Cellular Networking Perspectives

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The WIN *ad hoc* group has matured into TIA TR-45.2 Working Group V, and it also has a new chairman.

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Advanced capabilities included in E911 Phase II standard J-STD-036 are mobile assisted positioning, more accurate routing, updated position, 'pushing' position, and obtaining position after an inter-MSC handoff.

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The latest status of analog cellular standards, including those that have been published, and those that are still under development.

Next Issue: August 1, 2000

WIN *ad hoc* Morphs into TR-45.2 Working Group V

Wireless Intelligent Network (WIN) standards have long been developed by an *ad hoc* group within Working Group II of the TR-45.2 standards subcommittee within the TIA. However, recently the group was elevated to the stature of a full working group, indicating that the development of WIN standards is expected to be a long-lived part of cellular and PCS network standards development.

Working Group V was chosen because this number had not been used since the TR-45.2 structure was reorganized several years ago.

Not long after WIN became TR-45.2 WG V the long-time chairman, Peter Oldfield of Rogers Wireless, resigned (although these two events are not connected) and has been replaced by Ed Schlein of Sprint PCS.

The WIN group has been responsible for publishing IS-771 (WIN phase I, see our March, April and June 1997 issues), has recently approved IS-826 for publication (WIN Phase II prepaid), is close to completing IS-848 (other charging-related features) and is starting to work on WIN Phase III (location services).

E911 Phase II: Advanced Applications

The basic scenarios for enhanced Wireless 911 Phase II (providing more accurate position information) were described in our June, 2000 issue. There are some more specialized capabilities that are also supported by J-STD-036 (formerly known as PN-3890):

- Mobile assisted positioning,
- More accurate routing,
- Updated position,
- 'Pushing' position, and
- Inter-MSC handoff.

Mobile Assisted Positioning

The FCC initially envisioned E911 Phase II being based solely on network positioning, presumably because this is the only method that is compatible with the installed base of cellular and PCS phones. However, lobbying by manufacturers of GPS and other handset-based technologies, along with a realization that network-based technologies are not always the best answer has slowly opened the door to handset-based solutions through changes in FCC rules (see our October 1999 issue).

There are four different handset-assisted positioning solutions being standardized by TIA standards committees, one each for TDMA (TIA/EIA-136-740 SAMPS - System Assisted Mobile Positioning Through Satellite) and CDMA (IS-801) and two for analog (IS-817, compatible with IS-801, and one compatible with

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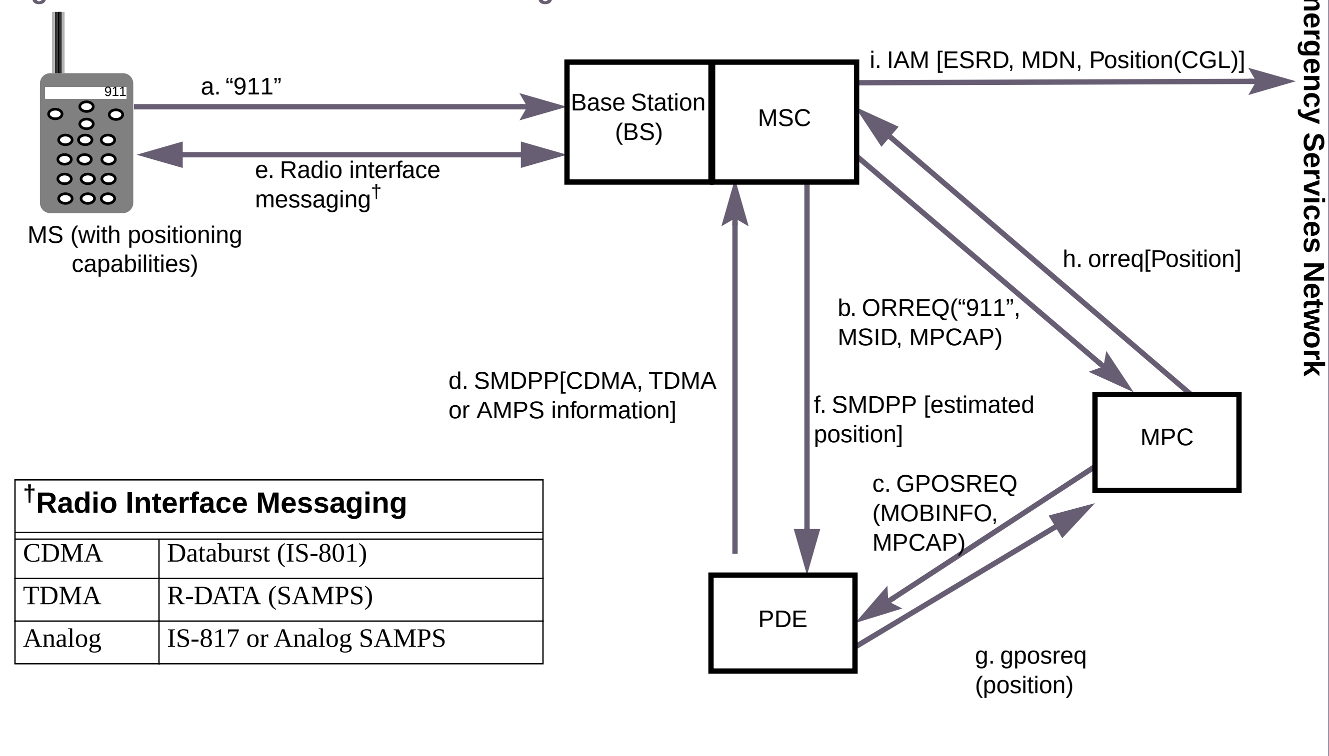
Figure 1: Handset Assisted Positioning



