Cellular Networking Perspectives

David Crowe [Editor] • Phone 1-403-289-6609 • Fax 403-289-6658 Vol. 6, No. 7 July, 1997

In This Issue ...

Cellular Networking Perspectives is available by Email!

To receive your issues via email, simply call 1-800-633-5514 or email us at cnpsales@cnp-wireless.com.

Next issue due: August 4, 1997

New Book Fills IS-41 Information Void

The following review of "Mobile Telecommunications Networking With IS–41"was written by Harry Young, a consultant for Strategis, well known for his expertise on wireless/wireline interconnection and in many other areas. The book (ISBN 0-07-063314-2) was published by McGraw-Hill.

Although the IS-41 standard facilitates the virtually ubiquitous, seamless wireless service that is enjoyed by millions of subscribers, it has remained an obtuse subject. Developed by a small group of people within the TR-45.2 standards subcommittee sponsored by the Telecommunications Industry Association (TIA), almost all of the information pertaining to this standard was limited to the massive, and not always easy to understand, official documentation published by the TIA. This presented a daunting task to those outside of the standards development group who wished to have a better understanding of how this complex protocol functions. Now, thanks to a new book by Michael D. Gallagher and Randall A. Snyder entitled "Mobile Telecommunications Networking With IS-41", that task has become infinitely easier.

Having been involved in the development of the IS-41 standard, Gallagher and Snyder have used their experience to explain this complex standard in a fashion that will be useful to engineers and non-engineers alike. For example, there is a process that is used by different standards bodies to describe relationships between functional entities and to diagram information flows. To illustrate this concept, the authors employ the simple, non-telecommunications, task of trash collection to demonstrate the functional entities and information flows involved in the process.

With the latest version of IS-41, now known as ANSI/TIA/EIA-41, covering over 1500 pages, the standard itself is obviously complex and all of the details could not be reasonably captured in a single book. The authors acknowledge this, as well as the fact that any standard is subject to interpretation. Nonetheless, Gallagher and Snyder provide a wealth of information about the major functions of IS-41. Separate chapters are devoted to functions such as call processing, intersystem roaming, authentication, and short messaging service (SMS). Within each of these chapters, many different applications of the standard are explained using diagrams that illustrate the information exchanged for a given situation. For instance, during the process of authenticating a roaming subscriber, the information exchanged depends on whether the systems will share SSD (Shared Secret Data) or not. These differences are readily identifiable to the reader because of the way the authors have presented the material.

A lot of other subtle, but important, data are contained within the 417 pages of this book. Earlier versions of IS-41 use an SS7 standard that exis-

Cellular Networking Perspectives (issn 1195-3233) is published monthly by Cellular Networking Perspectives Ltd., 2636 Toronto Cr. NW, Calgary AB, T2N 3W1, Canada. Phone: 1-800-633-5514 (+1-403-274-4749). Fax: +1-403-289-6658. **Subscriptions**: CDN$300 in Canada (incl. GST), US$300 in the USA and US$400 elsewhere. Payment by cheque, American Express or Visa. **Delivery:** Email, fax or 1st class mail. Additional charges apply for international fax delivery. **Copies:** Each subscriber may make up to 10 copies of each issue. Rates are available for more copies. **Discounts:** Educational and small business discount: 25% off any order (no fax delivery). **Back Issues:** Available individually for $35, or in bulk at reduced rates. **Email:** cnpsales@cnp-wireless.com **Web:** http://www.cnp-wireless.com/. **Language Editions:** English - Español.

ted in 1988 when an early version, IS-41A, was developed. The SS7 standard itself was revised in 1992 and even though the latest version of IS–41 was not approved until 1996, it also uses the 1988 version of the SS7 standard. As explained by the authors, this was done for three reasons: First, the later version of the SS7 standard is not completely backward compatible with earlier versions. Secondly, the later version specified a function called Intermediate Signaling Network Identifier (INSI) that the TIA deemed undesirable. Finally, a number of features in the latest SS7 version have not been implemented in the public SS7 networks. Although it is not intended as a tutorial for SS7, the chapters on IS-41 network interoperation with other networks and IS-41 implementation provide some excellent explanations of SS7 architectures and protocols.

While its title would suggest that the book is devoted to IS-41, the book also provides useful information on basic mobile telecommunications, network signaling, mobility management, mobile network functional entities, and the standards process itself. These chapters are helpful to the reader in understanding how the IS–41 standard fits into the entire mobile environment.

Gallagher and Snyder explain in the preface of the book that they hoped the book would expand the knowledge of IS-41 beyond the few people in the standards group who developed the standard. Another objective was for the book to serve as a reference source for software developers, executives, engineers, and marketing managers. Did they achieve these objectives?

