Cellular Networking Perspectives

David Crowe [Editor] • Phone 1-800-633-5514 • Fax 403-289-6658 Vol. 6, No. 3 March, 1997

In This Issue ...

Next issue due: April 2, 1997

TIA Subcommittee TR—45.3: TDMA Digital Standards

TIA subcommittee TR-45.3 is responsible for the definition of TDMA digital air interface standards. Their best known products are IS-54, which provided 3:1 time division multiplexed voice transmission in standard 30 Khz cellular channels coordinated by the FSK ("analog") control channel. More recently, they published IS-136 which uses the same voice coding method, but provides a higher bandwidth "digital" control channel. Their latest effort is IS-136 Revision A, which adds a more advanced voice coding algorithm - to answer critics of the voice quality of TDMA digital cellular.

TIA TR-45.3 is chaired by Peter Nurse of Lucent Technologies and has three active Working Groups:

- WG II: Data transmission (i.e. IS-130, IS-135).
- WG V Voice coders.
- WG VI Digital Control Channel (DCCH).

The missing Working Group numbers were assigned to groups that are no longer active.

Page 6 of this issue provides a summary of the standards that have been published by TIA TR-45.3, and the projects currently being developed - including notice of preliminary work occurring on Revision B of IS-136 TDMA digital cellular.

We Now Accept Visa

Cellular Networking Perspectives now accepts Visa cards for payment of subscriptions, back issue orders and other items. We continue to accept payment by American Express, Check or Money Order.

Start Your Collection of *Cellular Networking Perspectives* Trading Cards!

We have issued a limited edition set of nine trading cards. Each card, printed on tasteful two-tone recycled paper, contains contact information for *Cellular Networking Perspectives* on the front. On the reverse, most cards in the series contain useful reference information about a revision of the IS-41 standard for intersystem operations. Card 8 contains a quiz (complete with directions to a web page to enter, and possibly win prizes). When the complete set of cards are obtained, a mystery remains to be solved, about which we can say little, except to note that prizes will be awarded to the first ten people to crack the code.

We will be sending a random sampling of the cards to each of our subscribers in the near future. Non-subscribers can obtain these cards in other ways; by requesting a free sample, purchasing back issues or playing our regular monthly quiz, that can be found on our web site:

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

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. **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/.

ESN Ad-Hoc Group Prepares to Step Forward … Then Hesitates

An *ad-hoc* group reporting to the TIA TR-45 standards committee was recently formed to both take over ESN manufacturer code administration from the FCC and to allocate these codes more efficiently (see the May 1996 issue for more details). This group had been planning to lengthen the size of the manufacturer code from 8 to 14 bits, by absorbing the reserved bits in the middle of the ESN. If done as planned, with only unused manufacturer codes (specifically 1..127) it could have expanded the total number of codes from about 250 to over 4,000 – without requiring a change to mobiles or most network equipment.

However, at the last moment, this group decided to abandon that approach and continue with the allocation of 8 bit manufacturer codes. This will result in ESN manufacturer code exhaustion occurring much more quickly (although it will probably still take several years). Once this occurs, the industry will have to move to a larger ESN (probably 56 bits) - which will have a truly massive impact on terminals, base stations, switches, HLRs and upstream and downstream data processing.

This tentative decision of the ESN *ad-hoc* group will be discussed at the March 12-13, 1997 meeting of their overseers, TIA committee TR-45.

AMPS in Yet Another Band

Hawaiian Wireless recently launched TIA cellular standards into the 850 MHz SMR frequency band, using specially adapted Ericsson IS-136 TDMA digital equipment. These phones also support dual-mode operation, acting as analog or digital phones in the regular 800 Mhz cellular band. This system launch explains a previously mysterious application for System ID (SID) codes by a then anonymous SMR operator.

IS-136 Dual-Band Phones Demonstrated

In another dual-band phone announcement from Ericsson, the first IS-136 TDMA digital phones were demonstrated that operate in both the 800 Mhz "cellular" and 1800 Mhz "PCS" frequency bands on February 10, 1997. These phones will be an asset to cellular carriers who are committed to IS-136 TDMA digital cellular, rather than CDMA, and who have obtained PCS licenses to extend their coverage. It rather sounds like these phones are intended to wear the AT&T Wireless name!

