Portability 59

4.1.3 Notifying the Receipt of a Ported Subscriber 59
4.1.4 Downloading data from the NPAC-SMS 60
4.1.5 Auditing the NPAC-SMS Data 61
4.2 Number Administration 61
4.2.1 IMSI, MIN and MDN Administration 61
4.2.2 Disconnected Numbers 61
4.2.3 Location Routing Number Assignments to WSP 61
4.3 Billing 62
5. WIRELESS NUMBER PORTABILITY SYSTEM IMPACTS 63
5.1 Impacts to the Mobile Station 63
5.2 Impacts to the Air Interfaces 64
5.3 Impacts to IS-41 Signaling 64
5.4 Impacts to GSM Signaling 65
5.5 Impacts to the Home Location Register 65
5.6 Impacts to the Mobile Switching Center 65
5.6.1 Registration/Validation 66
5.6.2 Call Origination 66
5.6.3 Call Delivery 67
5.7 Impacts to Interconnection Types 67
5.7.1 Type 1 68
5.7.2 Type 2 68
5.8 Impacts to the Signaling Transfer Point 69
5.9 Impacts to Global Title Translation 70
5.10 Impacts to the Number Portability Service Control Point 71
5.11 Impacts to Customer Care and Provisioning 71
5.12 Impacts to Billing 72
5.13 Impacts to Maintenance 72
5.14 Impacts to Number Portability Data Administration 73
5.15 Impacts to Service and Network Reliability 73
5.16 Human Factors Impacts 74
5.17 Service Impacts 74
6. RELATED DOCUMENTS 76
7. ISSUES 77
8. LIST OF ACRONYMS 79

LIST OF TABLES

Table 1-1 Wireline versus Wireless Calling Aspects 12
Table 3-1 ISUP IAM Parameter Settings 27

LIST OF FIGURES

Figure 1-1 Theoretical Timeline 16
Figure 1-2 Potential Timeline Necessary to Meet FCC Mandate 17
Figure 2-1 Wireless Number Portability Building Blocks 19
Figure 2-2 Routing with a Location Routing Number 21
Figure 3-1 WNP Network Reference Model 24
Figure 3-2 Landline to Mobile Call Flow 34
Figure 3-3 Landline to Mobile with CFNA Interaction 36
Figure 3-4 Mobile to Landline - PSTN Performs Query 37
Figure 3-5 Mobile to Landline - MSC Performs Query 38
Figure 3-6 Mobile to Mobile - PSTN Performs Query 40
Figure 3-7 Mobile to Mobile - MSC Performs Query 41
Figure 3-8 Alternative 1 for SMS Delivery 46
Figure 3-9 Alternative 2 for WNP SMS Delivery 49
Figure 3-10 Alternative 3 for SMS Delivery 51
Figure 3-11 Alternative 4 for WNP SMS Delivery 54
Figure 3-12 Alternative 5 for SMS Delivery 56
Figure 4-1 Service Order and Provisioning Process Flow 58
Figure 5-1 Mapping of Platforms to Wireless Number Portability Model 63

REVISION HISTORY

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1. INTRODUCTION

1.1 Purpose and Scope

The purpose of this document is to characterize the network architecture and operational procedures necessary for the support of Number Portability (NP) in the wireless industry per Federal Communications Commission (FCC) order *Number Portability Report and Order, CC Docket 95-116*. This document represents consensus agreements among members of the Cellular Telecommunications Industry Association (CTIA). This document is applicable to analog Advanced Mobile Phone System (AMPS), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), and Global System for Mobile Communications (GSM) providers (including digital Specialized Mobile Radio (SMR) providers), alike. Differences among Wireless Service Providers (WSP) technologies and implementation strategies are noted where appropriate. Proprietary implementations are outside the scope of this document.

This document focuses only on Wireless Number Portability (WNP), mainly on the case of a subscriber porting to a WSP. WSPs have some fundamental differences with regard to service and network operations as compared to wireline service providers; therefore, certain aspects of NP concepts and definitions have different relevance to WSPs. This document will explain how the wireless solution will account for such differences.

The primary audience for this document is WSPs and wireless equipment and service vendors who assist in the definition, development and deployment of WNP. This document may also benefit other groups such as the wireline industry. It assumes the reader is familiar with the wireless telecommunications technologies.

The remaining sections of the introduction present necessary background information to establish a foundation for the WNP architecture, including the following:

- WNP goals,
- NP history,
- NP definitions and interpretations for WNP, and
- WNP assumptions as applicable to this document.

1.2 Solution Goals

The WNP solution as documented here has been developed in accordance with the following significant goals in order to uphold wireless call processing and mobility management:

- Minimize impact on existing networks.

- Continue to allow for roaming and roaming agreements with more than one service provider in any serving area per negotiated business arrangements.
- Do not inhibit the future growth of wireless technology.
- Support the long-term efficient use of numbering resources.
- Support wireless existing and changing service areas without inhibiting competition.

1.3 Definitions

Readers should use the following definitions when reading this document:

- *Service Provider Portability* is defined by the FCC as "the ability of end users to retain the same telephone numbers as they change from one service provider to another." [1]
- *Location Portability* is defined by the FCC as "the ability of users of telecommunications services to retain existing telecommunications numbers without impairment of quality, reliability, or convenience when moving from one physical location to another." [2]

  Location portability should be distinguished from the inherent mobility of wireless communication. Location portability in a wireless environment refers to a subscriber's ability to retain his/her directory number when moving from the serving area of one home system to another or changing the wireline rate center associated with the mobile directory number. (Refer to Section 1.6 for more details.)
- *Service Portability* is defined by the FCC as "the ability of users of telecommunications services to retain existing telecommunications numbers without impairment of quality, reliability, or convenience when switching from one telecommunications service to another service provided by the same telecommunications service provider." [3]
- *Home Serving Area* - the geographic area of coverage provided by a WSP where subscribers may originate and terminate calls without incurring roaming charges.
- *Mobility* - the ability of a mobile station (and thus subscriber)
  - to move temporarily from one location to another and still obtain telecommunication services (i.e., roaming); and
  - to be in motion while continually accessing telecommunication services (i.e., hand-off).

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[1] FCC *Number Portability Report and Order*, CC Docket 95-116, July 2, 1996 paragraph 172.

[2] ibid., paragraph 174.

[3] ibid., paragraph 172.

- *Number Portability Administration Center Service Management System (NPAC-SMS)* - a Service Management System (SMS) responsible for storing and broadcasting to service providers NP data updates within a region for ported DNs. The NPAC-SMS(s) is owned and maintained by a neutral, third-party.
- *Local Service Management System (LSMS)* - an SMS responsible for distributing the NP data updates from the NPAC-SMS to the service provider's NP-SCP, typically is owned and maintained by the service provider.
- *Mobile Station (MS)* "is the interface equipment used to terminate the radio path at the user side. It provides the capabilities to access network services by the user." [4]
- *Mobile Directory Number (MDN)* - a 10-digit North American Numbering Plan (NANP) directory number assigned to address a wireless service subscriber.
- *Directory Number (DN)* - any E.164 10-digit dialable number assigned to address a wireline or a wireless subscriber. DNs are inclusive of MDNs.
- *Mobile Station Identifier (MSID)* - either a 15-digit E.212 formatted International Mobile Station Identification (IMSI) or 10-digit Mobile Identification Number (MIN).
  - *International Mobile Station Identifier (IMSI)* - a 15-digit non-dialable number associated with a specific service provider and unique to each mobile station. It is programmed into the mobile station and used to identify the mobile, its home network, and its country. [5]
  - *Mobile Identification Number (MIN)* - a 10-digit non-dialable number associated with a specific service provider and unique to each mobile station (as an MSID). It is programmed into the mobile station and is designed to contain a NANP-formatted number (e.g., NPA-NXX-XXXX). This number, as an MSID, may be equivalent to the value of a dialable MDN. MIN is the prevalent identifier in AMPS networks.
- *Donor Network* - the network from which a subscriber ports. If the subscriber has ported more than once, the first network to release the subscriber is referred to as the original donor network. The original donor network is also the original owner of the number.
- *Recipient Network* - the network to which a subscriber ports.

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[4] IS-41.1 Rev C

[5] *International Mobile Station Identity (IMSI) Assignment Guidelines and Procedures*, Prepared by a Wireless Industry Forum, Sponsored by CTIA and PCIA, Version 1, February 12, 1996.

1.4 Background

1.4.1 The FCC Order

The FCC *Number Portability Report and Order, CC Docket 95-116,* dated July 2, 1996, mandates that all Commercial Mobile Radio Service (CMRS) providers provide the capability to deliver calls from their network to ported numbers anywhere in the United States by December 31, 1998. Furthermore, the order mandates that these providers offer service provider portability, including support for roaming, by June 30, 1999.[6]

The following are some key excerpts from the original FCC report and order:

- "We require all cellular, broadband PCS, and covered SMR carriers to have the capability of querying appropriate number portability database systems in order to deliver calls from their networks to ported numbers anywhere in the country by December 31, 1998."[7]
- "We require all cellular, broadband PCS, and covered SMR carriers to offer service provider portability through out their networks, including the ability to support roaming, by June 30, 1999. ... We believe a nationwide implementation date for number portability for cellular, broadband PCS, and covered SMR providers is necessary to ensure that validation necessary for roaming can be maintained."[8]
- Interim number portability measures are not required for WSPs.[9]
- Service and Location portability are not required at this time.[10] In addition, changes between wireline service providers and broadband CMRS providers or among broadband CMRS providers are considered changing service providers and not service. Thus, service provider portability includes wireless to wireless, wireline to wireless as well as wireless to wireline.[11] As mentioned in the introduction, this document focuses on those scenarios in which a subscriber ports to a wireless provider.
- Customers may need to purchase new equipment (e.g. mobile station) when switching among CMRS providers.[12]
- The issue of regional number portability databases and their content and administration is assigned to the North American Numbering Council (NANC).[13]

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[6] FCC *Number Portability Report and Order,* CC Docket 95-116, July 2, 1996, paragraph 172.

[7] ibid., paragraph 165.

[8] ibid., paragraph 166.

[9] ibid., paragraph 169.

[10] ibid., paragraph 181.

[11] ibid., paragraph 172.

[12] ibid., paragraph 157.

The FCC did not mandate a specific method for number portability but has recognized that the Location Routing Number (LRN) method is currently preferred by much of the industry, although not tested.[14] A field test of LRN as it applies to the wireline industry is scheduled for execution in Chicago through the summer of 1997.[15] [16] The intent of the test is to prepare for the wireline implementation and currently does not include the wireless solution. Refer to Section 1.7 regarding trial report availability.

The FCC, in its original order, established a list of nine performance criteria which must be met by any number portability method:

(1) "support existing network services, features, and capabilities;

(2) efficiently use numbering resources;

(3) not require end users to change their telecommunications numbers;

(4) not require telecommunications carriers to rely on databases, other network facilities, or services provided by other telecommunications carriers in order to route calls to the proper termination point;

(5) not result in unreasonable degradation in service quality or network reliability when implemented;

(6) not result in any degradation of service quality or network reliability when customers switch carriers;

(7) not result in a carrier having a proprietary interest;

(8) be able to accommodate location and service portability in the future; and

(9) have no significant adverse impact outside the areas when number portability is deployed." [17]

On March 6, 1997, the FCC issued its *First Memorandum Opinion and Order on Reconsideration*, CC Docket No. 95-116 to further clarify and rule on several outstanding inquiries regarding NP. The following points are notable:

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[13] ibid., paragraphs 91-102.

[14] ibid., paragraph 46.

[15] ibid., paragraph 79.

[16] FCC *First Memorandum Opinion and Order on Reconsideration*, CC Docket 95-116, March 6, 1997, paragraph 79.

[17] FCC *Number Portability Report and Order*, CC Docket 95-116, July 2, 1996, paragraphs 48-59.

(a) "...we find criterion four... is, from a practical perspective, unworkable. ... Thus, criterion four does not appear to be necessary in order to implement the statutory definition of number portability." [18]

(b) "We clarify that by June 30, 1999, CMRS providers must (1) offer service provider portability in the 100 largest MSAs, and (2) be able to support nationwide roaming. Although we have not provided a specific phased development schedule for CMRS providers as we have for wireline carriers, we expect that CMRS providers will phase in implementation in selected switches over a number of months prior to the June 30, 1999, deadline for deployment." [19]

(c) "...CMRS carriers need only deploy local number portability by this deadline in the 100 largest MSAs in which they have received a specific request at least nine months before the deadline (i.e., a request has been received by September 30, 1998)." [20]

1.4.2 Wireless Industry Studies

During August, 1996, CTIA released a Notice of Request for Information (RFI) to the telecommunications industry. The goal of the RFI was to solicit potential methods available to the wireless industry for number portability implementation. CTIA received more than one hundred inquiries leading to several substantive responses.[21] A Number Portability Forum was held October 9-11 in Las Vegas to review the presentations of the responses and find consensus on an approach to NP in the wireless industry.

On January 22, 1997, CTIA released to both TIA and Committee T1 standards committees a Standards Requirements Document (SRD) entitled *Wireless Number Portability CTIA Standards Requirement Document*. It provided the appropriate committees with an initial look into the requirements of WNP on current and future standards.

The FCC has sponsored a forum for agreeing to NP concepts via a Working Group under the North American Numbering Council (NANC). Since CMRS providers are regulated at the federal level (as opposed to the state level) and their participation in number portability is mandated, the involvement of WSPs and consideration of related wireless specific issues has become more crucial. This document is not intended to supersede any decisions made by these committees but is intended to capture portability as it involves WSPs.

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[18] FCC *First Memorandum Opinion and Order on Reconsideration*, CC Docket 95-116, March 6, 1997, paragraph 19.

[19] ibid., paragraph 136.

[20] ibid., paragraph 137.

[21] Contact CTIA for more information.

1.5 Assumptions

The following assumptions are made throughout the WNP architecture:

- When a subscriber ports, the subscriber's current terminal equipment may or may not be compatible with the new SP's technology. A subscriber may need to purchase a new mobile station in order to obtain the services from a new WSP. Therefore, a subscriber may or may not port his or her mobile station.
- The NPAC-SMS will contain a record for each ported wireline DN and each ported MDN (within the area that it serves).
- Service providers are responsible for maintaining the integrity of their copy of the NPAC-SMS data.
- Each subscriber is identified by at least one unique NANP directory number that will port with the subscriber from one service provider to another.
- This document makes no assumptions regarding the number nor distribution of NPAC-SMSs, except that more than one will most likely be established and will be in place in time for WNP.
- Although this document most often refers to the number portability query database as residing on an NP-SCP, the WNP Solution does not preclude a WSP from locating the number portability query database on another platform such as an STP.
- This document details service provider portability for facility-based WSPs. It does not consider the complications of a re-seller environment in its discussions. (A facility-based WSP is one that operates at least one MSC.)

1.6 Aspects of Wireless Number Portability

Because wireless service providers have some fundamental differences in their network operation and services as compared to wireline, differences arise in the design and implementation of wireless number portability. These differences impact how and when subscribers can port to a wireless service provider. To appreciate these aspects, this section presents an overview of these differences, a logical discussion toward explaining wireless portability boundaries, as well as the definition of those boundaries.

1.6.1 Differences between Wireless and Wireline

The differences between wireline LECs and WSPs that impact the definition of portability are summarized in Table 1-1.

Table 1-1 Wireline versus Wireless Calling Aspects

Wireline	*Wireless*
A directory number is associated with a stationary physical facility (e.g. local loop).	A mobile directory number is not associated with any fixed physical loop.
The customer can only be served in a single static location with the same terminal.	The customer can be served over a wide geographic area with a single terminal. Mobility is inherent.
Aspects of local calling (including rating) are regulated by the states.	Aspects of local calling are not regulated by the states. Areas of local calling do not match those defined by wireline providers. Areas of local calling do not match from one WSP to another.
Incumbent LEC are bound by inter-LATA restrictions.	WSPs do not recognize the concept of LATAs.
Service Provider Portability is geographically bounded by rate centers.	Mobile-to-mobile and mobile outbound calls are not bounded by rate centers. Furthermore, wireline rate centers and similar wireless boundaries do not overlay one another.

The FCC definition of service provider portability does not distinguish between wireless or wireline service providers. However, since service provider portability should not disrupt current call rating, the inclusion of a WSP and the added complexities of the above differences must be carefully evaluated.

The definition of location portability infers that the number is associated with a physical, fixed facility. It involves changing rate centers associated with a number which presents significant impacts in rating the call of the originating party when the called party has moved their number to another rate center. However, the landline rate center definitions are not required to rate calls originated by wireless subscribers.

In light of these differences and in order to preserve the integrity of routing and rating of calls to wireless subscribers, whether ported or not, adjustments in interconnection and business agreements (e.g., Points of Interconnection (POI)) may be required.

1.6.2 Geographic Boundaries

1.6.2.1 Wireline Boundaries

In order to understand how wireless can participate in the FCC order without changing the wireline call rating, understanding call rating is fundamental. The concept of "rating" was created by wireline carriers as a method to capture distance related costs in billing. This concept

has been adopted by LECs for local calls as well as by IXCs for toll calls. Local carriers accomplished distance rating by defining a *rate center* as a geographic area associated with a single V(ertical) and H(orizontal) coordinate. Each telephone number by its NPA-NXX to an associated with a single rate center, often defined as the area served by a single switch (or a combination thereof). The distance related component of rating a call between two telephone numbers is, in essence, based on the difference of the two coordinates of their associated rate centers. Toll and long distance carriers adopted the same concept except that several rate centers may be aggregated to form a *rate district*. The rate district concept was then used to rate calls terminating outside of the local calling area (i.e., inter-city calls).

Today, wireline carriers associates wireless numbers (as defined by NPA-NXX) with a specific wireline rate center for mobile terminated calls. A wireline carrier can rate a wireline-to-wireless call based on the rate center V&H coordinates associated with calling and called party numbers.

A common assumption for service provider portability is that a subscriber originating a call should not be rated differently because of the called party's service provider or porting status. If a wireline subscriber originates a call, the rating should be the same regardless if the called party has ported to a WSP or where the serving MSC is located. Preserving the rating can be accomplished by WSPs having an interconnection agreements with the wireline SPs. Uniform treatment by wireline providers of calls to wireless subscribers continues to be an issue. Will the rating be based on the original wireline rate center or the fact that the subscriber is being served by a WSP? This issue remains for further study.

Rating calls to a portable wireless number is calculated using the rate center associated with the called party number (not the LRN). WNP does not define any requirement that a WSP obtain an LRN for every rate center associated with their serving area in order to accept a wireline subscriber desiring to port.

1.6.2.2 Wireless Boundaries

WSPs may rate calls originated by mobile subscribers; however, WSPs are not obligated to use the same physical boundaries of wireline rate centers or rate districts. Instead, WSPs utilize the concept of a geographical area referred to as a *Home Serving Area* (HSA). HSAs are typically much larger than the geography defined by a wireline rate center; for example:

- Basic Trading Area
- Metropolitan Service Area
- Major Trading Area

A WSP may define a portion of the above as a HSA or combine several of the above into a larger area. Unlike wireline rate centers which are regulated by the state utility commissions, HSAs are not subject to state jurisdiction (or any jurisdiction for that matter). Thus, the size of the HSA is a business decision of the WSP and frequently differs from one WSP to another.

Subscribers that originate calls within their HSA do not incur roaming charges. A WSP may define different "bands" or calling scopes within or across multiple HSAs which indicate that all mobile originated calls that terminate within the same "band" are rated the same.