In this reviewer's opinion, "Mobile Telecommunications Networking With IS-41" fills an information void by providing a nice balance between technical detail and simplicity. There is enough technical detail in the book to satisfy most people who already have some knowledge of IS-41 but, at the same time, the text is straightforward enough so that other readers will not be overwhelmed. For anyone who needs to understand how seamless service is possible through IS-41, this book is a required reference source. There just isn't a viable alternative!

Harry E. Young is a Consultant To The Firm and Member Of The Board of The Strategis Group (formerly MTA-EMCI). In that capacity, he participates in due diligence reviews and provides advice on interconnection issues, new wireless services, economic analyses, regulatory assistance, plus technology and strategic planning. Harry has published a book on wireless services entitled *Wireless Basics* (now in its second edition), was a contributing writer for *The Electronics Handbook*, is a frequent speaker at industry events, and has conducted a number of public seminars on wireless interconnection. Harry can be reached at +1-404-255-2698 or heyoung@msn.com.

MIPS: Mobile Internet Phone Services Forum

John McQueen, formerly director of the TDMA Forum, is now leading a new group dedicated to promoting the development of internet access technologies, services and features from mobile devices. John can be reached by phone at +1-330-833-8690 or by email at 102437.1401@compuserve.com. The MIPS web site can be reached via our links, listed under "Technology Forums" at

http://www.cnp-wireless.com/pointers.html.

"The goal of the Mobile Internet Phone Services (MIPS) Forum is to promote the development of information services delivered to mobile appliances ranging from pagers to high end cellular smart telephones. This promotion will include market education and publicity, but the principal function of the Forum will be the development of a uniform standard for application-level interfaces in handsets and infrastructure equipment. These standards will encompass a variety of equipment types and will span all major air interface standards including AMPS/NAMPS, GSM, IS-136, IS-95, as well as future 3rd generation systems. The membership of the Forum will include wireless service providers as well as equipment vendors, semiconductor companies, software and content providers, as well as potential major end users. The scope of the Forum is international and efforts will be made to recruit membership in Europe, Asia, and Japan."

WIN Part IV: Our Score Card

We have summarized the capabilities and characteristics of the developing Wireless Intelligent Network (WIN) standard (TIA project PN-3661) in the March, April and June 1997 issues. We conclude by examining how well WIN scores points against the requirements defined by the CTIA in their November 1994 Standards Requirements Document (SRD) that initiated the development of WIN:

- No need to standardize new features (by using call models and trigger points).
- Facilitate interoperability between network elements.
- Facilitate interworking with IN.
- Seamless service while roaming.
- Personal and Terminal mobility.
- Coexistence of WIN and MSC-based (IS-53) features.
- Support for CALEA/SP-3580 (see related article on Page 5).
- Support for Enhanced 9-1-1.
- Forward Compatibility

Other requirements that can be inferred from the development of WIN or from statements by industry leaders are:

- Taking the HLR out of the service processing loop.
- Separating service logic (SCP) from resource management (IP).
- International Consistency

No Need to Standardize Features

With WIN there is no need to standardize features in industry documents, such as TIA IS-53. But, ironically, there never was any need to do this! MSC-based features defined in IS-53 are supported by the IS-41 protocol, however the feature definitions just serve as descriptions of a capability, there is plenty of room for carriers to implement features differently. For example, IS-53 describes a single call forward number for each type of call forwarding, but multiple call forward numbers are certainly possible.

A second irony is that WIN has described three features (incoming call screening, voice controlled services and calling name presentation/restriction) in significantly more detail than is necessary to develop the underlying WIN capabilities.

Much is made of the benefits of the Call Model and Trigger Points in achieving the goal of allowing each carrier to develop features independently that can still interwork. However, the call model is of little value unless a standardized Service Creation Environment exists (and this is not on the WIN workplan).

Triggers do not allow carriers to "draw outside the box", they only allow the use of different colors within the box. Carriers trying to develop truly new features will find they either need new triggers defined or that they need new information exchanged at the trigger point.

Score: Achieved by default.

Facilitate Interoperability

WIN has gone some way to defining interoperability between network elements (MSC, HLR, SCP and IP). However, some interfaces (e.g. HLR-SCP) contain a number of messages that are only partly defined, leaving much to proprietary protocol development. The SCP-IP interface is likely too complex to be practical.

Score: Partially achieved.

Facilitate Interworking with IN

WIN is not directly interoperable with IN, however there is nothing to stop a WIN-capable network element from also supporting IN protocols.

