

# Cellular Networking Perspectives

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## Back Issues

All our back issues are available by fax or mail. Phone or fax us for a complete list of issues, contents and prices.

## Comments Welcome

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

## Erratum: EDS PCD IS-41 Rev. B Field Trials

The status of IS-41 Rev. B field trials involving EDS PCD was incorrectly reported in the September issue. The Motorola/EDS PCD trial that was reported actually involves an EDS PCD Rev. A system. Unreported was an IS-41 Rev. B lab trial between EDS PCD and Ericsson that is currently in the planning stages, and will involve validation using X.25 transport services.

## TR-45.2 Standards Update: IS-53 Features Out for Ballot

TR-45.2 has released a major revision of the cellular feature standard for letter ballot as IS-53 Revision A (Standards Proposal SP-2977). The first version of this standard (Revision 0) contained descriptions of only 5 basic features, the new revision about 25 features of considerably greater complexity. Several require network capabilities that will not exist in a standardized form until IS-41 Rev. C is published. A description of all the features in IS-53 Revision A can be found in the October, November and December 1993 issues of *Cellular Networking Perspectives*.

TSB-41 (IS-41 Revision B Technical Notes, SP-2985) second ballot comments have been reviewed. Approved changes are being incorporated by an editing team prior to publication or a third ballot.

The IS-52 Revision A Cellular Dialing Plan (SP-3166) ballot period has expired and comments will be reviewed at the October TR45.2 meeting.

## TIA Emergency Services JEM In Summary

The Telecommunications Industry Association (TIA) held a Joint Expert's Meeting (JEM) on the subject of Enhanced Wireless 9-1-1 services on August 1st through the 5th, 1994. The report resulting from that meeting summarizes needed enhancements to wireless 9-1-1 service and plots an evolution to the ultimate "Dick Tracy" service that will know who you are and exactly where you are when you dial 9-1-1. The JEM report also describes the information required to provide various aspects of an enhanced 9-1-1 service, and associates it with existing and new network nodes. The report will be used by TIA TR45 standards subcommittees to develop air interface and network protocols to improve 9-1-1 service to wireless phones as technology comes available.

## Glossary of Terms

The following terms are used in the following discussion, and in Figure 1, which describes a network reference model for the development of enhanced wireless 9-1-1 systems:

1. ALI. Automatic Location Identification.

The database that can translate a phone number (received as ANI) into a street address, associated PSAP phone numbers and subscriber information.

2. ANI. Automatic Number Identification.

The digits that may be sent between

telephone switches to identify (usually) the calling party. Does not work with cellular roamers when restricted to 7 digits (as in current 9-1-1 systems).

3. BS. Base Station.  
The radio equipment for a cell.
4. BSC. Base Station Controller.  
The control interface for one or more base stations. Treated in combination with the BS for the purposes of this document.
5. ESN. Electronic Serial Number.  
The 'unchangeable' portion of a mobile identification.
6. HLR. Home Location Register.  
The database permanently containing subscriber information, including profile and validation.
7. MIN. Mobile Identification Number.  
The changeable portion of a mobile identification. This usually is the dialable mobile directory number. When associated with an ESN it uniquely identifies a cellular mobile (MS).
8. MS. Mobile Station.  
A fancy term for a cellular phone. It replaces the equivalent term CSS (Cellular Subscriber Station) in TIA IS-41 Revision C and beyond.
9. MSC. Mobile Switching Centre.
10. PSAP. Public Service Answering Point.  
A system that answers 9-1-1 calls, either directly (Primary PSAP), or after handoff from another PSAP (Secondary PSAP).
11. TLDN. Temporary Local Directory Number.  
A number allocated to allow routing of a call to a specific point in the telephone network. These numbers are not assigned to specific users, but are allocated from a pool and only when needed.
12. VLR. Visitor Location Register.  
The temporary repository for a subset of the HLR subscriber information while a mobile is roaming in a subtending MSC.

## Landline Enhanced 9-1-1

It is important to understand the capabilities being gained by "enhanced" landline 9-1-1 systems through the use of ANI and ALI. If a landline telephone exchange transmits ANI (effectively the 9-1-1 caller's phone number), the PSAP can consult the ALI database and retrieve subscriber information, including a street address, and the list of PSAP's (e.g. Fire, Police and Ambulance) with jurisdiction at that location. The ANI, being the subscriber's phone number, can also be used as a callback number. The reason that Enhanced 9-1-1 capabilities are so difficult to achieve in wireless systems is because none of the three capabilities of landline enhanced 9-1-1 (location determination, PSAP jurisdiction identification and callback number) can be obtained using ANI and ALI.

