

Cellular Networking Perspectives

Editor: David Crowe • Phone +1-403-289-6609 • Email crowed@cnp-wireless.com

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IFAST has played a significant role in facilitating international roaming between systems using the TIA/EIA-41 intersystem operations standard, but has been recently plagued by funding problems. Will it rise from the ashes?

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TIA/EIA-664 (formerly IS-53) is a massive repository of descriptions of wireless features. While the descriptions are not always adhered to by carriers, they are a starting point, and nowhere else does such a comprehensive document exist.

***TIA TR-45.4 Radio to Switching
Technology Standards ...*** p. 6

TR-45.4 (and its companion group 3GPP TSG-A) define the A interface between base stations and switches (MSC's). Its standards are of particular interest to CDMA carriers.

Huh?

If there are any acronyms or terms that you are unfamiliar with, check our website glossary, you will probably find them defined there:

[www.cnp-wireless.com/
glossary.html](http://www.cnp-wireless.com/glossary.html)

Next Issue: May 3, 2000

IFAST: Rising Again?

IFAST, the International Forum on AMPS Standards Technology was active between 1996 and 1999 in the investigation and resolution of international roaming problems. It attempted to bring equipment vendors, network providers and carriers together to facilitate interoperation of wireless systems around the world using the TIA/EIA-41 interworking protocol. As an informal group it was able to obtain mutually beneficial agreements without the bureaucracy that besets formally sanctioned international groups such as the ITU. The best example is that it created the concept of the International Roaming MIN (IRM), which allows wireless carriers outside North America to obtain globally unique blocks of MIN codes, a prerequisite for signing international roaming agreements. Since all carriers have an interest

in this arrangement, and organization with no enforcement powers is still able to function effectively.

From an administrative point of view, however, the informality of IFAST was almost its downfall. Until mid-1999 it was sponsored by the CTIA, but when they decided to assign their resources to other areas, IFAST was without the funds necessary to continue organizing meetings, and the Autumn 1999 meeting had to be cancelled. Eventually, the TIA decided to take over the role of secretariat, but only if arrangements were made for self-funding.

Even without formal meetings, IFAST continued to function, most notably by assigning IRM codes to carriers (check www.ifast.org for the most up to date assignments). Since this process is now being performed via email using volunteer labor it can continue for a limited time even in the absence of IFAST meetings or funding.

The first IFAST meeting with the TIA as secretariat was held on March 2, 2000 following the CTIA trade show in New Orleans, and another meeting is being planned where a funding proposal will be presented to the membership.

With the assignments of IRM no longer occupying IFAST meeting time, and with funding hopefully resolved, the IFAST should be able to focus on critical technical issues such as planning a migration from MIN to IMSI, resolving TLDN incompatibilities, and providing a direction for potential providers of international SS7 interworking.

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We have a limited quantity of handsome, useful and styrofoam-saving double-walled stainless steel coffee mugs adorned with the Cellular Networking Perspectives logo. Some subscribers are already enjoying using them. You too can obtain one by purchasing (or upgrading to) a subscription for more than 25 readers, or by purchasing both a *Cellular Networking Perspectives* and *Wireless Security Perspectives* subscription with a license for more than 10 readers. Contact us soon, supplies are limited!

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Contact Information: Phone: 1-800-633-5514 (+1-403-274-4749) Fax: +1-403-289-6658 Email: cnp-sales@cnp-wireless.com Web: <http://www.cnp-wireless.com/>.

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Cellular and PCS Features: TIA/EIA-664 Revision A nears Publication

TIA/EIA-664 is the standard that describes how wireless features are supposed to operate. While TIA/EIA-41 describes a protocol that allows features to be implemented in a multi-carrier, multi-vendor network, TIA/EIA-664 provides the user-level description. While it does not describe a protocol, it does perform two important functions. During the development of TIA/EIA-41 protocol modifications, TIA/EIA-664 acts as a requirements document, and later it acts as a source for carriers and vendors to determine how a feature is supposed to work. This does not mean that carriers always implement features according to this standard, as there are often particular market requirements or a desire for differentiation that interfere with complete standardization of feature operations.

