

# Cellular Networking Perspectives

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

Vol. 4, No. 6 June, 1995

## In This Issue ...

### *Possible TIA TR-45 and TR-46 Reorganization* p. 1

A proposal has been made to reorganize the TIA TR-45 and TR-46 standards committees along ancestral lines instead of radio frequency.

### *New Task Groups in TR-45.2* p. 2

Five new task groups have been created to study major work areas, such as 9-1-1 and the Wireless Intelligent Network. A dormant task group on data transmission has been revived.

### *International Update* p. 2

A description of progress resolving problems with international roaming due to restrictions of the current MIN identifier. The long term solution is the international standard IMSI identifier.

### *TR-45.2 Standards Update: IS-41 Revision C Out For Ballot* p. 4

### *Chair of TR-45.2 Resigns* p. 4

### *TIA TR-45.2 Cellular Intersystem Operations Working Group/Task Group Report* p. 5

## Possible TIA TR-45 and TR-46 Reorganization

Currently the division between the TR-45 and TR-46 standards committees is based on the frequency of operation (800 MHz versus 1800-2200 MHz). Unfortunately, this segmentation makes little practical sense. It has recently been proposed to, instead, split the work along ancestral lines, AMPS based standards in TR-45 and European GSM based standards in TR-46.

Not so long ago the gulf between Cellular and PCS, reflected in the structure of standards committees, seemed huge. Cellular was tarnished by commercial use, concentrating on the mundane features that were both wanted and practical. PCS was the realm of dreamers and philosophers. With no subscribers, it had no limits. Now that the dreamers have moved on, and investors have taken over PCS, it is looking remarkably like cellular. And cellular, by adding more personal features, is trying to look like PCS.

The biggest technological difference between US PCS and US Cellular is, in fact, the invasion of European Cellular, known as GSM (Global System for Mobile Communications). The battle between CDMA, TDMA and GSM proponents at 2000 MHz will be fought on many fields, one of which is the standardization committees.

The benefit of the proposed reorganization will be to reduce the amount of parallel development. If implemented, the reorganization will remove development of the Base Station to MSC "A"

interface for IS-95 (CDMA) PCS from TR-46.2, and keep it only in TR-45.4. The TDMA air interface will only be developed in TR-45.3 and no longer in TR-46.3. Similarly the CDMA air interface will be developed in TR-45.5 and not in TR-46.3. IS-41 and related network standards will only be developed in TR-45.2 and not in TR-46.2.

The most significant remaining area of common development between GSM and the AMPS family of standards will be in the area of I&I (Interworking and Interoperability). The goal of this project is to define interworking between the GSM MAP (Mobile Application Part) and the IS-41 standard for inter-system operations between systems utilizing AMPS air interfaces.

Cynics might see a political motivation in the reorganization. TDMA and CDMA proponents may hope that GSM loses credibility when it is left on its own in a standards committee. This motivation may exist, but it is unlikely to have much impact. GSM standardization may actually proceed faster with more focus.

The fate of TR-46 is not yet resolved, more back room lobbying and open TIA meetings will be required.◊

## How to Subscribe

Phone us at **1-800-633-5514** (toll free) or fax us at 1-403-289-6658. Tell us your name, company, mailing address, type of delivery (fax or mail), phone and fax numbers. We will invoice you for payment by cheque or American Express.

**Next issue due: July 5, 1995**

## Comments Welcome

We welcome comments on the contents and format of this newsletter, suggestions for future topics, letters, submissions and corrections. You may phone in your comments to 1-800-633-5514 (1-403-289-6609) or fax them to 1-403-289-6658.

## New Task Groups in TR-45.2

Five new task groups have been created by TIA subcommittee TR-45.2 to study the 9 CTIA priority features for incorporation in IS-53 Revision B, IS-41 Revision D and other standards. One dormant task group has been revived. A summary of TR-45.2 working groups and task groups is reported on page 5.

