

# Cellular Networking Perspectives

Editor David Crowe • Phone 403-289-6609 • Fax 403-289-6658

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## In This Issue ...

### ***Bellcore Relinquishes Control of the NANP*** p. 1

This announcement should allow better access to numbering resources to cellular and PCS carriers in the future.

### ***Smart Cards, Dumb Phones?*** p. 1

Will the TIA attempt to standardize the use of smart cards in cellular phones? Will this technology suit the North American marketplace?

### ***A+ Interface Looks for a Home*** p. 2

An update on the attempt by Motorola to standardize the Base Station Controller to MSC interface.

### ***Wireless Terminal Location Management Part III - Lessons for PCS*** p. 2

A summary of recommendations for PCS and future cellular systems based on Parts I and II of this discussion.

### ***TR45.2 Standards Update*** p. 3

### ***Goldilocks and the Three IS-41 Address Types*** p.3

What are MIN Global Title, PC/SSN and MSCID? What are they used for? How are they related?

### ***Cellular Education at UALR*** p. 4

### ***Status of IS-41 Rev. B Implementation*** p. 5

The first published report on the status of IS-41 Rev. B field trials. So far, all planning, no actual trials.

## ***Bellcore Relinquishes Control of the NANP***

As predicted by *Cellular Networking Perspectives* in October, 1992, Bellcore is relinquishing control of the North American Numbering Plan. The President of Bellcore, George Heilmeier, cried uncle in a letter dated August 16th, 1993 to James Quello, chairman of the FCC. Bellcore offered to transfer responsibility of the NANP as soon as an alternative organization can be identified or created. Bellcore maintained vigorously in the letter that charges of bias towards its owner's needs were completely unfounded.

Whether you believe the claims of Bellcore or not, this development will be good for most segments of the telecommunications industry, allowing all companies fair access to numbering resources. How quickly the new industry group can be established, and how well it can deal with the conflicting demands of the companies, industry associations and countries for NANP resources remains to be seen.◊

## ***Smart Cards, Dumb Phones?***

The TR45 committee has informally discussed the possibility of standardizing smart card technology for use in 800 MHz PCS (aka cellular). Smart cards, currently used in European GSM digital cellular systems, provide personalization of phone service associating the subscriber profile with the smart card, and not the phone. This is accomplished by including a computer chip and memory on a durable card similar in size to a credit card. The portability of the card increases the physical security of subscriber information and

potentially increases the number of types of phones that can be accessed with the same profile and subscription.

Smart cards do have some drawbacks however:

- They will make phones somewhat bigger.
- They will significantly complicate the network. A new entity, known in GSM as an Equipment Identity Register (EIR) is needed to store hardware identification, validity and capabilities, with subscriber information restricted to the existing HLR. New IS-41 procedures and messages would have to be defined to support this new entity to allow roaming.
- Subscribers will have to enter a PIN to establish their authority to use a particular terminal.

Perhaps the biggest unknown remains the direction of the North American wireless communications industry. If subscribers increasingly treat a portable phone as a personal item that they use for all phone calls, a smart card would provide little benefit. If, on the other hand, most people continue to use landline and pay phones regularly *and* if smart cards are supported by these phones, then they may provide subscribers with greater simplicity and portability of services.◊

### **Comments Welcome**

We welcome comments on the contents and format of this newsletter, suggestions for future topics, corrections or additional information.

## A+ Interface Looks for a Home

The recent Motorola proposal to standardize the so-called A+ interface appears to be quite popular, although some companies, such as McCaw and Southwestern Bell, have spoken against the idea. The problem appears to be finding a home for the standardization effort. With TR-45.2 overworked, the TR-45.4 sub-committee on 800 MHz microcells and microsystems appears to be the obvious place. The A+ interface would provide standardized communication between a Base Station Controller (BSC) and a Mobile Switching Centre (MSC). This interface is known as "A+", rather than "A" because it will support AMPS, NAMPS, TDMA plus the CDMA air interfaces.◊

## Wireless Terminal Location Management Part III - Lessons for PCS

The previous two parts of this series on location management have discussed its importance in providing seamless roaming services in a wireless network. In this last part we make several recommendations applicable to the design of future cellular or PCS air interfaces.

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### Custom Registration Control

Current cellular air interfaces (including NAMPS, TDMA digital cellular and CDMA digital cellular) require all terminals to execute the same autonomous registration algorithm. Terminals of the same air interface class will register in a way that is independent of the type of services, business arrangements or regulatory restrictions that might determine the accuracy of location information that is required. Increasing the accuracy of the information collected will increase the rate of registration by all mobiles.

