

Cellular Networking Perspectives

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Vol. 8, No. 6 June, 1999

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FCC Notice of Proposed Rule-Making on Number Conservation

The US **FCC** is planning to rule on number conservation, a topic we covered in our January and February, 1999 issues. The FCC is concerned because users of the North American Numbering Plan (NANP) are consuming area codes at an unprecedented rate, taking about 45 years to use the first 120 area codes, and only another 10 for the second 120. There are just under 800 area codes possible.

While the FCC has not made any decisions yet (the whole purpose of this notice is to stimulate input), they are obviously still enamored with number-pooling, stating that it could extend the lifespan of the NANP by 75 years.

If this position is not strenuously opposed, it will likely become the FCC's rules. Wireless carriers may find number pooling to be a very unreliable and high spending spouse. Apart from forcing wireless carriers to fully support LNP, pooling may force wireless carriers to abide by rate center boundaries which will make number allocation problems worse, by forcing carriers to allocate

Quote of the Month

“Current projections show that the North American Numbering Plan... may completely run out of area codes within the next 10 to 15 years.”

FCC Press Release, May 28, 1999

phone numbers from a larger number of smaller pools. Rate centers, in our view, are the real problem, and rate center consolidation would make a better marriage with the needs of wireless carriers, and is more likely to achieve conservation goals. Unfortunately, rate center consolidation is a solution that is under the control of State governments, not the FCC, and may also reduce the amount of revenue that the LECs obtain from intra-LATA calls (i.e. calls between two rate centers that do not qualify for carriage by inter-exchange carriers).

Local Number Portability Phase II: Porting Mobile Numbers

According to the FCC mandate, the first requirement for local number portability (LNP) in wireless systems, known as LNP Phase I, was to correctly terminate calls to ported landline numbers (see our May, 1999 issue). Phase II, the subject of this article, requires mobile numbers to be ported. This is also known as Wireless Number Portability (WNP).

WNP will allow a wireless phone user to port their directory number to another wireless carrier, or even to a landline carrier. It will also allow a consumer with a landline phone to port that directory number to a wireless carrier.

Currently, the wireless industry is under an FCC mandate to provide WNP by November 24, 2002 in specified metropolitan areas. Rural carriers are largely exempt. This mandate could be moved

Cellular Networking Perspectives (issn 1195-3233) is published monthly by Cellular Networking Perspectives Ltd., 2636 Toronto Cresc. NW, Calgary AB, T2N 3W1, Canada.

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Subscriptions: CDN\$300 in Canada (incl. GST), US\$300 in the USA and US\$400 elsewhere. Payment by cheque, bank transfer, American Express, MasterCard or Visa.

Delivery: Email or 1st class mail. **Back Issues:** Available individually for \$35 in the US and Canada and \$40 elsewhere, or in bulk at reduced rates. **Discounts:** Educational and small business discount: 25% off any order. **Copies:** Each subscriber is licensed to make up to 10 copies of each issue or back issue. Please call for rates to allow more copies.

up by the FCC if they decide that there is an urgent need (i.e. number conservation, as described in the preceding article) or moved back into the future.

The February, 1999 issue of *Cellular Networking Perspectives* summarized the regulatory and political background to the LNP requirements, and the May, 1999 issue covered the LNP Phase I requirements for mobile to ported-landline call processing. Acronyms related to LNP and WNP are defined as they are first used in this article, and also at:

www.cnp-wireless.com/glossary.html

IS-756-A: The Phase II Standard

TIA/EIA/IS-756-0 provides a standard Phase I LNP solution for wireless systems. IS-756 Revision A adds support for Phase II (WNP). It was published by the TIA in December, 1998.

This revision of the standard makes no changes to the TIA/EIA-41 protocol beyond the NumberPortabilityRequest message that was already present in TIA/EIA/IS-756-0. Revision A does provide some new scenarios and modified procedures to support WNP.

