Cellular Networking Perspectives

David Crowe [Editor] • Phone: 1-800-633-5514 • Fax: 403-289-6658 Vol. 5, No. 9, September 1996

In This Issue...

Surfing the NET??

Visit *Cellular Networking Perspectives* at our EXCITING web page at:

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

Look forward to your next issue on: October 1, 1996

Enhanced Wireless 9-1-1, Part II: A New Standard

Enhanced wireless 9-1-1 is more than just the ability to make a 9-1-1 call from a wireless phone at any time, or any place, there are several new capabilities that the emergency service community has lobbied for the wireless industry to provide. These capabilities were described in the August, 1996 issue of *Cellular Networking Perspectives.* In this issue, we describe how these capabilities are likely to be provided in future wireless systems based on TIA standards.

Standards development

The development of standards for wireless 9-1-1 has been pursued by TIA (Telecommunications Industry Association) subcommittee TR-45.2. At first this effort focussed only on cellular systems. More recently, a TR-45.2 ad-hoc group, chaired by Jeff Crollick of GTE TSI, has been created to allow participation from PCS standards committees TIA TR-46 and ATIS T1P1. Work is now proceeding, as TIA project PN-3581, to provide the same capabilities for both AMPS-based and GSM-based systems.

Standardization work started with two Joint Experts Meetings in 1994, one sponsored by the TIA, and one by PCIA, ATIS and the TIA. Both meetings reached similar conclusions, which were used for developing the basic requirements for a standard. These requirements were considerably clarified and simplified at the NENA Telco/ Vendors conference in February, 1996 and through the publication of a joint agreement between the wireless industry represented by the CTIA and the emergency service organizations NENA, NASNA and APCO in the same month (see the March 1996 issue for more details).

Standardization has proceeded as far as a baseline document, and a ballot-ready standard is expected in January, 1997. The standard has been given additional momentum by the July, 1996 FCC rule-making on the subject, which is concordant with the standards work, with the exception of requirements to provide 9-1-1 service to all phones, even those that are not service initialized. This portion of the rule-making will be subject to further lobbying. The standards impact of this FCC rule is not yet known, as it depends on which of the enhanced capabilities must be provided on emergency calls from phones that are not service initialized.

From Requirements to Protocol

The translation of requirements to a protocol definition is complicated by the presence of two parallel methods for wireless intersystem operations (IS-41 for AMPS and GSM MAP for PCS 1900 systems) and two different methods for PSTN interconnection (MF tone based signaling and SS7 ISUP

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. Fax: 403-289-6658. Subscriptions: CDN$300 in Canada (incl. GST), US$300 in the USA and US$400 elsewhere. A surcharge of up to US$200 per year is required for faxing to international subscribers. Payment by cheque, money order or American Express. Issues are faxed or mailed 1st class. Copies: Subscribers may make up to 10 copies of each issue. Rates available for more copies. Discounts: Educational & Small business 25% off any order, by mail only. Back Issues: Phone for price list and list of contents.

common channel signaling). Consequently, the final standard will probably have several modules that can be mixed as necessary.

Callback Using Mobile Directory Number

The basic callback capability will simply require the PSAP (Public Safety Answering Point) operators to dial the mobile number provided at the time of call setup, as illustrated in Figure 1.

There are, unfortunately, some circumstances in which this method of callback will not work:

- The mobile may have some kind of call forwarding active in their home system, which may redirect the call.
- The mobile may have call delivery disabled, or some type of termination restrictions active in their home system, which may block the call.
- The mobile is not service initialized.
- The MIN may be provided to the PSAP, instead of the directory number. This situation can only cause a problem when both of the following conditions apply:

  * The MIN is different from the directory number. This is uncommon today, but will occur more frequently in the future to accommodate international roaming and number portability. See the December 1994 issue for more information on this topic.

  …and…

  * The mobile is roaming and the directory number is not available to the serving system. The directory number is only provided to the serving system by the IS-41 Revision C protocol, which is not currently implemented in any commercial systems.

Callback Using Roamer Port

An alternate method of callback is to use the roamer port, as illustrated in Figure 2 (on the next page). The roamer port is provided on most cellular systems as a method of call delivery, which requires the caller to dial a shared access number (the roamer port), wait for second dialtone and then enter the MIN of the mobile to terminate to.