Figure 1 describes the relationships between TIA/EIA-664 and other TR-45.2 standards. Note that it is only

TIA/EIA-664 and TIA/EIA-41 that have a major influence on the wireless industry at present, as the TIA/EIA-93, -124, and -660 standards are generally given less weight than non-TR-45.2 standards, formal or de facto, that are also shown in Figure 1.

Humble Origins: IS-53

Before TIA/EIA-664, which is an ANSI standard, a lowly TIA interim standard (IS-53) defined five basic features (shown in the leftmost column in Figure 2) – three way calling (3WC), three types of call forwarding and call waiting (CW).

IS-53 was published in September 1991 and the features described largely corresponded to the capabilities provided by IS-41 Revisions A and B. These features are described in the October 1993 issue of *Cellular Networking Perspectives*.

Major Advance: IS-53 Revision A

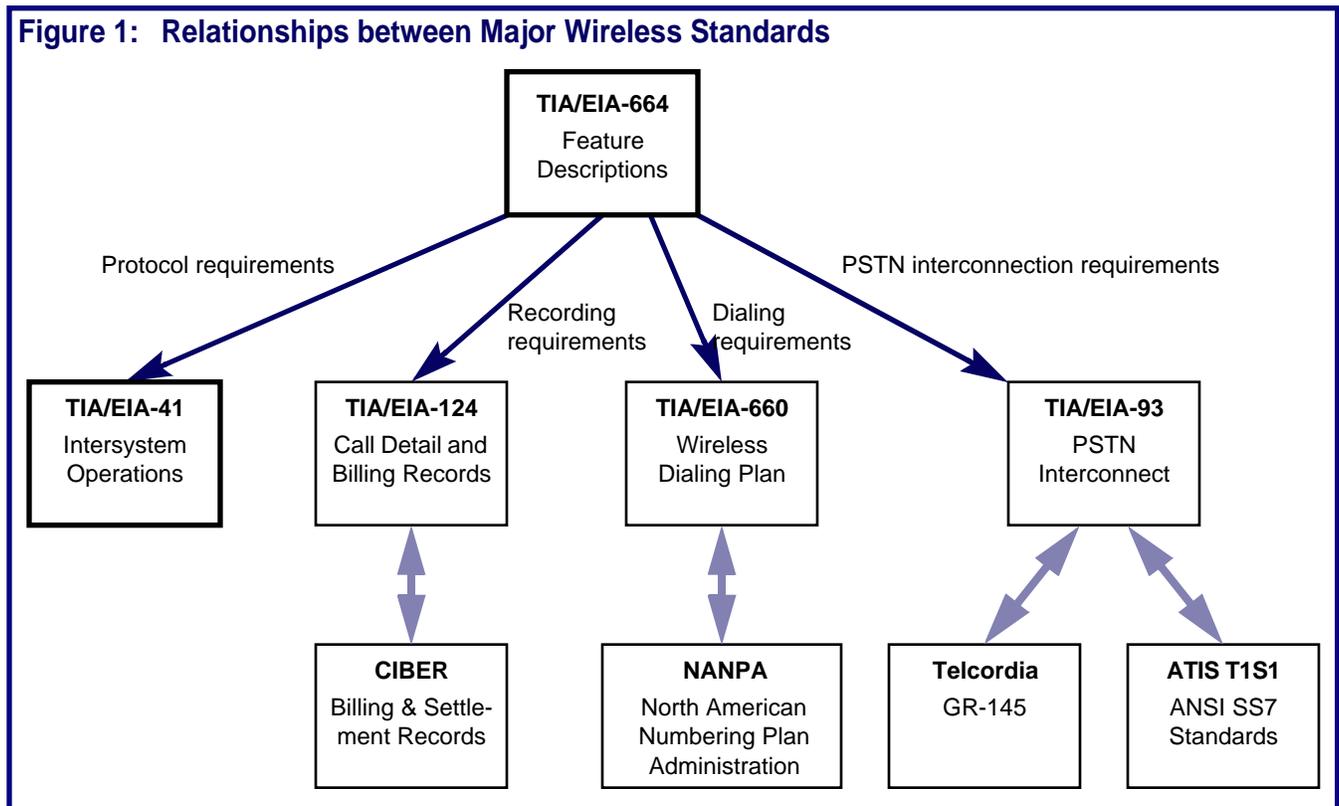
Compared to GSM, which was being commercialized around the time that the first revision of IS-53 was published,