†Radio Interface Messaging

CDMA	Databurst (IS-801)
TDMA	R-DATA (SAMPS)
Analog	IS-817 or Analog SAMPS

SAMPS). SAMPS positioning is transparent to the network because it is defines a new teleservice embedded within standard TIA/EIA-41 short messaging. CDMA positioning is transmitted within the TIA/EIA-41 network as short messages but terminates at the MSC or Base Station where messaging defined by IS-801 is initiated.

Although the implementations are quite different, the basic concepts are similar. The network initiates a series of transactions that causes the mobile to use its built-in GPS receiver to obtain positioning information. In some systems the mobile may actually calculate latitude and longitude, but in others it provides only a partially analyzed GPS signal. The network also provides GPS assistance data to help the mobile lock onto satellites, and thus provide position, more quickly.

The flow of messages shown in Figure 1 appears convoluted because of the division of responsibilities that causes an MSC to initiate an emergency services OriginationRequest (ORREQ) and later transparently pass through a series of short message transactions:

a. A mobile dials an emergency call (e.g. 911).

b. The MSC, recognizing that an emergency call has been originated, sends an OriginationRequest INVOKE (ORREQ) to the MPC (Mobile Positioning Center).

c. The MPC initiates a GeographicPositionRequest INVOKE (GPOSREQ) to the Position Determining Entity (PDE), including information about the mobile required to identify it, its current resource utilization and its capabilities.

d. The PDE, recognizing that the mobile has internal positioning capabilities, initiates a series of short message transactions, providing the mobile with information to assist with positioning, and obtaining either a position, or information that can be used to calculate position.

e. The MSC and BS initiate the appropriate radio interface messaging, depending on the radio interface technology being used.

f. At the end of the series of short message transactions, the PDE receives the estimated position, or the information required to calculate it.

g. The position is sent back to the MPC which stores it for the duration of the emergency services call.

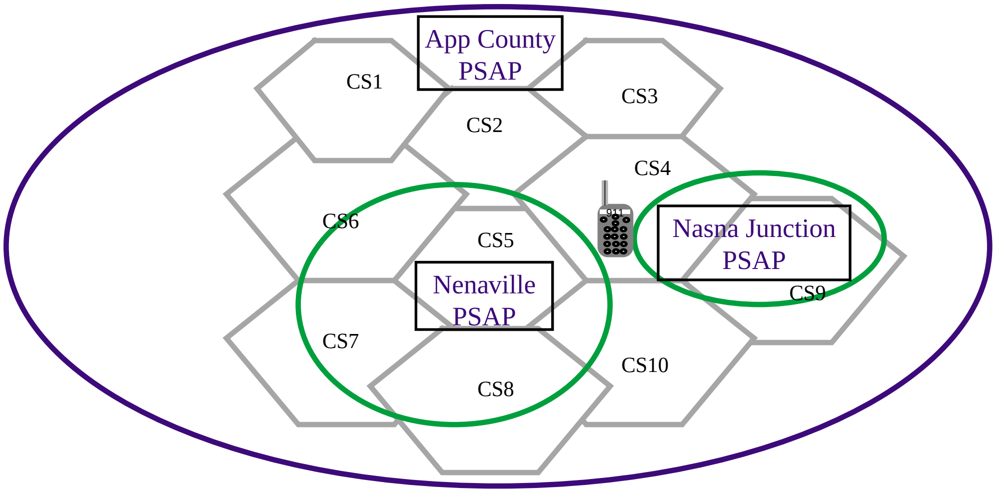
h. The MPC also sends the position back to the MSC in the OriginationRequest RETURN RESULT.

i. The MSC can now issue an SS7 ISUP IAM message containing the position (in the Calling Geodetic Location (CGL) parameter), or the position can be provided via the ALI database, according to the scenarios shown in Figures 3 and 4 in our June 2000 issue.

