Cellular Networking Perspectives

Editor David Crowe • Phone 403-289-6609 • Fax 403-289-6658 Vol. 2, No. 5 May, 1993

In This Issue ...

A noticeable trend in the cellular industry is the invention of new suites of services for niche markets, controlled by entrepreneurial companies, but relying on the cellular network for coverage and seamless roaming. In particular, this issue will discuss how the separation of HLR functionality from cellular call processing is critically important.

An updated IS-41 Rev. A implementation status is included this month on Page 5. Later onPage 1 we discuss some reasons why Rev. B field trials have not started yet.

NovAtel MTSO's were very common in small and medium sized cellular systems not long ago, but nothing is heard of them now. Has the equipment disappeared? The answer to this mystery is given on Page 2.

A new report in this edition, on Page 4, is a list of all documents that have been published by TIA sub-committee TR45.2, and those that are still being developed by it. This report complements our regular discussion of the status of all documents currently under development by TR45.2. To obtain published TIA standards contact *Global Engineering Documents* at 1-800-854-7179.

A new standard for the online transfer of call detail records, known as the *DMH* standard may have a big impact on the industry (particularly if all 600 pages are dropped on your toes). We outline this standard on Page 2 and discuss some of the uses of the call information that it deals with.

We conclude our discussion of the Working Groups of TIA sub-committee TR45.2 with a look at WG VII. This group, created in 1992, has the politically charged mandate to study interconnect between cellular systems and other telecommunications networks, such as the PSTN.◊

Where are the Rev. B Trials?

IS-41 Rev. B was published less than a year after Rev. A, yet considerably more than a year after the first Rev. A trials there is still no sign of Rev. B lab trials, let alone field trials. There are several reasons for this, the most important being the slowness of TR45.2 to finalize two documents resolving IS-41 incompatibility problems. A lesser reason is the lack of a burning need for IS-41 Rev. B features. The need for path minimization handoff has not yet been realized, and support for intersystem handoff of 3 party calls is not high on the priority list of carriers. The most important feature in Rev. B, SS7 Global Title Translation, can be implemented on IS-41 Rev. A systems.

The first of the two missing documents describes IS–41 Rev. A forward compatibility guidelines. These guidelines are required because most implementers, following their natural instincts, discard incoming messages that contain unrecognized parameters. This will result in the loss of any messages modified in IS–41 Rev. B and needs to be rectified before the first Rev. B systems can be turned up. The model for these compliance guidelines is IS-41 Rev. B. Unfortunately, imperfections in those guidelines have been found under close scrutiny.

The second document required for IS-41 Rev. B trials will resolve ambiguities in the standard that can result in incompatibilities between different implementations of the *same* revision of IS-41. This document, *IS-41 Rev. B Technical Notes*, is close to completion and also high on the priority list of TR45.2.

IS-41 Rev. B lab trials will begin soon after these documents are released, as most vendors have Rev. B under development, if not already completed.

An IS-41 Rev. B status list will be published in this newsletter once dates for the first lab trials are announced. Currently it is known that both Ericsson and AT&T are discussing lab and field trials with NTI. A new vendor, Alcatel-SEL, provider of switching equipment for the Hughes GMH-2000 cellular system, is discussing a field trial with GTE.◊

IS-41 Enables Innovation

Several new companies are illustrating that the cellular network can be an enabler of innovation, allowing wireless services to reach significant new markets, by building on the cellular industry's coverage, network and IS-41 roaming capabilities.

One example of this phenomenon is Aircell of Dallas which is planning to provide cellular service to unscheduled aircraft using standard cellular mobiles in planes, directional antennas pointing upward from selected cellsites and an IS-41 connected HLR for their subscribers. This will provide convenient and relatively inexpensive phone service for pilots in small aircraft.

The infrastructure requirements are low because equipment can be installed in existing cell sites and the cells are large because the upward pointing antennas create large cells. The large, directional cells also keep the number of handoffs to a manageable level. IS-41 is critical to this systems as airplanes will roam and perform intersystem handoff at a much higher rate than normal traffic.