AMPS had only a handful of features to boast about. As AMPS evolved towards digital (IS-54 and IS-136 TDMA as well as IS-95 CDMA), it was important that it showed that it could also support a wide variety of features and capabilities. IS-53 Revision A delivered about 20 new features, which are described in the October, November & December 1993 and January 1994 issues of *Cellular Networking Perspectives* and also listed in the second column of Figure 2. IS-53 Revision A was published in April, 1995 and the features correspond to the capabilities of IS-41 Revision C.

ANSIfication: TIA/EIA-664

TIA interim standards have a limited lifetime, and by the time IS-53 Revision A had been published, the three year lifetime was well past. Consequently, Revision A was almost immediately balloted as an ANSI standard, with a new moniker – TIA/EIA-664 (ANSI does not appear in the name of a TIA standard, it is the lack of the ‘IS’ acronym that gives its status away).

TIA/EIA-664 is therefore, very similar to IS-53 Rev. A and its capabilities corre-



spond to those of ANSI standard TIA/EIA-41 Rev. D. To add to the confusion, while IS-53 morphed into TIA/EIA-664, IS-41 retained its numbering and revision levels (i.e. TIA/EIA/IS-41-C was followed by ANSI TIA/EIA-41-D).

TIA/EIA-664 was published in July, 1996.

The Latest Features: TIA/EIA-664 Revision A

The months since July, 1996 have seen a continual blossoming of new features and capabilities. These have been documented in one TSB (TSB-76) and a number of interim standards, and have recently been compiled into TIA/EIA-664 Revision A which is expected to be published soon.

One major change in the structure of the standard is that it has been broken into 44 parts, each of which was balloted independently. While this made the initial ballot more complex, future modifications can be handled by balloting only the new or modified parts. The introductory part (TIA/EIA-664-000) contains the current list of parts, and will therefore always need to be updated, and will consequently reflect the revision level of the entire document.

The features that have been added are shown in the rightmost column of Figure 2 and are briefly described below.

Asynchronous Data Service

Both TDMA and CDMA digital wireless protocols support asynchronous, circuit switched data. Because transmission over the radio interface is digital, interworking at the base station or switch site is necessary for connection to a modem. If the connection is totally digital (e.g. direct connection to an IP network), only protocol conversion will be necessary.

The Asynchronous Data Service (ADS) is defined in TIA/EIA-664-525, with intersystem protocol support defined in IS-737 (to be included in TIA/EIA-41 Rev. E) and IS-728 (a separate protocol known as the Inter System Link Protocol (ISLP)). A more detailed description of this service is given in the October,

November & December, 1998 issues of *Cellular Networking Perspectives*.

Calling Name Presentation and Restriction

The name of the calling party, and not just their phone number, can be displayed, using the protocol described in IS-764 combined with access to the LIDB (Line Information Database). The description of the presentation service (CNAP) and the restriction service (CNAR) are described in TIA/EIA-664 parts 526 and 527, respectively.

Data Privacy

Data privacy refers to the encryption of asynchronous, circuit-switched data (see above) using the ORYX algorithm. Voice privacy algorithms cannot be used because a fixed mask, while barely adequate for voice, is completely inadequate for data. New data privacy algorithms can be expected as the standardization of AKA progresses (see the December, 1999 issue of *Wireless Security Perspectives* for more details).

The Data Privacy (DP) service is described in TIA/EIA-664-528.

Dual-band and PCS Support

The ability for wireless phones to operate in both the cellular and PCS bands is now taken for granted, but some operations, particularly those related to intersystem handoff, needed to be enhanced.

This service, classified under *Network Services* because it is invisible to wireless subscribers, is documented in TIA/EIA-664-803. Intersystem operation modifications are defined in TSB-76.

Emergency Services

A basic emergency service is described in TIA/EIA-664-529, not including the provision of subscriber identity and position to the emergency call taker (which is still under development). Protocol modifications are described (for both TIA/EIA-41 and GSM systems) in J-STD-034. The service is described in more detail in the June, July, August & September 1998 issues of *Cellular Networking Perspectives*.

