Cellular Networking Perspectives

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Comments

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Next Issue: March 1st, 2001

Passing Through the GSM-TDMA Gate with GAIT

by Raul Cardenas
Ericsson

Current wireless technologies are developing new and novel features to offer to their growing number of subscribers. Each technology, like GSM, CDMA and TDMA, provides enough capacity to expand their capabilities and provide many new features. Now is also the time for interoperability between some of these technologies as they move toward a true global telecommunications world. Specifically, this interoperability is being realized for GSM and TDMA (ANSI-136) through an industry initiative known as GAIT.

GAIT is the GSM/ANSI-136 Interoperability Team, a forum created in March, 1999 to develop specifications for interoperability between two different networks: GSM and ANSI-136/ ANSI-41. GAIT provides the specifications for Handset, Network, and Testing, and guidelines for the implementation of GSM/ANSI-136 interoperability.

The scope of GAIT is to:

- Develop terminal and network functional requirements and specifications for the interoperability and interworking of GSM and ANSI-136 based cellular/PCS systems.
- Work with other industry bodies and the appropriate standards bodies to standardize the GSM/ANSI-136 interoperability service.

Specifications for Phase 1 of GSM/ ANSI-136 interoperability are complete. The specifications define the requirements for the network elements used for communications when a subscriber of one network type (e.g., ANSI-41) roams to a network of another type (e.g., GSM). The key network element to achieve this roaming is called an Inter-working and Interoperability Function (IIF). The IIF maps message flows between GSM Mobile Application Part (MAP) and ANSI-41 MAP. The IIF supports a multi-mode mobile station with a removable Subscriber Identity Module (SIM).

Figure 1 illustrates the interoperability of GSM and ANSI-136.

GGRF: GSM Global Roaming Forum

GAIT was a leader in the development of interoperability with GSM. More recently, the GSM association has created GGRF with a mandate to develop interoperability with several technologies. Apart from GAIT, which is now part of GGRF, interoperability with the following other technologies is also being studied:

- CDMA, through the group known as G95.
- iDEN, the ESMR technology used by Nextel among others.
- TETRA, a European trunked radio standard.