Termination to a Ported Wireless Phone

The call processing modifications for calls terminating at ported wireless phones are surprisingly few, because it is only in failure conditions that the terminating wireless carrier performs NPDB

queries for calls to its mobiles. This is because the terminating wireless carrier is the "N" carrier, and it is usually the responsibility of the "N-1" carrier to perform the number portability query, which is either another local carrier or, for long distance calls, an inter-exchange carrier.

Even in the case of mobile-to-mobile calls, the originating wireless carrier is unlikely to distinguish the call from one to a landline phone, and the LNP query process is therefore exactly the same as for mobile-to-landline calls (see Figures 1 and 2 from our May, 1999 issue).

One situation where the originating carrier will recognize the dialed digits (see Figure 1), is in calls between two mobiles that belong to the same home system (in this case the wireless carrier acts as both the "N-1" and the "N" carrier). In this case the dialed digits will be recognized as from a block assigned to the originating wireless carrier, but if this block is portable the dialed number might have been ported out. The wireless carrier can query the HLR first (LOCREQ message) and, if the HLR reports that no matching record was found, then query the NPDB (NPREQ message). Alternatively, the originating MSC can query the NPDB first and, if the number is not ported (i.e. no LRN returned), query the HLR. Either choice can result in errors if the porting of an MDN is not yet complete. Assuming that porting of numbers affects only a minority of numbers in a block, the first

method (querying the HLR first) will be most efficient.

The major wireless infrastructure modifications required to support WNP are not due to the processing of calls to ported wireless phones, but due to the ramifications of MIN/MDN separation and problems for roamer port calls.

Impacts on short message service and global title translation are being resolved in the development of the LNP Phase III standard, along with any signaling optimizations that may reduce the number of queries required.

MIN/MDN Separation

The CTIA initially took responsibility for the definition of requirements for number portability for wireless carriers. The most significant decision that they made was to require the separation of the MIN (Mobile Identification Number) and the MDN (Mobile Directory Number). For a ported mobile, the MIN will identify the current home wireless carrier, while the MDN will be the unchanged phone number. This optimizes TIA/EIA-41 signaling, by allowing a registering mobile to directly identify the HLR to which validation and authentication messages need to be addressed, without ever requiring a number portability query, although this choice requires that the MIN be reprogrammed whenever a wireless phone is ported (which is unavoidable in the case of landline-to-wireless porting anyway).