US IMSI Management Council Appointed

An "IMSI Management Council" of 6 carrier representatives has been appointed by the CTIA and PCIA, to implement a soon to be published IMSI "Management Guidelines and Procedures" manual. This council will not be involved in day-to-day management, but is intended to oversee allocation of the IMSI mobile identifier for US Cellular and PCS Systems, and resolve any conflicts or disputes that may arise. The first members of the council are:

CTIA Appointees:

Paula Jordan, AirTouch

Beth Kimmel, Sprint PCS

Charlene Meins, AT&T Wireless

PCIA Appointees:

David Herndon, BellSouth DCS

Anna Miller, Omnipoint

Karen Mulberry, PCS PrimeCo

One voting member from the CTIA, and one from PCIA, along with non-voting members from the US Department of State and the US IMSI Administrator (currently the Bellcore Numbering Consulting Group) will round out the 10 member council.

See the June 1995 issue of *Cellular Networking Perspectives* for a discussion of the long term need for IMSI in wireless systems to replace the current MIN identifier.

New TIA Projects

Several new project number requests have been initiated by subcommittees of TIA committee TR-45. The process of obtaining a project number is designed to ensure that the work of all subcommittees is coordinated, visible and properly managed:

TR-45.2
- Addition of IMSI as a mobile identifier to IS-41.
- Local Number Portability.

TR-45.4
- Use of "A" interface in Wireless Local Loop systems.

  Note: This project application was rejected as premature, because an *ad-hoc* group on Wireless Local Loop has not completed its initial report.

TR-45.5
- Advanced Over-the-Air Service Provisioning to ensure that mobiles are activated only on eligible systems.

Congratulations, Muneerah and Shaynoor

Congratulations to our Marketing Manager, Muneerah Vasanji, and her husband Shaynoor, on the birth of their first child, a boy named Sahad, on January 31st. Muneerah is taking a leave from her duties at Cellular Networking Perspectives, but will be returning soon.

A T-Shirt for a Tip!

We are please to offer a unique *Cellular Networking Perspectives* T-Shirt for any tip that leads to a paid subscription. Just give us the contact information for your prospects and soon after they purchase a subscription, you will be the proud owner of one of our unbleached, recycled cotton shirts.