1.6.2.3 Mobility versus Location Portability

Wireless users have the inherent ability to move while using their service; it is important to view this as *mobility*, not location portability. Being mobile does not impact the billing or rating for a wireline originated call. Mobility may impact the wireless subscriber through call forwarding charges and/or roaming fees.

Location Portability with respect to wireless is the ability to change Home Serving Areas or change the wireline rate center associated with the MDN. In this case, the wireline billing paradigm is impacted in the same way as with wireline location portability. For the wireless subscriber, this allows them to use their mobile set in a different area without incurring the roaming fees previously encountered .

1.6.3 Porting To and From

With wireline portability, any movement (i.e., relocation of the physical point of service) is technically considered location portability. However, it is recognized that the wireline implementation of service provider portability can "accommodate" a limited amount of location portability. That is, as long as the serving location is within the same rate center, the NP implementation does not impact billing or rating. Relocating outside the present rate center introduces significant billing and rating implications.

However, once a subscriber ports to a WSP, mobility is inherent. A subscriber can utilize the mobile station independent of any wireline rate center boundary. Furthermore, the subscriber can use the mobile station outside any HSA (subject to roaming agreements and charges). This mobility is transparent whether the subscriber chooses to actually relocate their residence or not.

1.6.3.1 Porting to a Wireless Service Provider

It is assumed that in order to be a recipient network, the WSP must have an FCC license to serve the location of the subscriber. The WSP is also assumed to provide radio coverage over the physical location where service was previously obtained by the ported subscriber. Serving the subscriber via a roaming agreement with another WSP does not constitute eligibility. Finally, WSPs are not required to have switching facilities within the same rate center area as the ported subscriber's DN NPA-NXX.

Given a WSP is eligible to receive a ported subscriber as defined in the above paragraph, the following criteria must be met to preserve the billing paradigm:

- A wireless subscriber can port the MDN to another WSP as long as the wireline rate center associated with the MDN is geographically located within the HSA of the involved WSPs.
- A wireless subscriber can port the MDN to a wireline SP as long as the resulting wireline SP is geographically located within the wireline rate center associated with the MDN's NPA-NXX.
- A wireline subscriber can port the DN to a WSP as long as the rate center associated with the wireline number is geographically located within the HSA of the involved WSP.

1.6.3.2 Porting to Wireline Service Provider

A subscriber that ports to a wireline carrier may have originally had their number assigned by a WSP. In this case, calls from other wireline subscribers should still be rated the same as before.

Each wireless number is associated with a rate center from a wireline perspective. The rate center may or may not be the same rate center where the wireless switch is located. Furthermore, the wireless subscriber may or may not reside in the rate center associated with their MDN. Consequently, to maintain consistent rating from the calling party's perspective, porting from a WSP to a wireline service provider can only occur when the resulting wireline service is geographically located within the wireline rate center associated with the ported MDN.

Abiding by such constraints does not impact wireline rating. Wireline calls rated on the called party number would continue to be rated the same. Assuming the subscriber has not moved, then from a rating perspective, the situation analogous to a subscriber using the mobile station at the subscriber's residence. Once the subscriber has ported to a wireline provider, that subscriber is constrained to using the telephone number only at a fixed location.

1.7 Critical Dates

1.7.1 Regulatory Mandates

Several dates are included in the FCC order concerning portability implementation. The earliest implementation of wireline service provider portability by the incumbent LECs in the top 100 Metropolitan Statistical Areas (MSAs) is 4Q97.

CMRS providers are not required to implement any technology to support wireline service provider portability by this date and thus, can continue to route calls to the donor LEC as normal. However, CMRS providers must make arrangements to complete calls to portable subscribers by December 31, 1998. Since calls made prior to this date will connect successfully nonetheless, this date is interpreted as requiring the WSP to either

- directly query a database and route the call to the proper network, or

- make business arrangements for another provider to query and properly route the call to the proper network.

The WSP need not own nor operate the database; the WSP may have a business relationship with another entity regarding access to that entity's database.

The second critical date involving CMRS providers is June 30, 1999. By this date, WSPs must be capable of receiving and releasing wireless ported subscribers and must have all the capabilities required for service provider portability.

1.7.2 Implementation

In order to consider the ability to comply with the FCC mandated dates, the aspect of standards and equipment availability must be considered. If one considers the normal development time of 2 years for standards, 18 months for equipment development beyond standards and 12 months for equipment deployment, the time line on the following page would apply.

Figure 1-1 Theoretical Timeline

In order to meet the end date, the intervals must shortened or overlapped. The following compressed timeline in Figure 1-2 is offered for consideration in planning for WNP.

Figure 1-2 Potential Timeline Necessary to Meet FCC Mandate

Note: that the time points above the line are either actual or derived by the FCC.

The following is a short description for each of the time points:

- *SRD to Standards*: This is a completed activity. The initial CTIA SRD on WNP was delivered to TIA, TR45.2, TR46 and T1P1 in January, 1997.
- *WNP Solutions Document*: This point represents the release of this document.
- *FCC Field Trial Report Available for Wireline*: This is the FCC ordered date for a report of the field trial of wireline
- *Industry Implementation Agreements and Standards Complete*: This is a derived date based on the time needed to develop and deploy equipment to meet the FCC dates. This substantially shortens the typical interval to develop standards and come to industry agreement.
- Bracketed area illustrates the time frame in which all of the following items much be accomplished in some form:
  - *Wireless Field Trial*: A field trial of the wireless solution must be made prior to deployment of equipment on any significant scale due to the fundamental impacts of these changes. Due to the limited time available, this trial must be on a limited scope and short time frame. Other forms of testing will also be necessary to prepare for and supplement the trial.

- *Initial Equipment Changes Available:* This date represents the initial availability of any equipment changes to meet the December 31, 1998, date for delivery of calls to ported wireline numbers. This is an evolutionary step to the final wireless solution, not a separate step.

- *Equipment Deployment*: This represents the time required to deploy the needed new equipment, software and changes throughout the industry - a significant task for the wireless industry as nationwide roaming requires all participating carriers to have this capability.

- *Final Equipment Changes Available*: After the initial testing of the equipment and software, a number of adjustments are normally expected. This milestone represents the point in time that the final changes would be available for deployment.

- *Equipment and Procedures Testing*: Even with a field trial, each carrier will need to test the deployment of equipment and procedures within their specific environment to ensure proper operation of maintenance customer care, billing procedures, et al.

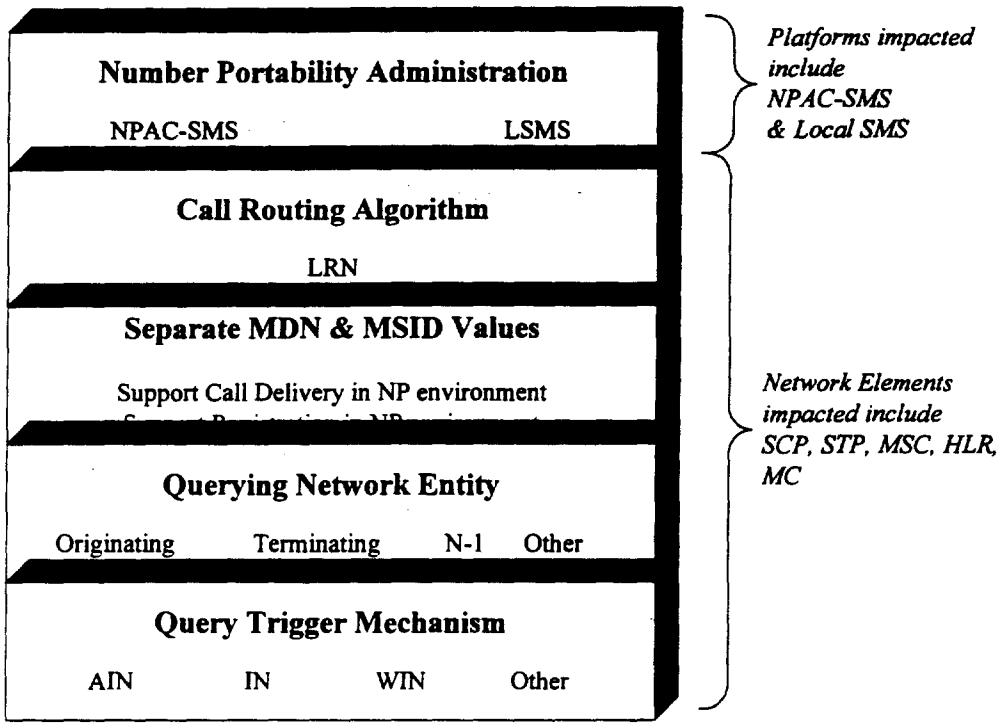
- *Calls delivered to ported wireline numbers:* This is the FCC ordered date for wireless to be able to deliver calls to ported wireline numbers within the top 100 MSAs.
- *Top 100 MSA Number Portability Deployment Complete*: This represents the time in which all wireless carriers involved in roaming have deployed the necessary equipment and software to support number portability.
- *Full Nationwide Roaming of Wireless Ported Numbers*: This represents the time in which all needed equipment is deployed and roaming involving ported numbers can be activated. All necessary coordination, services and systems are deployed and operational.

2. WIRELESS NUMBER PORTABILITY

2.1 Solution Overview

Figure 2-1 displays a model of the building blocks for implementing WNP. An explanation of the model follows the figure.

Figure 2-1 Wireless Number Portability Building Blocks



The five building blocks as illustrated in the figure are defined as follows:

- *Number Portability Administration*: This component contains the NPAC-SMS and LSMS which disseminate information regarding ported subscribers.
- *Routing Algorithm*: This component identifies the routing method by which calls are routed to the subscriber's new service provider (either wireless or wireline). The method is LRN.
- *Separation of MDN and MSID*: This component reflects the separation of the MDN and MSID and its significance to wireless registration and call delivery.

- *Querying Network Entity:* This component defines the network entity capable of querying to the NP-SCP database to obtain routing information. This entity could be in the Originating Network, Terminating Network, N-1 Network (i.e., the next to last capable network) or some other entity (e.g., a message center, a service node platform).
- *Query Trigger Mechanism*: This component encompasses the software procedure(s) within the querying network entity that activates a trigger and issues the query for portable NPA-NXX ranges. Possible trigger and query message mechanisms are AIN, IN, WIN or some other mechanism (e.g., IS-41) understood between an MSC and NP-SCP.

The right side of the figure maps the major functional hardware platforms to the building blocks. These building blocks drive the following major impacts to today's wireless network architecture:

(a) Incorporate call routing based on an LRN.

(b) Move to separate MDN and MSID values.

- Make the MDN the portable number; keep the MSID as a non-portable number and controlled by the wireless service provider. This separation is essential in order to avoid 10 digit translation in mobile registration and, equally important, in support system processing (e.g., roaming tables).
- Allow the MSID to be either a MIN or an IMSI.

(c) Support Global Title Translations (GTT).

The three items listed above are discussed in more detail. Also, Sections 3 (network architecture) and Section 4 (operations and administration) expand on the various points in the figure in greater detail.

2.2 Location Routing Number Call Routing

The Location Routing Number (LRN) is a 10-digit NANP-formatted Network Routing Address assigned to a switch. Of these10 digits, the first six are significant to the Public Switched Telephone Network (PSTN) for routing a call. For an existing switch, this code is an NPA-NXX code block the switch currently serves.

A Number Portability Service Control Point (NP-SCP) maps every ported number to its serving switch's LRN. A query capable network along the route would perform a query to the NP-SCP to obtain the LRN associated with the called party's 10-digit DN in order to correctly route the call based on NPA-NXX translation of the LRN. The network then sets up the subsequent leg of the call by sending an ISUP Initial Address Message (IAM) with the LRN.

The concept of the N-1 network performing the query to the NP-SCP is often associated with the LRN call routing method. If *N* denotes the network sequence number of the terminating network in the call path, the *N-1* network would identify the NPA-NXX of the dialed number as a portable block and would query the NP-SCP to retrieve the LRN. The subject of when to query the NP-SCP as it applies to WSPs is discussed in more detail in Section 3.

The ISUP IAM provides for an indicator noting a query has been performed. Therefore, any subsequent network need not perform additional queries.

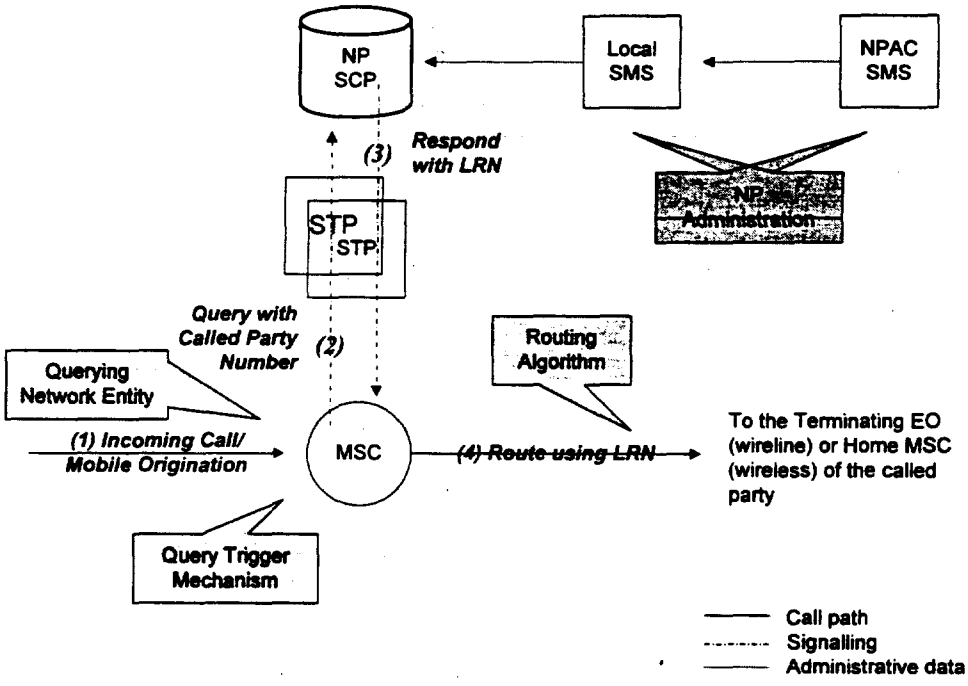
The summary, the LRN routing method is characterized by the following:

(a) It does not require a single unique network address for each ported number. The network address for ported number is associated with the ported-to switch address.

(b) Call routing remains consistent with current call routing schemes.

Figure 2-2 illustrates a typical LRN routing of a call to a ported subscriber.

Figure 2-2 Routing with a Location Routing Number



For completeness, the figure includes elements not directly involved in call processing, namely the NPAC-SMS and the LSMS.

2.3 Separation of the Mobile Directory Number from the Mobile Station Identifier

Prior to number portability, AMPS, CDMA and TDMA service providers performed registration, call processing, provisioning, customer care, and billing are based upon a single number for the subscriber - the Mobile Identification Number (MIN).

If today's MIN was portable, either a 10-digit Global Title Translation (GTT) or an NP-SCP dip would be required in order to locate the home network of the subscriber.[22] Neither of these alternatives is desirable. A dip during registration would increase the query rate on the NP-SCPs, and not all WSPs are equipped to perform 10-digit GTT in the time frame required.

In WNP, mobile stations will possess two types of numbers: a Mobile Station Identifier (MSID) and a Mobile Directory Number (MDN). The MDN will be a dialable NANP directory number, in the NANP format and will be the portable number. The MSID will be either an E.212 IMSI[23] and/or a NANP-like MIN and will not be portable.

With the introduction of number portability, existing TDMA and CDMA subscribers not yet ported will have two numbers (the MDN and the MSID) though both most likely equal to the existing MIN. When the subscriber ports, the MDN and MSID become separate and distinct. The ported subscriber will surrender the MSID to the donor network and receive a new MSID from the recipient network. The ported subscriber's MDN will remain unchanged. The donor network can then freely use this MSID for a new subscriber. It is possible that the same number may be used for an MDN in one network and an MSID (as a MIN) in another network. No adverse impacts because of this situation, however, have been identified

The GSM standards presently account for separate numbers: an E.212 IMSI for identifying the mobile station and an E.164number for dialing the mobile station.

Using an IMSI as the standard mobile station identifier was established as a goal of the wireless industry before the introduction of number portability. Because of this, the CDMA and TDMA standards allow for E.212 IMSIs in all mobile stations. Therefore, many CDMA and TDMA carriers may take advantage of the implementation of WNP to introduce IMSIs. However, the entire wireless industry may not flash cut to IMSI.

The industry must support MSIDs in IMSI and in MIN formats. This requires the following:

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[22] Refer to CTIA RFI Open Forum submitted responses

[23] *International Mobile Station Identity (IMSI) Assignment Guidelines and Procedures*, Prepared by a Wireless Industry Forum, Sponsored by CTIA and PCIA, Version 1, February 12, 1996.

- IMSI-capable networks and IMSI-capable mobile stations must be capable of supporting both IMSI and MIN MSIDs in order to continue to roam on non-IMSI-capable networks.
- Administration of MINs as MSIDs must be addressed (outside the scope of this document).

Variations and implementations of IMSI are being addressed in other forums and are not in the scope of WNP as long as the first six digits of the identifier can be used to ascertain the home network.

2.4 Global Title Translation for Number Portability

In addition to currently defined uses, Signaling System 7 (SS7) GTT may be used to support routing for the WNP query and for other services impacted by number portability. A 6-digit GTT is recommended in the WNP environment for delivery of the LRN query to the NP-SCP. If a WSP does not have GTT capabilities, direct MTP routing to the NP-SCP to obtain the LRN may be used.

GTT may be used to route messages for various services to the appropriate network element (e.g., recipient switch) when an NPA-NXX of a dialed number no longer uniquely identified the targeted network element. To support SS7 inter-system message for such services as CLASS, LIDB, or CNAM, GTT must be available somewhere within the service provider's network (or extended network relying on another provider for portability).

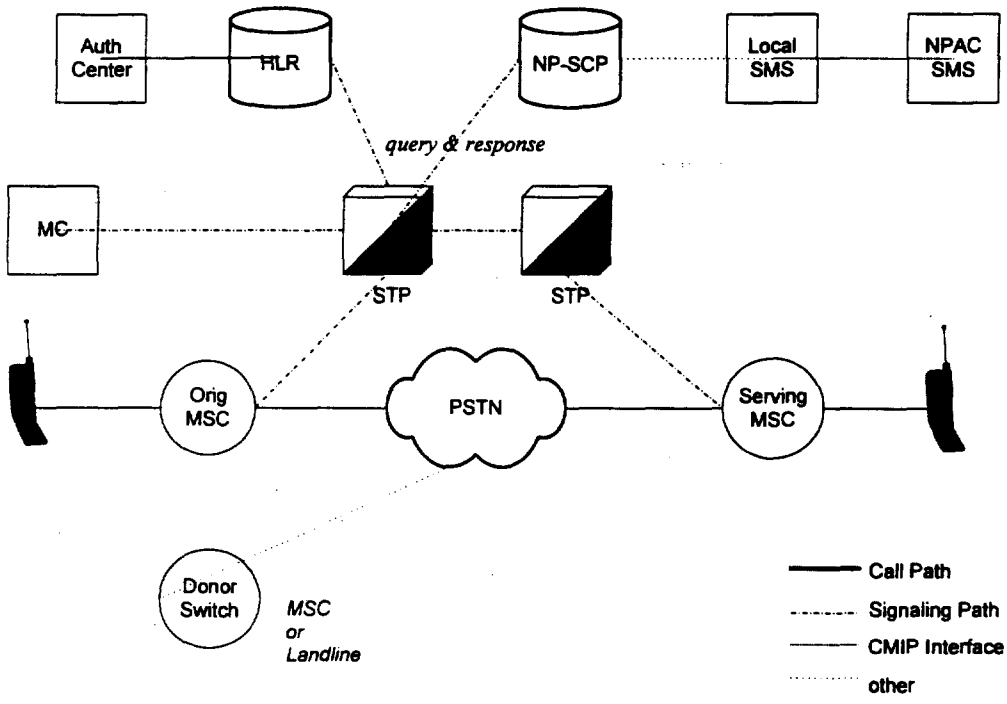
3. THE WNP NETWORK REFERENCE MODEL AND PROCEDURES

This section discusses the necessary wireless architecture (Section 3.1) and the feature interactions (Section 3.3) necessary to support WNP. Section 3.2 illustrates the various call routing scenarios via information flow diagrams. Section 3.4 presents some performance considerations.