This method also has its drawbacks:

- The mobile may have moved to another system. Roamer port paging is limited to the system associated with the roamer port number.
- The procedure is more complex for the PSAP operators, and is a special procedure that applies only to wireless systems.
- The wrong identifier may be provided to the PSAP. This situation can only cause a problem when both of the following conditions apply:

  * The MIN is different from the directory number.

  …and…

  * The mobile is roaming and the directory number is available to the serving system and provided to the PSAP. Currently, roamer ports require the MIN to be entered, if the MIN and directory number are different.

Reconnect

If a mobile in an emergency call loses radio contact, it is desirable to automatically reconnect the mobile, without manual intervention by either the PSAP or the phone user. If this reconnect operation fails, the PSAP can attempt a callback or the mobile user can simply reinitiate the 9-1-1 call. Figure 3 (on the next page) illustrates the reconnect procedure.

Location

The first phase of standardization, which matches the joint CTIA/NENA/NASNA/APCO agreement and the FCC rulemaking, will provide the cell-site identification (and sector, if applicable) to the PSAP. This will allow the location of mobiles calling 9-1-1 to be narrowed down somewhat. The hope is

Figure 1: Callback Using Mobile Directory Number

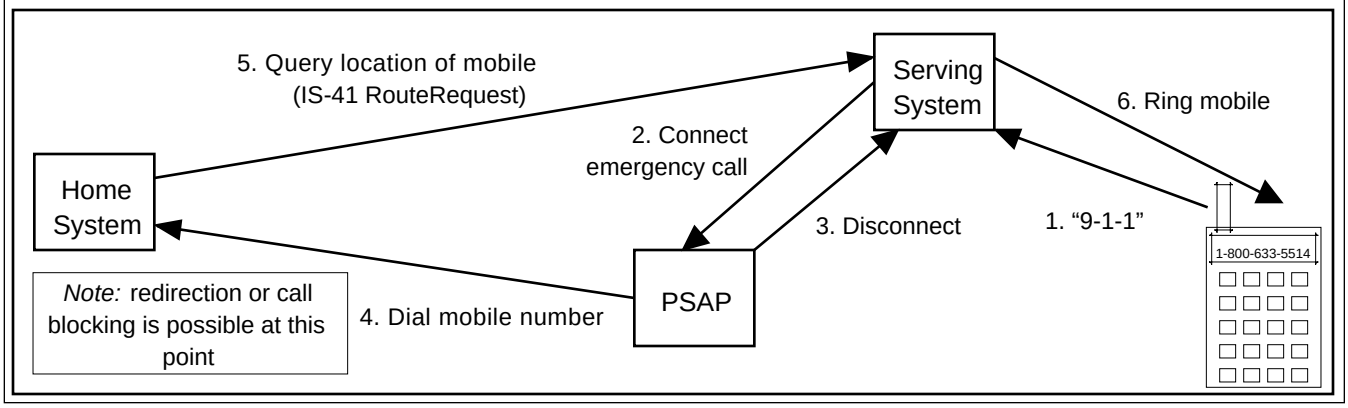


Figure 2: Callback Using Roamer Port

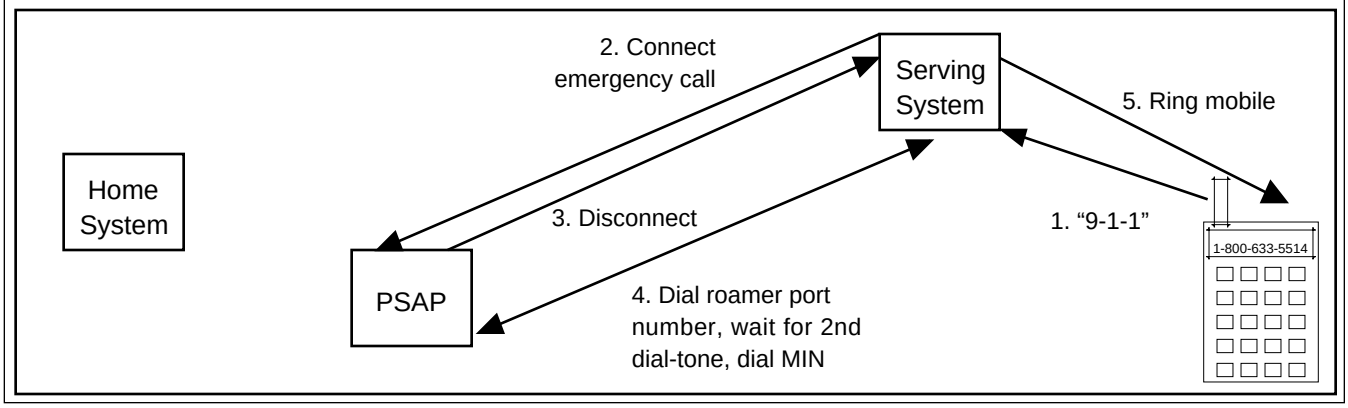
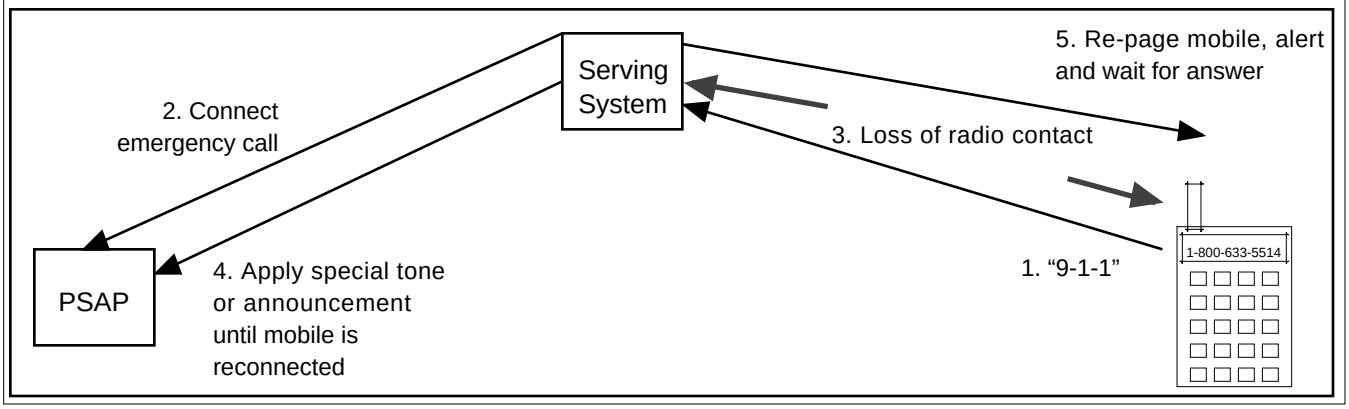


Figure 3: Emergency Call Reconnect



that, in conjunction with information provided by the caller, the exact location can be determined in most cases. Since the cell/sector identity is always known by each cellular system, obtaining it is not difficult, it is getting it to the PSAP that is the challenge.