Highway Master is hoping to service a different, but also highly mobile and communication dependent market segment: long haul truckers. This

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company is relying completely on the existing cellular infrastructure to provide coverage over most of the USA. They have designed a custom HLR to provide for origination and call delivery of both voice and data calls, and location information. IS-41 protocols are critical to allow the centralized control of subscribers and their trucker specific services while utilizing the immense infrastructure of cellular systems. While location tracking could be provided more accurately by other systems, only the cellular industry can support a complete suite of services economically and just about everywhere.

AccessLine is providing personal Single Number communications services by coordinating cellular phones, voice mail, pagers and wired phones used by a single subscriber. Subscribers can specify the circumstances that will result in termination to each terminal and let the Access Line system terminate calls to the right place by acting as an Intelligent Network (AIN) peripheral to the PSTN and as an HLR to the cellular network.

Several companies, such as GTE TSI, EDS PCC and Coral Systems provide somewhat more traditional HLR's that use proprietary software to track the flow of IS-41 messages for each subscriber to enhance the basic fraud detection capabilities of an HLR.

There are several aspects of the cellular network that have helped to facilitate this entrepreneurship, and that will enable even more new business opportunities in the future:

- Coverage. Over 90% of Americans are in range of a cellular system.
- Connectivity. The IS-41 network can provide subscriber validation, location tracking and custom feature management anywhere a subscriber roams.
- Architecture. IS-41 HLR technology allows centralized management of subscriber services, while allowing access to those services over the entire network.
- Competition / Cooperation. Cellular carriers want to attract the airtime of new market segments. If entrepreneurs are seen as competitors for subscribers, the airtime that they can generate will just move to the true competition of each carrier; the other band.
- Standards. Without a standard air interface (EIA-553) and standard networking (IS-41), providing services to most market niches would simply be uneconomical.◊

A DMH by any other name would weigh as much ...

The *DMH* standard being developed by WG IV of TR45.2 is intended to bring cellular billing into the 21st Century. Currently billing technology is still rooted in the 1960's. MSC billing tapes are often still shipped to a billing center, resulting in long delays between the time of a call and the time of billing. These delays reduce the usefulness of the information for time critical activities such as fraud detection.

The name first chosen for this standard: DMH (Data Message Handler) indicates the vagueness of requirements in this area. It is recognized that Call Detail Records can be used for fraud detection as well as for billing but since there are other functions that require Call Detail Records, it is difficult to limit the information that might be required, or to accurately define the network elements that receive and process the information. The authors of the standard have recognized this, humourously defining the job of the DMH as "moving stuff between things". Their solution has been to allow almost any event, and any data related to that event, to be transferred, relying on the marketplace to decide what will actually be used.

The following uses for Call Detail Records are known, others will certainly follow:

- Reducing the billing cycle.
- Near real-time billing services, such as required by rental phones.
- Auditing call detail collection.
- Revenue settlement between systems.
- Fraud detection.

The DMH standard defines five types of records:

- Audit record. A single summary record for each call.
- Leg record. One for each leg of a call (e.g. origination, termination, call forwarding).
- Segment record. One for each facility used in a call (trunk or transceiver).
- Activity record. One for each subscriber initiated activity, such as registration.
- Event record. One for each system initiated activity, such as a time change.

Speed of delivery is a major concern in the DMH standard. While real-time transport of all call detail records would not be possible or needed, delivery of at least some records within a few seconds is necessary. The baseline text for the DMH standard defines a *timing budget* to ensure that timing requirements are met regardless of the number of network elements involved in a call.

It is not likely that all the information that could be generated actually will be; the cost would simply be too high. Initial implementations of the DMH will provide a subset satisfying the immediate needs of the industry, with more exotic functions included later, if needed. The entire standard may never be completely implemented, but it is unlikely that any need not covered by the standard will ever be discovered!◊

What Happened to NovAtel?

NovAtel systems were very common in small and medium sized cellular service areas in the US until about a year ago. The company also participated actively in IS-41 Rev. 0 trials. In contrast, you may have noticed NovAtel's absence from the IS-41 Rev. A field trial list. The answer to this disappearing act is that, although NovAtel Communications Ltd. still exists, its MTSO technology was sold to Northern Telecom.

Back Issues Available

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

September, 1992
North American Numbering Plan changes, Part I.

October, 1992
North American Numbering Plan changes, part II.

November, 1992
Inter-System Handoff, part I - Handoff Forward/Back.