## Basic Requirements

There are a significant number of requirements for improved handling of 9-1-1 calls from cellular phones that were identified by the Joint Expert's Meeting:

### 9-1-1 Dialing

It is important for wireless systems to support access to emergency services by 9-1-1 dialing. Alternate methods, such as \*911 may be supported in case of user confusion, but should not be advertised or encouraged.

### 9-1-1 Priority

9-1-1 calls should be given priority over other calls in case of congestion, and should override normal terminal or network restrictions. This can be supported by implementation of the IS-53-A/IS-41-C Priority Access and Channel Assignment (PACA) feature. While most 9-1-1 calls may receive this extra special treatment, calls from some locations or subscribers may still be prevented (e.g. from prisons).

### Location

The location of the 9-1-1 caller is important, not only to route help to the right place when the caller is unsure of their location (very common with calls from mobile phones), but also to route the call to the emergency service that has jurisdiction at the location of the caller. This is a place where current

technology comes up short. The long term goal is to determine the location within 40 feet (including altitude), but the short term goal of 400 foot accuracy cannot even be obtained on current cellular systems. The best that can be done today is to identify the location of the cell that the caller is in, which will usually not even give 4,000 foot accuracy. A survey of location technology that was provided at the Joint Expert's Meeting indicated that several vendors can provide network based solutions, most not requiring terminal modifications, that will easily achieve the short term location goals. No technology was identified that would achieve the long term location identification goals for existing cellular phones under all circumstances and at reasonable cost. An updated version of this survey will be available in mid-October, 1994 from C.J. Driscoll & Associates (phone 310-832-8834).

Not only is accurate location information required at the start of each 9-1-1 call, but because wireless terminals have an unfortunate habit of moving during a call, location updates may also need to be provided if the mobile moves significantly during the 9-1-1 call.

In order to accommodate varied levels of location finding accuracy, the cellular network should transmit location information in a standard form. The preferred form appears to be latitude, longitude, altitude and a separate resolution field.

### Callback Number

Wireless 9-1-1 callers cannot be called back using their phone number (especially when roaming), unlike landline callers. Callback is necessary when the calling phone is accidentally disconnected or if more information is required after the 9-1-1 call ends normally. The caller's MIN cannot be used as a callback number for at least two reasons, a call to the MIN may not be routed correctly if the roamer does not subscribe to call delivery or is forwarded and the current 9-1-1 signaling interface cannot transmit the area code of the roamer's MIN to the PSAP. Because of these problems, a temporary local number will have to be assigned as a callback number. Unlike temporary numbers used for cellular (IS-41) call deliv-

ery, the length of time that it should be valid is not known, so the number will probably have to be allocated for a reasonable length of time (say one hour following call disconnect) to ensure that it is not discarded before it is required.

### Subscriber Information

The subscriber's name, address and home phone number are useful in some circumstances, along with special information concerning medical conditions. This information could be obtained, via the IS-41 network, from the subscriber's home system or from the terminal itself (although with the major disadvantage that it would not work with existing terminals).

### Other Identification Information

The identification of the calling terminal (MIN and ESN) and the identification of the serving system (SID: System ID) and a callback number are required.

### Conference Calls and Intersystem Handoff

There is a surprising interaction between conference calls, intersystem handoff and 9-1-1 calls. Normally, if a cellular phone dials another number mid-call, after an inter-system handoff, the conference call add-on procedure is handled at the anchor system. For 9-1-1 calls, however, the conference call should be set up at the current serving system in case the mobile has travelled into a different jurisdiction since the start of the call. It is possible that this requirement will eventually become unnecessary if routing to the appropriate PSAP can be performed from any MSC, based on precise location information.

### PSAP Disconnect Control

In a 9-1-1 call the PSAP should have control over when the call disconnects. The caller should not be able to initiate a disconnect (difficult to prevent if the caller turns off their phone!), but should be immediately disconnected when the PSAP disconnects.

### The Evolutionary Roadmap

The TIA 9-1-1 JEM mapped out four steps for the development of future 9-1-1 systems, based on changes required to the terminal, network and PSAP. Priority was placed on preventing changes in mobile terminals, since

very few of the 20 million or so cellular phones in use could be upgraded, so terminal changes are limited to the last evolutionary step. The four steps are:

1. Today  
Without any changes to the MSC and PSAP, cellular 9-1-1 calls should at least identify the cell that the 9-1-1 call is coming from.
2. Expanded Network and PSAP  
With changes mainly to the MSC, both caller location and subscriber information can be accessed by transmitting a temporary phone number to the PSAP, which can be correlated with other information at the MSC. MSC call processing can be modified to provide support for priority of 9-1-1 calls over other traffic, origination of 9-1-1 three-way calls from the serving system, PSAP control over disconnect and callback.
3. Enhanced Network and PSAP  
By providing an information path (e.g. SS7 or ISDN network connection) between the MSC and the PSAP, beyond the extremely limited MF digit transfer used today, more information can be transferred to the PSAP about subscriber location and identification. In the reverse direction, the PSAP can initiate transactions to throttle incoming calls or request location updates, for example.
4. The Final Goal  
Modifications to terminals could allow more accurate location determination (although the technology to do this reliably in a low cost, low power handset does not currently exist). Also, terminals could process 9-1-1 calls more forgivingly, allowing them while locked, without an identity module ("smart card") or in some other mode where calls would not normally be allowed.