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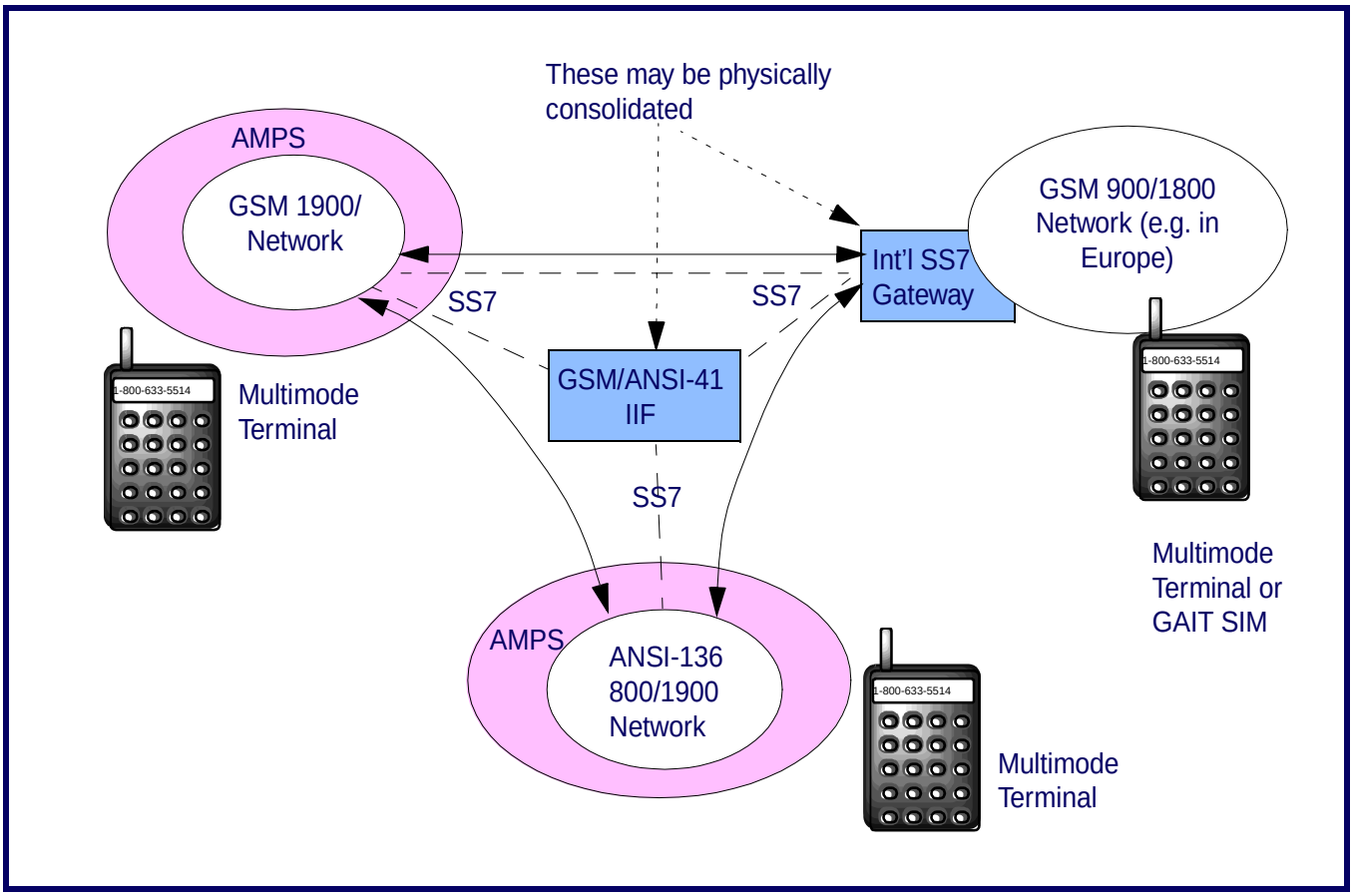
Figure 1: GSM/ANSI-136 Interoperability - Phase 1



Reference Model

The IIF provides a signaling control interface between TIA/EIA-41 and GSM network entities. This interface (illustrated in Figure 2) is provided to enable service access when a subscriber operates in a foreign network whose signaling protocol is different from the home network's protocol.

Provisioned Subscriber Data

Some basic subscriber identity information must be provisioned in the IIF to support this mapping process, such as the International Mobile Subscriber Identity (IMSI) used in GSM mode, the Mobile Identification Number (MIN) used in ANSI-136 mode, and the Electronic Serial Number (ESN) of the mobile equipment. Authentication and encryption services are also critical functions network interoperability must support. For subscribers homed to an ANSI-136 network, the ANSI-41 Authentication Center (AC) will contain the ANSI-41 specific authentication data (A-Key) and the IIF will contain the GSM specific authentication data (Ki). Conversely, for subscribers homed to a GSM network, the GSM AuC will contain the GSM specific authentication data and the IIF will contain the ANSI-41 authentication data.