December, 1992
Inter-System Handoff, part II - Path Minimization.

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. IS-41 Rev. A Field Trials

April, 1993
IS-41 in Summary.

The price of a back issue is:

CDN$25	Canadian fax number
US$25	US fax number
US$30	Other fax numbers

Subscribers may fax requests for back issues and be invoiced later.

Northern Telecom is not actively marketing the product but are still supporting installed equipment. Their support includes participation in at least one IS-41 Rev. A field trial, with AT&T. Further information on the status of the ex–NovAtel MTSO can be obtained from Northern Telecom◊

TR45.2 Progress Report

There are several standards documents currently under development by the TIA TR45.2 sub-committee responsible for standardization of non-radio cellular interfaces. The status of the most important unpublished documents at the conclusion of the May TR45.2 meeting are listed below. See Page 4 for a reference list of published and in-progress documents:

IS-41 Rev. B TechNotes • Will resolve several ambiguities in IS-41 that have resulted in incompatibilities between implementations of IS-41 Rev. A. All open issues have been resolved by a WG II task force. The list of decision points will be compiled by WG I for publication as *TSB–41*.

Rev. A Compatibility • Procedures to allow IS-41 Rev. A implementations to be forward-compatible with Rev. B. Remaining open issues are being resolved by WG II. The document will be published as *TSB-55*.

Border Cell • The draft document to resolve several problems that occur on the border of cellular systems is being reviewed by WG I. These extensions to IS-41 will be published as *IS-87*.

IS-41 Rev. B Test Plan • An application level test plan for IS-41 Rev. B is being developed by a WG II task force. The first draft has been reviewed. All comments will be incorporated into a second draft available in June. The test plan is scheduled for publication as *TSB-42*.

IS-41 Revision C • Most of the work on this revision to IS-41 is on the back burner until all the TSB's affecting IS-41 Rev. B are completed. Some work is going on in the development of IS-41 changes to support IS-53 Rev. A features, CDMA mobiles and TDMA data terminals. Rules for the exchange of private data in IS-41 messages are also being discussed.

Subscriber Features • Draft text for a major revision to the cellular Features Description standard is still being reviewed by WG V. Two features, *Extension Phone Service* and *Directory Number Hunt Group* have not yet been incorporated into the baseline text. The *Priority Access and Channel Assignment* feature has been removed from consideration pending clarification of requirements from the CTIA. This document will be published as *IS-53 Rev. A*.

PSTN Interface•A definition of both the analog (i.e. MF signaling) and digital (SS7 signaling) interfaces required to connect MSCs to the PSTN is being developed. This document may supersede Bellcore TR-NPL-000145 (1986) which is currently used to define analog interfaces for cellular. A draft containing Stage 1 high level interface descriptions was presented in May. WG VII has scheduled publication for 4Q'93. Don't hold your breath.

Intersystem Non-Signaling Data Communications (DMH) • 600 pages of draft text describing procedures and messages for the on-line transfer of call detail records are being reviewed by WG IV. The two main purposes of call detail record transfer are faster and more accurate billing and faster fraud detection. A recent proposal to redirect the standard toward X.400 and EDI standards is under consideration. Publication is scheduled for mid-1993.

Cellular Dialing Plan • Plans are being made to revise the cellular dialing plan standard, IS-52 Rev. 0, including moving the recommended feature activation and deactivation codes from IS-53. This standard will be published as *IS-52 Rev. A*.

International Applications • There are several recognized problems with the use of AMPS cellular outside North America. They were discussed briefly in the April, 1993 edition of this newsletter. TSB-29 Rev. A was an attempt to address these issues, but it has several known inadequacies. WG VI of TR45.2 is studying solutions to these problems. These recommendations will be published as *TSB-29 Rev. B*◊

TR45.2 Working Group VII: PSTN Interface

TR45.2 Working Group VII studies the interface between the PSTN and cellular systems. This includes two major areas, the so-called Analog interface (A_i), current method of interconnect, and the Digital interface (D_i), which uses Signaling System 7, and is only in trial use.

The reason for standardization of these interfaces is a little bit technical and a lot political. The A_i interface is currently defined by the 1986 Bellcore document TR–000145. Although this document is out of date the real reason for the TIA to proceed with standardization is to allow cellular carriers to gain control over this interface, and re-orient it to their vision of the US telecommunications network.