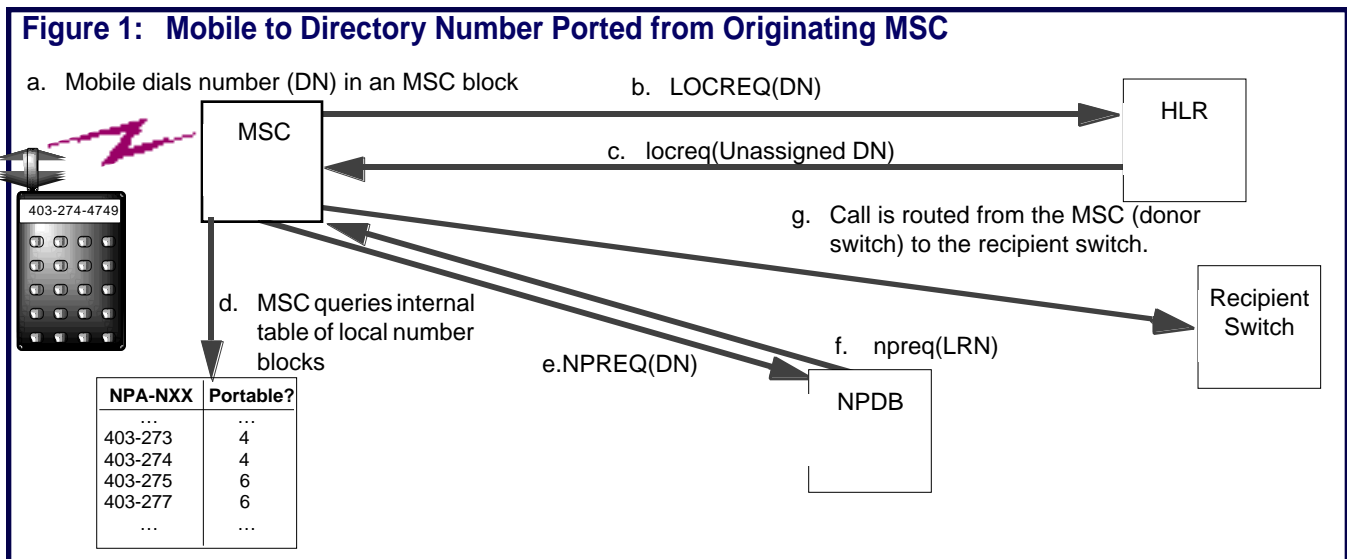
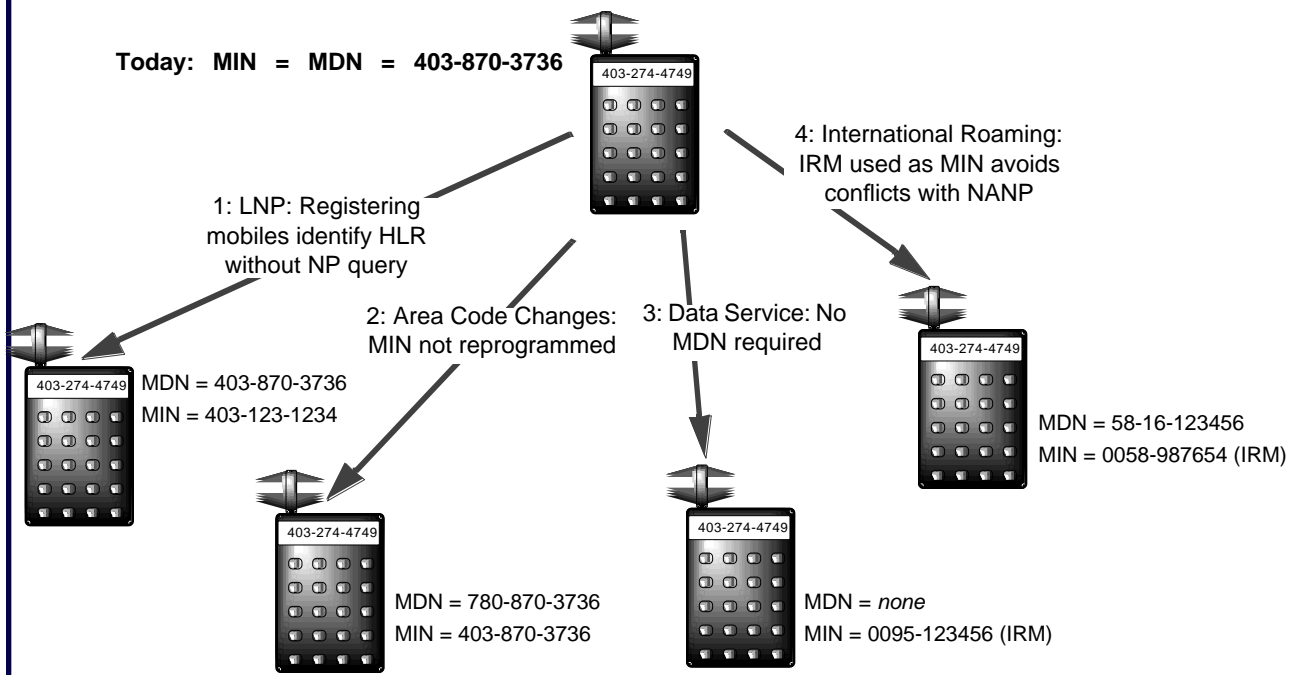


Figure 2: Four Benefits of MIN/MDN Separation



The separation of the MIN and MDN also requires a MIN allocation authority, an independent organization that can allocate the MIN resource to wireless carriers, just as the North American Numbering Plan Administration allocates phone numbers to wireless and landline carriers. The CTIA is currently developing the guidelines that this organization will work under, similar to the established US IMSI assignment guidelines. The separation of the MIN and MDN will also facilitate international roaming and eliminate the need to reprogram mobiles when area code changes occur. These, and other advantages, are described in Figure 2 and in our December, 1994 issue.