Group 3 Facsimile Service

This service, described in TIA/EIA-664-530, lists options for connecting a Group III fax machine to a line served by a wireless local loop. This is a technical challenge because the fax tones cannot be transmitted through digital voice coders. There are no corresponding intersystem protocol changes. Implementing this capability would be the responsibility of the (non-standardized) wireless local loop interface device (WASU – Wireless Access Subscriber Unit).

Network Directed System Selection

Accessing a wireless system once was a trivial problem, as cellular offered only two competing bands in each service area. PCS complicated matters by allowing up to another 6 bands in each service area. Many phones have internal algorithms to choose from a variety of systems offering service, but some CDMA carriers would prefer to have this decision under their control. Others wonder why a carrier would ever want to send business to a competitor.

Network Directed System Selection (NDSS) is described in TIA/EIA-664-531. Protocol modifications are defined in IS-735. The December, 1997 issue of *Cellular Networking Perspectives* provides a more detailed description of this feature and its limitations.

Non-Public Service Mode

TDMA proponents have seized upon in-building operation as one of the technology's advantages. The PSID (Private System Identification) and RSID (Residential System Identification) allow virtual systems to be created with access limited to, for example, employees of a company. Since the billing modifications for such capabilities can be provided without air interface modifications, the major advantage is the ability to display a name for the system on a mobile's screen.

ADS is described in TIA/EIA-664-532, and the protocol modifications required to support this are defined in IS-730. A more detailed description of this feature

is provided in the November, 1997 issue of *Cellular Networking Perspectives*.

Over-the-Air Service Provisioning

As wireless becomes more competitive there is a desire to eliminate the substantial commissions of dealers from the cost of acquiring new customers. As wireless becomes more complex there is a need to update information in the phone without user or dealer intervention. Over-the-air Service Provisioning is a protocol intended to do this. It allows a brand new phone to be activated using its radio interface, and allows automated modifications to the data within the phone (e.g. roaming lists).

Over-the-air service provisioning (OTASP) is described in TIA/EIA-664-553, and separate protocols for TDMA and CDMA systems are defined in IS-725 and IS-725 Revision A. This service is not supported by analog mobiles.

Service Negotiation

When faced with a bewildering array of data services, it is possible that a wireless phone will ask for a service that a system does not support (e.g. 14.4 kbps data), while the system supports an alternative capability (e.g. 9.6 kbps data). Service negotiation allows the phone to determine the best service that the system supports and is willing to provide to it.

Service Negotiation (SN) is described in TIA/EIA-664-534, and protocol modifications are defined in IS-737, along with support for other data services. A more detailed description of this service is provided in the November, 1998 issue of *Cellular Networking Perspectives*.

Subscriber Confidentiality

Many wireless systems (i.e. AMPS, TDMA and CDMA, but not GSM) transmit a mobile's phone number with every access. This makes it relatively easy to track a cellular phone, and by implication, its user. The separation of MIN and MDN will somewhat reduce this loss of privacy, and the use of IMSI (which is already used in GSM), will reduce it even further. However, the MIN and IMSI are still uniquely tied to a subscrip-

tion and could be used by sophisticated people to track the users of mobile phones. A Temporary Mobile Station Identity (TMSI) can obscure the identity of a mobile. In most systems a TMSI has to be reassigned when a mobile changes systems, but CDMA systems (at least in theory) allow the TMSI to be retained across system boundaries.

This capability to hide the identity of a subscriber is described in TIA/EIA-664-802, and protocol modifications to allow the exchange of TMSI information are defined in IS-735. The feature is described in more detail in the December, 1997 issue of *Cellular Networking Perspectives*.

User Group

One way to reduce the overhead of personal wireless systems is to broadcast data that is of interest to multiple mobiles. This is used by the control channel for information about a system that is of interest to all mobiles, and is the intent of the Broadcast SMS standard (IS-824). This is also the aim of the User Group (UG) feature, that allows simultaneous paging of multiple TDMA mobiles that belong to an extension phone group. Unfortunately, this assumes that all members of the group are usually in the same cellsite, otherwise the overhead may actually be higher than paging each mobile separately.