Key Capabilities

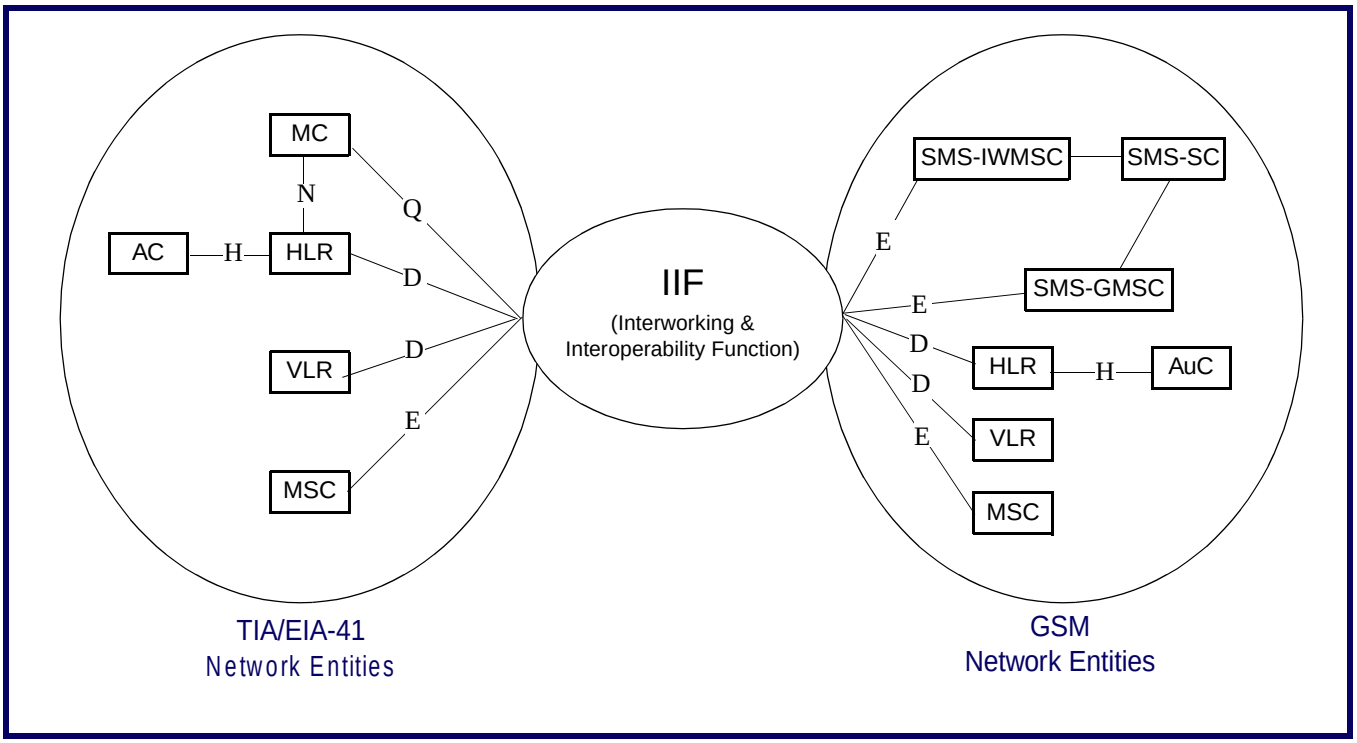
GAIT Phase 1 defines the following capabilities:

- A multi-mode mobile station providing operation across GSM (900, 1800, and 1900 MHz), ANSI-136 (800 and 1900 MHz), and AMPS (800MHz) systems.
- A common automatic network selection algorithm with carrier defined priorities.
- Handoff only between similar technology (GSM to GSM, and ANSI-136 to ANSI-136).
- Automatic registration and de-registration.
- Authentication in all modes.
- Encryption in all digital modes.
- SIM-based roaming in both GSM and ANSI-136 mode.
- Automatic call delivery.
- Transparent use of supplementary services across GSM and ANSI-136 mode of operation, including call forwarding, call waiting, three way calling, and messaging.
- Call barring support within the capability of existing standards.
- Optimal routing for late call forwarding.
- Mobile-originated and mobile-terminated short message service.
- Message waiting notification.
- Over-the-air activation (OTA) and programming.
- Circuit and packet data modes, subject to the status of standards and network readiness.

The Future

GAIT provides a new window for developing interoperability between GSM and

Figure 2: IIF Signaling Control Interface



ANSI-136. Some of the features GAIT is investigating for future specification development are shown in Table 1 below.

