

# Cellular Networking Perspectives

David Crowe [Editor] • Phone 1-403-289-6609 • Fax 403-289-6658

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## Analog Standards "Nobody Knows the Trouble I've Seen"

It has been several years since a new analog standard was published. EIA/TIA-553 Rev. 0, the successor to the IS-3 series of interim standards, was published in 1989 and IS-91 Rev. 0 in 1994. Yet, Revision A of EIA/TIA-553 and IS-91 are still not complete. A series of events have conspired to drag out their development. The EIA/TIA-553 Rev. A project began with a desire to incorporate authentication. During ballot review in early 1996 it was decided that it should become the "core" analog standard, that could be referenced by any standard with an analog compatibility mode. In particular, the *Flash with Info* and *Alert with Info* messages that were available in most air interfaces should also be supported by basic, no-frills analog mobiles (i.e. EIA/TIA-553). This strategy made EIA/TIA-553 the reference definition of the analog signaling protocol, reducing the likelihood of conflicting changes being introduced by the TDMA and CDMA standards committee, to support dual-mode mobiles. The IS-91 standard will also have additional capabilities such as NAMPS.

The "core" version of EIA/TIA-553-A went to a second ballot in December 1996. However, during this ballot it was de-

ecided that base stations should know the capabilities of each mobile, to ensure that they do not transmit messages that the mobiles cannot process. In some cases, this will cause mobiles to malfunction, and in other cases it is impossible to tell whether the operation worked or not, so that backup signaling using another method is not possible.

The method developed by TIA standards subcommittee TR-45.1 to eliminate this problem in future phones is the Protocol Capability Indicator (PCI), which was included in the third ballot of TIA/EIA-93-A (and IS-91-A) that was initiated in July 1997. Using PCI, a base station can indicate that it wants mobiles to report their protocol capability during initial registration in a system, or can request it at any time. Mobiles report PCI by using two new information elements, MSPC and MSCAP, in a new 40 bit signaling "word".

The 4 bit MSPC (Mobile Station Protocol Capability) (values shown in Table 1) report the most advanced mode of the mobile. New values will be added for significant revisions to those standards.

**Table 1: MSPC (Mobile Station Protocol Capability)**

Value	Meaning
0000	Reserved for compatibility
0001	EIA/TIA-553-A (Core analog)
0010	IS-91-A or TIA/EIA-691 (advanced analog)
0011	TIA/EIA-136-B (TDMA digital)
0100	TIA/EIA-95-B (CDMA digital)
...	remaining values reserved

The second field is the 3 bit MSCAP (Mobile Station Core Analog Protocol) with values shown in Table 2. It defines the core analog compatibility mode supported by the mobile. Currently only one value is defined, for the upcoming EIA/TIA-553 Rev. A standard. More values will be added for significant revisions to this standard.

Value	Meaning
000	Reserved for compatibility
001	EIA/TIA-553-A
...	remaining values reserved

According to EIA/TIA-553-A editor Charles Teising of Lucent, the third ballot resulted in fewer and less substantive comments than the first two. Review of the ballot comments is complete, and currently the editors of EIA/TIA-553-A, IS-91-A and related standard TIA/EIA-691 are ensuring that these standards are fully aligned prior to publication.

## TIA/EIA-41 Rev. E Network Reference Model

A network reference model (NRM) is a diagram that illustrates the network elements and interfaces that are of interest to a standards organization. The official TIA TR-45 NRM has just been published as TSB-100 and is available from Global Engineering Documents (1-800-854-7179). Figure 1 shows a simplified NRM that focuses on TIA/EIA-41 Rev. E capabilities (see the March 1998 issue of *Cellular Networking Perspectives* for more details and the report on pages 4 and 5 for the status of implementation).