The problem with providing location information stems from the limitations of PSTN signaling using MF tones (still the primary method of interconnect between wireless systems and the PSTN). This signaling is generally limited to providing two digit fields (destination address and ANI, usually the calling party number). Since SS7 ISUP common channel signaling may be converted to MF signaling at an intermediate point in the PSTN, even this more sophisticated signaling inherits the same limitations. The problem is that location is a third piece of information. In total, the information elements that must be provided to the PSTN are:

1. A number to route the call to the correct PSAP.

2. The subscriber identification (preferably the directory number).

3. The cell/sector identifier. It is generally assumed that this will be a phone number from the wireless carrier's pool.

Logically, the PSAP routing number should be the destination address field, and the subscriber identification should be the ANI field. The cell/sector location information appears to be the odd man out. However, these three information fields can be merged into two, by observing that it is the location of the mobile that will control the routing. If the cell/sector identifier is a phone number *assigned by the emergency services provider and not the wireless service provider,* then it can also be used as a routing number and all the required information can be transmitted in two fields. Figure 4 (on the next page) illustrates how this can work, in three steps:

1. A mobile user dials 9-1-1. The cell (or sector) receiving these digits is identified by a 10 digit phone number, allocated by the emergency service provider. In this case, the wireless system covers two area codes (406 and 208), and the identifying numbers assigned to cells and sectors reflect this. Note that identifiers assigned to neighbouring cells used by different carriers may be more similar than those assigned to cells for the same carrier in different areas.