WNP and IMSI

The IMSI identifier is unaffected by number portability, as the IMSI and the MDN are always two separate identifiers. On the positive side, separation of the MIN and MDN is one essential step en-route to the implementation of IMSI, essential for the long-term elimination of international roaming problems.

Other phone identifiers such as the ESN (analog, TDMA and CDMA) and IMEI (GSM) are also unaffected by WNP.

Roamer Port Calls

WNP may be the end of the road for the roamer port, which is a phone number on an MSC that allows call delivery to mobiles currently being served by that system. When a call is received at this number, the MSC provides a second dial-tone, and the caller enters the 10 digit MIN of the mobile they want to reach. This is cheaper, for reaching roamers, than using automatic call delivery, which routes calls through the home system, although roamer port calls are significantly more cumbersome for the caller, who has to know the roamer port number to call (based on the location of the mobile) and the multi-step procedure to follow.

MSC's can continue to accept the MIN on roamer port calls, which will confuse people attempting to call ported mobiles, as they will know the phone's MDN, but not its MIN, which will result in failure of the call or even routing to the wrong mobile.

An alternative is to use the method specified in IS-41 Revision C, and accept an MDN after the second dial-tone. This causes a number of problems, including:

- MDNs are not always 10 digits in length (e.g. international roamers),

which would require the entry of variable length strings. The ability to time-out the dialing of digits, or recognition of a delimiter (e.g. # key) would be needed to indicate the end of a directory number.

- Supporting roamer port access for international roamers would force a change in procedures – dialing the country code first. Dialing a US number would change from 10 digit dialing to 11 (i.e. "1"+10 digits).

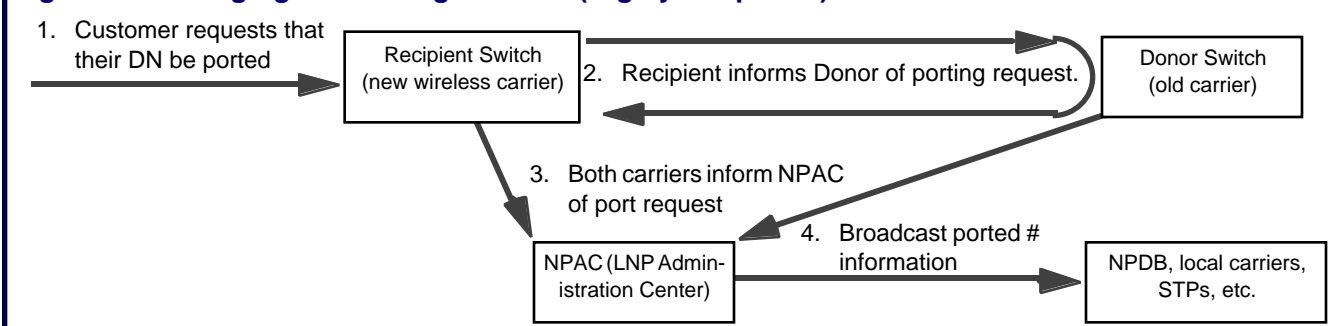
Default Routing

Calls may occasionally be routed to a wireless carrier for an MDN that has been ported to another carrier. This may be due to errors in number portability provisioning, or overload conditions that cause the "N-1" switch to route the call without an NPDB query. In this case, the terminating wireless carrier may need to perform the NPDB query itself when it discovers that there is no HLR record for the MDN.

Managing Ports

The biggest impact of WNP will not be the call processing impacts or MIN/MDN separation or the possible demise of the roamer port, it will be the challenge of

Figure 3 Managing the Porting Process (Highly Simplified)



managing the porting process. Once a number is actually ported, the sailing will become smoother.