### **Emergency Services**

A task group to study enhanced emergency services for cellular systems (Wireless E-9-1-1) has been created with Jeff Crollick, of GTE TSI, as chair. Their task is difficult because the final FCC decision on this issue has not been made. The major areas where improvements are thought to be required, based on two industry Joint Experts Meetings in 1994, are:

- a. Provision of more accurate mobile location to the 9-1-1 call handling Public Service Answering Point (PSAP). Currently, the location of the cellsite is the best information that can be provided.
- b. Provision of subscriber information to the PSAP.
- c. Callback capability from the PSAP to the mobile.

Requirements for this service are defined in more detail in the October, 1994 issue of *Cellular Networking Perspectives*.

### **Law Enforcement Intercept**

A recently signed act of the US Congress (Communications Assistance for Law Enforcement Act) gives law enforcement agencies the power to demand the installation of equipment at cellular switches to deliver intercept information to a central monitoring site. A new task group has been created to develop modifications to IS-53, IS-41 and other standards for this purpose. This group is chaired by Peter Musgrove of McCaw. The law enforcement requirements are summarized in the August, 1994 issue of *Cellular Networking Perspectives*.

## **CDMA Support**

A task group has also been formed to study the support of specific IS-95 Revision A features in IS-41. The group will concentrate on new air interface capabilities required to support the 9 CTIA priority features. This task group is chaired by Sam Broyles of Qualcomm.

### **TDMA Digital Control Channel**

In a parallel effort to the CDMA task group, support for new TDMA capabilities defined in IS-136, related to the new 'digital' control channel, will also be investigated. A purist would note that the 'analog' control channel is also digital. The new control channel defined in IS-136 is actually distinguished by a layered structure that, it is hoped, will ease the addition of new capabilities. This task group is co-chaired by Peter Musgrove of McCaw and Terry Watts of Southwestern Bell.

### **CDMA/TDMA Data Services**

It is ironic that it is more difficult to support the transmission of data on a digital cellular channel than on an analog cellular channel. While data can be transmitted on an analog channel using a regular modem or, for higher performance, a modem supporting special cellular protocols (such as MNP10 or ETC), a digital channel presents two different hurdles to achieve the same capability:

- a. Removing voice coding (i.e. compression).
- b. Connecting the resulting digital stream to a pool of modems before connecting the call through the PSTN to the terminating modem.
- c. Programming the modem selected from the pool.
- d. Dialing the correct digits to set up the call from the modem pool.

The TR-45.2 task group studying this issue, does not have to deal with air interface issues, but with the modem pool, PSTN connection, and with significant problems that occur following an inter-system handoff. The group is chaired by Michel Houde of Ericsson.

## **Wireless Intelligent Network**

The CTIA has a goal of creating a 'Wireless Intelligent Network' (WIN) that would allow services to be defined by carriers without modification to traditional cellular network elements, such as MSCs and HLRs. This is a similar goal to that of the Intelligent Network in wireline systems, although the WIN may be based more on IS-41 than actual IN (or AIN) protocols. A task group to define WIN has been created within Working Group II, with a goal of defining a first generation of WIN protocols to support at least the following features:

- Calling Name Delivery
- Voice Controlled Services
- Incoming Call Control

The task group is chaired by Huel Halliburton of AirTouch.◊

## International Update

Cellular based on the original AMPS air interface has unique problems with international roaming due to the design of the Mobile Identification Number (MIN). This number is 10 digits long, just long enough for the national part of a North American directory number, with no space for a country code. While the latest digital standards IS-136 and IS-95 Rev. A provide for an International Mobile Station Identifier (15 digit IMSI), the many millions of mobiles capable of using only MIN cannot be forgotten.

Despite the hurdles to be overcome, considerable progress has been made recently on several fronts since the TIA International Roaming Joint Experts Meeting held in November, 1994 (see the December, 1994 issue of *Cellular Networking Perspectives*).

### **Adoption of IMSI**

IMSI was adopted as a mobile identifier by the TIA for future cellular standards in February, 1995. Actually, by that time one standard (IS-136) had already been published with IMSI as an alternate identifier from MIN.