Table 1: Possible Future GAIT Features

Feature/Functionality
WAP and Microbrowser Interoperability
Packet Data Interworking
CAMEL/WIN Interoperability
Improved Supplementary Services Interworking
Improved SMS Interworking
Improved ITU and ANSI SS7 Interworking
Compatibility of Government-Mandated Capabilities
SIM Toolkit Enhancements

About the Author

Raul Cardenas is a Senior Software Engineer at Ericsson, and he is the Ericsson representative at the TR-45.2 E911 ad hoc as well as GAIT.

Until six years ago, Raul's work for Ericsson was in software development for TDMA and CDMA; he was also involved in quick product introduction efforts for specific markets.

His work with GAIT and E911 is a result of his efforts with "TDMA MSC" developments, which began 6 years ago.

Raul holds a degree in Computer Science Engineer from the State University in Saltillo, Mexico.

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FCC Action on Wireless Emergency Services Access for the Deaf

Jake Wolski

In its First Report and Order on E-9-1-1, the Federal Communication Commission (FCC) required all wireless carriers to be capable of transmitting 9-1-1 emergency calls on their networks using the TTY devices to accommodate individuals with speech or hearing disabilities. This requirement became effective on October 1, 1997. However, at that time, carriers operating digital wireless systems were unable to comply because they could not pass the Baudot-encoded audio tones produced by TTY devices.

Solutions and Deadlines

Recognizing this difficulty, the FCC suspended the TTY requirements for digital wireless carriers until December 31, 1998. Wireless carriers and manufacturers worked hard to develop efficient and compatible solutions to enable TTY users to make 9-1-1 calls on digital wireless networks. Lucent's solution has been adopted by CDMA and TDMA (ANSI-136) standards bodies, Ericsson has submitted a solution for the GSM standards body for which approval is expected, while Motorola is developing yet another solution for its proprietary iDEN technology used by Nextel and other E-SMR operators.

The March, 1999 and January, 2000 issues have more detailed descriptions of these solutions.

On December 14, 2000 the FCC released the Fourth Report and Order on TTY, establishing December 31, 2001 as the proposed deadline for implementation of digital wireless TTY solutions. Based on opposition to this deadline from some carriers and manufacturers, particularly in the GSM and iDEN communities, the FCC permitted an additional six months for carriers and public safety communities to integrate, test and

deploy the technology in their systems. June 30, 2002 is the new deadline for carriers to enable TTY signals to be transferred over digital wireless systems. Carriers must submit quarterly progress reports to the FCC, covering all of the digital cellular or PCS technologies they support.

Remaining Issues...

The FCC still has concerns that devices operating on higher speed proprietary protocols such as Turbo Code and HiSpeed will still not work with digital wireless phones. These protocols were widely adopted due to their throughput improvements and their ability to allow for conversation interruption. They worked well on analog wireless networks, but when used on digital networks, they sometimes failed partially or completely. The FCC has directed the industry to study support for these protocols.

Another problem to be studied is the availability of accessories to support voice carry over (VCO) for wireless E911. This is a form of telecommunications relay service (TRS), giving the person with the hearing disability the ability to speak directly to the other end user. The communications assistant (CA) types the response back to the person with the hearing disability. This requires both the microphone and TTY device be active at the same time. A push-to-talk button may be a solution.

Some phones do not allow both an audio jack and power adapter to be used at the same time. The FCC has requested that affected manufacturers resolve this issue.

Consumer advocates have also complained that analog service plans are not always as economical as digital plans. The FCC has requested carriers should ensure compatible pricing at least until digital wireless TTY service is widely available.

Obtaining the Report

The FCC's Fourth Report and Order on TTY and Wireless Systems is available at:

www.fcc.gov/Bureaus/Common_Carrier/Orders/2000/fcc00436.pdf

The document is also available in '.txt' (plain text) and '.doc' (Word 97) file formats.

Review of "Wireless Intelligent Networking"

P.J. Louis

Wireless Intelligent Networking, by Gerry Christensen, Paul G. Florack, and Robert Duncan is about the next generation wireless network – WIN.