The management challenge is due to the number of databases that have to be updated within a short time interval. Figure 3 conceptually illustrates the porting process. There are five major actors whenever a number is ported.

1. The new wireless carrier (Recipient) must inform the old (Donor) carrier and the NPAC of the port, assign a MIN to the mobile (not the same as the ported MDN) and create subscriber records in databases for billing, customer care and call processing (e.g. HLR, AC).
2. The donor wireless carrier, once notified, must erase any record of the directory number, to prevent problems if a call is erroneously directed to them. The MIN assigned to the mobile may be re-used (after some delay).
3. The NPAC (Number Portability Administration Center) has to compare and validate the information received about the port from the donor and the recipient, and must broadcast information on the ported number (and the ported block, if this is the first port in the block) to all local carriers.
4. All local LNP database providers have to add the newly ported number to their database, mark the block as ported if it is not already, and program a list of SS7 point codes for a variety of LNP-affected services (e.g. Calling Name Presentation), so that SS7 signaling messages can be redirected.
5. All local carriers and SS7 network providers will have to recognize the block containing the ported number as portable, if they do not already.

The problems that will occur if this process is not completed properly are numerous. The most likely symptom is that calls to a ported mobile will not complete or, more rarely, will be completed to the wrong mobile. More serious problems, such as switch failure or trunk group exhaustion due to uncontrolled looping are also possible.

Impact of WNP on Wireless Carriers Outside the LNP Mandate

The impacts of WNP are supposed to be limited to the urban wireless carriers that are covered by the FCC LNP mandate. However, the impacts may leak out and force upgrades of MSC's in the US in areas outside of the mandate, or even in other countries.

Emergency Calls

According to another FCC mandate, wireless carriers must upgrade their networks to allow the identification of wireless phones placing emergency calls. This requires the serving carrier to transmit the MDN to the PSAP (Public Service Answering Point), to allow callback and other capabilities. However, in the case of MIN/MDN separation a serving carrier that implements IS-41 Revision A or B will not have the MDN available, and may well send the MIN instead. This would cause routing to the wrong mobile if a callback was attempted.

If rural carriers are to support callback to ported wireless phones, they will need to upgrade to at least IS-41 Revision C and ensure that MIN/MDN separation is supported for ported roamers, if not for their own subscribers.

Long Distance Billing

When a wireless phone makes a long distance call, carriers must send ANI (Automatic Number Identification) to the long distance carrier to identify the party that is to be billed for the call. Carriers can either send a number that identifies the MSC (in which case they will be responsible for billing the calling mobile) or the identity of the mobile directly.

If a carrier was to choose to send the identity of the mobile, carriers outside the LNP mandate that do not have access to the MDN would cause the wrong mobile to be billed (this is one error that is to the benefit of the ported subscriber!). Luckily, most roamers are billed through a generic MSC number, because long distance carriers either will not accept ANI from distant locations, or may erroneously bill from the location identified by the ANI (i.e. the location of the mobile's home carrier).

If carriers outside the LNP mandate ever want to (or are mandated to) send ANI that identifies the mobile making the call, they will need to upgrade to at least IS-41-C to allow the MDN to be forwarded from the HLR when ported mobiles register in their system.

To be continued...

In our concluding article on Number Portability, we will discuss developing LNP Phase III standards, which will resolve problems with delivery of short messages to ported wireless phones and routing of SS7 messages using global title translation.