IMSI was adopted because it is an internationally recognized standard (defined by International Telecommunications

Union (ITU, previously CCITT) Recommendation E.212). It is already used by the European GSM cellular standard as a subscription identification. More importantly, it contains a country identifier and network routing information. The structure of an E.212 IMSI is:

- MCC** 3 digit Mobile Country Code. Most countries have been assigned 1 code, but the US has been assigned 7.
- MNC** Mobile Network Code. This is variable length and assigned by a national authority.
- MSIN** Mobile Station Identification Number. This is also variable length and assigned by the carrier holding an MNC.

The IMSI structure will obviously allow the home country of any international roamer to be clearly identified. It will also allow routing of signaling messages to the home system to be based on knowledge of the home mobile network.

### IMSI Allocation

The allocation of a Mobile Country Code obviously has to be followed by the assignment of a national Mobile Network Code allocation authority. This is a process that has been resolved by countries using GSM, but that has just started in the USA.

### Allocation in the USA

The current authority for allocation of IMSI codes in the US resides with the Department of State. It is normal for this authority to be transferred to another body if a large amount of allocation activity is going to occur. The wireless industry, represented by CTIA, PCIA and TIA have recently pressed for IMSI allocation authority to be passed to an impartial industry controlled organization.

The timing of the move is critical, as the State Department has recently assigned the first two Mobile Network Codes (MNCs) to MCI and APC. The State Department's allocation scheme assumed that only PCS carriers would require this resource. Their mixture of 2 and 3 digit MNCs would provide only 2,500 MNCs, not enough for all PCS, Cellular, Satellite and ESMR licensees.

### Number of IMSI Blocks in USA

The number of IMSI blocks needed will likely be close to the number of wireless licenses awarded. While the number of companies owning licenses will be much smaller, not keeping IMSI separate for each license would require re-programming phones or SIM cards with a new IMSI whenever a license is sold or traded. The number of wireless licenses known today are:

Service	Licenses
PCS	2074
Cellular	1586
ESMR	> 50
Satellite	> 4
Total	> 3714

The number of distinct IMSI blocks available in the USA depends on the length of the MNC (assuming that the current assignment of 7 MCCs does not change):

MNC Length	Number of Blocks
2	700
3	7,000
4	70,000

The use of 3 digit MNCs appears most reasonable, resulting in about twice as many codes as needed today. 4 digit MNCs appear to violate the spirit of the E.212 recommendation and may be impossible to implement in GSM phones (see below). The use of 2 digit MNC's will not provide enough blocks of IMSI identifiers.

### AMPS Cellular Compatibility

IMSI is certainly the long term solution to international roaming problems, however, no existing cellular phones have an IMSI capability. Base station equipment also does not currently support IMSI, and may take a long time to be fully upgraded. Consequently, systems will have to take account of cellular phones that contain only a MIN, and cellular phones with IMSI capability will have to also contain a MIN for use on systems without IMSI.

### GSM MNC Problem

GSM, developed in a European environment, uses IMSI, but restricts a MNC to 2 digits. Allowing 3 digit MNCs would be a relatively simple, as the SIM

card actually has one spare digit whenever an MCC/MNC combination is stored. Moving to 4 digit MNCs would require a major reorganization of the SIM card, making US SIM cards incompatible with European GSM.

GSM systems use the MCC/MNC combination transmitted by each base station to determine whether a mobile is in a preferred or forbidden system. The other use of IMSI, to identify the phone, makes no assumptions about the length of the MNC.

A transitional allocation scheme may be possible, such as allocating GSM systems 3 digit MNC codes ending with the digit 0 to give US GSM standards and systems time to be updated.

### Mexican Problem

A problem is looming in international cellular roaming between Mexico and the North American Numbering Plan (NANP) countries (US, Canada and the Caribbean). Mexican phones are currently programmed with a MIN with the first two digits being 52 (the Mexican wireline country code). The NANP just released the 52X area codes for assignment this year, with 520 already being allocated to Arizona (uncomfortably close to Mexico!). Luckily, Mexican phones never have 0 as the third digit.