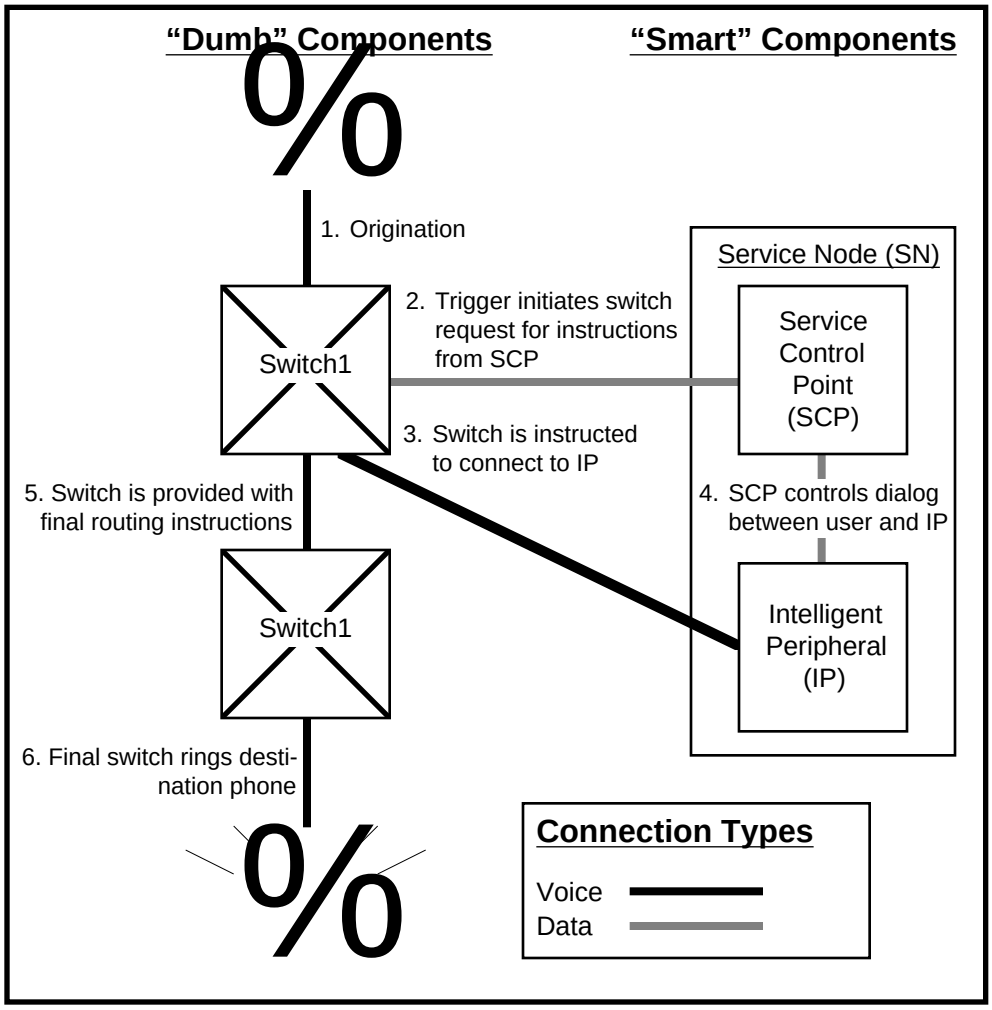
WIN: Wireless Intelligent Network, Part I: The Motivation

The Wireless Intelligent Network promises to bring cheaper, faster and more flexible feature development to wireless systems based on the IS-41 backbone network - but will it deliver on this promise?

The IN Concept

The basic concept of WIN is derived from landline IN (of which Bellcore's AIN, Advanced Intelligent Network, is a variant), in which switch intelligence is split into four components - call processing, switching, feature intelligence and special resources. The first two components remain in the switch, but the latter two are moved off-board, into separate devices. Feature Intelligence and Special Resources can be combined into a Service Node (SN) or kept separate in an SCP (Service Control Point) and an IP (Intelligent Peripheral). IN features can either use an SCP (e.g. 1-800 services that just require translation from one phone number to another) or both an SCP and an IP (e.g. one-number services, that may require an interaction with the caller). Figure 1 illustrates this basic concept.

Figure 1: Conceptual IN Model



WIN History

The Wireless Intelligent Network (WIN) was initiated by a CTIA sub-task group, that was chartered with bringing the benefits of the IN concept to wireless systems, although in a way that is optimized for wireless. In November, 1994 this group provided a Standards Requirements Document to the TIA, which described their view of the requirements for WIN. The TIA then formed its own *ad-hoc* group, under the auspices of Subcommittee TR-45.2, Working Group II. This group has been meeting for two years and recently has started to put together a package of standardization documentation. The CTIA sub-task group is still meeting to monitor the progress of WIN, and provide input into the process. It is in the context of WIN nearing completion, that we review the concept, the development and the future standard for WIN.

Warning: Because a standard for WIN is currently under development, the information in this article is subject to change. We will publish updates in future issues, as required.

IN/WIN Devices

IP - *Intelligent Peripheral*
A device that contains special trunk-based resources, such as tone generation or detection, recorded announcements and voice recognition.

SCP - *Service Control Point*
A device that contains logic and a database to control a special subscriber service.

SN - *Service Node*
A combined IP/SCP.

1,2,3 leetle WIN Features

The current phase of WIN development by the TIA/CTIA is limited to providing the triggers to support three basic feature sets: Voice Controlled Services (VCS), Incoming Call Screening (ICS) and Calling Name Presentation (CNAP).