The current PSTN interface is based on a hierarchy with wireless carriers connecting like PABX's to the superior local exchange carrier, and then to inter-exchange carriers. The cellular vision, however, is that cellular carriers should interface as peers to other major carriers.

The technical battleground for control of the network vision is ANI; Automatic Number Identification. Currently this information, which identifies the calling party, can be sent *from* a wireless carrier to a Local or Inter-Exchange carrier, but not *to* a wireless carrier. This allows Local or Inter-Exchange carriers access to the identification of wireless terminals, and control over billing.

An example of the impact of this restriction on cellular is the difficulty in providing *Calling Party Pays* services if the identity of the calling party is not known. This is what causes cellular subscribers to have to pay for charges on incoming calls that logically should be the responsibility of the caller.

Another consequence of the hierarchical nature of the current US telecommunications network is that wireless carriers have to pay access charges to enter the PSTN, but the PSTN does not have to pay to enter the wireless network. Any challenge to this view would have a major impact on the finances of all carriers. A change would require a radical rethinking of the entire network, including changes such as the elimination of flat rate local calling.

If cellular carriers were treated as peers by local and inter-exchange carriers, it would position them much better to provide local wired service and to provide interconnection for small PCS and PABX operators.

WG VII is chaired by P.J. Louis of Bellcore, with a subsidiary Ad-Hoc group chaired by Huel Halliburton of PacTel. Established in 1992, this is by far the newest working group in TR45.2.◊

Comments Welcome

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

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Completed Standards

IS	Title	Editor	WG	Published
IS-41-0	Cellular Radiotelecommunications Inter-System Operations	Terry Watts	I	2/1/88
IS-41-A	Cellular Radiotelecommunications Inter-System Operations	Terry Watts	I	1/10/91
IS-41-B	Cellular Radio-telecommunications Inter-System Operations	Terry Watts	I	12/11/91
IS-52	Cellular Subscriber Dialing Plan and Service Codes	David Baum	V	11/1/89
IS-53-0	Cellular Features Description	Terry Watts	V	9/1/91

Completed Telecommunications Systems Bulletins (TSB's)

TSB	Title	Editor	WG	Published
TSB-27	IS-41 Application Notes (never actually published, date is when released to WG I)	Glen Schmid	I	7/6/89
TSB-29-A	International Implementation of Cellular Systems Compliant with TIA-553	David Baum	VI	9/25/92
TSB-51	Inter-System Authentication, Signaling Message Encryption and Voice Privacy	Terry Watts	I,II,III	2/11/93
TSB-56	Application Level Testing for IS-41 Rev. A	David Crowe	II tg 1	3/29/93

Active TR45.2 Projects

PN	Title	Editor	WG	IS/TSB
2754	Cellular Inter-System Non-Signaling Data Communications	Kirk Carlson	IV	
2910	Mobile Border System Problems	David Crowe	I,II,III	IS-87
2977	Cellular Features Description (Rev. A)	Terry Watts	V	IS-53-A
2978	Application Level Test Plan (IS-41-B, IS-53-A)	David Crowe	II tg 1	TSB-42
2985	Technical Notes for IS-41 Revision B	Arzu Çalis	I,II tg 3	TSB-41
2991	Cellular Radio Telecommunications Intersystem Operations - Revision C	Terry Watts	I	IS-41-C
3063	IS-41 Rev. A/B Forward Compatibility	Charles Ishman	I	TSB-55
3098	Ai and Di Interfaces Standardization (PSTN/MSC)	Mike Buhrmann	VII	
3166	Uniform Dialing Procedures for use in Cellular Radiotelephone Systems	Steve Jones	VII	IS-52-A
3173	International Implementation of Cellular Radiotelephone Systems Compliant with ANSI/EIA/TIA-553	Steve Jones	VI	TSB-29-B