### Future Directions

The TIA subcommittees responsible for cellular standards, TR45.1, .2, .3, .4 and .5 will consider the requirements identified by the report in future revisions of standards under their control. The challenge is great, as most interfaces under the control of the subcommittees are

affected, as well as several new interfaces. In particular, the IS-41 standard for automatic roaming and the IS-93 standard for PSTN interconnect will have to be extensively modified. The extent of the changes is obvious from Figure 1, which illustrates the network entities and interfaces that will have to be created or modified to build the "ultimate" 9-1-1 system.

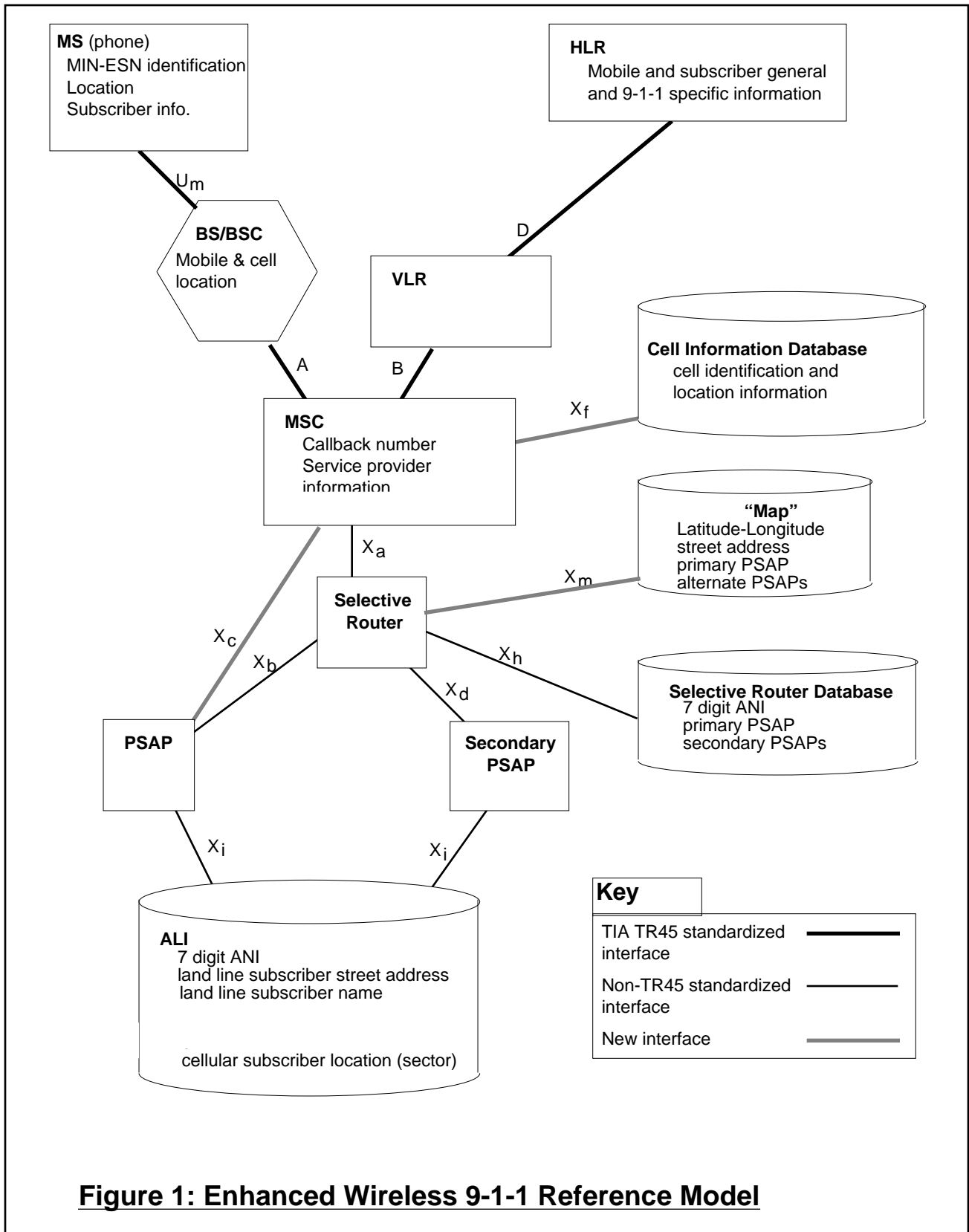
### Not Every Problem is Technical

There are many problems with enhancing 9-1-1 service that are not technical. The major problem is money to fund the development, purchase and operation of more sophisticated 9-1-1 systems. Also, the motivation to implement improved systems must be present, which will be some combination of government mandate and corporate goodwill, tempered with a concern for cost and, more so in the US than in Canada, a concern over liability when the system inevitably malfunctions.