3.1 Network Configuration

Figure 3-1 illustrates the network entities involved in wireless number portability. Specifically, this reference model only depicts those entities which are impacted by number portability; other entities might exist in wireless networks but may not be directly impacted and therefore, are not included. Other features and services (e.g., Voice Mail) that are not implemented in a standard manner must be studied by each WSP independent of this effort.

Figure 3-1 WNP Network Reference Model



The sub-sections following this figure explain the details of the WNP solution, including a description of each of the elements and the signaling between each of the elements. Although

the NPAC-SMS and LSMS are included, Section 4 presents a detailed description of the service management and operating infrastructure.

3.1.1 Number Portability Service Control Point

The NP-SCP is the database accessed in real time by the switches to provide the LRN value for a ported subscriber in order to correctly route a call. It contains the number portability information originally transmitted by the NPAC-SMS via the LSMS. Each service provider will either own or have access to an NP-SCP that will include the mapping of ported 10-digit DNs to their associated LRNs.

The WNP solution presumes, at present, the following data elements, at a minimum, must exist in each NP-SCP to support routing calls to ported numbers:

- Directory Number
- Location Routing Number

This document later suggests that MSID might be necessary for the support of Short Message Services (SMS) in number portability. Reference Section 3.3.5 for more details.

3.1.2 Mobile Switching Centers

An MSC is a wireless switch. Besides call routing, an MSC typically maintains the Visitor Location Register (VLR). In addition, depending upon the WSPs chosen architecture, the MSC might keep the Home Location Register (HLR). Some providers deploy remoted HLRs; others deploy HLRs integrated with the MSC.

The WNP Network Reference Model depicts three types of MSCs: Originating, Donor, and Serving. The Donor MSC is defined in Section 1.3. The Serving MSC is the MSC with which the subscriber is currently registered. Although not shown on the model, a Home MSC is the MSC which maintains the NPA-NXX relative to the subscriber's number. If the subscriber is registered "at home," the Home and Serving MSC are one in the same. If the subscriber is roaming, the Home MSC routes the call to the appropriate Serving MSC. Relating to WNP, routing by the LRN might take the call to the Home MSC. Routing from the Home MSC to the Serving MSC is a standard component of wireless architecture independent of number portability.

Routing within the subscriber's service provider network is at the discretion of each individual service provider. For example, a service provider may elect to deploy a single national or several regional 'gateway' MSCs. With the regional gateway architecture, all inbound calls to the service provider's subscribers would be routed by the PSTN to one of these 'gateway' switches. The service provider would then use internal logic to get the call routed to the appropriate subscriber. This type of architecture is supported by the WNP solution and should have no impact on the other service provider networks.

The MSC will need to have the capability to identify an NPA-NXX as being portable (i.e., contains ported numbers) in order to recognize the need for an NP query. An industry agreement is moving forward to add a portability flag to the Local Exchange Routing Guide (LERG).

Current roamer tables will continue to be valid for MINs but will no longer be valid for MDNs. Roamer tables should operate on MSIDs, whether MIN or IMSI.

The signaling for call connection to and from an MSC is discussed in Section 3.1.6, and the signaling for query from the MSC to the NP-SCP is discussed in Section 3.1.7.

3.1.3 Signaling Transfer Points

The STP provides SS7 signaling between the network elements per the reference model in Figure 3-1. The STP also provides the Signaling Connection Control Part (SCCP) signaling message translation and routing function. For number portability, the STP SCCP function determines the location of the NP-SCP and forwards the query. The query response message from the NP-SCP is returned via the STP.

3.1.4 Signaling

ISUP signaling is currently being enhanced to communicate NP query indicator and associated call routing information to the downstream networks.[24] The WNP solution is consistent with the wireline NP solution with regard to the necessary enhancements to the IAM message and therefore, with the Call Completion to a Ported Number (CCPN) enhancements. While this document specifies ISUP for number portability signaling, it recognizes networks which will use MF signaling or rely on third party networks. Both the ISUP and MF trunk signaling are discussed below.

3.1.4.1 ISUP signaling

The LRN approach requires additional signaling information for communicating the query status and routing information necessary for the establishment of call connections to a ported number. Call connections are made using the LRN of the home (recipient) MSC. The query indicator is needed to prevent subsequent switches in the call path from making unnecessary database dips. Finally, the serving switch also needs the dialed number for call termination. ISUP signaling ensures that the necessary additional signaling information will be available to the home MSC.

To explain in more detail, after the MSC queries the NP-SCP for a call initiation to a ported number and the MSC is ready to establish the call connection, an IAM is formulated with the enhancements documented in Table 3-1.

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[24] CCPN SS7 network capability in *T1 LB 557 Signaling System Number 7-Number Portability Call Completion to a Portable Number - Integrated Text* currently in ballot to become an American National Standard

Table 3-1 ISUP IAM Parameter Settings

IAM Parameters [25]	*Ported Not Dipped*	*Ported Dipped*	*Not Ported Dipped*	*Not Ported Not Dipped*
Called Party Number (CdPN)	dialed DN	LRN	dialed DN	dialed DN
Generic Address Parameter (GAP)	n/a	dialed DN	n/a	n/a
Forward Call Indicator (*FCI*)	FALSE	TRUE	TRUE	FALSE

(Note: This table only includes those parameters affected by NP.)

If the calling party is a mobile station, the Calling Party Number (CgPN) must be populated with the MDN of the originating mobile station. If the subsequent switch does not support ISUP enhancements, then the GAP and FCI parameters are not applicable and should not be populated.

A subsequent switch upon detecting the FCI as set for "translated number" should not perform an NP query. If the FCI is not set, a subsequent switch may query the NP-SCP. Some wireless service providers may arrange for another network (via business agreements) to perform the NP query. In this case, the switch routes the call to the aiding network where the NP query is launched. After this switch performs the database dip, it formulates the IAM message with the dipped settings and routes the call as appropriate.

The home MSC recognizes that it serves the dialed ported number by knowing the LRN in the CdPN is its own LRN. Upon this recognition, it retrieves the dialed number from the GAP parameter. If the dialed number has not been ported but is within a portable number block, the MSC can determine that it is the home MSC by recognizing that the FCI is set and it serves the dialed DN in the CdPN parameters. The home MSC will use the dialed number to terminate the call.

When a donor switch receives an IAM with the FCI not set, it should perform the NP query and route the call to the appropriate switch. Such might the case if there has been some network failure.

Another IAM parameter being discussed in conjunction with wireline number portability (yet not included in the table above) is the Jurisdiction Information Parameter (JIP).[26] The JIP is an optional parameter in the ISUP standard. The WNP Solution is not advocating nor opposing the population of this parameter in the outgoing IAM at this time.

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[25] CCPN SS7 network capability in *T1 LB 557 Signaling System Number 7-Number Portability Call Completion to a Portable Number - Integrated Text* currently in ballot to become an American National Standard

[26] *Generic Switching and Signaling Requirements for Number Portability*, Illinois Number Portability Workshop, Generic Requirements Issue 1.04, January 20, 1997.

3.1.4.2 ISUP Signaling with MF Signaling to the Home MSC

When ISUP signaling is available throughout the call path except at the final trunk MF signaling, the switch interworking ISUP and MF signaling will need additional capabilities. The interworking switch must locate the destination switch using the CdPN in the incoming IAM, and then extract the dialed ported number and use it as the called party address in signaling the destination switch. A destination switch must recognize that it is the home switch of the dialed ported number. It will terminate the call using the called party address.

3.1.4.3 ISUP and MF Signaling Interworking

Call paths that contain a mixture of ISUP and MF signaling are inefficient. After a switch obtains the LRN from the NP-SCP, for example, it formulates an IAM message. When the IAM arrives at an interworking switch that switch can only signal the dialed number to the next switch using MF signaling. The switch after the interworking switch may have to perform a redundant NP query to determine how to route the call. A mixture of ISUP and MF signaling in the call path will require multiple LNP queries to route the call to the serving switch.

3.1.5 WNP Trigger and Query Types

Triggers and queries are tightly coupled with intelligent network architectures for the deployment of advanced services. Such architectures include the following:

- Intelligent Network (IN)
- Advanced Intelligent Network (AIN)
- Wireless Intelligent Network (WIN)

Each of these intelligent network architecture utilities specific query protocols and procedures, terminology, and capability subsets. The WNP solution, however, recognizes that, prior to the implementation of any of these architecture, specialized trigger and query development may be required. This document recognizes that WSPs will have different implementation needs and that various standards bodies (e.g., T1P1, TR45.2) have a challenge to arriving at the standard trigger and query message (e.g., prior to WIN definition). These qualifiers will become more evident in the following subsections.

3.1.5.1 Trigger Type

Triggers expand basic call handling by allowing additional procedures to be defined and controlled by an external entity. The additional procedures are defined so that when certain conditions are met, the trigger is invoked. A common result of the trigger processing is initiating a specific TCAP query to an external element for information or instructions on how to proceed.

A trigger must be defined and implemented in the MSC in order to launch the query to the NP-SCP for number portability. However, the trigger is not dependent on the introduction of any

specific intelligent network architecture. Thus, the WNP solution does not specify requirements that any of the intelligent network architectures must be utilized or deployed, nor does it prohibit the use of any. WSPs can implement what is appropriate to their network.

This trigger involves the determination of which calls result in NP queries. It will be a conditional trigger based upon 3 to 10 digits of the dialed number and will be administered at the MSC. If defined in relation to other non-WNP triggers, the trigger for WNP should generally be the lowest priority of all of the dialed number triggers.

Services that involve persistent transactions[27] may be impacted with the implementation of WNP. A WNP trigger may be encountered in some persistent transactions. If the persistent transaction must be closed before an WNP query to the NP-SCP can be launched, these services may not function properly.

3.1.5.2 Query Type

The WNP query is a TCAP message sent to the NP-SCP as initiated by the WNP trigger discussed above. Upon satisfying all of the trigger conditions, the MSC sends the query with the 10-digit DN. If the number is ported, the NP-SCP responds with an LRN for that DN. If the number is not ported, the NP-SCP typically responds with the DN.

Various intelligent network architectures offer different query message types for communication between the switch and the database. Also, WSPs can choose to implement any of the protocols suitable to their networks and their chosen NP-SCP platform. WNP does not pose any requirements as to a specific query type.

The following is an overview of the options:

- *IN-based Protocol:* The switch initiates a "Instruction Start" message and awaits the "Control Connect" response. The IN based protocol is implemented in wireline portability and is anticipated to accommodate WNP without modifications.
- *AIN-based Protocol:* The switch initiates a "Info Analyzed" message and awaits the "Analyze Route" response. The query message indicates the CdPN as well as the Calling Party Number (CgPN) and bearer capability (e.g., the call type is voice). Though the latter two parameters are not required for portability, they are mandatory in the "Info Analyzed" message.
- *WIN-based Protocol:* A WIN-based protocol could be defined for querying the NP-SCP. It would include the DN and would be capable of returning the LRN, at a minimum. WIN, however, is an intelligent architecture currently being defined. The

[27] A persistent transaction is an intelligent network process that is maintained after the initial message exchange. An example might be the Auto Redial service which can be invoked after encountering a busy signal to monitor the busy line and receive a call back when the line is available.

WNP query will be required in advance of WIN incorporation in standards. Therefore, the WNP query may or may not be WIN-based.

- *Other*: A message could be defined outside of the other three call models; for example, an IS-41 message might be defined. Also, a GSM message must be defined, and it may or may not fall within any of the above call models.

3.1.5.3 Automatic Code Gap

The MSCs are not typically equipped with Automatic Code Gap[28] (ACG) capabilities as they do not normally trigger an SCP (in today's wireless environment). However, NP-SCPs are required to support mechanisms to control overload situations via ACG. ACG Indicators parameter of TCAP indicates the cause for applying an ACG control, the time duration for the ACG control to be in effect and the time interval (gap) between ACG application Consequently, MSCs should recognize and react appropriately to such indications in the TCAP message from the NP-SCP.

As ACG is mainly being suggested so that a WSPs can query an SCP also serving a wireline provider and deployed in a wireline environment, the WNP Solution suggests that the ACG implemented for the wireless query be in line with the wireline ACG standards and requirements for Number Portability.

3.1.6 Trigger Conditions

The trigger should activate if the NPA-NXX of the CdPN matches an NPA-NXX open for portability within the region served by the MSC (as provisioned in the MSC NP routing tables).[29] A WSP might also, however, provision the MSC to activate the trigger based upon other conditions (e.g., interconnection agreements). An MSC need not perform a query if the Called Party Number is served by the MSC itself.

3.1.7 Global Title Translation

GTTs are used in the WNP environment, based on the DN, the MIN, and the IMSI. The following text describes some of the GTTs available. The need for new translation type assignments will be identified as part of the NP standards process. This section defines and categorizes the possible GTT uses in the WNP environment. It is not a specific request for new translation type assignments.

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[28] ACG is sometimes referred to as Automatic Call Gapping, however the TCAP standards terminology for the control is Automatic Code Gap.

[29] This condition rules out querying on operator services calls and N11 (e.g., 911 calls) as is appropriate.

3.1.7.1 Number Portability Global Title Translation

NP GTTs are 6-digit GTTs used to direct WNP query messages to the NP-SCP to obtain the LRN routing information. The SCCP Called Party Address (CdPA) of NP GTTs contains the first six digits of the dialed DN. The wireline industry is pursuing the idea of a separate TT value for each protocol versus one TT value for all three (i.e., AIN, IN, and WIN). Separate TT values would allow the GTT function to provide a separate subsystem number (SSN) for each protocol. If just one TT value is used for all protocols, the NP-SCP must then determine the type of protocol as part of TCAP processing.

3.1.7.2 Mobile Station Identifier Global Title Translations

MSID GTT messages, if identified, contain the MSID in SCCP CdPA. They are used to perform GTT for MSID-based inter-network capabilities and services. Four GTTs are needed for MSID:

- six digits of the MIN to locate the HLR
- six digits of the MIN to locate the Message Center
- six digits of the IMSI to locate the HLR
- six digits of the IMSI to locate the Message Center

3.1.7.3 Mobile Directory Number Global Title Translations

Most GTTs in the past have been based on the MIN. However, with the separation of the MSID and MDN, GTT based on MDN may be needed to achieve this past functionality. MDN GTT messages, if needed, contain the MDN in the CdPA. They are used to perform GTT for MDN-based network capabilities and services. There are significant GTT impacts for MDN based activities that only provide the first six digits of the MDN in the CdPA. The impacts are because the previously used six digit numbering schemes no longer provide sufficient addressing granularity in a number portability environment. When a customer ports to a new service provider, a 10-digit GTT entry is needed in each inter-network service GTT database so that queries are delivered to the appropriate network. In these cases, inter-network service GTT databases will have 10-digit GTT entries and 6-digit default entries. The 10-digit GTT entries of the GTT database are the numbers ported to a new service provider in the served portability area that require inter-network service. When a 10-digit GTT entry for a ported subscriber is not found, the 6-digit default GTT is interrogated to obtain the necessary routing information.

Two solutions are available to address service GTTs. The first modifies all query originating applications to provide ten digits in the CdPA for GTT. This solution is not preferred by the wireline industry due to the update expense of the originating offices. The second solution, called TCAP-GTT, is used when only six digits are available in the CdPA. TCAP-GTT performs GTT by obtaining the MDN (or dialed digits) from the TCAP portion of the message. Note that this case requires a ten-digit MDN (or dialed digits) in the TCAP portion of the message. In most cases, this information is available. Normal SCCP error procedures should be invoked if the GTT fails, even if the failure occurred during TCAP interrogation.

3.1.7.4 Wireline Service Global Title Translations

Wireline Service GTTs for services sent to or received from wireline networks may be needed in wireless networks. These GTTs require 10-digit translation in order to determine the appropriate destination where the query is to be sent. Impacts to these GTT database are the same as described in Section 3.1.7.3 above.

3.1.8 Home Location Register and Authentication Center

The Home Location Register (HLR) is a standard function of wireless signaling and mobility management. The WNP solution presumes the HLR to serve the same function. The HLR holds the subscriber profile which should be capable of separating and mapping the MDN to the MSID.

The Authentication Center is also a standard function in wireless telecommunications. The separation of the MSID and the MDN may impact the AC and its associated authentication formulas; the signaling between the HLR and the AC, however, is not likely to be impacted by WNP

3.1.8.1 Directory Number to HLR Mapping

When a Location Request message is routed to the home network, the network must route the Location Request message to the subscriber's HLR. Some networks have stand-alone HLRs separate from the MSC; some networks have multiple HLRs.

HLR subscriber profiles are typically arranged and indexed by MSID. However, the home network may only have the subscriber's MDN to use for routing the Location Request message to the HLR serving the subscriber. Service providers that employ stand-alone HLRs or have multiple HLRs supported an MSC need to ensure that the Location Request message is routed to the correct HLR for the subscriber. This scenario is further complicated if a WSP deploys an MSC gateway architecture.

Service providers can implement a Location Request routing method that is effective in their internal network.

3.1.9 Abnormal Procedures

A number of situations exists where a call requires WNP processing but a failure prevents the switch from receiving an LRN for routing the call. Such instances include

- signaling link failure,
- NP-SCP outage or overload,
- WNP query timer expire, or

- incorrect STP translation.

Regardless of the cause, the MSC should route the call as if the dialed directory number were not in an open portable block. Specifically, the FCI bit in the IAM message should not be set and the CdPN parameter should contain the dialed DN.

This procedure of routing the call as if it were not ported is called "default routing" and ensures that additional attempts will be made to complete the call. With default routing, a chance exists that the call might route to the donor network. The donor network should attempt to perform the query and re-route the call to the correct service provider.

3.2 Call Flows

The call flows in this section are included to illustrate the inter-workings of the above network architecture. They are based on IS-41 but are not meant to preclude GSM based protocols. The messages are meant to convey the required function and are not necessarily the actual messages defined in the protocol. Furthermore, the call flows do not represent all the information that is conveyed in each instance, only that pertinent to number portability. The call flows are based on normal procedures and do not include error conditions.

3.2.1 Registration and Authentication

Because of the separation of the MDN and the MSID, the process of registration and authentication remains unchanged in WNP. Therefore, no call flow for registration and authentication has been included.