Status of IS-41 Rev. A Implementation

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Vendor1	Vendor2	Status	Completion	HVD	D/L	Location
Astronet	AT&T	Field Trial	11/92	- VD	X	Baltimore/Washington (BAM)
	GTE TSI	Field Trial	In progress	- VD	X	Baltimore/Washington (BAM)
	NTI	Lab Trial	Scheduled	- VD	X	Texas/New Mexico (ENMR)
AT&T	Astronet	Field Trial	In progress	- VD	X	Baltimore/Washington (BAM)
	EDS	Lab Trial	12/92	- V -	X	
	Ericsson	Commercial	12/92	HVD	S	Salt Lake City (McCaw)
	GTE TSI	Commercial	**06/92**	- V -	X	Baltimore/Washington (BAM)
		Commercial	**06/93**	- - D	X	Baltimore/Washington (BAM)
		Commercial	**02/93**	**- VD**	**S**	**Tampa, Fresno**
	Motorola	Commercial	05/92	HVD	X	Fresno (GTE/Contel)
		Commercial	**10/92**	**HVD**	**S**	**(McCaw)**
	NTI	Commercial	05/92	HVD	X	Detroit (Ameritech)
		Commercial		**- VD**	**S**	**(McCaw)**
EDS	AT&T	Lab Trial	12/92	- V -	X	
	Ericsson	Lab Trial	01/93	- V -	S	
	Motorola	Commercial	08/92	- V -	X	Los Angeles and Atlanta (PacTel)
Ericsson	AT&T	Commercial	12/92	HVD	S	Portland and others (McCaw)
	EDS	Lab Trial	01/93	- V -	S	
	Motorola	Commercial	12/92	**- VD**	S	Stockton and others (McCaw)
		Lab Trial		**H - -**	**S**	**Albany**
	NTI	Commercial	12/92	HVD	S	Tampa and Minneapolis (McCaw)
GTE TSI	Astronet	Field Trial	In Progress	- VD	X	Baltimore/Washington (BAM)
	AT&T	Commercial	**06/92**	- V -	X	Baltimore/Washington (BAM)
		Commercial	**06/93**	- - D	X	Baltimore/Washington (BAM)
		Commercial	**02/93**	**- VD**	**S**	**Tampa, Fresno**
	Ericsson	**Planning**		**- VD**	**S**	**Mexico**
	Motorola	**Field Trial**	**04/93**	**- VD**	**X**	**Seattle (US West)**
	NTI	**Commercial**	**01/93**	**- V -**	**X**	**Spokane (US West)**
		Commercial	**09/92**	**- VD**	**S**	**Greensboro (GTE Mobilnet)**
Motorola	AT&T	Commercial	05/92	HVD	X	Sacramento (PacTel)
		Commercial	10/92	HVD	S	Dallas (McCaw)
	EDS	Commercial	08/92	- V -	X	Los Angeles (PacTel)
	Ericsson	Commercial	12/92	- VD	S	Dallas (McCaw)
		Lab Trial		**H - -**	**X**	**Syracuse**
	GTE TSI	**Field Trial**	**04/93**	**- VD**	**X**	**Seattle (US West)**
	NTI	**Commercial**		**- VD**	**S**	**(McCaw)**
		Commercial	02/93	HVD	X	Philadelphia(Metrophone)
NEC	**AT&T**	**Lab Test**	**06/93**	**HVD**	**X**	**Brazil (Telebras)**
NTI	**Astronet**	**Lab Test**	**Planning**	**- VD**	**X**	
	AT&T	Commercial	05/92	HVD	X	Windsor(Bell Cellular)
		Commercial		**- VD**	**S**	**(McCaw)**
	Ericsson	Commercial	12/92	HVD	S	Ft. Meyers (ICN/Palmer)
	GTE TSI	Commercial	01/93	- V -	X	Spokane (US West)
		Commercial	**09/92**	**- VD**	**S**	**Greensboro (GTE Mobilnet)**
	Motorola	**Commercial**		**- VD**	**S**	**(McCaw)**
		Commercial	02/93	HVD	X	Allentown(Vanguard)

Explanation:

Status:	Development, Planning, Lab Trial, Field Trial or Commercial.
Completion:	Date of actual or expected completion of listed phase of testing.
HVD:	Type of Test ("H" - Includes Handoff, "V" - Includes Roamer Validation, "D" - Includes Call Delivery).
D/L:	Datalink Protocol (X - X.25 Level 2, S - ANSI SS7 or C - CCITT #7).
Location:	Location of Vendor1 equipment and carrier (usually listed for first trial only).