2. The system handling the call routes it to the PSTN, using the cell/sector identifier ("406-123-4401") in the routing address field and the mobile directory number ("403-870-3736") as ANI.

3. Intermediate tandem switches will route the call based on the address field, as they would for any normal call. For routing based on time of day, or other special emergency call processing requirements, the tandem switch will have to have special capabilities. However, even in this case, identification of a specific cell/sector will still be useful to facilitate the best routing decisions.

9-1-1 Dialed in Call

Figure 5 illustrates how a 9-1-1 call can be handled when dialed from a mobile that is already in a call:

1. A mobile dials 9-1-1 while it is already in a call.
2. If the mobile subscribes to three way calling, a new call leg is set up to the appropriate PSAP. Otherwise, the call will be denied.
3. The mobile may press the SEND key (known as a 'flash').
4. The serving system will connect the original party back into the call in a three way conversation.
5. The mobile may flash again.
6. Normally, this would result in the add-on party being disconnected. However, in this case, this party is the PSAP, so this flash, and any subsequent flashes, will be ignored.

Future 9-1-1 Requirements

The standard being created by TIA TR-45.2 is sufficient to address the first phase of enhanced wireless 9-1-1 requirements. A second phase of standardization will be required to address the more stringent location determination requirements (125 meter accuracy, 2/3 of the time) that are required to be implemented within 5 years. It is unlikely that this location information can be transmitted as digits using MF signaling and, for this phase, SS7 ISUP signaling may well be a requirement. ❒

Figure 4: Routing Using Cell/Sector Identifier

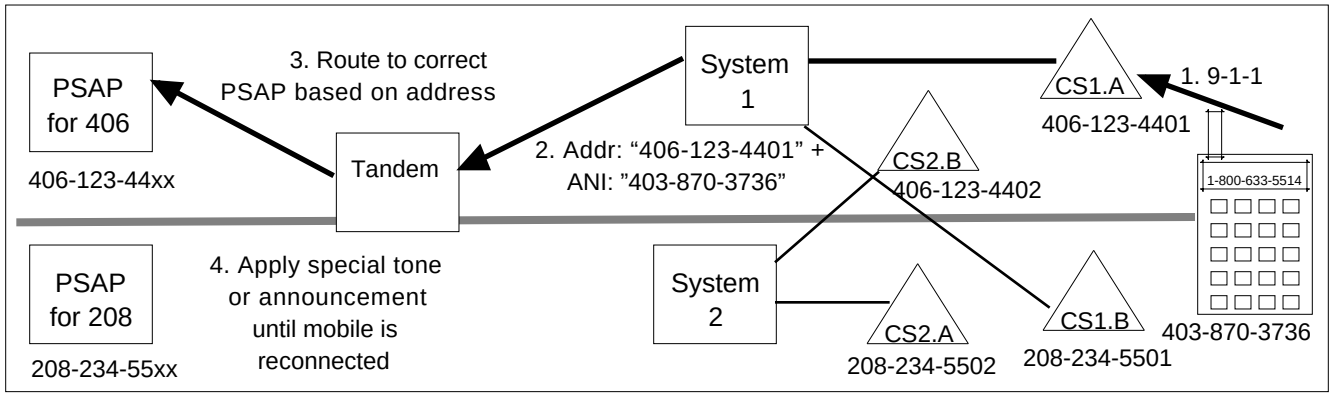
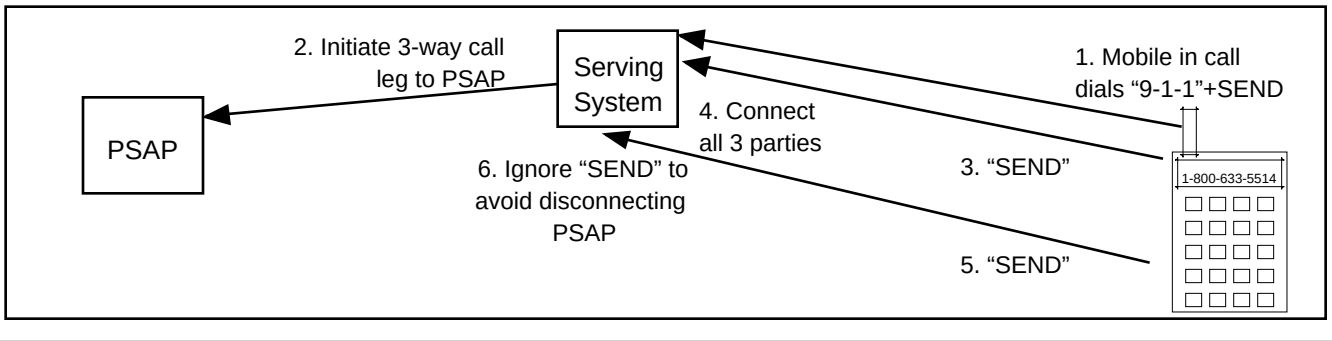