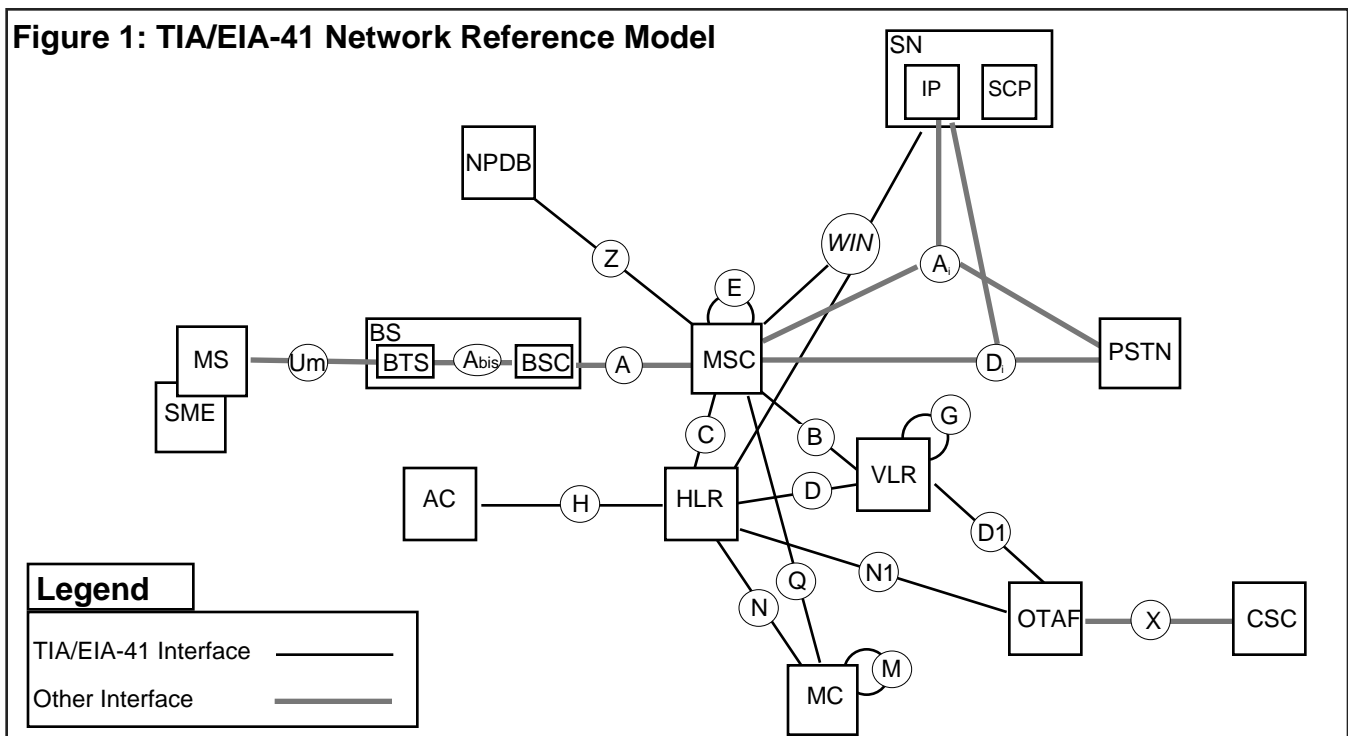
The most important reason for having a NRM is that it provides a common language for communication between people from manufacturers with radically different internal architectures. Note how the terms HLR, VLR, and MSC are edging out the older and vaguer term MTSO, for example.

### Network Elements

Network elements are devices where an interface terminates and processing occurs. An MSC, for example, performs

call processing, but must communicate with an HLR over the "C" interface to obtain subscription data for validation, feature management and location tracking of roamers. Different network elements do not need to be physically separate. For example, it is common for an MSC and a VLR to be realized as a single physical entity. It is also possible to split a network element into multiple physical entities, but there will be no support for standardized interfaces between these sub-elements. Even when network elements are merged, they may change roles during different call scenarios. Take, for example, a combined AC/HLR/VLR/MSC in Wireless, Louisiana. For subscribers at home, this physical device performs all four functions simultaneously in one call. However, when a subscriber roams to Mobile, Alabama, the home system performs only the role of AC/HLR, while the visited system acts as VLR/MSC.

The internal workings of a network element rarely needs to be standardized, just its interactions with the outside world (i.e. its interfaces). In other words, *what* a network element does is important, but *how* it does it is not.



The network elements most relevant to TIA/EIA-41-E (and therefore shown in Figure 1) are:

AC	Authentication Center Manages authentication and encryption information for mobiles.
BS	Base Station Includes transceiver subsystem (BTS) and base station controllers (BSC).
CSC	Customer Service Center The system that controls all non-realtime subscriber data, including mobile identification, profile, status, contact information and rate plans.
HLR	Home Location Register Repository of mobile id, subscriber profile, status and location information, and much feature handling logic.
IP	Intelligent Peripheral The Wireless Intelligent Network device that provides specialized resources, such as announcements, tones, and voice recognition.
MC	Message Center Stores and forwards short messages destined to a mobile or received from a mobile
MS	Mobile Station (i.e. wireless voice and/or data phone)
MSC	Mobile Switching Center (aka MTSO)
NPDB	Number Portability Database
OTAF	Over-the-Air Function Controls Over-The-Air-Service-Provisioning for mobiles.
PSTN	Public Switched Telephone Network Any telephone network outside the wireless domain (including wireless network elements that are not known to be wireless at the time of call processing).
SCP	Service Control Point The "brains" of wireless intelligent network feature processing.

