

# Cellular Networking Perspectives

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### Comments Welcome

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

## TIA Joint Expert's Meeting to Study International Roaming Problems

The problems of international roaming with cellular phones conforming to TIA cellular standards will be studied at a TIA Joint Expert's Meeting in the Washington, DC area the week of November 7, 1994. The major problem to be studied is the limitation of current cellular phones to a 10 digit identification number (MIN) which does not leave enough room to identify mobiles from countries outside the North American Numbering plan (NANP). This will result in increasing confusion for cellular system as the amount of international roaming grows and when the NANP allocates area codes that no longer are restricted in the second digit to a 0 or 1, starting in 1995.

This meeting will be strictly technical, adoption of any standards or recommendations by carriers or countries will be voluntary.

In the August issue we incorrectly listed the CCITT country code for Mexico as 53. It is actually 52. However, the new area code for Arizona is 520, so the possibility for confusion still exists. To make matters worse, some South-East Asian countries, Thailand and Singapore in particular, have been assigned CCITT mobile country codes starting with 52. So, another conflict could occur if any AMPS carriers in those countries program their MINs with their mobile country code.

## CTIA Forum on Cellular Extension Telephone Service, October 27th, 1994

The Cellular Telecommunications Industry Association (CTIA) will be holding a forum on cellular Extension Telephone Service on October 27th in San Antonio. The concern of the CTIA is that some entrepreneurs are providing this service by modifying the MIN and ESN of phones, providing an excuse or cover for illegal cloning for fraudulent purposes as well as denying carriers subscription revenue for the additional phones. For more information phone Lauren Fry at 202-736-3236.

## Cellular Networking Perspectives 1-800 Number

Communications with Cellular Networking Perspectives should be made easier with our new toll free number: 1-800-633-5514, valid in both the United States and Canada. Our other numbers are still valid for faxes (403-289-6658) and for calls from outside North America (403-289-6609).

## New Chair for TR45.2 WG VI on International Issues

A new chairman for TIA subcommittee TR45.2 Working Group VI on international issues was appointed on August 15th. He is none other than David Crowe, editor of this newsletter. David participates in TIA TR45.2 meetings under contract with Alcatel-SEL.

## **Guest's Cell: P.J. Louis on Wireless Interconnect**

**W**ireless network interconnection is an important, but poorly understood and often ignored topic. Cellular Networking Perspectives is therefore pleased to publish the following article by an acknowledged expert in the field; P.J. Louis of Bellcore. P.J. is active in many wireless industry groups, including the Bellcore sponsored Wireless Interconnect Forum and also the Telecommunications Industry Association TR45.2 sub-committee on inter-system issues where he chairs Working Group VII which studies interconnection between wireless systems and other telecommunications systems, such as the PSTN.

### **THE EVOLUTION OF WIRELESS NETWORK INTERCONNECTION**

One of the least discussed topics in wireless telecommunications is network interconnection. Perhaps this is because it is not exactly a hot media subject. However, it is very important today, and will be more so in the evolution of PCS networks in the future.

Network interconnection can be defined simply as the interfacing of two or more telecommunications networks. This is a very simple, but adequate, definition. Not long ago there were only six types of interconnections between landline phone companies and wireless carriers:

1. Dial Line Connections
2. Direct Inward Dialing (DID) Connections
3. Type 1 Connections
4. Type 2A Connections
5. Type 2B Connections
6. Private-line Connections

These interconnection types were all Multi-Frequency tone (MF) based. Network interconnection between landline and the wireless carriers is now migrating to the digital message based Signaling System 7. However, an understanding of the technology alone is inadequate, the industry issues that define the requirements for interconnection must also be understood.

Interconnection will be critically important in wireless networks which will be providing a plethora of services by a plethora of providers on a plethora of networks. In the last few years the telecommunications industry media has been publicizing 800 MHz cellular service and 1800 MHz personal communications services (PCS). The latest industry rages are cable television infrastructure for wireless, Enhanced Specialized Mobile Radio, Narrowband PCS and various flavors of mobile data. All of these have claimed to have PCS attributes. The only differences are in the type of network platform used or the physical technology being used for the "last mile" to the home or user. Despite the rapid growth of wireless systems, the majority of North America's telecommunications traffic is still land carrier originated and terminated.

The large number of providers, services, and networks involved in providing these new services will make network interconnection an issue. Despite the various business stances some have taken regarding network interconnection, at some point a user on one network will want to speak to another user on a different network. If these networks are "islands" of communication, this will not be possible.