The information exchange, however, is impacted. When the mobile registers, it will pass the MSID Upon receiving an MSID in the registration notification message, the HLR shall include the MDN of the mobile subscriber in the registration notification response message. This will provide the MDN to the Serving MSC/VLR for subsequent call processing.

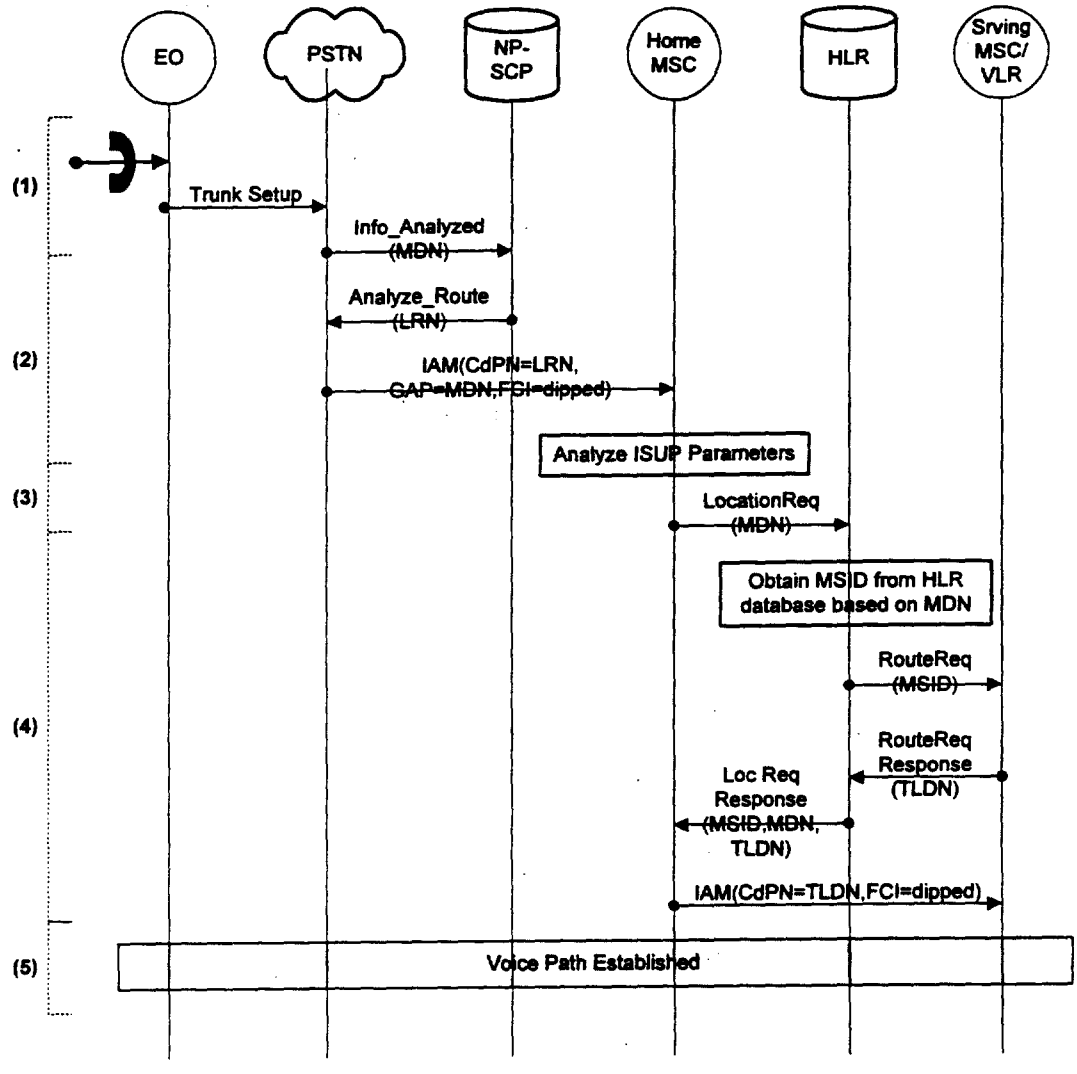
3.2.2 *Call Routing To a Ported Directory Number*

Wireless call routing can be divided into three scenarios: Land-to-Mobile, Mobile-to-Land, and Mobile-to-Mobile.

3.2.2.1 The Landline-to-Mobile Call

Figure 3-2 illustrates a landline call to a ported mobile subscriber. Text follows the figure for an explanation of each step.

Figure 3-2 Landline to Mobile Call Flow



Associated Call Flow Description:

(1) A landline phone originates a call.

(2) A landline switch queries the NP-SCP, obtains the LRN for the ported MDN, and uses the LRN to route to the Home MSC.

(3) Upon receipt of the IAM message, the MSC performs the following analysis:

(a) It confirms that the CdPN belongs to its own network.

(b) It checks the FCI mth bit for the NP-SCP dip indication. If the mth bit is not set, then the call flow skips to step 4. If the mth bit is set, but no GAP is included, the call flow skips to step 4. If the mth bit is set and the GAP is included, the MSC uses the value in the GAP parameter as the CdPN.

(4) The MSC now attempts to locate and deliver the call to the mobile using existing call delivery procedures with the following highlights:

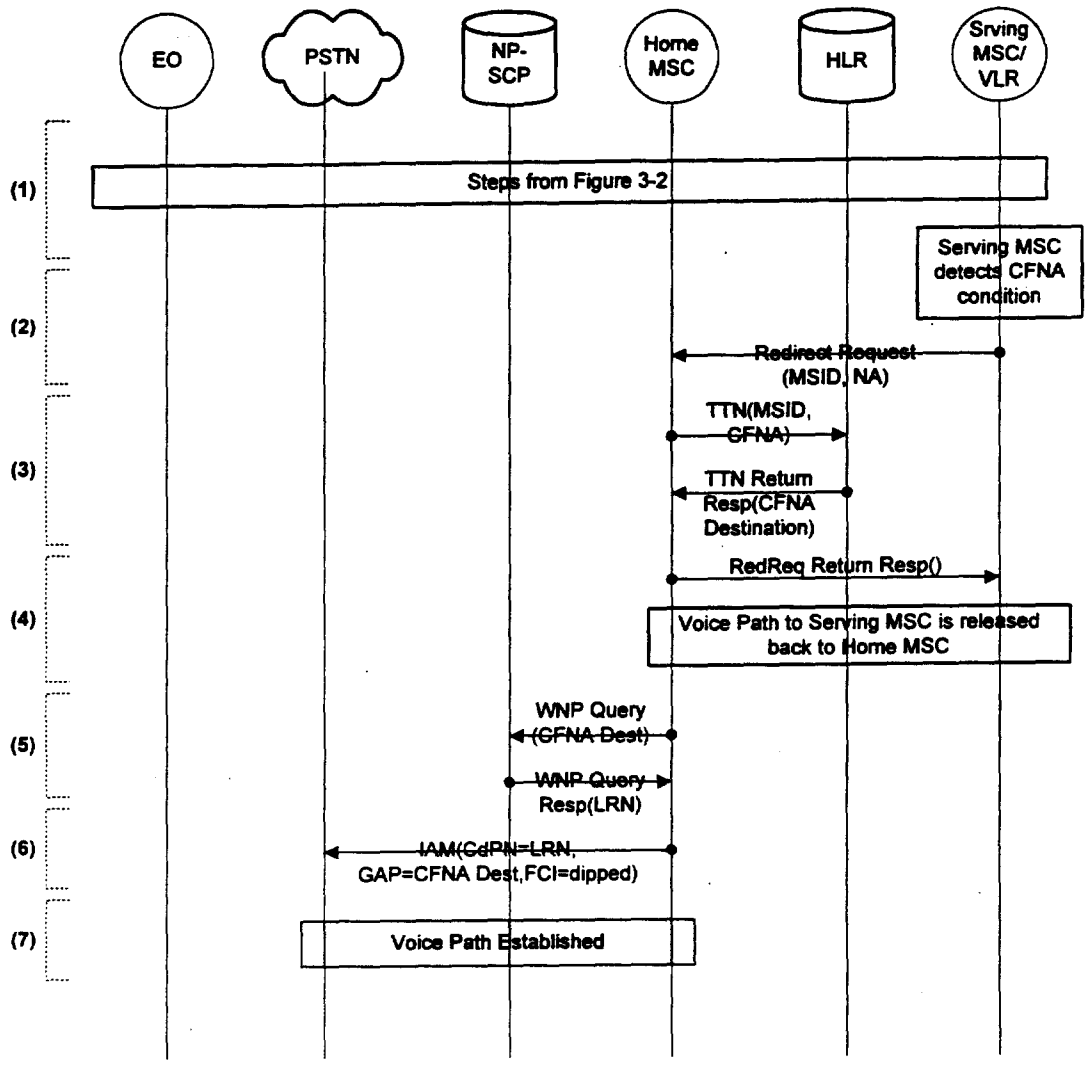
- The Location Request Return Result should include the MSID.
- The final trunk setup IAM message should ensure that a query is not necessary on a TLDN by setting the FCI query indicator.
- If the MSC cannot distinguish between TLDN digits and Call Forwarding digits, the MSC, in attempting to route out the call, may activate the WNP trigger and unnecessarily query the NP-SCP. This document recommends that IS-41 provide the means to indicate type of digits so that, at a minimum, the MSC can know to set FCI bit as appropriate so that an unnecessary dip does not occur in the PSTN during final trunk setup.

(5) The mobile station answers the call and the voice path is established.

3.2.2.2 The Landline-to-Mobile Call with Call Forwarding interaction

Figure 3-3 illustrates a landline call to a ported mobile subscriber. This call flow, however, depicts the subsequent leg of the call when the call is forwarded, for example, to a voice mail system. Specifically, this call flow illustrates only one example of redirection, Call Forwarding No Answer (CFNA). Text follows the figure for an explanation of each step.

Figure 3-3 Landline to Mobile with CFNA Interaction



Associated Call Flow Description:

(1) A landline phone originates a call. The processing to establish the voice path to the serving MSC is identical to the call flow in Figure 3-2 and is, therefore, not repeated here.

(2) The Serving MSC detects a No Answer (NA) condition and send a Redirection Request message to the Home MSC indicating the reason (NA) for the redirection request.

(3) The Home MSC sends a Transfer-to-Number Invoke to the subscriber's HLR and forwards the NA indicator. The HLR determines if the subscriber has the CFNA feature authorized and active. If the CFNA feature is authorized and active the HLR sends a Transfer-to-Number return result message back to the Home MSC with the CFNA destination digits included.

(4) The Home MSC sends a Redirection Request Return Result message to the Serving MSC, and the voice connection between the Home MSC and the S-MSC is released.

(5) The CFNA destination digits are analyzed in the Home MSC to determine if a query should be made on the destination digits. The query returns the LRN.

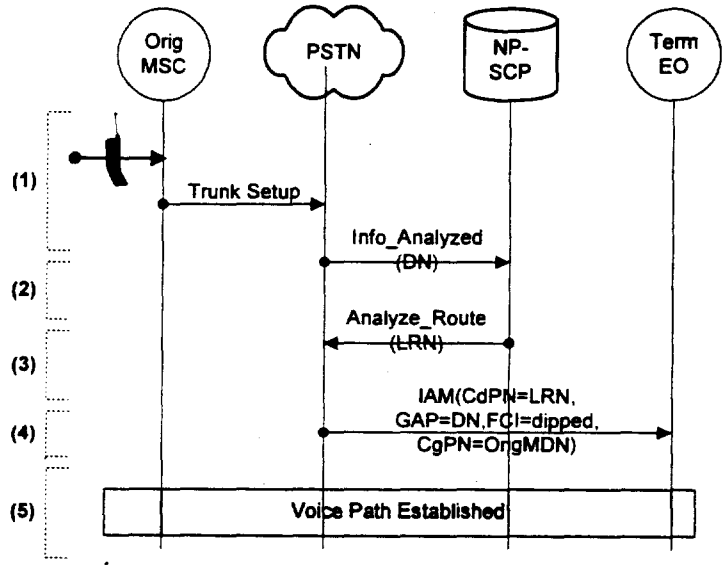
(6) The Home MSC formulates the IAM message with the CdPN equal to the LRN, the GAP equal to the CFNA Destination Digits, and the FCI indicator to dipped.

(7) The call is completed with the new destination.

3.2.2.3 The Mobile-to-Land Call

Figure 3-4 illustrates a mobile to landline call in which the MSC is not the designated querying switch, i.e. a PSTN switch will perform the query. Figure 3-5 also illustrates a mobile to landline call, but in this case the MSC is the designated querying switch.

Figure 3-4 Mobile to Landline - PSTN Performs Query



Associated Call Flow Description:

(1) A mobile places a call, and the Originating MSC passes the call to the PSTN.

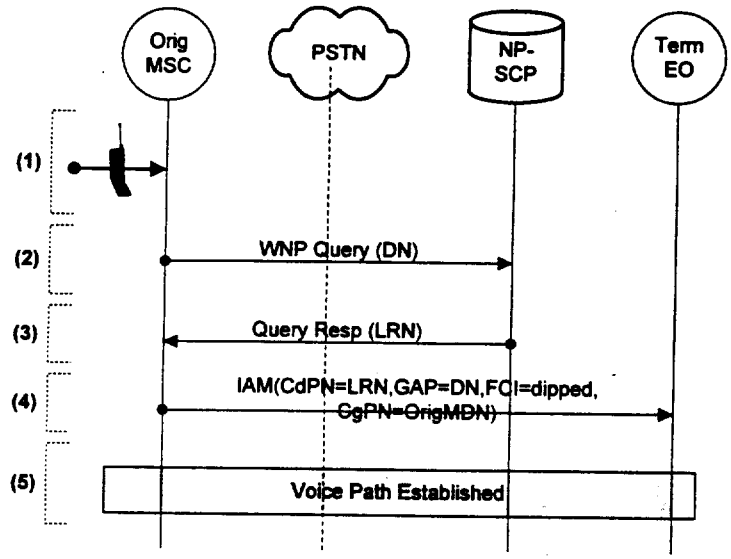
(2) The PSTN detects DN is within a portable block and launches a query to the NP-SCP with the landline DN.

(3) The NP-SCP returns the LRN for the DN.

(4) The PSTN formulates and sends the IAM message with the CdPN equal to the LRN, the GAP equal to the DN and the FCI mth bit set as queried to the terminating end office.

(5) The Terminating EO will complete the call to the loop to the assigned to the DN. The call is then connected.

Figure 3-5 Mobile to Landline - MSC Performs Query



Associated Call Flow Description:

(1) A mobile places a call

(2) The Originating MSC detects DN is within a portable block and launches a query to the NP-SCP with the landline DN.

(3) The NP-SCP returns the LRN for the DN.

(4) The MSC formulates and sends the IAM message with the CdPN equal to the LRN, the GAP equal to the DN and the FCI mth bit set as queried to the terminating end office.

(5) The Terminating EO will complete the call to the called DN.

3.2.2.4 The Mobile-to-Mobile Call

Figure 3-6 illustrates a mobile to mobile call in which the MSC is not the designated querying switch, i.e. a PSTN switch will perform the query. Figure 3-7 also illustrates a mobile to mobile call, but in this case the MSC is the designated querying switch. In fact, these figures illustrate that a concatenation of the previous figures (mobile originated and mobile terminated) produce expected results. This is an expected result because the originating and terminating MSCs are unaware of one another.

Therefore, no text is included beyond the figures for the sake of readability. Readers can infer the appropriate descriptions based on the previous call flows.

Figure 3-6 Mobile to Mobile - PSTN Performs Query

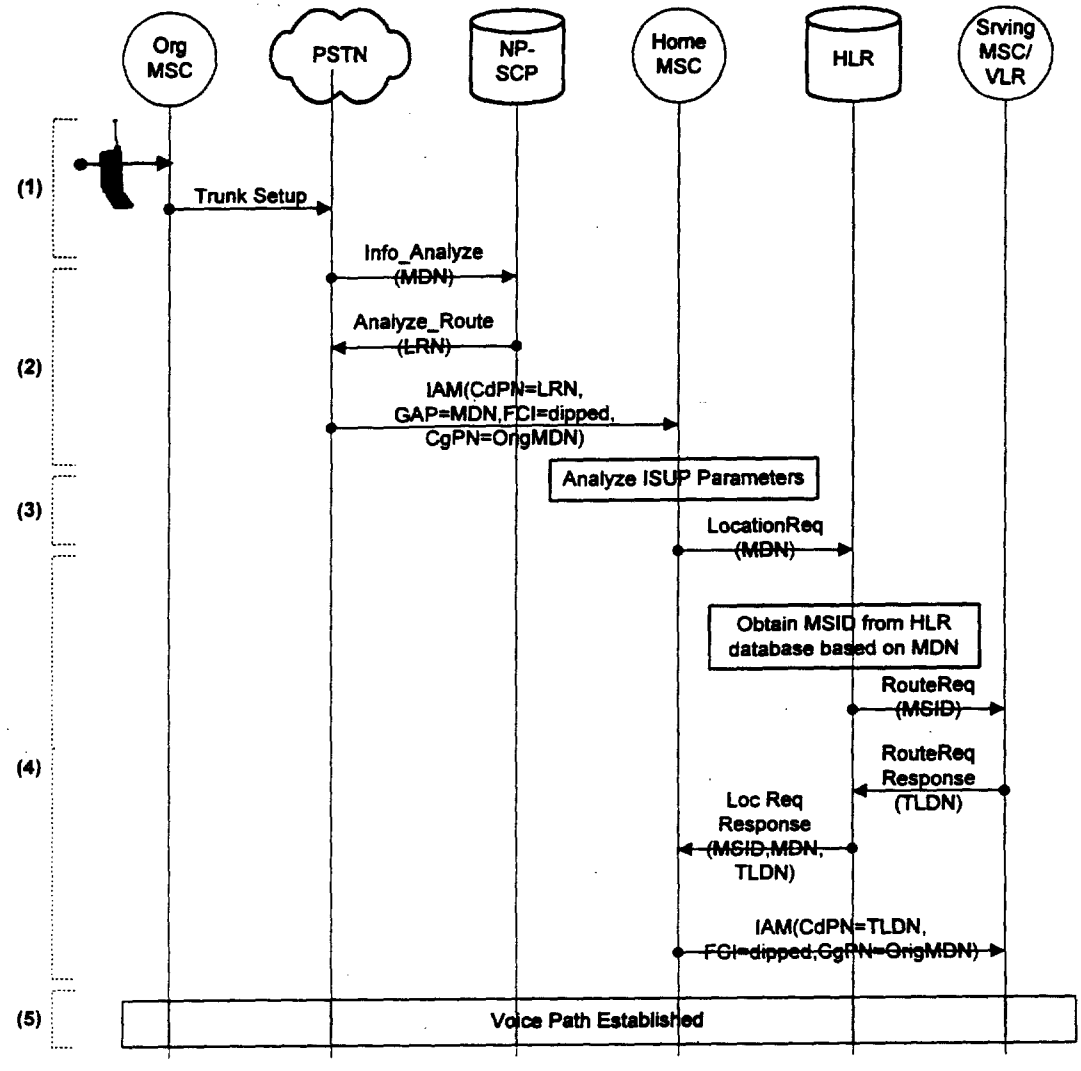
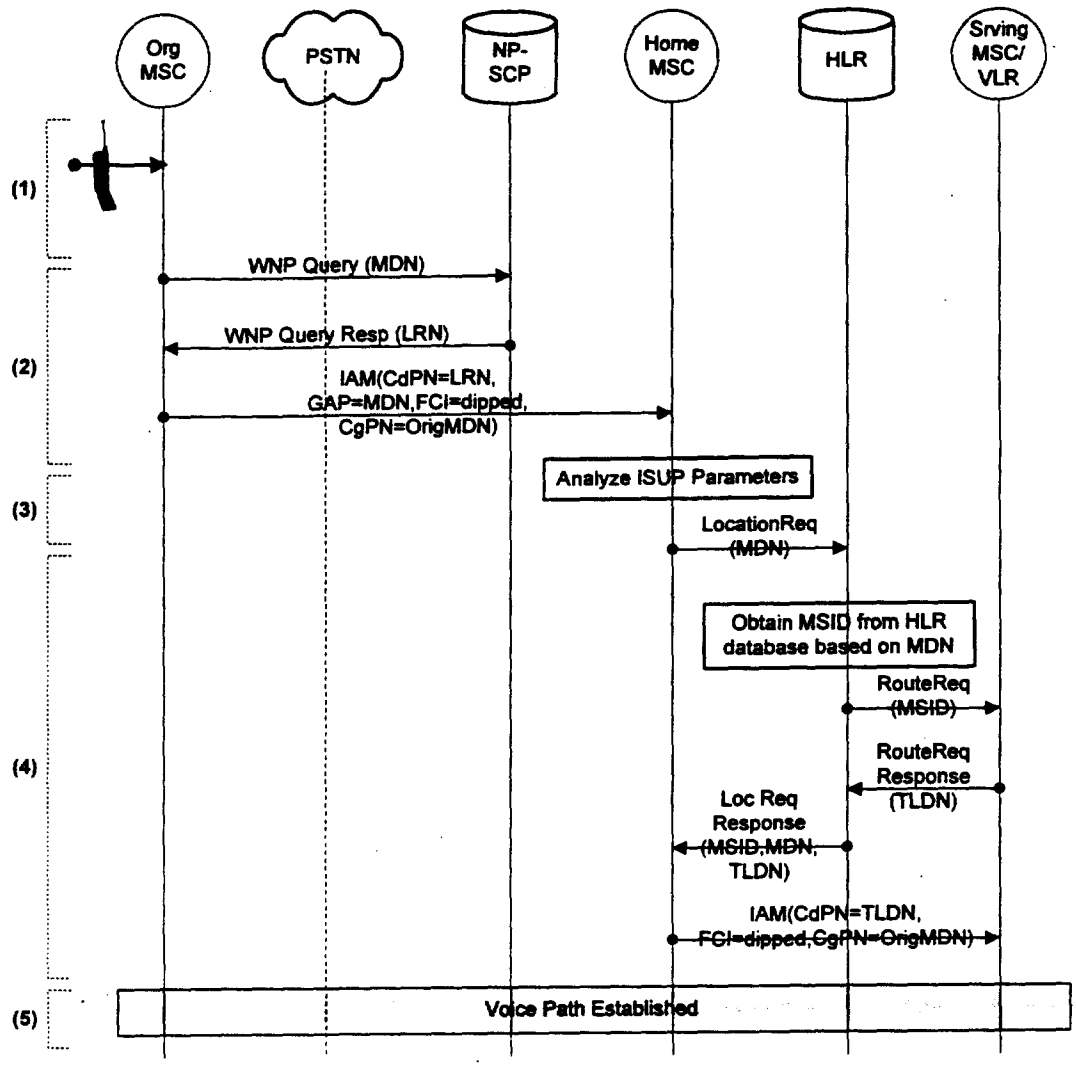