SME	Originator or receiver of a short message.
SN	Service Node (combined IP and SCP)
VLR	Visitor Location Register Repository for roamer information.

### Interfaces

Interfaces are more important to a standard than a network element. While the internal workings of a network element are of little interest to a standards committee, the precise details of an interface are. In fact, the only aspect of a network element that should be of interest to standards writers is the interfaces it supports.

Figure 1 distinguishes between interfaces defined by TIA/EIA-41-E (thin black lines) and others (thick grey lines). The non-TIA/EIA-41-E interfaces are:

<u>Interface</u>	<u>Definition</u>
A	IS-634, IS-653 and a number of proprietary protocols.
Ai,Di	IS-93 and Bellcore's TR-145. Ai is the analog (MF tone) interface and Di is the ISDN/ISUP interface.
Um	Various air interfaces including EIA/TIA-553 analog, IS-95 CDMA and IS-136 TDMA.
X	Non-standard interface used for over-the-air service provisioning.

The TIA/EIA-41-E standard interfaces serve a variety of purposes:

<u>Interface</u>	<u>Definition</u>
B	MSC/VLR communication (usually internal or non-standard).
C	Call delivery and feature processing.
D	Registration and call delivery.

D1	Over-the-air Service Provisioning (OTASP).
E	Inter-system handoff, redirection and border cell problem management.
G	TMSI management (CDMA only).
H	Authentication and voice, data and signaling message encryption.
M	Short message delivery
N	Short messaging.
N1	Over-the-air Service Provisioning (OTASP).
Q	Short message delivery.
WIN	Represents a variety of Wireless Intelligent Network interfaces, identified as C1...C7 in TSB-100.
Z	Local Number Portability queries.

### TR-45 Ad Hoc Group Changes

The ESN *ad hoc* group within TIA standards committee TR-45 has disbanded, following completion of the ESN allocation guidelines. ESN manufacturer codes are now being assigned by John Willse of CRAG, supervised by the TIA. Development of the expanded 56-bit ESN will take place in individual subcommittees, now that the basic structure has been defined.

The Network Management *ad hoc* group is under review, to determine whether it should request subcommittee status and whether the aging CTIA SRD is still valid, or needs updating.

### Erratum

In our March 1998 issue we identified the developing wireless Calling Name Presentation/Restriction standard as PN-4134, instead of PN-4103.

# Status of IS-41 Rev. C and TIA/EIA-41-D Implementations (part 1 of 2)

<b>Vendor and Radio Technology</b>														
<b>Intersystem Operations Capability</b>	Alcatel			Ericsson		GTE (HLR)			Lucent			Motorola		
	Analog	CDMA	TDMA	Analog	TDMA	Analog	CDMA	TDMA	Analog	CDMA	TDMA	Analog	CDMA	
<b>Authentication</b>	4	4	4	4	4	4	4	4	4	4	4	4	4	
<b>CNAP/CNAR</b>														
<b>CNIP/CNIR</b>		4	4						4	4	4	4	4	
<b>Data (IS-737)</b>														
<b>I/S handoff: Analog to...</b>	4		4	4	4				4		4	4		
<b>I/S handoff: CDMA to...</b>	4	4							4			4	4	
<b>I/S handoff: TDMA to...</b>	4		4	4	4				4		4			
<b>IMSI (IS-751)</b>														
<b>Hyperband handoff (TSB-76)</b>			4		4					4	4		4	
<b>LNP Phase I (IS-756)</b>	☉	☉	☉											
<b>MWN</b>		4	4						4	4				
<b>Origination Triggers</b>	4	4	4						4	4	4	4	4	
<b>SMS Origination</b>														
<b>SMS Termination</b>		4	4	4	4				4	4		4	4	
<b>Termination Triggers</b>									4	4	4	4	4	
<b>Voice Privacy</b>			4							4	4		4	

Glossary	Analog CDMA CNAP/CNAR CNIP/CNIR: Data IMSI I/S Handoff Hyperband Handoff  LNP Phase I  MWN SMS TDMA	EIA/TIA-553 or IS-91. Some more advanced features may only be supported for IS-91 phones. IS-95 Code Division Multiple Access digital cellular/PCS radio interface. Calling Name Presentation/Restriction Calling Number Identification Presentation/Restriction Support for data transmissions from digital cellular/PCS terminals when roaming (IS-737). Support for E.212 International Mobile Station Identity (IS-751). Inter-system (i.e. inter-MSC) handoff. Inter-system handoff between cellular and PCS bands, or between different PCS bands using TSB-76. Local Number Portability Phase I (routing to ported wireline directory numbers) using IS-756. Phase II (not yet standardized) will support ported mobile directory numbers. Message (e.g. voice mail) Waiting Notification using audible or visual signals. Short Message Service. IS-136 Time Division Multiple Access digital cellular/PCS radio interface.
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# Status of IS-41 Rev. C and TIA/EIA-41-D Implementations (part 2 of 2)