Score: Achieved by default.

Seamless Service

A long term goal of the CTIA has been to ensure seamless service for cellular subscribers. This creates a conundrum for WIN. If services are controlled by the serving system then home system or carrier specific services will not work. If services are provided by the home system, then a standard signaling interface needs to be defined, and a trunk back to the home system will be needed if the feature requires a user dialog.

WIN provides basically the same two solutions for this problem as IS-41 Rev. C. One solution is to have the serving system provide resources (such as announcements) under the control of the home system. This solution provides support for simple features, but does not support features such as speaker dependent voice recognition. A second solution is to simply allocate a trunk to a home system controlled resource. Both solutions support redirection following any dialog that takes place.

One enhancement beyond IS-41 Rev. C is the ability to provide services from an external SCP (i.e. other than the HLR).

Score: Achieved by inheritance from IS–41 Rev. C.

Personal and Terminal Mobility

Personal mobility is usually illustrated by GSM, which keeps personal (subscription) information on a "Smart Card" and in the HLR, and terminal information in an EIR and in the phone. Consequently, any phone can be personalized simply by the insertion of a card.

"AMPS" based systems can also provide personal mobility, although not in such an exotic fashion. The trick is to separate the MIN (terminal identification) from the MDN (subscription identification). IS-41 Rev. C services for extension phone service (known as *Flexible Alerting*) and hunt groups (known as *Mobile Access Hunting*) illustrate the possibility of having a personal number that maps onto multiple phones (not necessarily all wireless devices). Although less advanced in development than the relatively mature GSM Smart Card approach, better control over the terminal is provide for such mundane matters as fraud and theft management.

WIN simply extends the capabilities of IS-41 Rev. C in this area.

Score: Achieved by inheritance from IS–41 Rev. C.

Coexistence of WIN and MSC-based Features

WIN features can only coexist with traditional features if they agree not to manipulate the same data. For example, if a subscriber can activate and deactivate call forwarding either with *XX… feature strings (an MSC-based feature) or with voice commands, a significant problem arises with updating the HLR information while maintaining the consistency of the data.

WIN allows two partially satisfactory solutions, one inherited from IS-41 Rev. C and one new, but both incomplete. The first solution is to simply have the SCP/SN translate commands into *XX… feature codes and send them to the HLR. This limits feature processing to whatever can be specified by *XX… commands, and does not allow access to HLR data (e.g., consider the spoken command "Tell me my call forward number").

The second solution, first provided by WIN, is to use the Search and Modify operations to get information from the HLR database or to update it. While these commands sound very powerful, the contents of the messages are undefined, requiring a proprietary HLR-SCP interface definition to be usable.

Score: Partially achieved by inheritance from IS-41 Rev. C or by proprietary extensions.

Support for CALEA and Enhanced 9-1-1

WIN was envisioned before CALEA (US Communications Assistance for Law Enforcement Act) and Enhanced 9–1–1 requirements were fully defined. Now that standards for these capabilities are nearing completion, it is obvious that no support from WIN is required. CALEA does not affect WIN interfaces for security reasons (a surveillance flag in any inter-system messages would be a red flag indeed!) nor does Enhanced 9-1-1 (for performance and availability reasons). WIN only needs to avoid interfering with these capabilities.

Score: No longer a requirement.

Forward Compatibility

It is important for WIN to be developed in stages. New capabilities in WIN should fail gracefully when communicating with network elements that are at a lower revision level. This is a standard IS-41 requirement, although determining whether it can be achieved by WIN will have to wait until a second phase of development.

Backward compatibility with IS-41 was not listed in the CTIA SRD. However, this is obviously a requirement. When some network elements cannot support WIN, they should be able to inform the user that advanced services are not available, or default to less sophisticated services.

Score: Too early to tell.

Taking the HLR Out of the Loop

A requirement that was not listed in the CTIA SRD, but that has been verbally provided by carriers on numerous occasions, is to remove service logic for new features from the HLR. This is both to prevent HLR overload and to achieve the perceived benefits of the new open interface that is provided.

It is not clear that HLR capacity is a significant issue, because it is relatively easy for blocks of subscribers to be moved to a new HLR if overload occurs.

Taking the other benefit, of open interfaces, at face value, WIN has been able to provide this for mobile originated services (based on triggers that can direct signaling messages to an SCP) but cannot for incoming calls. In fact, for incoming calls the count of messages that must be processed by the HLR is greater with WIN, than without. Given the known complexity of handling TCAP formatted messages, the overhead of handling WIN features on incoming calls (e.g. Incoming Call Screening) may be greater than the savings provided by off-HLR processing.