To support diverse features, classes of terminals, business agreements, fraud management strategies and regulatory restrictions, it should be possible to provide registration algorithms and parameters for terminals based on their

individual needs. Some terminals could, for example, be forced to register on every cell boundary, while others would register only between systems. Other terminals would be told to use algorithms somewhere in between, registering perhaps only when crossing LATA boundaries within a cellular system.

For customized registration to be supported, not only air interfaces would have to change, but each HLR would have to store information about the registration algorithm to be used by each terminal and VLRs would have to be educated about when to filter registrations out and when to pass them on to the HLR. IS-41 procedures and messages would have to be designed to transport registration control information from HLR to VLR to MSC and ultimately to each terminal.

It would also be possible to control the flow of registration updates to the HLR at the VLR. This would allow the amount of registration traffic from VLR to HLR to be minimized while providing location information of sufficient accuracy without requiring changes to any air interfaces. On the other hand, this would obviously not limit the registration traffic on the control channel, which might be one of the major motivations for customizing registration algorithms.

The TDMA digital control channel is being developed with some capability for customized control of registration, although no consideration has yet been given to incorporating this into IS-41 to allow its use in a roaming environment.

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### Eliminate Rescan Problems

Terminal rescan has created most of the border cell problems in analog and TDMA cellular networks. When a mobile responds to a stimulus transmitted in one cell (e.g. change in registration parameters) and responds in another cell in another system (due to the mandatory rescan), existing systems get understandably confused. Currently such calls get mishandled and even with the upcoming Border Cell TSB, solutions are messy, inefficient and incomplete.

Air interfaces like CDMA may not suffer from these problems by using a completely different control channel structure, but those relying on a model

similar to the analog control channel could easily eliminate these problems by having each control channel transmit a globally unique address, such as the SS7 Point Code of its MSC along with a local cell address. Mobiles could echo this information in every access, allowing the receiving base station and MSC to easily determine whether inter-MSC routing would be required, and where the IS-41 messages designed for this purpose should be sent.

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### Working Together

The major problems in location management could have been avoided fairly easily by considering the needs of the network during air interface design. Designers and standards committees have traditionally worked in isolation, usually communicating only when their decisions are a *fait accompli*. PCS systems have a real opportunity to avoid some of the problems of cellular if they consider a modern marriage of the air interface and network as equal, communicating partners.

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### Summary

Location information can be used for many purposes, including Call Delivery, Fraud Management and Location Tracking. In this respect location management information has a similar wide range of use as do Call Detail Records. A good understanding of the possible uses, and good planning to balance accuracy of location tracking against system and air interface

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overhead, can result in enhanced depth and breath of service to all subscribers. Services in future cellular and PCS systems can be enhanced by taking a systems approach to design, integrating air interface and network design decisions.◊

### TR45.2 Standards Update

The status of all Interim Standards (IS) and Telecommunications Systems Bulletins (TSBs) that the TIA TR-45.2 sub-committee is developing is listed below, ordered by estimated publication date.

**Border Cell TSB (PN-2910)** • The draft document to resolve several problems that occur on the border of cellular systems has been balloted. Due to the number of technical changes made in response to numerous ballot comments, this document will be **reballoted** if the edited version to be made available to TR-45.2 in September is acceptable.

**Intersystem Non-Signaling Data Communications (PN-2754)** • This document, known internally as *DMH*, describes record layouts and protocols for online transmission of cellular call detail records for billing, fraud detection and other purposes. This document is **out for ballot** as an Interim Standard. Ballot comments will be reviewed at the September TR-45.2 meeting.

**IS-41 Rev. A Compatibility (TSB-55, PN-3063)** • Procedures to allow IS-41 Rev. A implementations to be forward-compatible with Rev. B. Currently **out for ballot**. Ballot comments will be reviewed at the September TR-45.2 meeting.

**PSTN Interface (PN-3098)** • A definition of both the analog (i.e. MF signaling) and digital (SS7 signaling) interfaces required to connect MSCs to the PSTN has been written. It was **approved for ballot** at the August TR-45.2 meeting, and is on schedule for publication in December.

**CDMA TSB (PN-3199)** • A TSB on CDMA inter-systems operations in IS-41 Rev. B systems has been completed by a Working Group I task group. The

document is undergoing Verification and Validation review, and will likely be **sent to the TIA for ballot** following the September meeting of TR-45.2.

**IS-41 Rev. B Technical Notes (TSB-41, PN-2985)** • Will resolve several ambiguities in IS-41 that have resulted in incompatibilities between implementations of IS-41 Rev. A by different vendors. The completed baseline document has been reviewed and will likely be approved for **ballot in September** (well, maybe October).