The book starts off with an introduction to wireless communications, explaining the basics of mobility. It continues with a solid in-depth review of the standards arena and an explanation of the types of standards currently being developed.

Part one of the book also contains an overview of basic out-of-band signaling. The authors clearly understand that the current work on intelligent networking has its roots in "old time" out-of-band signaling techniques. A quarter of the book is spent establishing a foundation of understanding for the reader.

Part two starts with an explanation of the origins of wireless intelligent networking (WIN), including its various evolutionary stages. This part of the book also defines WIN by comparing it to fixed intelligent networking (IN or AIN).

Part three provides an overview of business issues in the wireless space. This is illuminating, for it provides the engineer with the reasons why carriers and other telecom players make technology choices. To many engineers, the best technical solution should dictate what is built and sold; in reality, that is untrue. The market dictates what is built and sold. If the providers and manufacturers are successful in their marketing efforts, the consumer might be convinced a new product is something they have always wanted and cannot live without it. The bottom line…the ones with the money decide what is successful and what is not; these people are called customers. Part three also includes a chapter on value creation, from the perspectives of both technology development and business development.

Part four gives the reader a more detailed view of the evolution of WIN. This part also provides a view of wireless intelligent networking trends.

If you are looking for a book on Fourier analyses for the engineering masses, this is not the book for you. It is not a text book, either. The book is intended for the technical audience. However, the book can be read and understood by a less technical audience as well.

Most published telecommunications books read like text books. The audience for those books is comprised of those who are performing detailed engineering work in the specific field. Such books have no value beyond pure instruction. Today, there is a plethora of books on the topic of intelligent networking; so many exist, and yet it appears none add any real value to the telecommunications professionals' development.

What I found interesting about "Wireless Intelligent Networking" is it provided both a technical and a business view of wireless intelligence. The book provides the reader a solid foundation for learning what wireless intelligent networking is and what it will become. The authors have laced the book with their own views, unobtrusively, but these opinions are their own, based on their experiences (and experiences of others) and the activities taking place throughout the telecommunications industry.

I would like to point out that few telecom professionals have ever acknowledged the origins of intelligent networking. Many people in the field have acted as if intelligent networking began in the mid-1980s, when Bell Communications Research (Bellcore) developed IN1. However, to the authors' credit, they acknowledge the existence of the concept of intelligent networking back even further, beginning with switchboard operators and transitioning through to the development of automatic call processing and switching. To the reader, this means the authors have taken the pain to provide a balanced view of intelligent networking.

The telecommunications professional entering the wireless intelligent networking arena for the first time will find the book a great introduction to the field. To the "old timers" of wireless intelligence, this book will serve as a good reference.

Wireless Intelligent Networking (ISBN: 1-58053-084-2) was written by Gerry Christensen, Paul G. Florack, and Robert Duncan and was published by Artech House in 2000. Contact major booksellers or go to:

www.artechhouse.com

About the Author

P. J. Louis is the author of "Telecommunications Internetworking", "M-Commerce Crash Course" and "Delivering Telecom Services - Mining The Network Value". He currently works at TruePosition.

TIA TR-45.2 Wireless Network Standards

Cellular Networking Perspectives

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Note: 1. IS- Interim Standard, TSB- Telecommunications Systems Bulletin, PN- 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 TIA at www.tiaonline.org/standards/search_n_order.cfm.