The User Group service is described in TIA/EIA-664-535, and protocol modifications in IS-730. A more detailed description of this feature and its limitations is in the October, 1997 issue of *Cellular Networking Perspectives*.

What the Future Holds

The development of wireless features is far from over. There are a number of 2G features and capabilities that are not yet in TIA/EIA-664 (such as the broadcast short message service, IS-824), and a number that have not yet been completed. These may include:

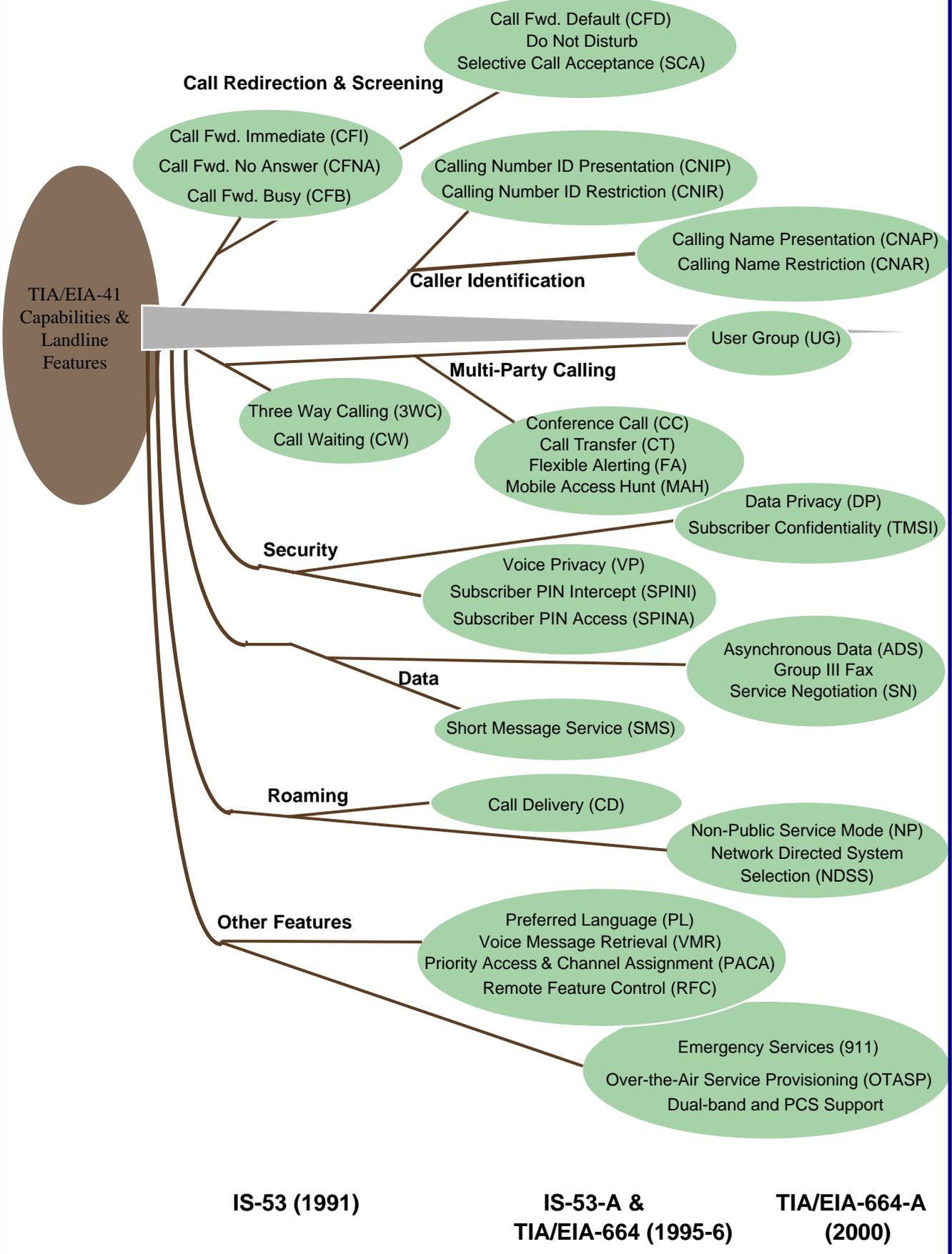
- Answer Hold.
The ability to place a call on hold before it is answered.