Figure 3-7 Mobile to Mobile - MSC Performs Query



3.3 *Feature Interactions*

This section describes the effect of WNP on the current base of wireless services.

3.3.1 *Operator Services*

An MSC can connect to an operator tandem switch in one of the three following ways:

- via a Type 1 connection to a local telephone company central office switch that interconnects with the operator tandem;
- via a Type 2D connection directly to the operator tandem; or
- via a Type 2A connection to an access tandem that interconnects with an inter-exchange carrier operator tandem using Feature Group D (FGD) signaling.

A mobile station dialing any of the following should route the call directly to the operator tandem where, if necessary, it will perform the query:

- 0-
- 00-
- 10xxx0-
- 101xxxx-0-
- 0-NPA-NXX-XXXX
- 10XXX-0-NPA-NXX-XXXX
- 101XXXX-0-NPA-NXX-XXXX

Existing ANI information transfer and AMA recording at the operator tandem will be sufficient to support WNP. However, the MSC must be modified to forward the MDN and not the MSID as the ANI digits.

3.3.2 *Roamer Access Port*

The Roamer Access Port service is one of several means of supporting call termination to roamers. Another feature of the Roamer Access Port is to allow the caller to directly be connected to the serving system, eliminating the call segment from the home system to the serving system.

Under the Roamer Access Port services, today, the caller dials a roamer access port number to reach the visited system and enters a roamer's MIN (as an MDN). When the MDN and MSID are separate, the serving system will also need to know the roamer's MSID.

3.3.3 Emergency Services

An MSC can connect to Emergency Services Providers (ESPs) in many ways. The current arrangements typically do not automatically forward the mobile station callback number to the ESP. For such arrangements, the ESP attendant must verbally request the callback number, if desired. FCC rules regarding emergency service calls from wireless systems dictate that by April 1, 1998, an MSC must automatically forward the mobile station callback number along with information identifying the cell site of call origin.

In any proposed configuration, the MDN must be provided to the ESP for callback purposes. The impact on the MSC with the WNP is such that the MSC must be modified to forward the MDN and not the MSID.

To meet the proposed April 1, 1998, FCC requirements, both the MF-FGD signaling and the SS7 ISUP (CPN) signaling arrangements may, in fact, be utilized. Therefore, the MSC must forward the MDN and not the MSID as the FGD ANI digits and must forward the MDN in the CPN parameter of the SS7 ISUP IAM message. This requirement applies to both home mobile stations and roaming mobile stations. Consequently, the MDN must be retrieved from the home system for any registered roaming mobile stations.

The impact of WNP with regard to Emergency Callback whether the call back is over a roamer access port or otherwise requires further study.

3.3.4 Short Message Service

3.3.4.1 Impact of Number Portability

Today, the recipient of a short message is identified by an MDN. The originating network uses the dialed MDN to route the short message to the destination home system. The dialed MDN is the same as the MIN or the first 6 digits of the dialed MDN are the same as the first 6 digits of the MIN if the MDN and MIN are separated. Typically, the first six digits of today's dialed MDN or MIN provide sufficient routing information for the short message to be delivered to the destination home system.

The wireless industry has decided to separate the MSID and the MDN to support WNP. As a result, Short Message Service (SMS) delivery is impacted. SMS will not operate properly as it is currently defined if the destination mobile station has ported its MDN. When the mobile station ports to another service provider, it is assigned a new MSID. The new MSID, particularly the first six digits, will identify the new service provider. However, when a short message is initiated to the ported mobile station, the calling party will only provide the MDN to the network. Since the destination MS has ported, the originating Short Message Entity (SME) or the SS7 network must analyze all the digits of the MDN to derive the necessary routing information to deliver the short message to the destination home system of the ported mobile station.

Five alternatives have been proposed to address the SMS routing problem in the WNP environment. In order to discuss and compare the alternatives, they must each address the following scenarios:

(a) Direct Routing to the Destination Home MC

If the short message need not go through the message originator's home MC, the short message is sent to the destination home MC directly from the originator's serving MSC. The case where a short message is sent from the originator's home MC to the destination home MC is covered under this scenario.

(b) Force Routing through the Message Originator's Home MC

If the SMS Origination Restriction of the originator indicates that the short message must be routed through the originator's home MC, the short message should be sent to the originator's home MC first.

(c) International Roaming

Each alternative must work if the short message is to be sent across the national boundaries (e.g., from the originator's serving MSC in one country to the destination home MC in another country).

Messages routing across national boundaries involves global title translations (GTTs) at the STPs in the national SS7 networks, originating and destination, and at the international gateway STPs in the international domain/level. This section focuses on messages required to be sent across the national boundaries and the translation types that may be required when a particular alternative is discussed.

3.3.4.2 Possible SMS Delivery Alternatives

The alternatives described in this section are to provide the industry with a starting point in addressing SMS impact in a WNP environment. The final solution(s) is for further study.

The descriptions of the alternatives below illustrate the successful delivery of a mobile originated short message to a ported MS. Also, these alternatives assume that the originating system is different from the destination system. Lastly, these alternatives are illustrated using IS-41 messaging protocol as an example.

The call flow procedures described below for each of the five alternatives are for scenario A and in the domestic domain. However, the discussion of the advantages and disadvantages of each alternative will cover scenarios A, B and C.

The following are for clarification in describing the alternatives: [30]

- Short Message Entity (SME) is a functional entity that composes and decomposes short messages. It may be located within and be indistinguishable from an MSC, HLR, VLR, MS, or MC.
- The message center (MC) is an entity that stores and forwards short messages. The MC may also provide supplementary services for SMS.

The following translation types have been identified in the forthcoming alternatives as potentially needed for routing short messages:

- MIN-to-MC translation. This translation type is existing, TT=12.
- IMSI-to-MC translation. This translation type is also existing, TT=13.
- MDN-to-MC translation. This translation type has not yet been defined.
- LRN-to-MC translation. This translation type has not yet been defined.
- MDN-to-NP-SCP translation. This translation type has not yet been defined. This translation type is needed in alternatives 2, 3 and 4 if the short message is to be delivered outside of the NPAC region.

SMS Alternative 1: SMS Forward to Serving Home MC

In alternative 1, an SMS Delivery Point to Point (SMDPP) message is first routed to the donor message center (MC). The donor MC then forwards the short message to the subscriber's home destination MC. The short message is routed to the donor MC by an MDN-to-(donor) MC translation via a 6-digit GTT at the STP or internal lookup table.

The donor MC locates the correct "serving" home MC of a ported subscriber by mapping the dialed MDN to its home MC (i.e., the translation is established via business arrangement). Then, it forwards the message to the serving home MC. The donor MC may be the "original" home MC that serves the MDN before it is ever ported or may be an MC that provides an SMS forwarding service to "original" home systems that do not support SMS (e.g., third party donor MC or wants a third party to perform the forwarding function).

In the situation where the original system is a non-SMS capable system (i.e., had no MC), it is preferable for the third party donor MC to serves all the ported subscribers of the original system (within an NPA-NXX block). This will allow the preservation of 6-digit translation (e.g., 6-digit GTT at the STP) in routing short messages to the donor MC.

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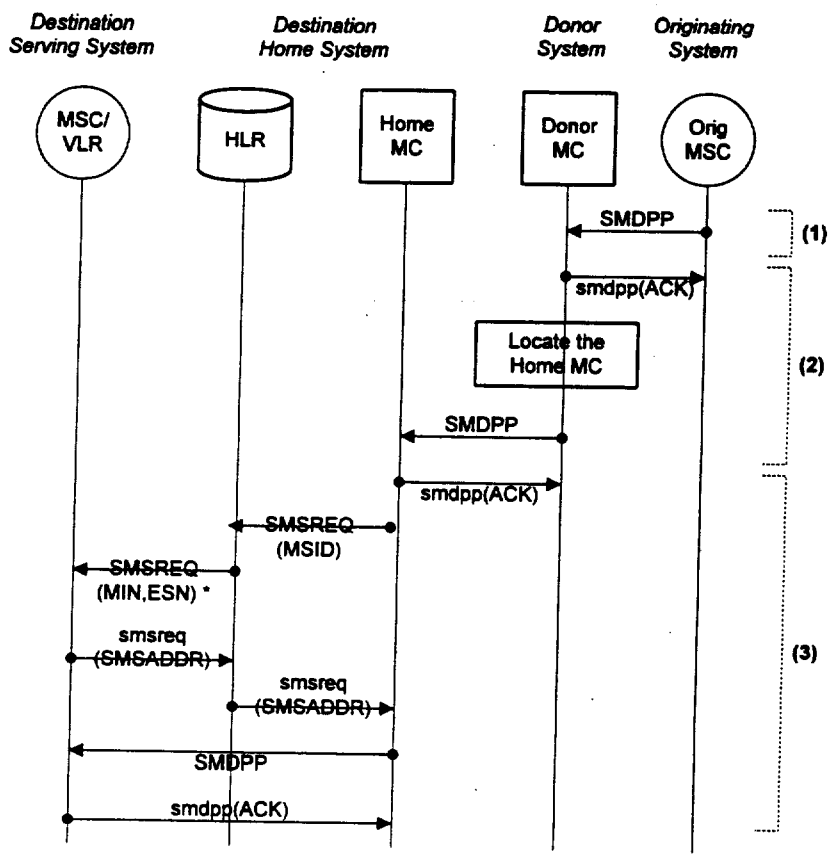
[30] The definitions are from IS-41, TIA/EIA SP 3588.1, Functional Overview, sections 5.1.6 and 5.1.10.

The following illustration along with the call flow procedures describes a successful short message delivery to a ported MS-based SME (i.e., terminating supplementary services):

Figure 3-8 Alternative 1 for SMS Delivery



* These messages are sent if the HLR does not have a current temporary SMS routing address

The detailed steps are as follows:

(1) The originating MSC routes the short message to the donor MC by performing an MDN-to-MC translation (i.e., via GTT at the STP or internal table).

If the subscriber has not been ported the donor MC is the subscriber's destination home MC and should existing procedures to deliver the short message.

(2) When the donor home MC receives the SMDPP requesting delivery to a ported MS, it identifies the destination home MC of the ported MS by performing an MDN-to-MC lookup.

In the event that the donor MC is able to forward the SMDPP to the destination home MC or that it is the destination home MC, the donor MC responds to the originating system with an SMDPP positive acknowledgment.

If the MDN has not been ported out, the donor MC (which is the destination home MC) delivers the message using existing procedures. In some instance, it may be more efficient for the donor MC to determine if it is the home MC before it uses the MDN-to-MC lookup table.

In the ported MDN case, the donor MC forwards the short message to the destination home MC.

(3) When the destination home MC receives the SMDPP request, it delivers the short message following existing procedures.

If the donor MC is not able to forward the SMDPP to the destination home system because the donor MC fails to map the MDN to the destination home MC (e.g., there is no business arrangement or the SMDPP was routed to the donor MC in error), the donor MC responds to the originating system with an SMDPP negative acknowledgment with the SMS_CauseCode=1 for address translation failure.

The advantages of Alternative 1 are as follows:

- It uses the 6-digit MDN-to-MC translation to get to the donor MC.
- There is no need to query the NP SCP. This is a cost saving for the carriers if they have to pay for NP SCP queries.
- Wireless carriers may establish reciprocal business arrangement for the donor MC service.
- Short messages for MDNs that are not ported do not need to be forwarded.
- Short messages from other countries will be delivered to the donor MC using the MDN-to-MC translation.
- There is no need for additional translation types. Thus, no need to pay for additional GTTs.

The disadvantages of Alternative 1 are as follows:

- Business arrangements with every donor MC or third party donor MC need to be established to ensure that SMS forwarding will be provided by the donor MC.
- The donor MC needs to maintain an MDN-to-"serving home" MC lookup table. The donor MC needs to be informed by the old service provider to terminate the message

forwarding service and by the new service provider requesting for the donor MC to forward the ported subscriber's messages to the new home MC. The new service provider will have to establish new business arrangement with the donor system while the old provider terminates its arrangement. This is a responsibility that the donor MC assumed because of its business arrangement. Thus, this function should be inherent to the business agreement.

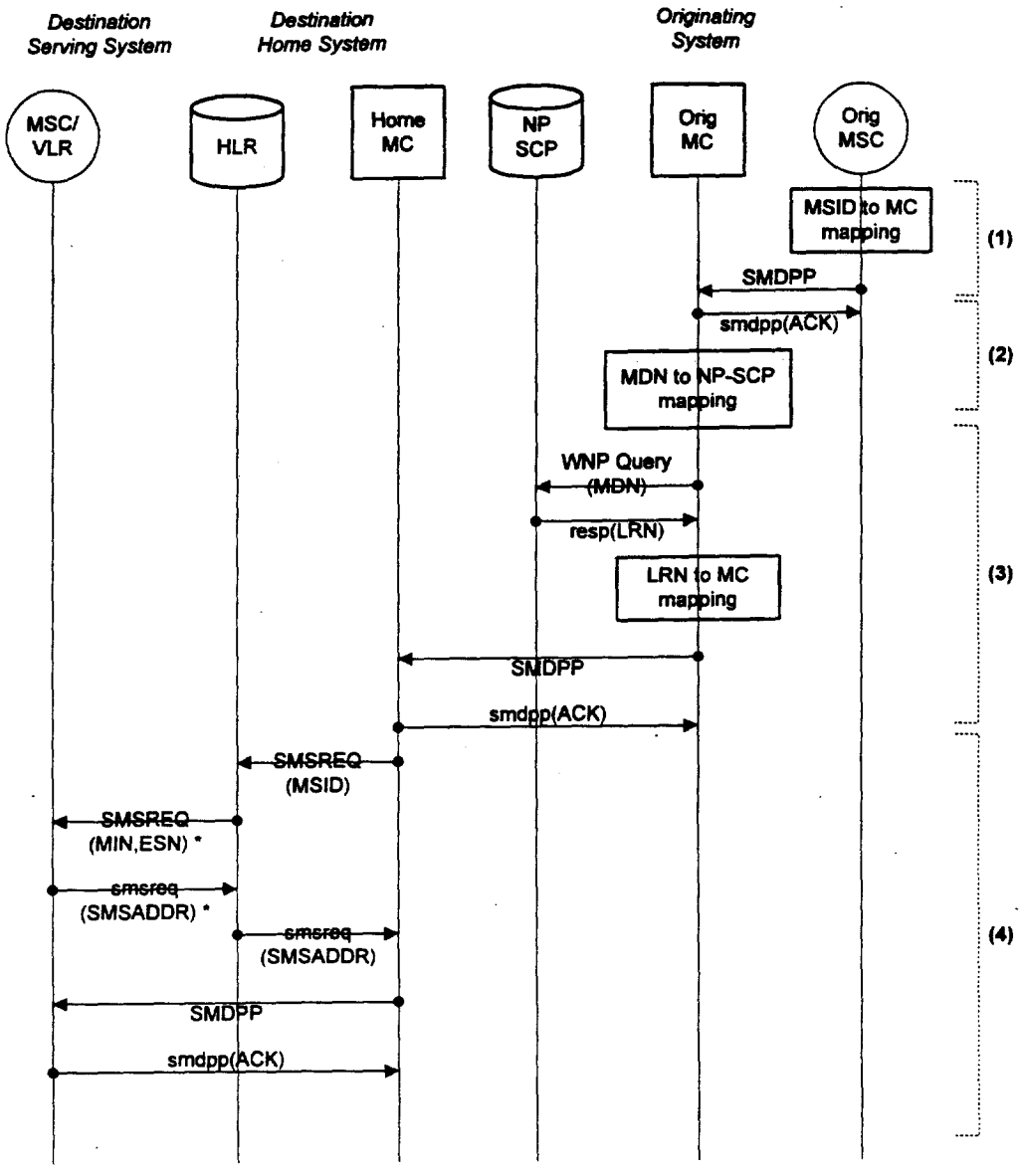
The following items with regard to Alternative 1 should be further investigated:

- Administration of the MDN-to-MC lookup table within the donor MC.