A single MIN may have 3 plausible interpretations, with no indication of which is intended:

- a. NANP interpretation, format NPA-NXX-XXXX. This is used by all cellular phones with a home system in the North American Numbering Plan area.
- b. E.212 interpretation recommended in TIA TSB-29, format MCC-N-XXXXXX (where N is a 1 digit MNC). It is not known how extensively this format is used.
- c. E.164 interpretation, as used in Mexico, format CC-XXXXXXXX, where CC is the variable length country code (e.g. 52 for Mexico).

Since this problem was noticed by Mexican carriers, there have been two meetings, in February and May, 1995 including representatives of the CTIA, Mexican carriers, US carriers and equipment manufacturers. The solutions proposed at these meetings have been divided into short term, mid term and long term:

#### Short Term: Hold 52X Codes

The NANP administration and the Industry Numbering Committee (INC) have agreed to hold back all remaining 52X codes for allocation until 1997. Even after allocation, a year or two may pass before assignment actually begins.

#### Mid Term I: Double Dipping

The mid-term solution proposed at the February meeting was to query the two, or possibly three, HLRs that a MIN might belong to. The ESN could be used to determine which is the correct HLR.

#### Mid Term II: Non-dialable MINs

At the May meeting, the Mexican carriers proposed that, instead of multiple HLR queries, they would prefer to reprogram all their phones to use MINs that start with '05' instead of '52' to form a non-dialable NANP number. A drawback with this proposal is that some non-dialable MINs are already in use within the NANP for special services, and there is no allocation authority, although Cibernet does publish reported use of non-dialable MINs.

#### Long Term: IMSI

The long term solution is the use of IMSI, as described above. This may not eliminate the mid-term solution for a long time unless carriers are willing to replace all phones of those that want to roam internationally.

### Summary

The migration from MIN to IMSI will facilitate roaming between countries and between different wireless modes, but the transition will not be quick or painless. IMSI will be supported in GSM and AMPS cellular and PCS systems and some ESMR and satellite systems, where it should allow a single subscription to be used in multiple different phones. However, for the 25 million AMPS cellular phones in the US and the millions of others worldwide, more complex and less complete solutions will have to do.

### Continued...

In the next issue we will discuss the evolution of international SS7 network support for wireless systems.◊

### ***TR-45.2 Standards Update: IS-41 Revision C Out For Ballot***

The oft delayed Revision C of IS-41 is finally out for ballot. It was distributed to members of the TR-45.2 subcommittee on May 15th, 1995, with ballot responses due back by July 3rd.

The status of each major outstanding TR-45.2 project is listed below, in approximate order of completion:

**Cellular Dialing Plan (IS-52 Rev. A, PN-3166) • In Press.** ANSI ballot is being arranged, with only minor modifications from the TIA published version.

**Subscriber Features (IS-53 Rev. A, PN-2977) • In Press.** ANSI ballot is being arranged, with only minor modifications from the TIA published version.

**IS-41 Revision C (PN-2991) • Out for ballot.** Ballot responses are due back by July 3, 1995.

**International Applications (TSB-29 Rev. B, PN-3173) •** TR-45.2 WG VI is studying the implementation of E.212 mobile identification, international SS7 global title translation requirements and other issues, for incorporation in TSB-29 Revision B, scheduled for ballot in January, 1996.

**Multiple HLR Queries (PN-3528) •** This project will study the requirements for determining the home system of a mobile with an ambiguous MIN through multiple queries to the 2, or possibly 3, candidate HLRs. The urgency of this project may be reduced if cellular carriers in Mexico and other countries choose to implement other solutions (see articles on International Roaming, this issue). Currently, this project is scheduled for completion in September, 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. A number of deficiencies have been identified by those companies attempting to implement the originally published standard. This revision is scheduled for ballot in 1Q'95.

**Subscriber Features (IS-53 Rev. B, PN-3362) •** The CTIA list of 9 priority features will form the basis for additions to IS-53. Separate projects have been created for detailed examination of several of the features. Balloting is scheduled to start in January, 1996.

**IS-41 Rev. D (PN Pending) •** Ballot is scheduled for January, 1996.

**Interconnection (IS-93 Rev. A, PN-3295) •** Balloting is scheduled to start in November, 1995. No changes have yet been proposed.