For all WIN features, HLR or MSC support (or both) for each new trigger and for every new trigger parameter is required, putting a significant crimp on the ability to add new features without modifying the traditional network elements.

Score: "B" for mobile originated WIN features, "D" for mobile terminated.

Separating Service Logic from Resource Management

An implied requirement in WIN is the separation of service logic (in an SCP) from resource management (in an IP) as an alternative to the combined approach (in an SN). This is defined in WIN, but we do not believe that this is a practical approach, for two main reasons:

i. A modern user-driven user interface requires that service logic is driven by user inputs. It is impossible for the SCP to tell the IP what to do next when it is up to the user to choose!

ii. Resource management for most new features that will provide a marketing advantage by turning the heads of users will require large amounts of software. Adding dialog or database management is too trivial a task, in comparison, to justify a standalone network element.

Other reasons to question this requirement include the overhead of the interface and the necessity to define every dialog element twice (e.g. add a voice prompt to the IP database, with a numeric identification, and then add the numeric announcement identification to the appropriate step in the SCP dialog).

Score: Should not be a requirement.

International Consistency

A long term goal of WIN is to promote international consistency between the various IN standards. The benefits of this will be more consistency between the services provided by the GSM and "AMPS" family of wireless devices. This will be particularly important as multi-mode phones become available. Before this requirement becomes important, WIN will have to prove itself as a competitive advantage.

Score: Too early to tell.

Conclusion

WIN, like ISDN before it, is an idea that has been eclipsed by its own problems and the ability of entrepreneurs (e.g. AccessLine, Wildfire etc.) to provide solutions to the marketplace faster and with greater power and flexibility. The fact that WIN may be a more "elegant" solution will likely be lost on consumers. Even the carrier-perceived drawbacks of proprietary solutions, such as the lack of integration with the network and the need to route trunks through a custom switch are actually advantages to the user of these services. The lack of integration minimizes the time-to-market of new features, while the need to route trunks to these systems allows for enhanced features, such as the ability to handle voice commands at any time in a call.

US Law Enforcement Surveillance Standard Part I: Overview

We reported about the controversy surrounding the ongoing ballot of SP-3580 in the June 1997 issue. This standard is being designed to allow carrier conformance to the capability requirements of the 1994 US CALEA law.

Standards & Technologies

SP-3580 will apply to all wireless technologies, with active representation by manufacturers and carriers representing AMPS (analog and digital) and GSM. More notability, LAES is unique because it is the first network capability applicable to wireline systems that is being driven by a wireless standards committee. This may provide a coup of sorts for the TIA TR-45.2 standards subcommittee if it ever gets published in the face of opposition from the law enforcement community, and if wireline carriers decide to build to the standard.

This standard is also unique in another way, being probably the first publicly available surveillance standard (as mandated by the US CALEA law). While this may seem crazy, good methods of surveillance should be like a good encryption algorithm - access to the algorithm should not allow access to the secrets being protected.

SP-3580 is being developed for ANSI (American National Standards Institute) standardization, to avoid the appearance of bias towards any particular technology. If published, it will be known by the TIA and ATIS as ANSI J-STD-025.

Note: This discussion is based on an unpublished ballot document. Due to the controversial nature of this proposed standard, there is a reasonable possibility that significant changes will be made before publication or even that the document will never be published.

Transparency

Surveillance can only be effective if it is invisible to the intended target. This requirement for transparency puts severe limitations on the LAES standard for monitoring voice information, which is required in a minority of surveillances (known as a "Title 3"). Voice ("call content") monitoring must occur without extraneous noises or noticeable delays in call setup. Noises are easily prevented with digital technology, but delays are harder to eliminate. The most likely setup will be for voice monitoring to be transmitted on dedicated trunks (CCC) with virtually no setup delay. Call identifying information can be carried on a separate datalink (CDC), possibly at a slightly later time.

Other alternatives for preventing noticeable delays to the target of surveillance allow the provision of call identifying information and surveillance circuit setup prior to delivery of call contents. One approach is to clip the call contents, although this will probably not be satisfactory to law enforcement. Another approach is to buffer the call contents until setup is complete, and then deliver the voice with a time delay. This will probably not be satisfactory to the carriers, because of the cost of providing buffers on every CCC.