SMS Alternative 2: Message Center Query, LRN response to Originating MC.

In alternative 2, the short message is always sent to the originator's home MC based on the message originator's MSID (i.e., MSID-to-MC GTT at the STP or internal lookup table at the originating SME). When the originator's MC receives the SMDPP, it queries the NP SCP for the LRN associated with the dialed MDN. The short message is routed to the destination home MC using the LRN (i.e., LRN-to-MC GTT at the STP or internal lookup table at the originator's MC).

Figure 3-9 Alternative 2 for WNP SMS Delivery



* These messages are sent if the HLR does not hav a current temporary SMS routing address.

The detailed steps are as follows:

(1) The originator's MSC forwards the SMDPP to the originator's home MC using the MSID-to-MC translation via a 6-digit GTT at the STP or internal mapping.

(2) The originator's home MC retrieves the dialed MDN from the SMDPP message. It sends an IS-41 query message to the NP SCP through an STP. The STP performs an MDN-to-NP SCP GTT to identify the appropriated NP-SCP and forward the query message to that NP-SCP.

The NP-SCP maps the MDN to its associated LRN and responds with the LRN to the originator's home MC.

(3) Either an LRN-to-MC GTT translation is done at the STP or, using an internal table in the originator's home MC, the SMDPP message is routed to destination home MC.

(4) The destination home MC delivers the message using existing SMS procedures.

The advantages of Alternative 2 are as follows:

- The existing MSC-NP SCP interface can be used for the MDN-to-LRN translation to support SMS, although it is defined call routing.
- The NP SCP does not need to maintain additional routing information for SMS.

The disadvantages of Alternative 2 are as follows:

- The originator's home MC needs to have IS-41 query capability to query the NP-SCP.
- If multiple MCs serve the same MSC the network needs to support multiple LRNs per MSC or use one of the four digits of LRN for MC.
- New translation types are needed to support the MDN-to-NP SCP GTT (for inter-system) at the STP and the LRN-to-MC GTT at the originator's home MC or STP.
- Administration for the point code of MCs used for the LRN-to-MC GTT will be needed.

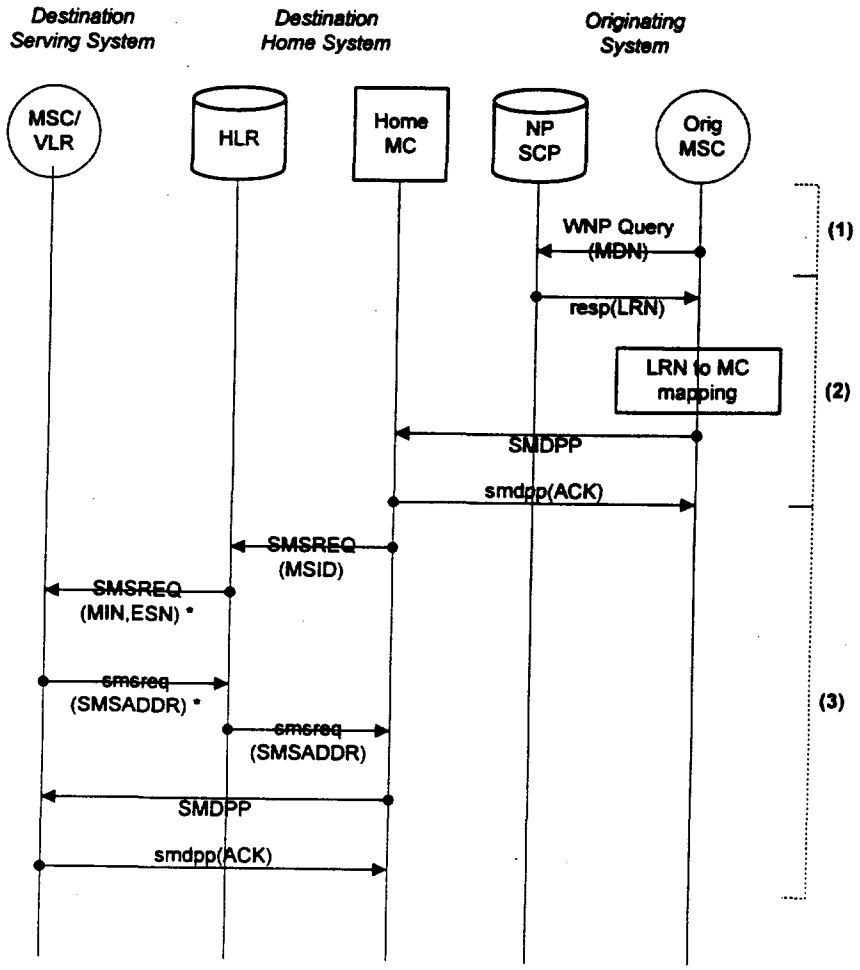
The following items with regard to Alternative 2 should be further investigated:

- In order to support international roaming, an originating system (i.e., originator's MC) that is in a foreign country needs to query the NP SCP for an LRN before the SMDPP can be routed to the destination home MC.
- Business arrangements will need to be established with remote NP SCP providers so that queries can be targeted to the appropriate NP SCP with the necessary translation information.

SMS Alternative 3: MSC Query - LRN response to Originating MSC

In alternative 3, the originator's MSC queries the NP SCP for the LRN associated with the dialed MDN. Then, the originator's MSC routes the short message to the destination home MC using the LRN (i.e., LRN-to-MC GTT at the STP or internal lookup table at the originator's MC).

Figure 3-10 Alternative 3 for SMS Delivery



* These messages are sent if the HLR does not hav a current temporary SMS routing address.

The detailed steps are as follows:

(1) The originator's MSC sends an IS-41 query message with the MDN to the NP-SCP through the STP. The STP performs an MDN-to-NP SCP GTT to determine the appropriate NP SCP to forward the query.

The NP-SCP maps the MDN to its associated LRN and responds with the LRN to the originator's MSC.

(2) Either an LRN-to-MC GTT is done at the STP or, using the internal table in the MSC, the SMDPP message is sent to the destination home MC.

(3) The destination home MC delivers the message using existing SMS procedures.

The advantages of Alternative 3 are as follows:

- The existing MSC-NP SCP interface can be used for the MDN-to-LRN translation to support SMS, although it is defined call routing.
- The NP SCP does not need to maintain additional routing information for SMS.

The disadvantages of Alternative 3 are as follows:

- The originator's MSC needs to query the NP-SCP.
- New translation types are needed to support the MDN-to-NP-SCP GTT at the STP and the LRN-to-MC GTT at the MSC or STP.
- Administration for the point code of MCs used for the LRN-to-MC GTT will be needed.
- If force routing is invoked, the originator's MSC, after it receives the LRN from the NP SCP query response, needs to forward the LRN to the MC of the originating system. Enhancement to the IS-41 standard is needed.
- If multiple MCs serve one MSC, the network needs to support multiple LRNs or use one of the four digits of LRN for MC.

The following items with regard to Alternative 3 should be further investigated:

- In order to support international roaming, an originating system (i.e., originator's MSC) that is in a foreign country needs to query the NP SCP for an LRN before the SMDPP can be routed to the destination home MC. This item needs further investigation.
- Business arrangements will need to established with remote NP SCP provider so that queries can be targeted to the appropriate NP SCP with the necessary translation information.

SMS Alternative 4: MDN-to-MSID Translation at the NP SCP

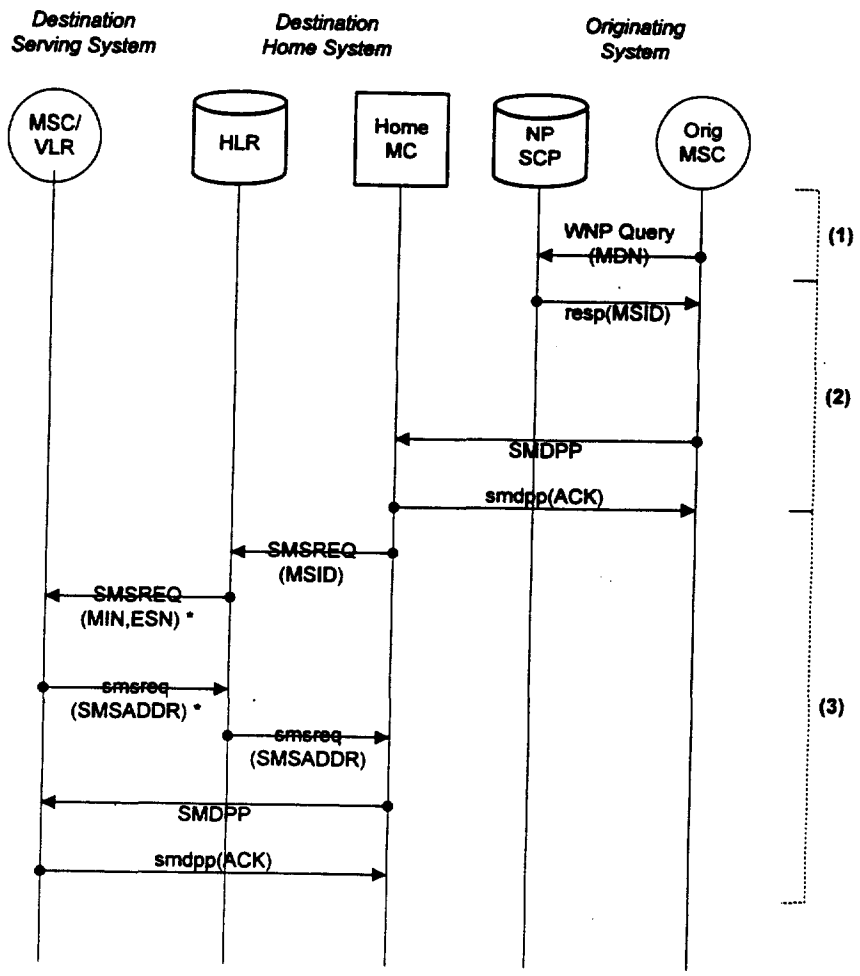
Alternative 4 requires that the NP SCP contains MDN-to-MSID translations. The MDN-to-MSID translations need to be maintained and administered by the regional NPAC-SMSs. Updates for the translation may use the same method defined for MDN-to-LRN translations.

This scheme requires the originating system to query the NP SCP for an MDN-to-MSID translation. Then, the originating system routes the short message to the destination home system using the MSID provided in the query response.

In the event that the dialed MDN is not within the coverage area of the regional NPAC-SMS, the originating system may have to query an NP SCP that contains the data for the region of the dialed MDN or query an NP SCP that contains nationwide NP data.

The first figure illustrates the call flow for the scenario when the MSC queries the NP SCP for the called party's MSID and the second figure shows the call flow for the MC querying the NP SCP.

Figure 3-11 Alternative 4 for WNP SMS Delivery



* These messages are sent if the HLR does not hav a current temporary SMS routing address.

The detailed steps are as follows:

(1) The MSC of the originating system queries the NP SCP with the dialed MDN. The NP SCP responds to the query with the MSID associated with the dialed MDN.

(2) The originating system routes the SMDPP message to the destination home MC using the MSID.

(3) When the destination home MC receives the SMDPP request, it delivers the short message following existing procedures.

The advantages of Alternative 4 are as follows:

- The existing MSC-NP SCP interface can be used for the MDN-to-LRN translation to support SMS, although it is defined call routing.
- The MSID-to-MC translation can be used to route short messages to the destination home MC.

The disadvantages of Alternative 4 are as follows:

- NP SCP, local SMS and NPAC-SMS need to support the MDN-to-MSID translations for all wireless subscribers within its region.
- The MSC or the MC need to have the capability to query the NP SCP for an MSID.
- The NP SCP query element needs new protocol.
- Under scenario B where message routing is through the originator's home MC, if the originator's MSC is performing the NP SCP query for an MSID, the originator's MSC needs to forward the MSID to the originator's home MC.

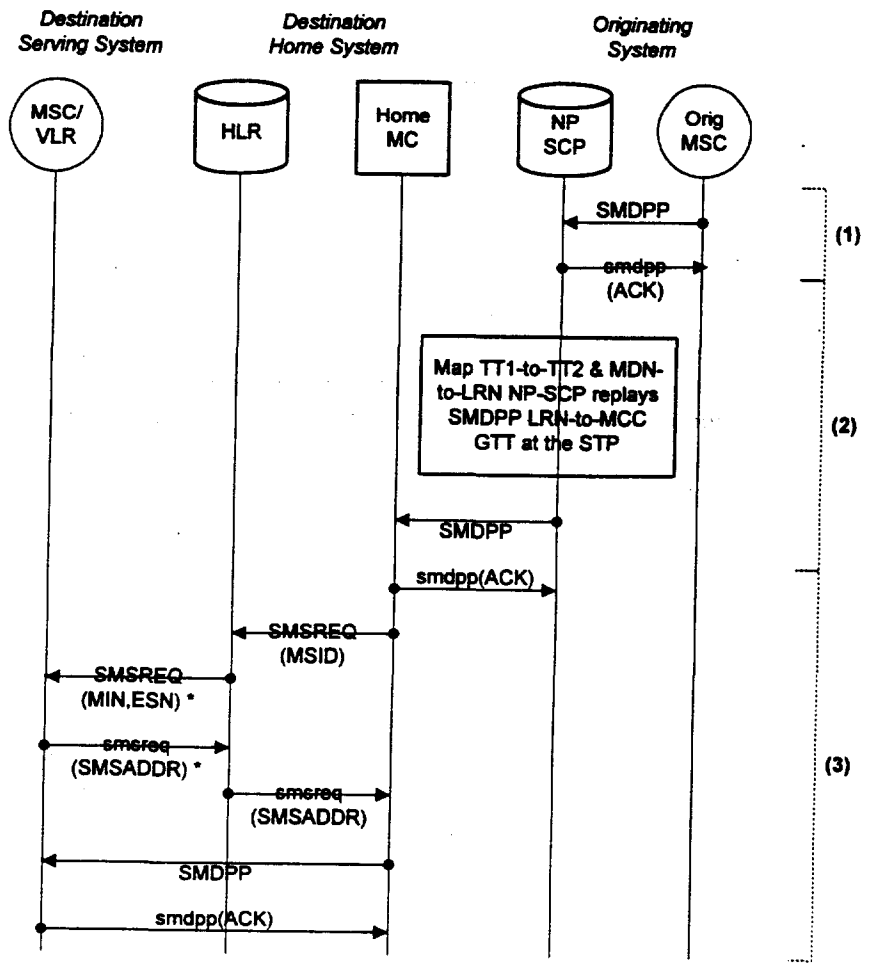
The following items with regard to Alternative 4 should be further investigated:

- Since NPAC-SMSs only contain regional data, it is foreseeable that a query may be launched to an NP SCP that only contain data from the region it is in. Thus, it may be preferable to have the MDN-to-MSID translations for wireless subscribers available nationwide.
- International roaming may require this alternative to have a gateway MSC to launch a query to the NP SCP for the MSID of the called party or may require the foreign country to query the NP SCP.

SMS Alternative 5 - 10-digit GTT at the NP SCP

In alternative 5, the originating MSC or MC routes an SMS Delivery Point to Point (SMDPP) message to called party's home destination MC via a 10-digit GTT at the NP SCP. When the short message arrives at the STP, a 6-digit MDN-to-NP SCP GTT is performed. This may need a new translation type (TT) to forward the message to the NP SCP. Then, the NP SCP maps the MDN to its associated LRN and the incoming translation type to an outgoing translation type for LRN-to-MC translation. The NP SCP relays the short message to the destination MC via a 6-digit LRN-to-MC GTT at an STP.

Figure 3-12 Alternative 5 for SMS Delivery



* These messages are sent if the HLR does not hav a current temporary SMS routing address.

The detailed steps are as follows:

(1) The originating MSC or MC routes the SMDPP to the destination MC.

(2) The STP performs a 6-digit MDN-to-NP SCP translation for SMS. When the NP SCP receives the message, it translates the incoming translation type (TT1) to an outgoing translation type (TT2) and maps the MDN to its associated LRN. The NP SCP relays the

short message to the destination MC. Then, the STP performs a 6-digit LRN-to-MC translation to route the message to the destination MC.

(3) When the destination home MC receives the SMDPP request, it delivers the short message following existing procedures.

The advantages of Alternative 5 are as follows:

- Step 2 uses the same 10-digit intermediate GTT at the NP SCP process that the wireline industry is developing/investigating for the support of services such as CLASS, Inter-switch Voice Messaging, Calling Name, and ABS/LIDB.
- The NP SCP does not need to maintain additional routing information for SMS.
- Short messages from other countries will be delivered to the destination home MC using this alternative.
- 10-digit intermediate GTT at the NP SCP is more efficient than querying the NP SCP for the LRN.

The disadvantages of Alternative 5 are as follows:

- The NP SCP needs to the have the capability to perform a 10-digit intermediate GTT at the SCCP level.
- There is a need for two new translation types; one for MDN-to-NP SCP (MC) translation and the other for the LRN-to-MC translation.
- Administration for the point code of MCs used for the LRN-to-MC GTT will be needed.

The following items with regard to Alternative 5 should be further investigated:

- None identified.

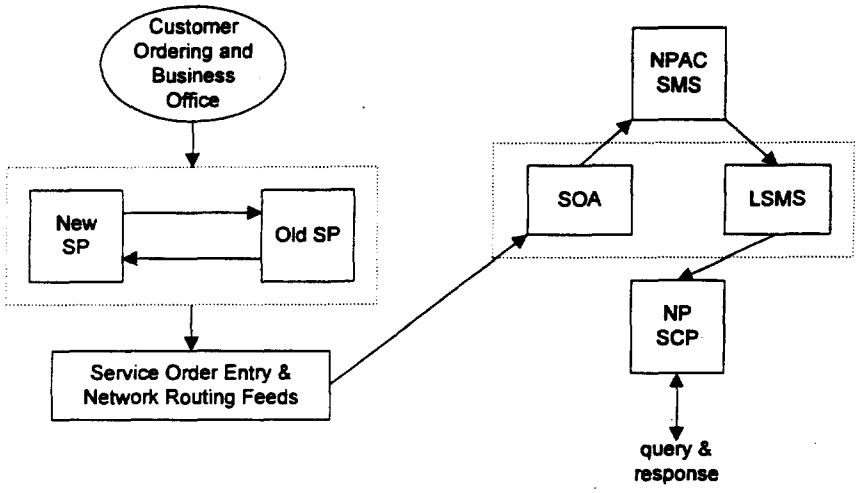
4. BUSINESS SYSTEMS, OPERATION SYSTEMS AND BILLING

4.1 Service Order and Provisioning

4.1.1 Process Flow Overview

Figure 4-1 below illustrates the overall information sharing process for portability.[31]

Figure 4-1 Service Order and Provisioning Process Flow



The NPAC-SMS is an administration center developed, owned and operated by a neutral, third party company (i.e., neutral to all telecommunications service providers). It collects and disseminates information that maps ported subscribers to service providers in a geographic area. Presently, seven geographic areas have been agreed upon[32] for covering the United States, with areas roughly corresponding to the state boundaries associated with the seven Regional Bell Operating Companies (RBOC).

The LSMS is logical Operations Systems (OS) function that accepts downloads from the NPAC-SMS and disseminates the data to the NP-SCPs. This logical function could be a stand-alone system on the WSP premise, an application within another OS, or function provided by another company. A WSP can deploy a single LSMS, LSMSs per NPAC-SMS or LSMSs per NP-SCP;

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31 *North American Numbering Council LNP Architecture and Administrative Plan*, Issue 5, March 4, 1997.

