

Cellular Networking Perspectives

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TR46 and TR45.4 Projects: PCS Networking Standardization

TR-45.4 and TR46 are the other standards groups in the TIA with responsibility for networks to support mobility, outside of TR-45.2. The TR-45.4 sub-committee has responsibility for the development of Micro-Cell and Micro-System standards in the 800 MHz band, a mandate that has recently been stretched to encompass at least the preliminary stages of development of a general purpose BSC/MS "A+" interface. TR-46 has responsibility for all aspects of PCS standardization in the 1800-2200 MHz band, a responsibility that is uneasily shared with the ECSA (Exchange Carriers Standards Association) T1 committees through a Joint Technical Committee (JTC).

The projects undertaken by TR45.4 and TR46 are listed on page 5 of this issue.

She has a Bachelor's degree in Computer Science and a Masters in Information and Communications Science.

Arzu's priorities for WG VI in 1994 are to complete the development of IS-41 Rev. C modifications to support extended (15 digit) mobile identification. She hopes that a March TIA Joint Experts Meeting on network and air interface interactions that will address this issue will help in this effort. A secondary priority is Revision B of TSB-29 which encompasses all issues concerning use of TIA cellular standards outside North America. TSB-29-B is scheduled for completion in 1995.

IS-41: The Networking Standard for PCS

This article is an edited version of a talk given by David Crowe at the Wireless World '93 conference, sponsored by Cellular Business, in Orlando on November 3rd, 1993.

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TR45.2 International WG VI - Musical Chairs

TR-45.2 Working Group VI on international issues now has its third chairperson in about a year due to the recent resignation of the second chair, Kimberley Harris, from Ericsson. Replacing her is Arzu Çalis of BNR.

Arzu has represented BNR at the TIA TR-45.2 meetings for 2 years. Before that she worked in the areas of corporate network design, AIN and ISDN protocols on the NTI DMS 250 switch.

Lessons for PCS Developers

Cellular has succeeded in North America because of standardization. Subscribers to cellular systems can use one phone and one number to roam virtually anywhere in the US and Canada that has coverage. Compatibility, interoperability and seamlessness have been more than words. PCS must also standardize to succeed.

The development of standards for the increasingly seamless cellular network has not been without

problems. Most of these problems will also exist in PCS standardization, and several new problems will also be encountered.

PCS cannot attract customers without networking standards that promote seamlessness. Since PCS does not have the time to reinvent the wheel, the only mobile communications models worthy of emulation are North American AMPS cellular or GSM. Given the reluctance of the US to adopt European standards, I have concluded that PCS vendors and carriers will use AMPS cellular networking standards, particularly IS-41.

Problems in Cellular Standards Development

The history of cellular standards development illustrates several areas where problems in PCS can be avoided:

- Coordination between air interface and network standards developments groups.
- Building to end-user goals and not to internally generated goals.
- Adaptability to regulations, such as equal access.
- Advance planning based on the long lead time of past standardization efforts.

It might already be too late to prevent fragmentation in PCS and the negative consumer perception that will bring.

Coordination of Standards Groups

Some of the most serious problems in the cellular industry have their roots in the lack of coordination between air interface and network standards committees. An analysis of these problems is an object lesson for those trying to standardize in PCS.

Border Cell problems result in the mishandling of calls on the boundary between two cellular systems. These problems were created because the original analog cellular air interface was designed without proper consideration for networking issues. While this was excusable in

the infancy of the industry, the lack of a full solution 10 years later is not.

Fraud in analog cellular is an immense and still growing problem. Several years ago, during the development of the IS-54 TDMA digital cellular standard, it was recognized that a more sophisticated method than MIN/ESN validation was required. But the CTIA and TIA proceeded in their development of only a highly complex long term solution. It should not have been necessary to have 13 million analog mobiles in the field without adequate protection against fraud before the publication of an upgraded analog standard.

International Roaming Problems arose from the success of AMPS outside North America. Since the original standards were developed with only North American 10 digit phone numbers in mind AMPS mobiles cannot roam between countries without the danger of conflict between mobile identification numbers. A phone from Oregon might be indistinguishable from a phone from El Salvador, for example. A solution requires coordination between the TIA air interface and network sub-committees responsible for cellular. Although the problem has been recognized for several years little progress has been made toward a solution.