**Emergency Services (PN pending) •** A new task group will study the changes to IS-53, IS-41, IS-93 and IS-124 to support enhanced wireless emergency services (i.e. 9-1-1).

**Law Enforcement Intercept (PN pending) •** A new task group will study the changes to IS-53, IS-41, IS-93 and IS-124 to support US law enforcement requirements for lawfully authorized interception of cellular phone calls (aka "wireless wiretap").

**Wireless Intelligent Network (PN pending) •** A new task group will study the changes to IS-53, IS-41, IS-93 and IS-124 to support the wireless intelligent network.

**Network Support for CDMA (PN pending) •** A new task group will study the changes to IS-53, IS-41, IS-93 and IS-124 to support the features of the IS-95 Revision A standard for a second generation CDMA air interface.

**Network Support for TDMA (PN pending) •** A new task group will study the changes to IS-53, IS-41, IS-93 and IS-124 to support the features of the IS-136 standard for a TDMA air interface incorporating the so-called Digital Control Channel.

**CDMA/TDMA Data Support (no PN) •** A long dormant task group will study changes to IS-41 required to support digital cellular data services.◊

### ***Chair of TR-45.2 Resigns***

John Marinho, the chairman of TIA sub-committee TR-45.2 since 1989, recently announced his resignation. He will continue as chairman of the TR-45 committee. It is expected that the current vice-chair of TR-45.2, Cheryl Blum, also of AT&T, will be elected in his place.

WG	TG Mandate	Chair	PN	Document	Editor
Plenary	Cellular System Operations	John Marinho (resigning) Cheryl Blum (vice-chair)			
	<b>1 Enhanced 9-1-1 Service</b>	<b>Jeff Crollick</b>	<b>n/a</b>		
	<b>2 Law Enforcement Intercept</b>	<b>Peter Musgrove</b>	<b>n/a</b>		
I	Stage I Development (User Perspective) <i>(previously WG V)</i>	Terry Watts	3362	Cellular Features Description (Rev. B)	Terry Watts
II	Stage II Development (Network Perspective) <i>(previously WG II and III)</i>	Cheryl Blum	2991	IS-41 Rev. C	Terry Watts
			n/a	IS-41 Rev. D	Terry Watts
	<b>1 IS-41 Test Plan</b>	Kirk Carlson	-	TSB-56 Rev. B	David Crowe
	<b>2 Data Services</b>	<b>Michel Houde</b>	-		
	<b>3 TDMA (IS-136) Support</b>	<b>Peter Musgrove</b>	<b>n/a</b>		
		<b>Terry Watts</b>			
	<b>4 Wireless Intelligent Network (WIN)</b>	<b>Huel Halliburton</b>	<b>n/a</b>		
	<b>5 CDMA (IS-95-A) Support</b>	<b>Sam Broyles</b>	<b>n/a</b>		
III	Stage III Development (Encoding & Procedures) <i>(previously WG I)</i>	Charles Ishman	2991	Cellular Radio Tele- communications Inter- system Operations (IS-41-C)	Terry Watts
			n/a	IS-41 Rev. D	Terry Watts
IV	Message Accounting	John Willse	3293	Cellular Inter-System Non-Signaling Data Communications (IS-124-A)	<b>Huel Halliburton</b>
V	<i>inactive</i>				
VI	International Applications	David Crowe	3173	International Imple- mentation of Cellular Radiotelephone Systems Compliant with ANSI/ EIA/TIA-553 (TSB-29-B)	Steve Jones
				<b>3528 Multiple HLR Query</b>	<b>Terry Jacobson</b>
VII	Interfaces to Other Telecommunications Networks	P.J. Louis	3295	Ai and Di Interfaces Standard (PSTN/MSC) (IS-93 Rev. A)	

- Notes:**
- n/a - PN not assigned by TIA yet.
  - WG - Working Group number (assigned by TIA TR-45.2 sub-committee).
  - TG - Task Group or Ad Hoc Group number.
  - PN - Project Number (assigned by the TIA).