32 ibid.

this deployment will depend upon the WSPs infrastructure, NP-SCP platform deployment, and network coverage area.

The Service Order Activation (SOA) function is similar to the LSMS in that it is a function which ties the NPAC-SMS with the WSPs service order processing systems. As with the LSMS, this function could be a physically separate system or a function within another system.

The interface between the NPAC-SMS and the LSMS is an open interface based upon the Common Management Information Protocol (CMIP). This interface, including the CMIP objects, is currently documented in various locations, mostly on a state or regional basis; and the objects can vary among the NPAC-SMSs. However, the NANC NP Working Group is presently looking into creating a single interface document for all of the regions.

The interface between the NPAC-SMS and the SOA is also a CMIP-based interface and similarly documented.

The interface between the LSMS and the NP-SCP as well as the between the SOA and the WSP's Service Order Entry systems is at the discretion of the WSP.

The processes by which these systems communicate information is discussed below.

4.1.2 Provisioning a Number Block Open for Portability

Once a number block opens for portability, every telecommunications provider within the region serving that block must provision the block as open within its switches. More specifically, a WSP must populate the appropriate number portability tables in the MSC with the open NPA-NXX so that the NP trigger will trigger the query upon detecting that a called party number's NPA-NXX matches this open NPA-NXX. All open blocks served within the region must be provisioned in the MSC. The determination of how many or few open blocks are provisioned in a single MSC is at the discretion of the WSP depending upon the architecture deployed by the WSP balanced with the responsibility of supporting WNP per the FCC order and this document.

The source for open number blocks will be the LERG. The means for notification is still to be determined. The format of the information will be in NPA-NXX blocks.

4.1.3 Notifying the Receipt of a Ported Subscriber

The process of notifying the receipt of a port subscriber involves (a) notifying the NPAC-SMS of the new LRN for the DN so that it can broadcast the new LRN to all SPs within the region, and (b) coordinating the change with the old SP (e.g., service activation, line side provisioning).

A standard process definition is currently being worked by the NANC NP Working Group based upon efforts by various states in defining the flow. This document will not attempt to describe the details of these flows and urges WSPs to review and comment on the work in progress.

The essence of this flow, however, can be described at a high level:

(a) The New SP receives written authorization regarding the subscriber's intention to port.

(b) The New SP communicates the port to the Old SP via an Electronic Data Interchange (EDI) interface.

(c) The Old SP confirms the receipt of notification

(d) The New SP (and optionally the Old SP) notifies the NPAC-SMS of the new LRN for the DN via the SOA.

(e) The New SP and the Old SP coordinate the activation date and line side provisioning (automated and manual processes are being defined).

(f) The subscriber is activated.

(g) The NPAC-SMS downloads the new LRN to all LSMSs. All SPs update their NP-SCPs with the data in the LSMS.

(h) Calls route to the new, ported subscriber per the WNP Solution.

Although simplified, one can realize the complex yet crucial coordination that must occur between two SPs. In fact, the lines of communication (manual and/or electronic) must be established between every SP (wireline and wireless, alike).

4.1.4 Downloading data from the NPAC-SMS

The NPAC-SMS holds the master copy of the mapping from DN to LRNs as it is the center which notifies all SPs of a subscriber's new LRN when the subscriber ports.

The point in the process in which the download occurs can be seen as step (g) above. As with the above process description, many states have documented their defined version of the contents of the NPAC-SMS and the CMIP interface (including objects) between the regional NPAC-SMS and the LSMS. As a result, currently seven versions of the interface exist. However, the NANC NP Working Group has taken on the effort to arrive at a single, standard NPAC-SMS set of objects. WSPs are urged to become involved and comment on these efforts.

Besides downloading the data to the NP-SCP (e.g., DN to LRN mapping), the NPAC-SMS is being designed to have the capability to download the necessary data for the GTT functions required for number portability. More about this download can be found in documents which describe the NPAC-SMS and its interface.

4.1.5 Auditing the NPAC-SMS Data

Along with defining a process by which data is delivered to or received from the NPAC-SMS into an SPs systems, an audit function is being defined to allow for SPs to validate the contents of the database at periodic intervals.

4.2 Number Administration

4.2.1 IMSI, MIN and MDN Administration

MDNs are NANP numbers and should be administered as today's wireless directory numbers are administered today.

IMSIs are assigned by the Bellcore Numbering Consulting Group (NCG) upon carrier request and in accordance with the *IMSI Assignment Guidelines and Procedures*, Version 1, February 12, 1996. For WSPs that choose to deploy IMSI MSIDs, they must plan for and implement an administration process for obtaining, assigning, maintaining, and aging as appropriate IMSIs.

In WNP the assignment and management of MINs as MSIDs is yet to be determined. As with IMSIs, WSPs using MINs as MSIDs must plan for and implement an administration process for obtaining, assigning, maintaining and aging as appropriate MINs. The WNP Solution assumes that the MINs used by WSPs today for dialable numbers will be retained by the WSPs for MSID usage.

4.2.2 Disconnected Numbers

When a wireless subscriber terminates service (i.e. does not port but rather drops service altogether), the WSP may choose to provide intercept treatment. During this period, no changes are indicated to the NPAC-SMS and calls will continue to be routed to the WSP.

During this time, the service provider may offer standard or custom intercept treatment for calls to this number. After the period of providing intercept expires, the serving WSP then notifies the NPAC-SMS that the portable number entry should be removed. The number reverts to the service provider which was allocated the NPA-NXX associated with the freed number.

4.2.3 Location Routing Number Assignments to WSP

In order to receive calls for ported subscribers within a serving area, a WSP needs assigned at least one LRN within that serving area. A WSP may designate a single MSC in the serving area as a single point of entry for incoming calls (e.g., a gateway MSC). In this case, the gateway MSC would require at least one LRN value for other networks to route calls. Once the MSC receives the call; it may invoke existing wireless procedures for obtaining a temporary routing number to complete the call. The MSCs behind the gateway do not require LRNs.

Alternatively, a WSP may choose to allocate at least one LRN for every MSC in the serving area which would result in routing calls to various MSCs and eliminating the concept of a gateway MSC. If multiple MSCs share the same code block (i.e., NPA-NXX), then a unique LRN is needed to identify each MSC. Either method is acceptable and at the discretion of the WSP.

Assigning an LRN to an MSC may require that the MSC be listed in the LERG. A majority of MSCs are currently not LERG-listed. The exact impact requires further study.

4.3 Billing

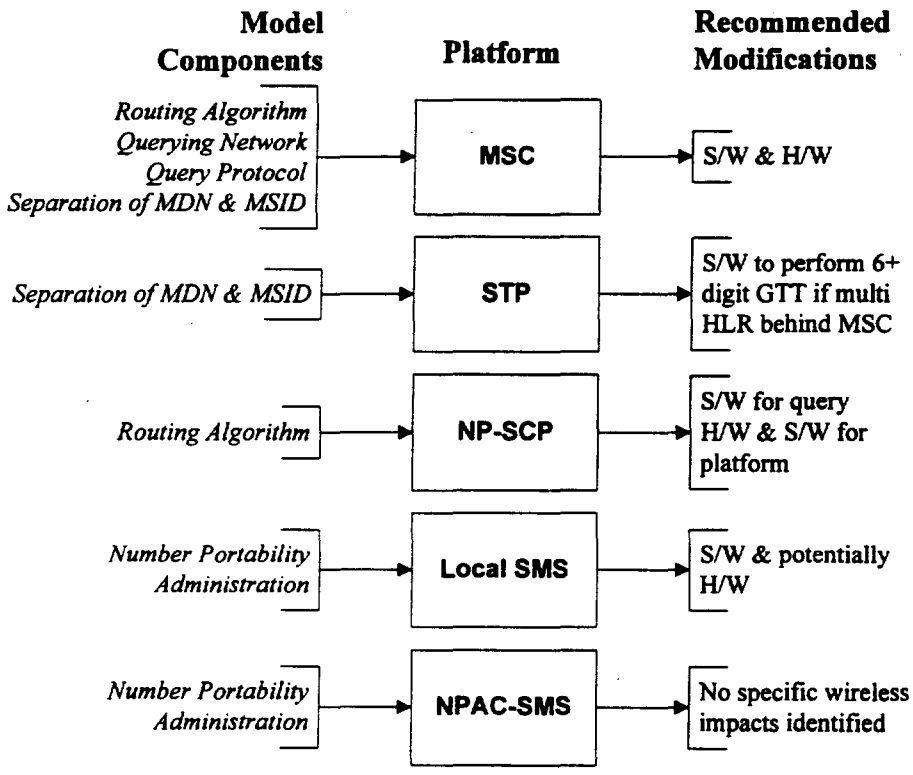
The impacts and processes regarding billing, including clearinghouse reconciliation, have not been identified at this time for WNP. However, the separation of the MDN and MSID, allowing the MSID to identify the WSP with the first six digits should alleviate some of the impacts to such things as the roaming tables. Additionally, discussions have been held regarding the addition of some billing parameter (probably not dependent on MIN, IMSI, nor MDN and yet to be defined) which might help identify the service provider for the calling record.

5. WIRELESS NUMBER PORTABILITY SYSTEM IMPACTS

This section summarized the anticipated WNP architecture impacts to each of the entities in the network architecture.

Figure 5-1 below maps the components of the wireless number portability building blocks in Figure 2-1 to the wireless NP platforms (e.g., network elements, operations systems). Most platforms map to only one building block; the exception is the MSC as it maps to multiple. The figure also illustrates the recommended modifications related to each platform.

Figure 5-1 Mapping of Platforms to Wireless Number Portability Model



5.1 Impacts to the Mobile Station

The following impacts are anticipated on the MSs:

- Because the solution separates the MSID from the MDN, the MS will need to contain both the MDN and the MSID. This implies both IMSI (if IMSI capable) as well as the MIN (as long as MIN is used as an MSID).
- The MS will register with the IMSI on an IMSI capable network or with the MIN on MIN-capable networks. If the mobile is not IMSI-capable, it will register with MIN on IMSI or MIN networks.
- It will be desirable for the phones to display the MDN or nothing instead of the MSID when the subscriber powers on his/her phone.
- Porting from one SP to another SP may require that the mobile station be reprogrammed with a MIN or an IMSI as appropriate to the recipient provider. The impacts of portability on pseudo-IMSI mobile stations will require further study.

5.2 Impacts to the Air Interfaces

No impacts have been identified for the following air interface protocols: IS-136, IS-95 and GSM.

However, if a provider chooses to implement an IMSI network, the following impacts should be known (and is being worked on by the IS-136 standards committees):

- In the IS-136A standards, if both an IMSI and a MIN are programmed in the mobile, the MIN takes precedence over the IMSI while in the mobile's home country. Therefore, modifications to the standard are required in order to reverse the precedence, allowing IMSI to be the primary identifier in an IMSI-capable network.

5.3 Impacts to IS-41 Signaling

The following impacts to the IS-41 signaling standards are anticipated:

- All IS-41 messages which contain MIN (e.g., Registration Notification) will need to be enhanced to support MSID.
- The contents of the dialed digits parameter in the IS-41 messages (e.g., LocationRequest) will be the MDN instead of the MIN.
- IS-41 will need to be enhanced to support Automatic Code Gap (ACG), particularly to the NP-SCP.
- A query must be defined and documented. This could be either an existing, a modified, or a new IS-41 message.
- The IS-41 Location Request Return Results message should be modified in order to distinguish whether the destination digits are a TLDN or another type of digits (e.g. Call Forwarding digits).

- MIN is currently a mandatory parameter in the SMSREQ message. For SMS in WNP, the appropriate value (for what is a MIN today) will be the MDN. The SMSREQ message should be modified to require the MDN.

5.4 Impacts to GSM Signaling

The GSM signaling modifications to support WNP involve two areas. The first area involves ISUP which should be based on the same modifications adopted for wireline portability. These include the following[33]:

- new FCI bit indication for translated number
- new GAP code point to indicate Called Party Number

The other change involves the Mobile Application Part (MAP) protocol which is a specific type of TCAP protocol. The changes include the following:

- a definition of a query message and response
- incorporation of ACG protocol and procedures

5.5 Impacts to the Home Location Register

The WNP architecture notes the following impacts on the HLR:

- The HLR must provide a mapping between the MSID and the MDN for all subscribers.
- The MDN should be made available to the MSC/VLR at the time of registration for all subscribers.
- If multiple MDNs are used for the same MSID, the HLR must designate one MDN as the preferred MDN for the domestic network.
- The HLR must support any enhancements to the IS-41 (or equivalent) messages required to accommodate MSID, MIN, MDN, and IMSI, as appropriate.

5.6 Impacts to the Mobile Switching Center

The MSC is impacted in multiple areas including registration/validation, call origination, call delivery, roamer tables, digit screening, query capabilities, and others. Some of these items are detailed below.

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[33] CCPN SS7 network capability in *T1 LB 557 Signaling System Number 7-Number Portability Call Completion to a Portable Number - Integrated Text* currently in ballot to become an American National Standard

To ensure the Calling Number Identification Presentation (CNIP) service continues to deliver the appropriate number to the called party the MSC must populate the calling party number parameter with the MDN in the ISUP IAM.

5.6.1 Registration/Validation

The impacts on the MSC due to the proposed WNP architecture, pertaining to the MS registration and validation, are the following:

- The MSC must support (or at least portions of) IS-41 Revision C (or equivalent) protocol for the Mobile Application Part if the MSC is to perform NP functions.
- The MSC must send the registration request to the HLR requiring GTT of the MSID digits at the STPs.
  - IMSI will use a TT of 9, and MIN will use a TT of 3.
  - IS-41 Revision C must be modified to include the MSID in place of the MIN as a mandatory parameter in the RegistrationNotification message.
- The MSC will receive an HLR response to the registration/validation message which is MTP routed from the HLR. The profile macro in the response message must include the DN of the MS.
- The MSC must be able to differentiate between MSID and MDN and to store them in the call register.

5.6.2 Call Origination

The impacts on the MSC due to the proposed WNP architecture, pertaining to the MS call origination, are the following:

- The originating MSC must populate the CgPN in the ISUP IAM with the MDN. This MDN is obtained from MS's HLR in the response to the registration response.
- The originating MSC must populate the Charge Party Number in the ISUP IAM with the MDN. This DN is obtained from MS's HLR in the response to the registration response.
- If the CdPN belongs to a ported NPA-NXX block, then the following must hold true:
  - The MSC must have a trigger for the NP-SCP query when the MSC determines that the call is intra-LATA and non-local. The MSC will query the NP-SCP using the WNP Query message to obtain the LRN of the entry switch of the ported number.
  - The MSC must be able to interpret the response received from the NP-SCP. The response contains the LRN for ported DNs and the dialed DN for non-ported DNs.

- Upon receiving the LRN, the MSC must send an ISUP IAM message, to the next switch with the *m*th bit set in the FCI, the CdPN set to the retrieved LRN, the CgPN set to the MDN of the calling party, and the GAP parameters set to the dialed DN.

- If the MDN is not ported, the NP-SCP will respond with the CdPN parameter set to the dialed DN in the response message. The MSC must be able to process this message.

- If MSC determines that it is an inter-LATA call, it must route the call to the appropriate IXC for further processing using ISUP or Multi-Frequency (MF) trunk set up messages. The IXC may then perform the query to the NP-SCP.

5.6.3 Call Delivery

The impacts on the MSC due to the proposed WNP architecture, pertaining to the MS call delivery, are the following:

- The MSC must be able to process the IAM parameters, including the FCI *m*th bit and the GAP.
- The MSC pointed to by the LRN (i.e., entry MSC) must recognize the LRN in the CdPN as its own. It must then replace the CdPN value with the GAP value. This new CdPN will then be processed by the MSC as usual.

  The MSC will send a query to its HLR based on the MDN received from the ISUP message. Since the MDN is different from MSID and since multiple HLRs may support be supported at the MSC (for some networks), a special translation of the DN may be needed to locate the HLR.
- When setting up the trunk to the Serving network, the MSC must populate the IAM message with the CdPN equal to the TLDN, the GAP equal to the MDN, and the FCI indicator as set (no query is necessary during this leg of the call).
- If the call is forwarded to another number, the entry MSC must treat the forwarded number as a new dialed number and follow the LRN solution. Thus, if the forwarded number is within a ported range, the MSC will query the NP-SCP to get the LRN of the destination switch.

5.7 Impacts to Interconnection Types

There are two basic types of interconnection used by wireless carriers for interconnecting with the PSTN[34] [35], Type 1 and Type 2. Type 1 and Type 2 trunks can be used for interchanging

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[34] EIA/TIA IS-93 *Cellular Radio Telecommunications A_i-D_i Interfaces Standard*

[35] Bellcore GR-145 *Compatibility Information for WSP-LEC Interconnection*

traffic in both directions, i.e. wireless-to-wireline and wireline-to-wireless. A description of these interconnection types and the impacts of WNP follows.

5.7.1 Type 1

Type 1 interconnection is a trunk interconnection between an MSC and a wireline End Office switch and can support interchange of traffic between the MSC and the PSTN. This includes traffic to and from customers served by that Type 1 office, traffic to and from other end offices and MSCs in the local network, and traffic to and from long distance carriers. Type 1 trunks also support interchange of other types of traffic (i.e., ancillary traffic) such as operator services, directory assistance, and emergency service access (i.e., 911).

Since Type 1 trunks are configured as trunks with line treatment (TWLT) at the Type 1 end office, they can only support MF or ISDN access signaling and not SS7 ISUP signaling. Therefore, the substitution of the LRN in the CdPN, and the use of the FCI and GAP parameters proposed in the SS7 ISUP IAM for NP cannot be supported by Type 1 trunks. Consequently, providers using Type 1 trunks for wireless-to-wireline calls following an NP-SCP query by an MSC will lose the benefit of the query.

Type 1 trunks can continue to be used for wireless-to-wireline calls (including wireless-to-wireless via the wireline) in an NP environment in the following instances:

(a) where a WSP establishes a business agreement with the Type 1 service provider to perform the NP queries,

(b) for calls to non-ported NPA-NXXs,

(c) for long distance calls where the IXC, and not the Type 1 service provider, would perform the NP query, and

(d) for ancillary services such as operator services, directory assistance, and emergency service access.

Type 1 trunks can also continue to be used for wireline-to-wireless calls (including wireless-to-wireless via the wireline) in an NP environment where there exist no ported numbers within the entire NPA-NXX in the WSP's Type 1 number range.

If type 1 interconnects are to be replaced with an interconnection type such as type 2A-SS7 to support the LRN call routing method, the MSC will need to be re-homed from the end office to an access tandem.

5.7.2 Type 2

There are multiple Type 2 interconnections, i.e. Type 2A, 2B, 2C & 2D.