Interconnection has evolved from a technical and perception standpoint, as described in Bellcore Technical Reference: TR-NPL-000145, Issue 2 and TIA Interim Standard IS-93. These documents illustrate a change in the way the landline and wireless carriers view each other, and this is reflected by the ways in which carriers want to interconnect to each other. The interconnections described in both documents depict a symmetrical, peer-to-peer relationship instead of the hierarchical, asymmetrical relationship assumed in the original (1986) Bellcore Technical Reference on interconnection. This change in perception will likely change the type of interconnections created.

Interconnection is evolving from just a way to let a peripheral telephone system (e.g., a PABX) access

the public switched telephone network to a world in which carriers can provide each other a variety of call processing, OA&M, and switching capabilities. To a significant extent, the type of services offered will be dependent on how the networks interconnect. What I am describing goes beyond traditional interconnection which is a mostly unidirectional relationship; new interconnection types create a bidirectional relationship; carriers offering other carriers various services.

Another example of interconnection is the "A" interface between a wireless carrier's switch and the radio system, which the TIA TR46 committee and TR45.4 subcommittee have been working towards standardizing. The "A" interface standard will provide an opportunity for carriers to mix and match switching and radio equipment. Ultimately, the end user should benefit from this work; lower costs to the carrier means lower costs to the end user, and opening up the interface should lead to enhanced services for the end user. The "A" interface offers a unique opportunity for those carriers interested in the interconnection (access) business. Carriers can choose to provide just radio services or just network services, instead of both, as in the cellular industry.

Network interconnection in a wireless environment has evolved beyond simple MF based interconnection to allow termination of calls in the landline network. Interconnection now allows carriers to provide bearer and supplementary services to each other. It is evolving to the point where interconnection may even be established at the terminal switching equipment. Interconnection will be key in determining what services are offered to the user and which carrier offers those services. Interconnection will play a major role in the development and fulfillment of network alliances.

**P.J. Louis  
Chairman - TIA TR45.2 Working  
Group VII, PSTN/ISDN Interfaces**

## TIA Joint Expert's Meeting on Enhanced Cellular 9-1-1 Service

### The TIA Joint Expert's Meeting on Enhanced Cellular

Emergency Service, held on August 1-5, 1994 was a success, if the number of attendees (68) can be used to judge. We will publish a summary of its conclusions once the report is approved.

## TIA IS-52: The Cellular Dialing Plan Standard

The TIA attempt at standardizing a cellular dialing plan is currently out for ballot as IS-52 Revision A. This standard, if approved without major changes, will contain two major sections; a list of ANI (Automatic Number Identification) II digit codes and a much larger list of recommended dialing patterns (see Table 1).

Standardizing dialing patterns might seem somewhat futile, as whatever issues carriers do not have control over, the North American Numbering Plan administrator clearly does, leaving the TIA in the role of gentle persuader. However, a standardized dialing plan may help the gradual transition of the industry to more consistent dialing methods. There is certainly a motivation, as all carriers want to encourage roamers.

One of the problems with the adoption of a similar dialing plan by all carriers is Equal Access. MFJ-restricted carriers (GTE and most of the RBOCs) must use the preferred inter-exchange carrier of each subscriber when a "1+" long distance call is dialed by a subscriber. Unrestricted carriers (such as McCaw) will choose the interexchange carrier for their subscribers. Whereas the original version of IS-52 went into gory detail about all the many possibilities for handling such calls, Revision A concentrates more on the dialed digits (which are the same in both cases) and the end result (the same in both cases) and less on the intermediate routing (which differs wildly).

### Dialing Patterns

Interesting dialing patterns being proposed in IS-52 Revision A which are not commonly or consistently used are:

- N11 -- PSTN or Cellular Service Code (e.g. 611). Routing is determined by the serving system and treatment may vary from system to system.
- \*N11 - Serving System Service Code. Preferred over N11 for cellular service calls because of more consistent treatment.
  - \*511 Roamer Port (e.g. same as NXX-ROAM).
  - \*611 Cellular customer care.
  - \*711 Roaming assistance.
  - \*811 Cellular business office.
  - \*911 Treat as 911.
- \*FC - Home System Feature Code. These codes are intended to be interpreted by the home system. The problem with this, when the codes are dialed by a roamer, is that many carriers use dialing sequences starting with an asterisk not only for activation and deactivation of features but also for easily remembered speed-dial codes (e.g. \*AAA for road service, \*CG for the coast guard, \*SKI for a snow report, etc.). While feature codes should be handled by the home system, speed-dial codes cannot be. The best compromise is to check for local speed-dial codes and, if none match, then try the home system which will match against its list of feature codes.
- \*\*FC - Serving System Feature Code. It is hard to imagine a cellular subscriber knowledgeable enough to be able to manage features like call forwarding in two places, nor is it clear how practical having feature information stored in a volatile record in a visited system is. But, just in case such super-roamers exist, the double-asterisk dialing prefix is reserved in IS-52-A for control of local system features.
- #XX - Carrier Specific Feature Control. This pattern is reserved for carrier specific features and speed-dial codes. Whether carriers and sub-

scribers will adopt this dialing pattern in practice is questionable, especially as the '#' key is usually seen as a terminator or delimiter in many other systems.