Voice Controlled Services

A subscriber will be able to make phone calls and control features from their phone using voice commands. More exotic features, such as voice

authentication are also being considered. WIN can only provide the ability to control a connection to a voice recognition device, it obviously cannot define how such a device will work.

Incoming Call Screening

Calls to a subscriber will be screened based on the caller's number, their DTMF tone responses to prompts, their spoken name or even spoken commands. The time of day, location of the called party and status of the called party (e.g. inactive) can also be considered. Note that screening that does not require an external SCP, and that does not require voice band interactions, can be performed by an IS-41 Rev. A/B/C HLR.

Calling Name Presentation

The name of a calling party can be presented on the display of a wireless terminal (assuming that the terminal supports this capability), based on a query to a database for calling number identification-to-calling name translation.

What About IS-41 Rev. C?

The TIA IS-41 Revision C standard for intersystem operations contains IN-like capabilities, including the ability to query the HLR based on a dialed digit trigger. This trigger handling could be extended to an SCP, but would not allow direct SCP-MSC communication that would bypass the HLR. Triggers are currently defined based on digit count and destination type (e.g. local number). IS-41 Revision A and B (and, of course, Rev. C) also contain implicit triggers based on the terminal state (e.g. redirection on no answer, no page response and busy triggers). The main limitation of the IS-41-C approach is that only the HLR can be queried, and not an arbitrary SCP. As we describe WIN, we will also detail the benefits and limitations of this alternative to full-blown WIN.

The Promise…

IN is strongly supported by landline carriers because of the benefits it promises, all of which stem from the separation of feature intelligence from switching and call processing, with the resultant (and required) opening of the interfaces. Wireless carriers hope that WIN with also have major benefits:

1. More Sophisticated Features

   Non-traditional suppliers should be better able to provide peripheral equipment for special purposes (e.g. voice recognition).

2. Customized Features

   Carriers should be able to develop their own features on their own platform, or through a contract with a third party. Part of the concept of IN is a Service Creation Environment that will allow non-technical people to safely design features using a palette of standard triggers, and responses to those triggers.

3. Cheaper Features

   Feature development should be cheaper because of the greater competition that comes from an open interface, which will allow more suppliers entry to the market.

4. Faster Feature Development

   Feature development should be faster because of greater competition, and because development can occur on platforms optimized for software development, using the latest development techniques, rather than entirely within the complex software environment of a switching system.

The Risk…

For every proposed benefit of IN/WIN there is a corresponding risk of failure:

1. More Sophisticated Features

   The limitations of open interfaces may significantly constrain the user-friendliness of features, relative to those provided on a switch, or with a custom interface.

2. Customized Features

   While Service Creation Environments (SCE) are available, they are proprietary, and they can only work with the currently available triggers. Consequently, features may be restricted to certain platform types, or may not be possible at all until new triggers are standardized.

   Current WIN development plans do not include standardized SCE interfaces.

3. Cheaper Features

   MSC vendors must still provide triggers to enable IN/WIN features. If every major new feature requires a new trigger, carriers may end up paying for the trigger what they would have paid for a switch-based feature *and* paying for SCP/IP/SN development in addition!

4. Faster Feature Development

   If the Switch to IN/WIN-peripheral interface is not sufficiently precise, development can be bogged down resolving protocol incompatibilities. If a new trigger is required for a new feature, switch software delays can still delay feature development.

In addition to each potential benefit of IN and WIN having a dark side, there is an additional concern over processing and network capacity on the newly defined interfaces. If the division of responsibilities between network elements is not carefully defined, each invocation of a feature could result in a massive exchange of messaging which, multiplied by hundreds of simultaneous IN invocations, could bring the IN network to its knees. Outside of feature invocation, additional network traffic may be required to coordinate information that is stored in multiple locations, as an IN feature may affect the subscriber profile in the switch, and switch based features may interact with IN features.