Superseded Interim Standards

Standard	Description	Status
IS-41-C	Cellular Radio Telecommunications Intersystem Operations	Published 02/96
IS-52-A	Uniform Dialing Procedures for use in Cellular Radiotelephone Systems	Published 03/95
IS-53-A	Cellular Features Description	Published 04/95
IS-725	IS-41 support for Over-the-air Service Provisioning (OTASP)	Published 09/97
IS-756	Wireless Number Portability (WNP), Phase I (database query)	Published 04/98
TSB-29-A	International Implementation of Cellular Systems Compliant with TIA-553	Rescinded
TSB-29-B	International Implementation of Wireless Systems	Rescinded
TSB-29-B.1	TSB-29-B addendum including IFAST#6 updates (11/97)	Rescinded
TSB-29-B.2	TSB-29-B addendum, including IFAST #7 updates (02/98)	Rescinded
TSB-29-C	International Implementations of Wireless Systems	Published 09/99
TSB-41	Technical Notes for IS-41 Revision B	Published 11/94
TSB-51	Inter-System Authentication, Signaling Message Encryption and Voice Privacy	Published 05/93
TSB-55	IS-41 Rev. A/B Forward Compatibility ("Tech Notes")	Published 05/94
TSB-64	Wideband Spread Spectrum Intersystem Operations	Published 02/94

ANSI Standards and Annexes

ANSI Std.	Description	Status
TIA/EIA-41-D	Intersystem Operations	Published 12/97
TIA/EIA-93-A	Ai and Di Interfaces Standard (including 9-1-1 Phase I cell/sector location)	Published 11/98
TIA/EIA-124-B	Cellular Inter-System Non-Signaling Data Communications	Published 07/99
TIA/EIA-124-C	**Support for WIN and CIBERNET NSDP-B-and-S protocol**	**Published 08/00**
TIA/EIA-660	Cellular Dialing Plan (formerly IS-52)	Published 07/96
TIA/EIA-664	Cellular Feature Descriptions (formerly IS-53)	Published 06/96
TIA/EIA-664-A	Cellular features Stage I description (formerly PN-3362)	In press

Published TIA/EIA Interim Standards

Standard	Description	Status
J-STD-025	CALEA surveillance support (joint with ATIS T1) - interim standard	Published 12/97
J-STD-025-1	**Addendum to J-STD-025**	**Published 07/00**

J-STD-025-2	**Addendum to J-STD-025-A**	**Published 07/00**
J-STD-025-A	**CALEA surveillance support (joint with ATIS T1) including FCC Report and Order requirements**	**Published 05/00**
J-STD-034	Enhanced Wireless 9-1-1, Phase I: identify mobile and cell/sector location	Published 12/97
J-STD-036	**Enhanced 9-1-1 (E911), Phase II (125 m. location accuracy)**	**Published 08/00**
J-STD-036-1	**Corrected and enhanced emergency services support for SMS, inter-system handoff and SAMPS**	**In press**
TIA/EIA-664-536	Analog Group III Fax for CDMA Wireless Local Loop Systems (Stage I description)	In press
IS-725-A	IS-725 enhanced to include Over-the-air Parameter Administration (OTAPA)	Published 07/99
IS-728	Inter-System Link Protocol (ISLP). Supports data calls after inter-MSC handoff.	Published 04/98
IS-730	TIA/EIA-41 Support for IS-136 DCCH (TDMA digital control channel)	Published 10/97
IS-735	TIA/EIA-41 Support for IS-95-A (advanced CDMA)	Published 02/98
IS-737	TIA/EIA-41 support for circuit switched data services for CDMA and TDMA terminals	Published 05/98
IS-751	TIA/EIA-41 support for International Mobile Station Identity (E.212 IMSI)	Published 02/98
IS-756-A	Wireless Number Portability (WNP), Phase II (MDN/MIN separation to allow porting to or from wireless phone numbers)	Published 12/98
IS-764	Calling Name Presentation/Restriction (Stage II, III)	Published 06/98
IS-771	**WIN (Wireless Intelligent Network) Phase I: voice controlled services and call screening**	**Published 07/99**
IS-778	Authentication enhancements	Published 03/99
IS-807	Internationalization of TIA/EIA-41	Published 08/99
IS-807-1	Updates global title translation types in IS-807	Published 06/00
IS-812	TIA/EIA-41 message segmentation (to overcome SS7 network packet size limitations)	Published 08/99
IS-824	**Broadcast/Multicast Short Message Service (BTTC)**	**Published 11/99**
IS-826	**WIN Phase II: Prepaid calling**	**Published 09/00**
IS-837	**Answer Holding (AH)**	**Published 07/00**
IS-838	**User Selective Call Forwarding (USCF)**	**Published 08/00**
IS-841	**MDN Based Message Centers**	**Published 09/00**