### ANI Information

ANI digits are used to communicate the identification of the party responsible for paying for a call crossing the interface between a cellular switch and another carrier. Because this is an internal interface issue, not visible to subscribers, its presence in a document with subscriber dialing patterns seems incongruous.

ANI includes a 7 or 10 digit billing number and a two digit code giving additional information concerning call treatment and billing:

- 61 The calling party is not authorized for additional services. The ANI may identify the originating carrier and not the specific subscriber.
- 62 The calling party is authorized for additional services such as directory assistance call completion or operator assistance.
- 63 The *called* address is an internal number (e.g. TLDN) and should not be presented to the subscriber (e.g. on a bill).

### Summary

IS-52 is currently out for ballot, and therefore may be significantly changed before it is published. Even when it is published it will not necessarily be implemented by all carriers. Two motivations to increase compliance with IS-52 Rev. A in the future will be the growing complaints of roamers about confusion caused by local dialing idiosyncracies and the participation of carriers in organizations like Mobilink and the North American Cellular Network that may adopt some or all of IS-52 as a condition of membership.

### Back Issues

All our back issues are available by fax or mail. Phone us at 1-800-633-5514 or fax us at 1-403-289-6658 for a complete list of issues, contents and prices.

**Table 1: The Proposed IS-52 Revision A Dialing Plan Summarized**

Call Type	Dialed Digits	Note
Directory Assistance	[1]+[NPA]+555-1212 or [1]+411	A
Emergency Service	911 or *911	
Other Service Codes	N11	B
Cellular Service Codes	*N11	
Home Feature Control	*FC ...	C
Local Feature Control	**FC ...	C
Carrier Specific Feature Control	#FC ...	C
NANP Address	[1]+[NPA]+NXX+XXXX	A,D,E
International Address	011+CC+NSN	E,F
Operator Assisted NANP Address	0+[NPA]+NXX+XXXX	A,D,E
Operator Assisted International	01+CC+NSN	E,F
Long Distance Carrier Cut-Through	10NXX or 101NXXX or [1]+950+XXXX	G
NANP Address, Explicit Carrier	10NXX+[1]+[NPA]+NXX+XXXX or 101NXXX+[1]+[NPA]+NXX+XXXX	A,D,G
International, Explicit Carrier	10NXX+011+CC+NSN or 101NXXX+011+CC+NSN	F,G
International, Explicit Carrier, Operator Assisted	10NXX+01+CC+NSN or 101NXXX+01+CC+NSN	F,G
Local Cellular Operator	0 or *0	
Long Distance Operator	00	E
Long Distance Operator, Explicit	10NXX0 or 10NXX00 or 101NXXX0 or 101NXXX00	G

**Notes**

- A Roamers must dial the area code (NPA) for all calls, 7 digit dialing is not allowed.
- B Service codes may be treated as a cellular service code or local exchange carrier service code, at the discretion of the serving system.
- C A feature control string consists of a 2 digit feature code, possibly followed by modifier digits such as a forward-to number.
- D Special non-geographic area codes include 700, 800, 900 and, in the near future, 500. They may require special treatment and routing.
- E The preferred long distance carrier is used if equal access is supported and IS-41 communications with the home system is available, otherwise the carrier is chosen by the local system.
- F CC = Country Code, NSN = Nationally Significant Number. The total length of CC+NSN must not exceed 15 digits.
- G The long distance carrier is identified by an NXX 3 digit code now (e.g. 288 for AT&T) or by an NXXX 4 digit code in the future.

**Abbreviations**

- N N represents any digit 2 through 9.
- X X represents any digit.
- [ ] Square brackets enclose optional items.

**TR-45.2 Standards Update: TSB-41 and IS-52 Out for Ballot**

**T**IA subcommittee TR-45.2 has released the cellular dialing plan standard (IS-52 Revision A) for letter ballot, while TSB-41, the IS-41 Revision B Technical Notes, is out for a second ballot. IS-52 ballot comments are due by September 16, 1994 and TSB-41 ballot comments by September 1, 1994.