- Type 2A interconnection is a trunk interconnection between an MSC and a wireline tandem switch, and can support interchange of traffic between the MSC and the PSTN. This can include traffic to and from end offices and other MSCs served by that Type 2A tandem switch, and traffic to and from long distance carriers if the Type 2A tandem also serves as an access tandem. Type 2A trunks can operate with MF or SS7 ISUP signaling. To support NP, Type 2A trunks must be converted to SS7 ISUP in order to be able to send and receive the LRN in the CdPN, and the FCI and GAP parameters in the SS7 ISUP IAM.
- Type 2B interconnection is a trunk interconnection between an MSC and a wireline end office switch, and can support interchange of traffic between the MSC and only customers served by that Type 2B office. Type 2B trunks can operate with MF or SS7 ISUP signaling and are usually provisioned to allow overflow traffic to route to an associated Type 2A trunk group. To support NP, Type 2B trunks can remain MF as long as none of the NPA-NXXs served by the Type 2B end office or MSC contain any ported numbers. Further, the Type 2B end office and MSC can perform an NP-SCP query with the result indicating that the call should be routed to a Type 2B trunk group. Again, MF signaling can still be used in such cases as long as the Type 2B end office and MSC can retain the LRN for use with the associated Type 2A overflow trunk group, should all of the Type 2B trunks be found busy. Type 2B trunks can be converted to SS7 ISUP and optionally arranged for sending and receiving the LRN in the CdPN, and the FCI and GAP parameters in the SS7 ISUP IAM.

  WSPs can make business arrangements for another provider to query and properly route the call to the ported-to network.
- Type 2C interconnection is a trunk interconnection between an MSC and an E911 tandem for Emergency Service calls. Signaling over Type 2C trunks is not impacted by WNP. Emergency Services feature interactions with WNP are covered in section 3.3.2.
- Type 2D interconnection is a trunk interconnection between an MSC and an Operator Tandem. Signaling over Type 2D trunks is not impacted by WNP. Operator Service feature interactions with WNP are covered in section 3.3.1.

5.8 Impacts to the Signaling Transfer Point

Note: It is recommended that all service providers utilize the GTT capability at their STPs for routing SS7 queries. Although MTP routing capability can be used, it will not be able to utilize all of the performance and administrative benefits of GTT.

The proposed NP architecture will have the following impacts on the STPs in the SS7 backbone network:

- If STP GTT is used, STPs must support a new TT value for routing messages to the WNP query messages to the NP-SCP. Wireless networks, for WNP queries, should use the same TT values as used in the wireline networks. [36]
- The STPs shall perform appropriate SS7 route and SCCP management for routing queries.
- If IMSI is implemented, the STPs must support GTT of IMSI for the new IMSI TT. Although IMSI has 15 digits, the STPs may need to perform GTT only 6-digit GTT on IMSI to locate the home service provider's network. If the home network supports multiple HLRs for the same mobile network code of the IMSI, it may have to perform GTT on greater than 6-digits of the IMSI in order to locate the HLR for the MS. Only the IMSI digits needed to perform GTT are required in the SCCP CdPA. The complete IMSI value used by the end application should be provided in the TCAP.
- STPs must have route-sets defined for every possible destination network with which the service provider has a roaming agreement.
- STPs should be able to support DN-to-HLR routing translation based on a new intra-network TT yet to be defined.
- STPs will perform Intermediate GTT (IGTT) for messages to remote network nodes and Final GTT (FGTT) for routing to the local network nodes.

5.9 Impacts to Global Title Translation

The impacts below apply to the location of GTT databases within a network. These impacts only apply to networks that plan to use GTT for the routing and management of query messages.

- The NP-GTT database is a six-digit GTT database located on the STP.
- It is perceived that MSID GTTs are STP based and are not impacted by number portability.
- MDN GTTs for inter-network service and capabilities are the most impacted in a number portability environment. Much discussion has occurred on whether to locate the MDN-GTT database on the STP or on the NP-SCP. Regardless of location, MDN-GTTs may require interrogation of the TCAP portion of the message to complete the GTT lookup. A local SMS interface may be beneficial depending on the volume of updates received. The local SMS would provide updates for ported numbers. It is up to each service provider to update their default GTT databases for each inter-network service via existing service provider procedures.
- MDN-GTTs and the associated TCAP interrogation may be provided on STPs. The STPs provide GTT load sharing of queries to application SCPs and STPs. The STPs

[36] A current move is underway to have separate NP TTs for each protocol as opposed to one TT for all three (i.e., AIN, IN, and WIN).

provide SCCP management in the case of application failures. Service providers need to ensure correct and timely provisioning to avoid circular routing conditions between STPs performing GTT.

- MDN-GTTs on the SCP and the associated TCAP interrogation may be provided on NP-SCP (or other SCP) platform. The NP-SCPs should provide load sharing of queries to application SCPs and Gateway STPs as necessary. The SCPs should also provide SCCP management in the case of application failures. Service providers need to ensure correct and timely provisioning to avoid circular routing conditions between STPs performing GTT and between STPs and SCPs performing GTT.
- MDN-GTTs on the SCP require a six-digit GTT database on the STP for each GTT database located on the SCP. This service provider managed database is used by the STP to locate the SCP performing the ten-digit GTT.

Another option is to follow a capability being studied by some land-line service providers. This is a capability where the NP-SCP changes the TT value and CdPA of GTT messages. This scenario requires a six-digit GTT at the STP, a ten-digit GTT at the NP-SCP where a second TT value is reassigned and the changing of the CdPA to the LRN. A service provider that receives these messages from another network is required to support the new TT value and service based LRN database. Each receiving network is required to have and maintain this database for this scenario to be successful.

5.10 Impacts to the Number Portability Service Control Point

The WNP solution will have the following impacts on the NP-SCP (some of which are already known in the LRN solution):

- The NP-SCP must support WNP query messages from wireless network and a response message including the LRN of the ported subscriber's MSC.
- NP-SCPs should be deployed with redundant replicates for total availability. This will require synchronization of the data in all replicated units to be provided by a centralized service management system.
- NP-SCPs should comply with Bellcore GR-1280-CORE, AIN SCP Generic Requirements, Section 11. Requirement 11-4 demands that the Mean Response Time at the rated transaction load be 100 ms or less, and the 95% response time be 120 ms or less.
- The NP-SCP should implement congestion control and indicate such a condition to MSCs via ACG as to defined by IS-41 and/or GSM standards.

5.11 Impacts to Customer Care and Provisioning

The following list describes the potential impact of NP on customer care and provisioning systems, depending upon a service provider's infrastructure:

- Some system in the Customer Acquisition/Care provisioning stream must interface to the regional SMS for negotiating/announcing ported numbers with the other service provider(s) and for querying existing subscriber records.
- Any system which interfaces with the regional SMS system must do so with the enhanced format of the Customer Account Record Exchange (CARE), also known as the Inter-Service Provider Maintenance, Administration, and Provisioning (ISPMAP) information.

5.12 Impacts to Billing

The following list describes the potential impact of NP on billing and fraud management systems.

- Roaming tables may need to be modified to support both IMSI and MIN. If the billing systems store IMSI, standard call records will also need to be modified and expanded. Additionally, telephone inventory records must be modified.
- Billing systems will most likely need to support more than one identifier for a subscriber: MIN, IMSI, and/or MDN.
- Any system or process which is built on MIN must be modified to support another ID - rating, cycle changes, splits, et al.
- Fraud Management will also be impacted for the same reason as above. Call Detail Records from the visited service providers are currently extracted on the basis of NPA-NXX translation of the billed number.
- A billing module may have to be added to the existing AMA records for calls involving ported numbers. The details are for future study.
- A billing identifier may be added to the call setup or AMA records. Future study is required.
- Call data message handling (e.g., IS-124) needs must be addressed.

5.13 Impacts to Maintenance

The following list describes the potential impact of NP on the maintenance operations:

- Performance and measurements
- Fault Detection, isolation and recovery
- Alarm detection and alarm reporting
- Maintenance and administration position
- Test procedures of the non-ported number, ported number and disconnected ported number

5.14 Impacts to Number Portability Data Administration

The following list describes the potential impact of NP on customer and network data administration.

- Service providers need to have an EDI interface for exchanging ported subscriber's data.
- WSPs must provide for an LSMS function to mediate the data sent from the NPAC-SMS to the NP-SCP, including the CMIP interface to the NPAC-SMS.
- WSPs must provide for an SOA function to mediate the data sent from the WSP's service order entry systems to the NPAC-SMS, including the CMIP interface to the NPAC-SMS.
- The CTIA Cellular Operations Record Distribution (CORD) and the LERG data distribution procedure must be updated to provide rapid exchange of PC/SSN, MIN, and other pertinent routing and subscription information.
- WSPs must provide for a means (e.g., an Operations Support System, manual) with which to provision network data, including
  - portable NPA-NXX block indicator for the MSCs,
  - new TT and new GTTs in the STPs,
  - HLR updates to include ported numbers, and
  - translation data in NP-SCP.

5.15 Impacts to Service and Network Reliability

The porting of a customer from one service provider to another requires provisioning changes that are both accurate, timely, and precisely coordinated between all service providers in a portable area. This provisioning is especially critical with respect to GTT databases. Incorrectly provisioned GTT databases can result in SCCP circular routing conditions that may utilize all of a link set's capacity within seconds. A circular routing mechanism is therefore needed that eliminates SCCP circular routed messages from occurring.

ANSI T1.112 provides procedures for SCCP message looping in the form of the SCCP Hop Counter. This hop counter is available in SCCP X-Unitdata (XUDT) messages only. Network elements will require upgrades to support XUDT message formats. Due to economics and desired dates of implementation, the UDT message will be used for number portability and existing applications. The XUDT message has been flagged as the desired long term solution.

5.16 Human Factors Impacts

Today, mobile subscribers may dial seven digits for calls within their home NPA. An NPA is pre-pended to the dialed digits for some mobile originated calls. In a Number Portability environment, 10 digits must be sent in the query to the NP-SCP. Wireless Number Portability is driving the separation of MSID and MDN, with the possibility that the MSID (as MIN) will not reflect the NPA of the subscriber's MDN.

The question then is how will the MSC determine what NPA to pre-pend to a 7 digit dialed number. The call might be misrouted, or the wrong information sent to the NP-SCP, if the MSC relies on the MIN MSID or the NPA of the MSC to determine the NPA of the called number.

There are 3 possible solutions:

(a) Require 10 digit local dialing for all mobile subscribers. This would treated all mobile subscribers equally (whether ported or non-ported) but may put the wireless carrier that implements 10 digit local dialing at a competitive disadvantage if the other local carriers, wireless or wireline, still support 7 digit local dialing. (A variation would be to have only the ported subscriber dial 10 digits. But that disadvantages that subscriber, would not meet dialing parity criteria, and would require the carrier to maintain multiple dialing plans for different classes of subscriber.)

(b) Assign the ported subscriber an MSID in MIN format with the same NPA as the ported MDN. It is not clear if this would always be possible, and this practice may affect MSID administration and may lead to inefficient use of the MSID. (MIN administration is for further study.) If the mobile subscriber has an IMSI as MSID, and no MIN, the MSID provides no value for this process since an IMSI does not contain an NPA.

(c) Use the NPA of the MDN of the calling mobile subscriber. This solution assumes that the calling party's MDN is available at the time of this substitution.

5.17 Service Impacts

The following impacts to services, as known today, are anticipated with the introduction of number portability as proposed in this document:

- Over the Air Activation must support the delivery of a MDN to the MS.

  The User Initiated Over The Air Function (OTAF) will not have impact with Call Origination on Wireless Number Portability. The Network Initiated OTAF with Call Termination will have some impact on Wireless Number Portability.

- CNIP must support the delivery of the MDN and not the MIN as the call party number for mobile originated calls.

- Emergency services must ensure that the subscriber is known to the operator by the MDN and not the MSID. Refer to section 3.3.2 for further discussion.

- Delivery of an SMS message to the Destination MC and ultimately the mobile station is based upon the MIN. In WNP, the delivery network only has the MDN of the mobile station. Therefore, the service is impacted in routing to the Destination MC. Refer to section 3.3.5 for presented solutions.

Impacts to CLASS type services are similar to those outlined in the ICCF document "INC Report on Number Portability," section 13.1.5.1.

There may also exist impacts to proprietary service implementations not appropriate for this document.

6. RELATED DOCUMENTS

The following documents can provide additional information regarding Number Portability:

- *Industry Numbering Committee (INC) Report on Number portability, Industry Service providers Compatibility Forum (ICCF)*, INC 96-0607-013, July 11, 1996.
- *FCC First Report and Order and Further Notice of Proposed Rulemaking*, FCC 96-286, June 27, 1996.
- *Federal Communications Commission (FCC) Notice of Proposed Rulemaking (NPRM) for the Local Number Portability*, Docket Number 95-116, July 13, 1995.
- *Generic Requirements for SCP Application and GTT Function for Number Portability*, Illinois Number Portability Workshop, Issue 0.95, September 4, 1996.
- *Generic Switching and Signaling Requirements for Number Portability*, Illinois Number Portability Workshop, Issue 1.02, June 17, 1996.
- *CCPN*, T1 Letter Ballot 557
- *IMSI Assignment Guidelines and Procedures*, Version 1, February 12, 1996.
- *North American Numbering Council LNP Architecture and Administrative Plan*, Issue 5, March 4, 1997.
- *T1 LB 557 Signaling System Number 7-Number Portability Call Completion to a Portable Number - Integrated Text*, currently in ballot to become an American National Standard

Information is available via the World Wide Web regarding number portability. In some cases, the above mentioned document may be found at these web sites.

- *www.fcc.gov* - information regarding the NANC LNP activities, FCC orders, meetings, etc.
- *www.ported.com* - this site contains various documents and information related to wireline portability.
- *www.tl.org/index/0701.htm* - this site contains, among many other things, the CCPN document.

7. ISSUES

The following issues are currently being or must be investigated before implementing the WNP Solution:

(a) How many LRNs will be assigned per MSC -- one per serving area, one per POP/POI, one per NPA-NXX, one per MSC, and/or one per MC (if multiple MCs are associated with an MSC)?

(b) Are there any methods wireless could employ for more efficient routing.

The following text was submitted as contribution to this document but has not been agreed upon:

"Call routing for mobile to mobile calls can be more efficient if the originating wireless network can identify that the outgoing call is wireless. There are two options for identifying a wireless call:

- The Originating MSC could maintain a list of LRNs assigned to MSCs. After the MSC receives the LRN in the WNP Query Response, the MSC can check to see if the LRN is assigned to an MSC.

- A wireless indicator could be maintained in the NP-SCP. The indicator would be returned in the WNP Query Response along with the LRN. This option requires significant effort and corporation with all industry providers.

An originating MSC, upon identifying an outgoing wireless call, may route a Location Request message to the called party's HLR using a 6-digit LRN to HLR GTT a the STP or per internal translations. (Note: If there are multiple HLRs, either the MSC has multiple LRNs or more than 6-digits may be needed for the GTT.) If the called party is roaming, the HLR will return the TLDN in the location request return result message. The originating MSC can route the call using the TLDN."

(c) The impact of WNP with regard to Emergency Callback whether the call back is over a roamer access port or otherwise requires further study.

(d) Performance and capacity impacts should be studied.

(e) How will MINs be administered?

(f) It may be assumed that providing resellers with numbers in and of itself does not make these numbers ported (and thus have LRNs assigned in the NP database). However, what if a reseller wishes to resell off a different facility provider and still retain its

numbers? Can a reseller port a block of numbers? What other issues will existing WNP with resellers? The treatment of resellers, resellers numbers and number portability will be noted on this issue list and addressed at some future date.

(g) Uniform treatment by wireline providers of calls to wireless subscribers continues to be an issue. Will the rating be based on the original wireline rate center or the fact that the subscriber is being served by a WSP?

(h) Will notification of an NPA-NXX opening for portability in order to provision the MSC be obtained from the LERG? If so, what is the process and system impact? Will this data also be available from the NPAC-SMS, and if so, in an automatic download?

(i) A standard solution (for the included alternatives or other) for delivery of a short message to a ported MDN must be chosen.

(j) Impacts of WNP on Code Splits must be further studied.

(k) The following implementation alternatives have been submitted for contribution in order to aid the complexities of routing a Location Request to the HLR from the gateway MSC:

- The MSC can translate the called MDN to the address of the called subscriber's HLR.
- The SS7 Signaling network can translate the called MDN to the address of the associated subscriber's HLR.
- The Originating MSC can query a NP-SCP to obtain the LRN, and route the signaling message to the HLR associated with the LRN.

Choosing the appropriate solution for the problem documented in Section 3.1.8.1 requires further study.

8. LIST OF ACRONYMS

The following acronyms have been used within this document.

Acronym	*Expansion*
ACG	Automatic Code Gap
AIN	Advanced Intelligent Network
AMA	Automatic Message Accounting
AMPS	Advanced Mobile Phone System
CC	Customer Care
CCPN	Call Completion to a Ported Number
CDMA	Code Division Multiple Access
CdPA	Called Party Address
CdPN	Called Party Number
CFNA	Call Forward No Answer
CgPA	Calling Party Address
CgPN	Calling Party Number
CLASS	Custom Local Area Signaling Services
CMIP	Common Management Interface Protocol
CMRS	Commercial Mobile Radio Service
CNAM	Calling Name
CORD	Cellular Operations Record Distribution
CTIA	Cellular Telecommunications Industry Association
DN	Directory Number
EDI	Electronic Data Interchange
EO	End Office
ESN	Electronic Serial Number
ESP	Emergency Service Provider
FCC	Federal Communications Commission
FCI	Forward Call Indicator
FGD	Feature Group D
GAP	Generic Address Parameter
GSM	Global System for Mobile Communications
GTT	Global Title Translation
HLR	Home Location Register
IAM	Initial Address Message
IMSI	International Mobile Station Identifier (E.212)
IN	Intelligent Network
IS-41	Interim Standard - 41
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IXC	Inter Exchange Carrier
LATA	Local Access Transport Area

Acronym	*Expansion*
LEC	Local Exchange Carrier
LERG	Local Exchange Routing Guide
LIDB	Line Information Database
LRN	Location Routing Number
LSMS	Local Service Management System
LSP	Local Service Provider
MC	Message Center
MCC	Mobile Country Code
MDN	Mobile Directory Number
MIN	Mobile Identification Number
MNC	Mobile Network Code
MS	Mobile Station
MSA	Metropolitan Statistical Area
MSC	Mobile Switching Center
MSID	Mobile Station Identifier
MSIN	Mobile Station Identification Number (as part of IMSI)
MTP	Message Transfer Part
NANC	North American Numbering Council
NANP	North American Numbering Plan
NE	Network Element
NP	Number Portability
NP-SCP	Number Portability Service Control Point
NPAC-SMS	Number Portability Administrative Center Service Management System
NPRM	Notice of Proposed Rulemaking
O-MSC	Originating Mobile Switching Center
OAM&P	Operations, Administration, Maintenance, and Provisioning
OEO	Originating End Office
OSS	Operations Support System
OTAF	Over The Air Function
PC	Point Code
PODP	3/6/10 Digit Public Office Dialing Plan
POI	Point of Interconnection
POP	Point of Presence
PSTN	Public Switched Telecommunications Network
RBOC	Regional Bell Operating Company
SCCP	Signaling Connection Control Part
SCPs	Service Control Points
SME	Short Message Entity
SMR	Specialized Mobile Radio
SMS	Service Management System
SMS	Short Message Service
SOA	Service Order Activation
SP	Service Provider

Acronym	*Expansion*
SS7	Signaling System 7
SSN	Sub-System Number
STP	Signal Transfer Point
TCAP	Transaction Capabilities Application Part
TCPN	Translated Called Party Number
TDMA	Time Division Multiple Access
TEO	Terminating End Office
TLDN	Temporary Local Directory Number
TT	Translation Type
V-MSC	Visited Mobile Switching Center
VLR	Visiting Location Register
WIN	Wireless Intelligent Network
WNP	Wireless Number Portability
WSP	Wireless Service Provider