The Impact of Mobility

Wireless IN has an additional complication: Mobility. A WIN subscriber may request service from any switch, and should continue to obtain their WIN features, which should operate the same as at home. This is a major additional hurdle, for several reasons:

1. Triggers must move with the subscriber's mobile.

   Triggers may be customized for an individual subscriber, but how do they get to the current serving MSC? One approach is to query the home system at every step of call processing, but this is clearly impractical. Consequently, a list of standard triggers must be passed from the HLR to the visited system in the subscriber profile. This requires not only that a common set of triggers (and associated parameters) be standardized, but that each trigger be associated with an SCP that will handle that trigger.

2. Use of Local Infrastructure is Impractical.

   The network impact of WIN can be minimized if the local SCP/IP/SN infrastructure is used. However, this directly conflicts with a major goal of WIN - customizable features. Use of the local infrastructure would require that all WIN equipment for all carriers with business agreements have the same capabilities (i.e. identical announcements and voice prompts), which would allow either total cooperation between carriers or none at all. Consequently, WIN features must be processed by equipment that is under the control of the home carrier (not necessarily the home system). When roaming in a market controlled by the same carrier as in the home market, use of local infrastructure may be practical, but not in general.

3. Use of Home Infrastructure may be Expensive.

   When a WIN feature requires a voice connection to an IP (e.g. voice controlled services), and carrier-customized services require the use of a home-controlled IP, long distance connections to an IP may need to be set up.

4. The HLR cannot be cut out of the loop.

   As much as it is desired to off-load the HLR when WIN features are activated, it is usually impossible. For example, all incoming calls require at least one HLR query. Consequently, the messaging and processing overhead of WIN features is usually greater than of the same feature implemented in an HLR/MSC.

5. Coordination of Multiple Databases

   Each WIN SCP will have to contain profile information, and this will have to be coordinated with the HLR. Any change in a feature initiated by WIN via an external SCP (e.g. voice controlled services) will require an HLR database update. Conversely, any change in a feature initiated in the traditional way may require an SCP update. Database inconsistencies are likely to be a perennial headache, resulting in customer confusion.

   Similarly, if a separate SCP and IP are implemented (rather than an integrated SN), the databases have to be coordinated, often in real-time. If it is desired to provide multiple SCP's within one carrier's network that can act as a pool for subscribers, then again, database coordination is required.

   This database coordination can be performed on an as-needed basis, with one device marked as the primary site for each data element (this being the IS-41 model) or by storing data elements in multiple locations. This will require complex procedures whenever a data element changes to ensure reliable updates.

If the WIN Fits…

WIN is being designed by a task group within Working Group II of Subcommittee TR-45.2 of the Telecommunications Industry Association (TIA). It is being designed to fit into the IS-41 network architecture (see *Cellular Networking Perspectives Technical Report #1*), with the addition of the SCP, IP and SN network elements.

Figure 2: WIN Network Reference Model

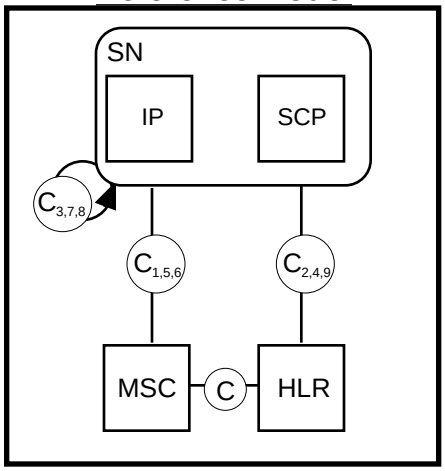


Figure 2 is a simplified extract from the WIN network reference model that shows the new interfaces. All interfaces are named C_n, where n is a number from 1 to 9. We have grouped the interfaces on our diagram. We use the convention that an interface that terminates at a *composite* network element (i.e. the SN box that contains the IP and SCP boxes) can terminate to a physical realization of the composite network element, or to any of the elements contained within it.

For completeness, the WIN interfaces are:

Interface	Network Elements
C	MSC-HLR
C_1	MSC-SCP
C_2	HLR-SCP
C_3	IP-SCP
C_4	HLR-SN (C_2+C_9)
C_5	MSC-IP
C_6	MSC-SN (C_1+C_5)
C_7	SCP-SN
C_8	SCP-SCP
C_9	HLR-IP

To be continued…

Next month we will continue our discussion of WIN, with a discussion of the WIN call model and the ITU network reference model. Following that we will discuss the current proposed additions to IS-41, on an interface by interface basis.