The lesson for PCS is to ensure continuous and meaningful coordination between air interface and network standards groups.

Consistency with Landline Phones: A Distracting Goal

Consistency between cellular and landline phone service has always been an accepted goal of cellular network standards groups. An example is the analogy drawn between a hookflash on a landline phone and the SEND button on a cellular phone when used to control a three-way call. A problem occurs with this analogy because the hookflash must always come *before* digits on a landline phone

Back Issues Available

Back issues are available from July, 1992 to the present. Articles in recent issues are:

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•Wireless Terminal Location Management, Part II• TR-45.2 Grows More Tentacles•TR-45.2 Continues to Pump Standards Out.

August, 1993

Bellcore Relinquishes Control of the NANP•Smart Cards, Dumb Phones?• A+ Interface Looks for a Home•Wireless Terminal Location Management Part III - Lessons for PCS•Goldilocks and the Three IS-41 Addressing Types

October, 1993

FCC Allocates PCS Frequencies•IS-53 Revision A, Part I - Cellular Feature Overload• Taking MINs to the Max - Problems with International Roaming•TIA TR-45.2 Project Status Report.

November, 1993

IS-41 Rev. A Compatibility Guidelines•IS-93: Timely or Time Bomb?• IS-53 Revision A, Part II - More Cellular Features•Status of IS-41 Rev. B Implementation.

December, 1993

IS-53 Revision A, Part III - The Last of the Features(?)•Summary of Features to be Included in TIA IS-53 Revision A•Structure of TIA Mobile & Personal Communications Committees •Status of IS-41 Rev. A Implementation.

January, 1994

TR46: PCS Civil War•IS-53 Revision A, Part IV - Our Perspective on Features•TR-45.2 Standards Update•Structure of TIA Committee TR46: Mobile & Personal Communications 1800 MHz "PCS" Standards•TIA TR-45.2 Project Status Report.

The price of a back issue is, by mail or fax is:

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US\$30 Other Countries

and SEND must always come *after* digits on a cellular phone. Amazingly, although complete consistency is obviously impossible to achieve, that has not stopped the expenditure of resources and time in an effort to make cellular phones more difficult to use!

In another example, the TIA initially came out with an excellent scheme for activation codes for features such as call forwarding. But when the Bellcore NANPA pointed out that the codes were not consistent with the wireline network, the cellular industry backed down. That cellular had a better scheme was ignored. Even now, feature activation codes have not been standardized where differences exist with Bellcore.

The unanswered question for PCS is: How many cellular subscribers want their phone that looks different, feels different and is in many ways superior, to be dumbed down to act like their landline phone?

Equal Access and Other MFJ Issues

PCS and other forces may cause radical changes in the application of MFJ restrictions. If PCS providers avoid MFJ restrictions entirely, MFJ-restricted cellular carriers will cry foul. However, if all wireless carriers are relieved of this burden, inter-exchange carriers will gradually be eliminated and both they and the local exchange carriers will cry foul.

The only viable solution is to apply equal access to all telecommunications service providers and eliminate other MFJ restrictions.

Time from Concept to Standard

Sausages and standards have at least one thing in common; Nobody who enjoys the end product should watch them being made.

There are many ingredients that go into a well spiced standard. It is easy to overlook the impact of individual people, and their workload in the standards committees and

within their own company. But, without skilled people with the time and support to focus on high priority standards, standards setting *can* fail the industry.

Build on the Good Cellular Standards

Cellular standards are not perfect, but they cover the most important areas and are customized for the North American business, legal and regulatory environment:

- IS-53 reflects the rich set of features demanded by fussy North American consumers.
- IS-52 reflects the influence on cellular dialing plans of both the unique North American dialing plan and Equal Access restrictions.
- IS-41 provides for mobility and seamlessness between systems while supporting many features and also MFJ regulatory restrictions.
- The CIBER and IS-124 billing standards reflect the large number of cooperating carriers and the high incidence of roaming.
- Air interfaces, such as IS-54 TDMA, IS-95 CDMA and IS-88 NAMPS support high density use, reflecting the incredible success and market penetration of cellular in North America. Yet all standards provide compatibility with EIA/TIA-553, preventing obsolescence of subscriber equipment.
- IS-93 is an assertion by cellular carriers that they are peers of the other telecommunications service providers.