SP-3580 Glossary

AF	-	Access Function (location of IAP).
CALEA	-	Communications Assistance for Law Enforcement Act.
CCC	-	Call Content Channel Carries the voice or data being transmitted and received by the surveillance target.
CDC	-	Call Data Channel Carries information related to a call being monitored.
CF	-	Collection Function (within law enforcement agency).
DF	-	Delivery Function (within TSP).
IAP	-	Intercept Access Point A logical entity where communications are accessed.
LAES	-	Lawfully Authorized Electronic Surveillance (informal name for SP–3580).
SP	-	ANSI Standards Proposal.
TSP	-	Telecommunications Service Provider (carrier).

Security

Surveillance must not only be transparent to the intended target, but also (by law) must be available only to employees of a carrier who have a "need to know". Consequently, information about surveillances must not be included in existing protocols (such as IS-41, IS-93 or IS-124). This also forces separate surveillances from physically separate devices (e.g. multiple MSC's serving one market).

Interfaces

SP-3580 provides only one standard interface, known as the 'e' interface, between the telecommunications carrier's Delivery Function (DF) and the law enforcement agency's Collection Function (CF). The 'd' interface between the logical entity known as the Intercept Access Point (IAP) and the DF is assumed to be internal and proprietary. See Figure 1 in the June 1997 issue for a network reference model.

The 'e' interface supports two different facilities, the Call Data Channels (CDC) and the Call Content Channels (CCC). There will probably be one CDC for each connected law enforcement agency and multiple CCC's. The CDC will be used to transmit SP–3580 protocol messages. User traffic, if monitored, may be transmitted on one or more CCC's. Some user information, such as short messages, may be transmitted on a CDC.

To be continued...

The August 1997 issue will provide a description of the SP-3580 protocol messages.

Editor David Crowe • Phone 403-289-6609 • Fax 403-289-6658 *Last published 01/97*

Analog Air Interface Standards - First Generation

Standard	Description	Status
IS-3 (Rev. A,B,C,D)	Original analog air interface standards (see EIA/TIA-553-0)	Rescinded 09/89
EIA/TIA-553 Rev. 0	Analog air interface	Published 09/89
IS-19-B	Mobile minimum performance standards	Published 06/88
IS-20-A	Base station minimum performance standards	Published 06/88
TSB-35	Cellular mobile receiver dynamic range	Published 04/92
TSB-39	Message type assignment for extended protocol	Published 03/93

Analog Air Interface Standards - Second Generation

Standard	Description	Status
IS-88	Narrowband (3:1) analog air interface ("NAMPS")	Published 02/93
IS-89	IS-88 base station performance standards	Published 02/93
IS-90	IS-88 mobile performance standards	Published 02/93
IS-91 Rev. 0	Analog air interface (including "NAMPS" and authentication)	Published 10/94
IS-94	In-building analog air interface ("CAPS")	Published 05/94
IS-680	Residential ("cordless") base station PSTN interface	Published 05/96
TSB-70	Cross reference for FSK control channel	Published
TSB-83-A (SP-3798)	**Additional modem options for IS-680 ("cordless")**	**Published 04/97**

Analog Air Interface Standards - Third Generation

Standard	PN- #	Description	Status
EIA/TIA-553-A	**SP-3598**	**Analog air interface (including authentication, alert/flash with info, abbreviated alert, message waiting indicator & protocol capability indicator)**	**Second ballot**
EIA/TIA-690	SP-3495	Mobile minimum performance standards (IS-19-B)	Second ballot
EIA/TIA-691	**SP-3665**	**Enhanced analog ANSI version of IS-91-A (w/o IS-680 cordless)**	**Second ballot**
EIA/TIA-712	**PN-3597**	**Base station minimum performance standards (prev. IS-20-A)**	**In press**
IS-91-A	PN-3476	Revised IS-91 air interface (including IS-94/IS-680/sleep mode)	Second ballot
IS-713	**PN-3668**	**1900 MHz upbanded AMPS (based on IS-91-A)**	**Pub. est. 4Q'97**
TSB-70-A	**PN-3610**	**Updated version of TSB-70 cross reference**	**Development**
TSB-71	PN-3477	IS-94 enhancements and issues	Published 10/95

Analog Air Interface Standards - Fourth Generation

Standard	PN- #	Description	Status
IS-91-B	**SP-3666**	**Revised version of IS-91 (including IMSI, PCS band support, over-the-air-provisioning, priority access, 9-1-1)**	**Development**

Note: 1. IS- TIA Interim Standard, J-STD- TIA/ATIS Joint Technical Committee standard, PN- TIA Project Number, SP- ANSI Standards Proposal, TSB- TIA Telecommunications Systems Bulletin.

2. **Bold Type** indicates modification since the previous publication of this report.

- Thanks to Bob Slocum of Ericsson and Charles Teising of Lucent, for their assistance compiling this information.