Current Telcommunications Systems Bulletins

TSB	Description	Status
TSB-29-C-1	Addendum to international Implementations of Wireless Systems	Published 12/99
TSB-56-A	Application Level Testing for IS-41 Rev. B, IS-53 Rev. 0 and TSB-51	Published 06/94
TSB-76	PCS Multi-Band Support	Published 09/96
TSB-114	Broadcast of emergency alert messages to wireless phones (EAS)	Published 12/99

Balloting TR-45.2 Projects

Standard	Project	Description	Status
J-STD-025	**PN-4846**	**ANSI version of J-STD-025**	**On hold**
J-STD-025-A	SP-4464	ANSI version of J-STD-025-A. May be published (with revisions) following next FCC report and order	On hold
IS-786	**PN-4410**	**Automatic Code Gapping (ACG) Overload Control**	**In press**
IS-808	**PN-4582**	**User Identification Module (R-UIM) for use in 3G systems**	**In press**
IS-848	**PN-4289**	**WIN Phase II: Premium Rate Charging, Wireless Freephone**	**In press**
TSB-124	**PN-4871**	**Support for WIN Prepaid (IS-826)**	**In press**

Developing TR-45.2 Projects

Standard	Project	Description	Status
TIA/EIA-41-E	PN-3590	Intersystem Operations	Development
TIA/EIA-93-B	**PN-3295-RV2**	**Ai and Di Interfaces Standard (including JIP and 9-1-1 Phase II location). Formerly PN-4206**	**Ballot 01/01**
TIA/EIA-124-D	PN-4853	Further enhancements to call detail and billing records	Development
IS-843	PN-4818	WIN Phase III: location based services	Development
IS-847	**PN-4785**	**VLR Roamer Database Verification (RDV)**	**In press**
IS-847-A	**PN-xxxx**	**RDV, allowing MDN range verification and query of nodes other than VLR**	**Development**
IS-868	**PN-4925**	**SIM roaming from TIA/EIA-41 (CDMA) to GSM**	**Development**
IS-872	**PN-4934**	**IP core network support for legacy mobiles**	**Development**
IS-873	**PN-4935**	**IP core network support for multimedia terminals**	**Development**
IS-875	**PN-4863**	**Network based enhancements for international dialing, calling number id and callback**	**Ballot**
TSB-29-C.2	**PN-4761**	**Addendum to International Implementations of Wireless Systems**	**Project cancelled**
TSB-29-D	**PN-4609-RV4**	**TSB-29 revision with IFAST-assigned IRM codes removed**	**In press**
	PN-4284	TIA/EIA-41 and TIA/EIA-124 modifications for expanded ESN (Electronic Serial Number)	**Cancelled**
	PN-4288	Enhanced Emergency Services (E9-1-1), Phase III: Optional features beyond FCC mandate	Development
	PN-4392/3	Enhanced Security (authentication and encryption) for TIA/EIA-41	Development
	PN-4610	**Optimal routing to roamers.**	**On hold**
	PN-4616	3G circuit switched data	**Cancelled**
	PN-4720	Intersystem support for 3G packet data, Phase I	Development
	PN-4746	Location services authentication, privacy and security. Merged with PN-4747	Project cancelled
	PN-4747	Location service enhancements, including security	Development
	PN-4755	Intersystem support for 3G packet data, including simultaneous voice and data	Development
	PN-4762	**Using IP as transport for TIA/EIA-41 messages**	**Development**
	PN-4926	**CDMA roaming between GSM and TIA/EIA-41 networks**	**Development**
	PN-4927	**Interworking and interoperability (IIF) enhancements to support IS-868**	**Development**