GSM may have an equally complete set of standards, more complete in some areas, but it is not customized for the North American market, nor do existing GSM systems support anywhere near the same number of subscribers as AMPS systems in North America.

Capabilities Supported by IS-41

The history of the development of the IS-41 intersystem operations standard exhibits the depth of experience in mobility management that the cellular industry has gained. Not only does IS-41 span many functional areas (handoff, call delivery and validation), but there are many layers of experience built on each functional area to support multiple air interfaces, border cell problems, enhanced fraud protection and MFJ regulations. Many issues that were insignificant when AMPS cellular was first being developed, such as automatic roaming and fraud, grew to become significant. Because of the number of challenges that have been overcome by cellular, the PCS industry is going to have a hard time competing if it starts at the beginning again.

What is PCS Anyway?

I close with some tongue in cheek re-definitions of the acronym PCS:

PCS = *Prettypmuch Cellular Services*

PCS services will look much like cellular: untethered voice services will dominate.

PCS = *Plagiarizing Cellular Standards.*

PCS will need standards. Successful PCS service providers will base their standards on IS-41 and other TIA cellular networking standards.

PCS = *Priority: Coordination of Standardization*

PCS is not radio, it is mobility. Mobility demands a network as well thought out and as sophisticated as the radio access methods. If the network and air interface standards groups work in isolation, as cellular did in the early days, many avoidable problems will be created.

PCS = *Pleasing Customers for Success*

Like cellular carriers, PCS service providers will discover that they have to cooperate with their competitors in order to grow the entire

industry. Competition must not be destructive.

Postscript

In the few months since this talk was presented the confusion in the emerging PCS industry remains. With MCI's announcement of support for GSM, the situation is even more confused and fragmented. The standards committees are still fighting between themselves and within each committee. The Clinton administration will have to choose whether to allow market forces to prevail, which could cause several years of chaos similar to the situation after airline deregulation, or whether to mandate a single standard before issuing any licenses.

In the cellular industry cooperation between air interface and network standards committees continues to improve, albeit slowly. The Joint Experts Meeting scheduled for the week of March 21st is an important step. Topics to be discussed include:

- **Border Cell Issues**
Border cell problems should be eliminated by the air interface and not patched over by complex, inefficient and expensive network messaging.
- **Extended Mobile Identification**
International roaming of AMPS compatible mobile requires more than 10 mobile identification digits.
- **Short Message Service**
Network services must be matched with air interface capabilities.
- **Emergency Services (911)**
More accurate location information is required for 911 calls, as well as the ability to keep a cellular phone in an emergency call.
- **IS-53 Rev. A Features.**
Several features defined in the upcoming revision A of IS-53 will require support in air interfaces, including Priority Access and Channel Assignment, Calling Number Delivery, Distinctive Alerting and Message Waiting Notification.

Comments Welcome

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

TR-45.2 Standards Update

TR-45.2 has published its work plan for 1994, focussing on the IS-52 dialing plan standards, the IS-53 features standard and Revision C of the IS-41 inter-system operations standard. After publication as a TIA standard, all three documents will be balloted as ANSI standards for the first time.

The status of the major outstanding TR-45.2 projects follows:

IS-41 Rev. A Compatibility (TSB-55, SP-3063) • Procedures to allow IS-41 Rev. A implementations to be forward-compatible with Rev. B. This document was balloted a second time to decide compatibility issues of the SS7 SSN (Sub-System Number) parameter. Ballot comments will hopefully be resolved in February, allowing the TSB to be approved for publication.

Border Cell TSB (SP-2910) • The draft document to resolve several problems that occur on the border of cellular systems is out **for second ballot**. Ballot comments will be reviewed at the February TR45.2 meeting.