- Calling Party Pays
This feature is still on the books, but it appears that the industry has lost interest.
- Enhanced Security
The output of the ESA project to increase the security of wireless systems.
- Expanded ESN.
This project may be abandoned if the industry determines that a 32 bit ESN is satisfactory.
- Location Services.
Commercial services taking advantage of more accurate positioning mandated by the FCC E911 rulings.
- Optimal Routing
Bypassing the home system when routing to a roamer.
- Roamer Database Validation.
Allows an HLR to verify the information held by its roaming partners.
- Packet Data.
- User Selective Call Forwarding. The ability to forward an incoming call.

Other features and capabilities are not likely to be included for a variety of reasons:

- WIN features are classified as service drivers, with the intent that they be customized by carriers, rather than standardized.
- Lawfully Authorized Electronic Surveillance is kept separate because the protocol defined by J-STD-025 is not defined in the TIA/EIA-41 inter-system operations standard for security reasons.
- International Roaming.
At the time that projects for IMSI, global title, etc. were initiated, Stage I descriptions were not produced for network services.
- Number portability.
Requirements for this service are defined by FCC rule-makings (and, outside the US, by other regulatory agencies) and various industry forums.

Figure 2: Evolution of Wireless Features



TIA TR-45.4

Radio to Switching Technology Standards

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Editor: David Crowe • Phone +1-403-289-6609 • Email crowed@cnp-wireless.com

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Superseded Interim Standards and TSBs

Standard	Description	Published
TSB-80	IS-634-0 Addendum (corrections, SMS, subrate voice frame format)	11/96
IS-94	Mobile Station - Land Station Compatibility Specification for Analog Cellular Auxiliary PCS (CAPCS)	05/94
TSB-104	PCS Service Description (now IS-104 in committee TR-46)	06/94
IS-634-0	MSC-BS "A" Interface Standard	12/95
IS-634-A	MSC-BS "A" Interface standard, supporting analog, CDMA, SMS, data services, frame relay transport, and 1800MHz PCS	10/98
TIA/EIA-634-B	"ANSI" version of MSC-BS "A" Interface standard, supporting analog, CDMA, SMS, data services, frame relay transport, and 1800MHz PCS, with multiple sections: .000 - global references, definitions, terminology, purpose, scope, organization, conventions .100 - Common protocol .200 - Architecture A: SDU located at base station .300 - Architecture B: SDU located elsewhere .400 - Message, message element and timer definitions .500 - Interoperability between architecture A and B	08/99

Completed Internal Documents

PN	Description
PN-3142	Cellular Microcell/Microsystems Requirements Document (project transferred to TR-45.1)
PN-3296	MSC-BS Interface (A-Interface) Requirements for Public 800 MHz

Active TR-45.4 Projects

PN/SP	Description	Status	Standard
PN-3964	Use of A-Interface standards in Wireless Local Loop (WLL)	Project cancelled	
SP-4276	Fixed Wireless Access (Stage I Description)	Pending further review by CDG WLL	
SP-4377	Next revision of TIA/EIA-634 "A" Interface (including addendums & Japanese/Korean input)	Cancelled	TIA/EIA-634-C
PN-4378	Addendum to TIA/EIA-634-B to support TIA/EIA-136 (TDMA)	Cancelled due to lack of interest	TIA/EIA-634-B.x
PN-4379	Addendum to TIA/EIA-634-B to support TIA/EIA-95-B (CDMA). To be included in TIA/EIA-634-C	Incorporated into PN-4545	TIA/EIA-634-C
PN-4545	cdma2000 Access Network Interface based on CDG IOS V4	Ballot complete	IS-2001
PN-4546	cdma2000 Access Network Interface (ANSI version)	Development	TIA/EIA-2001
PN-4604	A bis (BTS-BSC) interface for cdma2000	Development	TIA/EIA-828
PN-4683	Tandem free operation (eliminates intermediate voice coders in mobile-to-mobile calls, when the same voice coder is being used by both mobiles)	Ballot due May 20, 2000	TIA/EIA-829

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

Thanks to Steve Jones (NEC) for his assistance compiling the information in this table.