The status of each major outstanding TR45.2 project is listed below:

**IS-41 Rev. A Compatibility (TSB-55, SP-3063) • Published May, 1994.**

**IS-41 Rev. B Technical Notes (TSB-41, SP-2985) • Out for a second ballot.** Comments due by September 1, 1994.

**Cellular Dialing Plan (IS-52 Rev. A, PN-3166) • Out for ballot.** Comments due by September 16, 1994.

**Subscriber Features (IS-53 Rev. A, PN-2977) • “Frozen” until IS-41 Rev. C is ready for ballot.** Some minor changes based on the development of IS-41 Rev. C procedures to support IS-53 features are being incorporated.

**IS-41 Revision C (PN-2991) •** Messages and procedures to support IS-53 Rev. A features are being developed and reviewed. **Balloting is scheduled for October, 1994.**

**International Applications (TSB-29 Rev. B, PN-3173) •** TR-45.2 is studying several problems with international use of AMPS cellular. A TIA Joint Expert’s Meeting (JEM) will be held the week of November 7, 1994 to try to resolve the most urgent problem; ambiguity of international mobile identification. The remaining problems are considered a lower priority and will be **completed in 1995.**

**Online Call Record Transfer (IS-124 Rev. A, PN-3293) •** TR-45.2 is considering revisions to the “DMH” standard for the online transfer of call records for billing, fraud and other purposes. This activity is a low priority and will be **completed in 1995.**

**Subscriber Features (IS-53 Rev. B, PN-3362) •** A list of features is being accumulated for development in Revision B of this standard. Activity beyond this will not proceed until IS-53 Rev. A is approved for publication.

# Status of IS-41 Rev. B Implementation

## Cellular Networking Perspectives

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Vendor1	Vendor2	Status	Date	Type	Location
Alcatel-SEL	Astronet*	Commercial	08/94	H V D S	Mobile, Alabama (BellSouth)
	AT&T	Field Trial	09/94	H+V D S	Orlando, Florida (BellSouth)
	EDS PCD	Commercial	08/94	V D S	Mobile, Alabama (BellSouth)
	GTE TSI	Commercial	08/94	V D S	Mobile, Alabama (BellSouth)
	Motorola	Field Trial	09/94	H V D S	Jacksonville, Florida (BellSouth)
Astronet	Development				
AT&T	Alcatel-SEL	Field Trial	09/94	H+V D S	Florida (BellSouth)
	EDS PCD	Planning		V X	Location not announced
	GTE TSI	Planning		V DXS	Location not announced (BAM)
	NEC	Commercial		H V D S	Brazil
	NTI	Planning		H+V DX T	location not announced
Celcore	AT&T	Lab Trial		V DX	St. Louis, Missouri (SWBMS)
EDS PCD	Alcatel-SEL	Commercial	08/94	V D S	Mobile, Alabama (BellSouth)
	AT&T	Planning		V X	Location not announced
	Motorola	Commercial		V X	Dedham, MA
Ericsson	Motorola	Commercial		V D S	
	NTI	Planning		H VAD S	location not announced
GTE TSI	Alcatel-SEL	Commercial	08/94	V D S	Mobile, Alabama (BellSouth)
	AT&T	Lab Trial	TBD	V DXS	Location not announced (BAM)
	Motorola	Commercial		V DX	Los Angeles & Orlando
Motorola	Alcatel-SEL	Field Trial	09/94	H V D S	Orlando (BellSouth)
	Astronet*	Lab	4Q94	H V D X	location not announced
	AT&T*	Commercial		V D S	Several locations
	EDS PCD	Commercial		V X	Dedham, MA
	Ericsson	Commercial		V D S	Piscataway, NJ (Comcast)
	GTE TSI	Commercial		V D X	Orlando, Florida
	NEC	Commercial		V D S	Brazil
	NTI (MTX)*	Commercial		H V D X	Denver, CO
NTI(800CM)*	Field Trial	07/94	V D X	Raleigh, NC	
NEC	AT&T	Commercial		H V D S	Brazil
	Motorola	Commercial		V D S	Brazil
NTI	AT&T	Lab Trial	TBD	H V DX	Windsor (Bell Mobility)
	Ericsson	Planning		H VAD S	Ft. Myers (Palmer)
	Motorola	Field Trial	TBD	H V D X	location not announced (Sprint)

Explanation: \* Other vendor is using IS-41 Rev. A with TSB-55 for compatibility.  
 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.  
     T Uses TDMA (IS-54) digital mobiles.  
     W Uses CDMA (IS-95) digital mobiles.  
 Location: Location of test and carrier. Usually listed for first trial only.