TIA TR-45.6

Packet Data Standards (Including CDPD)

Cellular Networking Perspectives

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Last published June, 1998

Published Standards

Standard	Description	Published
IS-732	Cellular Digital Packet Data (CDPD) Standard. See June, 1998 issue for full list of part numbers	02/98
TSB-87	IS-732 support documents. See June, 1998 issue for full list of part numbers.	02/98

Developing TR-45.6 Standards

PN/SP	Standard	Description	Status
PN-4166	IS-732-311-A	Lower Layer Subprofiles	Development
PN-4167	IS-732-312-A	Subnetwork Subprofiles, including option for IP communication between MD-ISs	Development
PN-4168	IS-732-500-A	Mobility Management, allowing an intermediate MD-IS in the Location Update Service (LUS)	Development
PN-4169	IS-732-501-A	Mobile Network Location Protocol, allowing an intermediate MD-IS in the Location Update Service (LUS).	Ballot
PN-4170	IS-732-A	Standard and System Specification Overview	Development
PN-4286		Wireless IP Network Architecture for 3G Systems	Development

Thanks to Mark Munson (GTE; Chair of TR-45.6) for his assistance compiling the information in this report.

TIA TR-45.7 – Operations, Administration & Service Provisioning Standards

First Publication

Developing TR-45.7 Standards

PN-	Standard	Description	Status
PN-4108	n/a	Wireless Network Management, Stage I and II	Development
PN-4424	n/a	Wireless Network Management, Stage III	Development

Thanks to Thaddeus Kobylarz (Lucent; Chair of TR-45.7) for his assistance compiling the information in this report.

- Note:
1. IS- TIA Interim Standard, TSB- TIA Telecommunications Systems Bulletin, PN- TIA Project Number, SP- ANSI Standards Proposal.
 2. **Bold Type** indicates a modification since the previous publication of this information.
 3. Published TIA standards can be obtained from Global Engineering Documents at 1-800-854-7179.

ATIS T1P1 & TIA TR-46 PCS-1900 ('GSM') Standards

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Published Standards

PN-	Description	Status
IS-104-A	PCS Service Descriptions	04/96
IS-129	Interworking/interoperability between DCS1900 and IS-41 MAP	07/96
IS-651-0	SS7/GSM "A" Interface (RS/PCSC)	07/95
IS-651-A	SS7 "A" Interface (RS/PCSC) for GSM systems	02/98
IS-652-0	Intersystem Operations - DCS1900 (GSM) MAP based	05/96
IS-653-0	ISDN "A" Interface (RS/PCSC). Includes SS7 as a transport option.	10/96
J-STD-007	PCS Air Interface Specification	In press
J-STD-007A	Calling Name Presentation supplement to J-STD-007	In press
J-STD-014A	"PACS" air interface standard for 1900 MHz	In press
J-STD-015	W-CDMA Air Interface Compatibility Standards for 1.85 to 1.99 GHz PCS Applications	In press
J-STD-017	Composite CDMA/TDMA air interface for 1900 MHz	In press
J-STD-023	Intersystem Operations based on PCS1900 (GSM) Standard (prev. IS-652)	12/96
J-STD-024	SS7 based A-interface Standard (previously IS-651)	In press
J-STD-025	Lawfully Authorized Electronic Surveillance (CALEA)	12/97
J-STD-034	Enhanced Emergency Services (E911) Phase I (callback, cell/sector identification)	12/97

Standards in Ballot

PN-/SP-	Standard	Description	Status
<i>No standards in ballot</i>			

Active T1P1 and TR-46 Projects

PN-	Description	Status
	Determining Location of a GSM Phone	development
	Adaption of GSM A-Interface to PCS-1900	CR to ETSI
	GSM support for 14.4kbps data	CR to ETSI
	PCS 1900 Number Portability Phase II (SMS and other services)	CR to ETSI

Thanks to Terri Brooks (Nokia) for her assistance compiling the information in this table.

- Note:
1. CR - Change Request, ETSI - European Telecommunications Standards Institute, IS - TIA Interim Standard, J-STD - Joint ATIS/TIA Standard, PN - TIA Project Number, SP - ANSI Standards Proposal Number, T1 - Prefix for ATIS T1 ANSI standards (and standards committees), TSB - TIA Telecommunications Systems Bulletin.
 2. **Bold Type** indicates a modification since the previous publication of this information.
 3. Published TIA and ATIS standards can be obtained from Global Engineering Documents at 1-800-854-7179 (<http://global.ihs.com>).