TIA TR-45.3 TDMA Digital Air Interface Standards

Cellular Networking Perspectives

Editor David Crowe • Phone 403-289-6609 • Fax 403-289-6658

Last published April, 1996

TDMA Digital Air Interface Standards - First Generation

IS/TSB	ANSI	Description	Comment
IS-54-B	**TIA/EIA-627**	**Original TDMA Dual-Mode Air Interface Standard**	**ANSI pub. 09/96**
IS-55/56	**TIA/EIA-628/629**	**TDMA mobile/base station minimum performance standards**	**ANSI pub. 09/96**
IS-85	**TIA/EIA-635**	**TDMA full-rate voice coder (3:1)**	**ANSI pub. 09/96**
TSB-46		Verification of Authentication for IS-54-B Mobiles	Published 03/93
TSB-47		IS-54 Implementation Issues	Published 05/94
TSB-50		User Interface for Authentication Key Entry	Published 03/93

TDMA Digital Air Interface Standards - Second Generation

Standard	PN/SP	Description	Comment
~~*IS-54-C/IS-7X*~~		~~*See IS-136*~~	~~*Cancelled*~~
IS-130-0		Data services radio link protocol	Published 04/95
IS-135-0		Asynchronous data and fax services	Published 04/95
IS-136.1 Rev. 0		Digital Control Channel (DCCH)	Published 12/94
IS-136.1/2-1		**Addendum to IS-136 Rev. 0**	**Published 12/94**
IS-136.2 Rev. 0		FSK control channel, analog voice channel, TDMA traffic channel	Published 12/94
IS-137-0		TDMA/analog mobile minimum performance standards	Published 12/94
IS-138-0		TDMA/analog base station minimum performance standards	Published 12/94
	~~PN-3466~~	~~Digital hands-free performance standards~~	~~*Cancelled*~~

TDMA Digital Air Interface Standards - Third Generation

Standard	PN/SP	Description	Comment
IS-130-A	**PN-3795**	**Radio Link Protocol**	**Ballot 02/97**
IS-136.1-A		**Enhanced digital control channel (9-1-1, OTA, Calling Name ID, One-button Callback, Private Networks (enhanced), PACA)**	**Published 10/96**
IS-136.1-A-1		**IS-136 Rev. A, first addendum: section 1 corrections**	**Published 11/96**
IS-136.1/2-A-2	**PN-xxxx**	**IS-136 Rev. A, second addendum: section 1 and 2 corrections**	**In press**
IS-136.2-A		**FSK control channel, analog voice channel, TDMA traffic channel**	**Published 10/96**
IS-137-A	**PN-3605**	**Mobile minimum performance standards for IS-136-A**	**Ballot 12/96**
IS-138-A	PN-3606	Base station minimum performance standards for IS-136-A	Development
IS-641		Enhanced full-rate speech codec	Published 05/96
IS-669	PN-3616	STU-III support for TDMA systems	Development
IS-684		**Isochronous radio link protocol for data (for STU-III)**	**Published 08/96**
IS-686		Enhanced full rate voice coder performance standards	Published 01/97
TSB-73		**IS-136 Rev. 0/Rev. A compatibility issues**	**Published 07/96**
TSB-77	**PN-3731**	**IS-641 implementation issues**	**Published 12/96**

TDMA Digital Air Interface Standards - Fourth Generation

Standard	PN-/SP-	Description	Comment
IS-136-B		**Long message transport, broadcast SMS, originating SMS on traffic channel, double/triple rate channels (symmetrical and asymmetrical), stronger voice privacy, charge rate indicator**	**Development**

Note:
1. IS- Interim Standard, TSB- Telecommunications Systems Bulletins, PN- Project Number, SP- ANSI Standards Proposal.
2. **Bold Type** indicates modification since previous publication.
3. Published TIA standards can be obtained from Global Engineering Documents at 1-800-854-7179 (+1-303-792-2181).