**IS-41 Rev. B Test Plan (TSB-42, PN-2978)** • An application level test plan for IS-41 Rev. B is being developed by WG II Task Group 2. If a set of tests concerning the interaction of Call Waiting, 3 Way Calling and Inter-System Hand-off are received and approved in September, the test plan will be forwarded to the TIA for ballot.

**IS-41 Revision C (PN-2991)** • An initial draft of this revision of the cellular intersystem operations standard was available to committee members at the July meeting of TR-45.2. This document is still in a very preliminary state, not yet including, for example, text from TSB-51 on authentication. Publication is **scheduled for December, 1993** but it is unlikely that this date will be met.

**Subscriber Features (IS-53 Rev. A, PN-2977)** • A completely revised and rewritten version of the baseline document was accepted at the August TR-45.2 meeting. Publication is **scheduled for December, 1993**, but it appears unlikely that this date can be met due to the amount of ongoing discussion of some features.

**Cellular Dialing Plan (IS-52, PN-3166)** • Plans are being made to revise the cellular dialing plan standard, IS-52 Rev. 0. It has been updated to include the feature activation and deactivation codes that previously resided in IS-53. IS-52 Rev. A will also describe the recommended treatment for ANI (Automatic Number Identification).

**International Applications (TSB-29 Rev. B, PN-3173)** • There are several recognized problems with the use of AMPS cellular outside North

America. WG VI of TR45.2 is studying solutions to these problems. Publication is scheduled for December, 1993, but it is recognized to have a lower priority than other documents and its deadline is being allowed to slip.◊

### Goldilocks and the Three IS-41 Address Types

One of the most confusing aspects of IS-41 is the addressing used to route messages from one element of the network to another. There are 3 basic kinds of IS-41 addresses:

- NANP digits (MIN and Dialed Digits).
- SS7 Point Code (PC) and Sub-system Number (SSN).
- MSC or VLR identification number (MSCID or SWID).

The confusion relates not only to the information contained in each type of address, but their relation to each other (which is also illustrated in Figure 1).

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#### NANP Address

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NANP digits can be used to address data messages in an SS7 network. In an IS-41 network they can be used to route a RegistrationNotification, or similar message, from an MSC or VLR to an HLR, based on the MIN received in the mobile access. They can also be used to route a LocationRequest based on dialed digits received from the PSTN. The NANP digits will be translated at each SS7 Signaling Transfer Point (STP) using Global Title Translation (GTT).

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#### PC/SSN Address

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PC/SSN routing is the basic SS7 addressing method, and therefore requires less STP processing than global title translation. This address type consists of an SS7 point code (PC) and a Sub-system Number (SSN) identifying an application within an SS7 node.

Since mobile phones do not contain PC and SSN information a translation, equivalent to GTT, is necessary for IS-41 messages caused by a mobile access at an MSC or VLR. The use of global title translation can be avoided if

IS-41 network entities store the PC and SSN whenever they receive it. As an example, an HLR receiving a RegistrationNotification Invoke may use the received PC/SSN to address the Return Result and also subsequent messages, such as a QualificationDirective, destined for the same roaming mobile.

actually means the same thing. Why IS-41 defines an MSCID as a SWID and then defines the SWID as SID plus SWNO is a mystery dating to the earliest days of IS-41 development. The SWID concept could actually be removed from IS-41 to avoid confusion without any loss of information.