Even in the area of technical standardization there is confusion, for between the MSC, PSTN and PSAP, responsibility for standardization is not precisely divided between the wireless (TIA TR45) and wireline (ATIS T1) standards committees.

### YAFJ: Yet Another (9-1-1) JEM

The Personal Communications Industry Association (formerly Telocator) is sponsoring another Joint Expert's Meeting on Wireless 9-1-1 starting October 10th, 1994 in the Washington DC area. It might be asked why another JEM is needed, when the results of the TIA JEM have not yet been fully absorbed. The official answer is that PCS 9-1-1 service will have some technically different requirements than cellular. That appears to be unlikely, given that one of the major starting points for the TIA 9-1-1 JEM deliberations was a paper prepared by PCIA and other groups. The remaining possibility is that the JEM is an attempt by the PCIA to regain turf they appear to have lost to the TIA. However, to us, it is inconceivable that a Washington based organization would stoop to politicking! Therefore the purpose of the PCIA JEM remains a mystery and hopefully will not come up with requirements that are contradictory to those developed by the TIA JEM.



# TIA TR-45.2 Project Status Report

*Cellular  
Networking  
Perspectives*

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## Obsolete Interim Standards and TSBs

<b>IS/TSB Title</b>	<b>Published</b>
IS-41-0 Cellular Radiotelecommunications Inter-System Operations	02/88
IS-41-A Cellular Radiotelecommunications Inter-System Operations	01/91
TSB-27 IS-41 Application Notes (never published, date is when released to WG I)	07/89
TSB-56-0 Application Level Testing for IS-41 Rev. A, IS-53 Rev. 0	03/93

## Published Interim Standards

<b>IS</b>	<b>Title</b>	<b>WG</b>	<b>Published</b>
IS-41-B	Cellular Radiotelecommunications Inter-System Operations	I	12/91
IS-52-0	Cellular Subscriber Dialing Plan and Service Codes	V	11/89
IS-53-0	Cellular Features Description	V	09/91
IS-93-0	Ai and Di Interfaces Standard (PSTN/MSD)	VII	10/93
IS-124-0	Cellular Inter-System Non-Signaling Data Communications	IV	09/93

## Published Telecommunications Systems Bulletins (TSBs)

<b>TSB</b>	<b>Title</b>	<b>WG</b>	<b>Published</b>
TSB-29-A	International Implementation of Cellular Systems Compliant with TIA-553	VI	09/92
TSB-51	Inter-System Authentication, Signaling Message Encryption and Voice Privacy	I	02/93
<b>TSB-55</b>	<b>IS-41 Rev. A/B Forward Compatibility</b>	<b>I</b>	<b>05/94</b>
TSB-56-A	Application Level Testing for IS-41 Rev. B, IS-53 Rev. 0 and TSB-51	II	06/94
TSB-64	Wideband Spread Spectrum Intersystem Operations	I	02/94
TSB-65	Mobile Border System Problems	I	04/94

## Projects in Ballot Process (SP = Standards Proposal Number)

<b>SP</b>	<b>Title</b>	<b>Editor</b>	<b>WG</b>	<b>IS/TSB</b>
2985	Technical Notes for IS-41 Revision B	<b>Kirk Carlson</b>	I	TSB-41
<b>3166</b>	<b>Uniform Dialing Procedures for use in Cellular Radiotelephone Systems</b>	<b>Steve Jones</b>	<b>VII</b>	<b>IS-52-A</b>
<b>2977</b>	<b>Cellular Features Description (Rev. A)</b>	<b>Terry Watts</b>	<b>V</b>	<b>IS-53-A</b>

## Active TR45.2 Projects (PN = TIA Project Number)

<b>PN</b>	<b>Title</b>	<b>Editor</b>	<b>WG</b>	<b>IS/TSB</b>
2991	Cellular Radio Telecommunications Intersystem Operations	Terry Watts	I	IS-41-C
3173	International Implementation of Cellular Radiotelephone Systems Compliant with ANSI/EIA/TIA-553	Steve Jones	VI	TSB-29-B
3293	Cellular Inter-System Non-Signaling Data Communications	Kirk Carlson	IV	IS-124-A
3295	Ai and Di Interfaces Standard		VII	IS-93-A
3362	Cellular Features Description (Rev. B)	Terry Watts	V	IS-53-B