IS-41 Rev. B Test Plan (TSB-42, SP-2978) • An application level test plan for IS-41 Rev. B, IS-53 Rev. 0 and TSB-51 is **out for ballot as TSB-42**. Ballot comments will be reviewed at the March TR45.2 meeting.

IS-41 Rev. B Technical Notes (TSB-41, PN-2985) • Will resolve several ambiguities in IS-41 Rev. B that have been detected as incompatibilities between different implementations of IS-41 Rev. A. This document is **scheduled for ballot in March**.

Cellular Dialing Plan (IS-52, PN-3166) • IS-52 requires major revisions, yet the purpose of the document is not clear. Recognizing this, TR-45.2 is discussing how best to revise it. It is recognized that IS-52 should be published at approximately the same time as IS-53 as it recommends a subscriber feature dialing plan. **Balloting is scheduled for April**.

Subscriber Features (IS-53 Rev. A, PN-2977) • Descriptions of all features have been accepted as baseline text. **Balloting is scheduled for May**.

IS-41 Revision C (PN-2991) • A baseline draft of this major revision to IS-41 has been developed, but many procedures, messages and parameters remain to be defined. Most of the remaining work will be in incorporating the new IS-53 Rev. A features and supporting extended 15 digit mobile identifications to facilitate international roaming. **Balloting is scheduled for July**.

International Applications (TSB-29 Rev. B, PN-3173) • TR-45.2 is studying several problems with international use of AMPS cellular. This is considered a low priority project and will be **completed in 1995**.

Online Call Record Transfer (IS-124 Rev. A, PN-3293) • TR-45.2 recently opened this new project number to revise the just published "DMH" standard for the online transfer of call records for billing, fraud and other purposes. This activity is considered a low priority and will be **completed in 1995**.

Digital Cellular/CDPD/PCS Course

The Wireless Institute of Technology is presenting a 2 day seminar entitled *Digital Cellular Technologies, CDPD and PCS System Design & Planning* on February 28th - March 1st, 1994 in San Diego, California. The seminar will concentrate on different digital technologies used in PCS systems and design methods and tools for PCS system planning. For more information call 1-800-484-9873 ext. 9724 or fax 1-510-490-6459.

TIA TR-46 Committee Public 1800 MHz PCS Project Status Report

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Active TR46 Projects (PN=TIA Project Number)

PN	Title	Editor	TR46.	IS/TSB
3167	System Requirements for 1800 MHz PCS	Steve Jones	TR46.1	<i>internal</i>
3168	PCS Service Descriptions	Steve Jones	TR46.1	IS-104
3169	Network Reference Model	Vera Kripalani	TR46.1	<i>internal</i>
3211	Network Interface (based on TR45.2 IS-93)	P.J. Louis	TR46.2	
3212	Intersystem Operations - IS-41 MAP based	P.J. Louis	TR46.2	
	- GSM MAP based	Eric Figueras	TR46.2	
---	Radio System - PCSC (A) Interface Requirements for 1800 MHz	Steve Jones	TR46.1	<i>internal</i>

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TIA TR-45.4 Subcommittee Public 800 MHz PCS/Microsystems Project Status Report

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Projects in Ballot Process (SP = Standards Proposal Number)

SP	Title	Editor	WG	IS/TSB
3034	PCS Service Description	Steve Jones	I	TSB-104
3165	Mobile Station - Land Station Compatibility Specification for Analog Cellular Auxiliary PCS (CAPCS)	Bill Litzinger	III	IS-94

Active TR45.4 Projects (PN=TIA Project Number)

PN	Title	Editor	WG	IS/TSB
3141	Definitions and Acronyms Document (being moved to TR45)	Steve Jones	I	TSB-59
3158	Microsystems (A2 Interface)	Steve Jones	III	IS-
3277	Cellular Microcell/Microsystems Requirements Document (CMMRD) Rev. A	Steve Jones	III	<i>internal</i>
3296	MSC-BS Interface (A-Interface) Requirements for Public 800 MHz	Mike Burke	II	<i>internal</i>