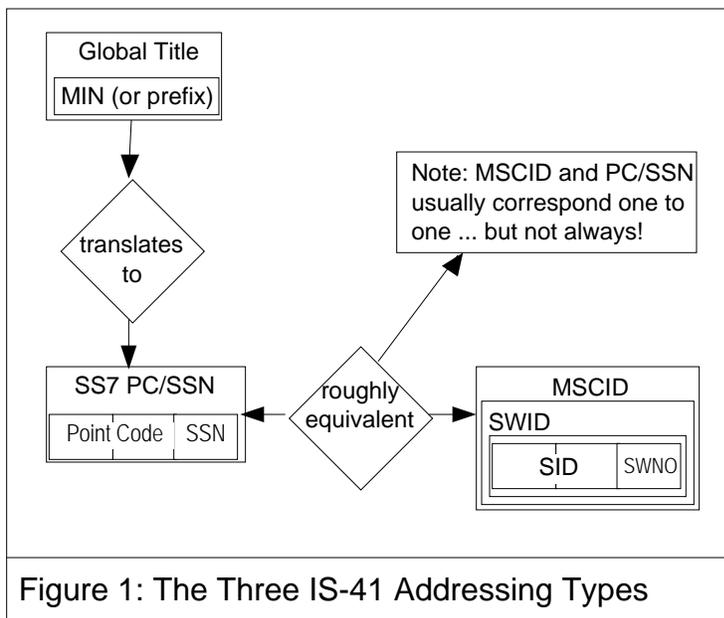
## Cellular Education at UALR

The University of Little Rock at Arkansas is presenting a 3 day course entitled *Cellular Mobile Telephones: System Engineering and Advanced Technologies* on October 4-6, 1993. This overview of cellular technology includes segments on IS-41 and automatic roaming. For more information contact Lea Mabry at (501) 569-8213.◊

MSCID Address	Summary
<p>MSCID, the third type of address in IS-41 has nothing to do with SS7. The MSCID is composed of a SID, the unique system identification number assigned by the FCC, and a SWNO, an arbitrary number used in systems containing more than one MSC and VLR. MSCID addressing always requires translation by internal tables so the main advantage is that it was available in IS-41 Rev. A before PC/SSN was, and is equally amenable to use on X.25 networks.</p>	<p>Just like the 3 bears liked their porridge flavoured in 3 different ways, different systems have different addressing needs. Some will rely extensively on global titles for simplicity in an SS7 environment while others will find MSCIDs more suited to an X.25 network. Since the trend is towards SS7 systems where GTT and PC/SSN must be used, it can be predicted that MSCID will eventually fall into disuse. However, new entrants, still living in the present and not the future, have to choose their own combination of addressing methods based on a thorough understanding of the three still available and in use.◊</p>

### MSCID/SWID Confusion

An additional problem with MSCID is confusion with the term SWID, which



### Back Issues Available

Back issues are always available. Major topics in recent issues are:

#### January, 1993

Inter-System Handoff, part III - Feature Interactions

#### February, 1993

Inter-System Handoff, part IV - New Air Interfaces. IS-41 Rev. 0 Field Trials.

#### March, 1993

Wireless '93 in review.

#### April, 1993

TR-45.2 News. IS-41 Explained. TR-45.2 International Working Group VI.

#### May, 1993

IS-41 Rev. A Status Report. IS-41 Rev. B Status. NovAtel. DMH. IS-41 Enables Innovation. TR45.2 Project Status.

#### June, 1993

Wireless Terminal Location Management, Part I. Brace for the Standards Flood. TR-45.2 Working Group Report.

#### July, 1993

ITN Named CTIA Backbone IS-41 Network Provider. New TIA Standardization Efforts Loom. Wireless Terminal Location Management, Part II. TR-45.2 Grows More Tentacles. TR-45.2 Continues to Pump Standards Out. IS-41 Rev. B Trial Update. IS-41 Rev. A Implementation Status.

The price of a back issue is:  
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# Status of IS-41 Rev. B Implementation

## *Cellular Networking Perspectives*

Editor David Crowe • 403-289-6609 • Fax 403-289-6658

Vendor1	Vendor2	Status	Date	Type	Location
Alcatel-SEL	EDS PCC	Planning		- V - DS	Mobile, Alabama (BellSouth)
	GTE TSI	Planning		- V - DS	Mobile, Alabama (BellSouth)
Astronet		Development			
AT&T	NTI	Planning		HV - DX	Detroit (Ameritech)
EDS PCC	Alcatel-SEL	Planning		- V - DS	Mobile, Alabama (BellSouth)
Ericsson	NTI	Planning		HVADS	<i>location not announced</i>
GTE TSI	Alcatel-SEL	Planning		- V - DS	Mobile, Alabama (BellSouth)
Motorola	NTI	Planning		HV - DXS	<i>location not announced</i>
NTI	AT&T	Planning		HV - DX	Windsor (Bell Mobility)
	Ericsson	Planning		HVADS	Ft. Myers (Palmer)
	Motorola	Planning		HV - DXS	<i>location not announced</i>

Explanation:    Status:            Development, Planning, Lab Trial, Field Trial or Commercial  
                           Completion:        Date of actual or expected completion of listed phase of testing.  
                           Type:                Type of test:  
     H        Includes handoff forward and back  
     H+      Also includes path minimization and/or flash handling  
     V        Includes validation  
     A        Includes authentication (TSB-51)  
     D        Includes call delivery  
     X        Uses X.25 datalink protocol  
     S        Uses ANSI SS7 datalink protocol  
     C        Uses CCITT SS7 datalink protocol  
                           Location:            Location of test and carrier. Usually listed for first trial only.