<b>Vendor and Radio Technology</b>					
<b>Intersystem Operations Capability</b>	Nortel			Telos	
	Analog	CDMA	TDMA	Analog	TDMA
<b>Authentication</b>	4	4	4	4	4
<b>CNAP/CNAR</b>					
<b>CNIP/CNIR</b>	4	4	4		4
<b>Data (IS-737)</b>					
<b>I/S handoff: Analog to...</b>	4		4		
<b>I/S handoff: CDMA to...</b>	4	4			
<b>I/S handoff: TDMA to...</b>	4		4		
<b>IMSI (IS-751)</b>					
<b>Hyperband handoff (TSB-76)</b>		4	4		
<b>LNP Phase I (IS-756)</b>					
<b>MWN</b>	4	4	4		
<b>Origination Triggers</b>	4	4	4		
<b>SMS Origination</b>					
<b>SMS Termination</b>	4	4	4		
<b>Termination Triggers</b>					
<b>Voice Privacy</b>					

- Symbols:
- Indicates a capability that is not technically feasible at present.
  - 4
In field trial or commercial service.
  - ⚠
In lab trial.
  - ⊙
Under Development

Updates: To have information for another company included in future revisions, or to update or correct information, please contact the editor by email at [crowed@cnp-wireless.com](mailto:crowed@cnp-wireless.com), by phone at +1-403-289-6609 or by fax at +1-403-289-6658.

# TIA TR-45.4 Subcommittee Radio to Switching Technology Standards Status Report

*Cellular  
Networking  
Perspectives*  
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Editor David Crowe • Phone 403-289-6609 • Fax 403-289-6658

## Published Documents

Standard	Description	WG	Published
EIA/TIA-634	MSC-BS "A" Interface Standard	II	12/95
IS-94	Mobile Station - Land Station Compatibility Specification for Analog Cellular Auxiliary PCS (CAPCS)	III	05/94
<b>TSB-80</b>	<b>IS-634-0 Addendum (corrections, SMS, subrate voice frame format)</b>	<b>II</b>	<b>11/96</b>
TSB-104	PCS Service Description (now IS-104 in committee TR-46)	I	06/94

## Completed Internal Documents

PN	Description	WG	Editor
3142	Cellular Microcell/Microsystems Requirements Document	III	Steve Jones
3296	MSC-BS Interface (A-Interface) Requirements for Public 800 MHz	II	Mike Burke

## Active TR-45.4 Projects (PN=TIA Project Number)

PN	Description	Editor	IS/TSB
PN-3539 <i>[reballot]</i>	MSC-BS Interface (A-Interface) Standard, including support for: <ul style="list-style-type: none"> <li>• IS-54 (TDMA)</li> <li>• IS-95 Rev. A (CDMA)</li> <li>• IS-91 Rev. A (analog)</li> <li>• EIA/TIA-553 Rev. A (analog)</li> <li>• IS-41 Rev. C and IS-53 Rev. A</li> <li>• Short message service</li> <li>• Data services for CDMA/TDMA (IS-99, IS-130, IS-135)</li> <li>• Frame Relay</li> <li>• 1800 MHz</li> <li>• Optimization</li> </ul>	Mike Dolan	IS-634-A
PN-3746 <i>[on hold]</i>	<b>ISDN based A-Interface, adding:</b> <ul style="list-style-type: none"> <li>• <b>address alignment with Mobility Management Application Protocol (MMAP)</b></li> <li>• <b>CDMA and TDMA support, and</b></li> <li>• <b>support for architectures with separate mobility management and call control functions</b></li> </ul>		<b>IS-653-A</b>
PN-3964	<b>Use of A-Interface standards in Wireless Local Loop (WLL)</b>		<b>n/a</b>

Note: 1. IS- Interim Standard, J-STD- Joint T1/TIA Standard, PN- Project Number, SP- ANSI Standards Proposal , TSB- Telecommunications Systems Bulletins.  
2. **Bold Type** indicates modification since previous publication.  
3. Published TIA standards can be obtained from Global Engineering Documents at 1-800-854-7179.

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