Figure 5: 9-1-1 Dialed in Call



TIA TR-45.5
CDMA Digital
Air Interface Standards

Cellular Networking Perspectives

Editor David Crowe • Phone: 1-800-633-5514 • Fax: 403-289-6658 *Last Published 03/96*

CDMA Digital Air Interface Standards - First Generation (Cellular)

Standard	Description	Status
IS-95	CDMA dual-mode air interface standard	Published 07/93
IS-96	CDMA service option 1: voice coder	Published 04/94
IS-97	Base station minimum performance standards	Published 12/94
IS-98	Mobile minimum performance standards	Published 12/94
IS-126	CDMA service option 2: loopback	Published 12/94
TSB-66	Technical corrections to IS-95	Closed, see IS-95-A

CDMA Digital Air Interface Standards - Second Generation (Cellular & PCS)

Standard	PN- #	Description	Status
IS-95-A	*published*	IS-95 Revised	Published 05/95
IS-96-A	*published*	CDMA 8kbps voice coder	Published 05/95
IS-99	*published*	Data services (fax and circuit switched data)	Published 07/95
IS-125	*published*	Voice coder performance standards	Published 05/95
IS-637	*published*	Short message service	Published 12/95
J-STD-008	PN-3384	IS-95 adapted for 1800 MHz frequency band (PCS)	In press
J-STD-018	PN-3385	PCS mobile minimum performance standards	In press
J-STD-019	PN-3383	PCS base station minimum performance standards	In press
TSB-58	PN-3139	Administration of parameter value assignments	Published 12/95

CDMA Digital Air Interface Standards - Third Generation (Cellular & PCS)

Standard	PN- #	Description	Status
IS-95-B	PN-3693	IS-95 for 800 MHz and 1800 MHz frequencies (i.e. including J-STD-008)	Development
IS-96-B	PN-3649	CDMA voice coder (8 kbps)	Published 08/96
IS-97-A	PN-3645	Base station minimum performance standards (including JSTD019)	In press
IS-98-A	PN-3647	Mobile minimum performance standards (including JSTD018)	In press
IS-126-A	PN-3646	Service option 2: traffic channel loopback test capability	Published 08/96
IS-127	PN-3292	Option 3: enhanced variable rate (8 kbps) voice coder (EVRC)	In press
IS-657	PN-3472	Packet data services	Published 08/96
IS-658	PN-3473	Data inter-working function interface (e.g. modem pool)	Published 08/96
IS-683	PN-3569	Over-the-air programming of mobile stations	In press
IS-xxx	PN-3571	STU-III (strong voice encryption)	Development
IS-xxx	PN-3648	Minimum performance standards for EVRC voice coder	Development
IS-xxx	PN-3676	14.4 kbps data services	Development
TSB-74	published	14.4 kbps radio link protocol and inter-band operations	Published 12/95
TSB-xxx	PN-3682	Bit exact description for EVRC (IS-127)	Development

Note: 1. *IS*- Interim standard, *J-STD*- TIA/ATIS joint technical committee standard, *PN*- TIA project number, *SP*- ANSI standard proposal, *TSB*- TIA telecommunications systems bulletin

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

3. The same authentication standards are used in analog, CDMA and TDMA systems. For more details, see the January, 1996 issue of *Cellular Networking Perspectives* (page 6).

TIA Subcommittee TR-45.2 Working Group and Task Group Organization Chart

Cellular Networking Perspectives

Editor David Crowe • Phone: 1-800-633-5514 • Fax: 403-289-6658