More Accurate Routing

The main motivation for obtaining the position of an emergency calling mobile is to dispatch emergency workers more accurately to an emergency. However, another important reason is to decrease the frequency with which emergency calls are routed to the wrong PSAP which can result in delays while the call is being transferred (see Figure 2). With standard E911 Phase II routing is based

Figure 2: Cellsite Coverage not Concordant with Emergency Service Jurisdictions



The wireless phone shown may be within the jurisdiction of Nenaville, Nasna Junction or App County. More accurate positioning can help route the call to the correct PSAP.

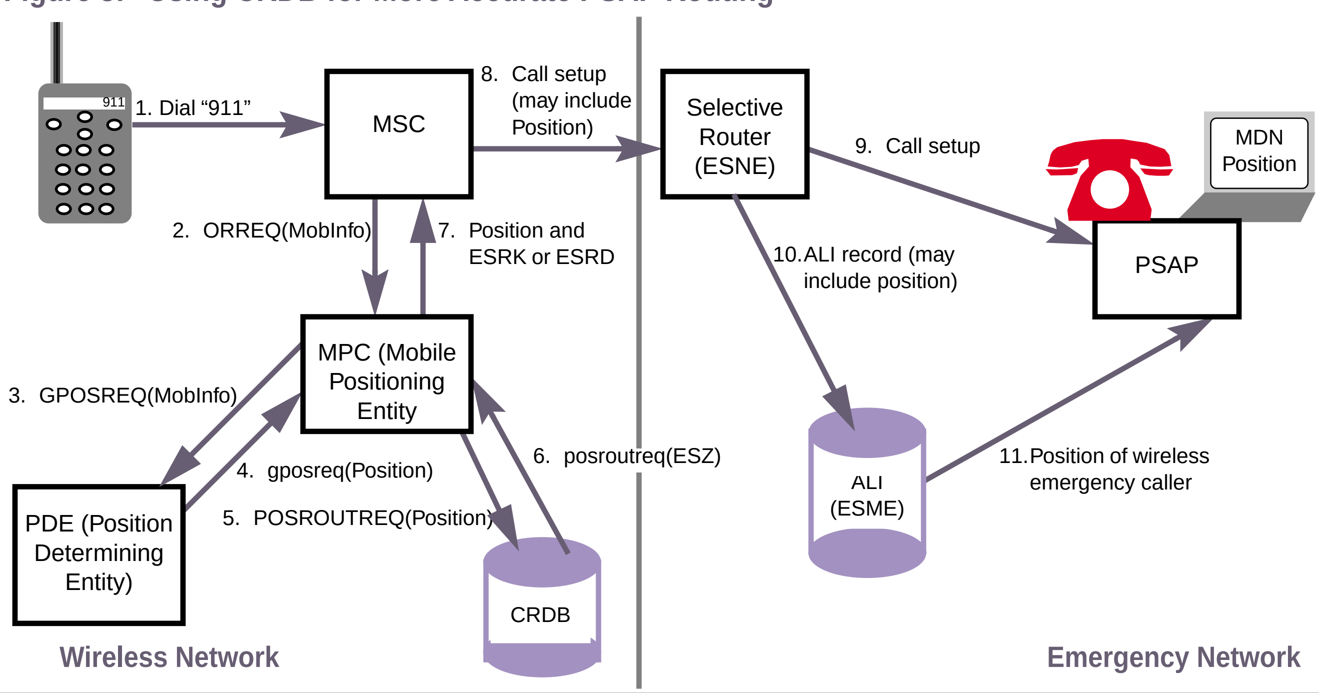
on the cell currently serving the mobile, its position is merely provided to the emergency network.

J-STD-036 defines a new network element, known as the Coordinate Routing Database (CRDB) that can be used to determine the appropriate PSAP by mapping the estimated position onto the outlines of the PSAP jurisdictional boundaries. This still does not guarantee routing to the correct PSAP under all circumstances, but it will do better than routing based only on cell identification, assuming that position can be estimated more accurately than the radius of the cell.

Figure 3 illustrates how a CRDB can be used to provide more accurate routing to the PSAP. After position is obtained via the PDE (step 4) this information is used to query a geographical database and retrieve digits that identify the ESZ (Emergency Services Zone). These digits may be used without modification, or may be converted into an ESRK or ESRD. At the MSC these digits are analyzed, resulting in routing to the appropriate selective router, and can also be used by the Selective Router to determine routing to the correct PSAP.

Note that the position information may be included in call setup (e.g. the SS7 ISUP CGL parameter) without penalty in this scenario because call setup is already being delayed until position is obtained. If location information is not

Figure 3: Using CRDB for More Accurate PSAP Routing



included, most likely because the Selective Router has not been upgraded, it can be provided through the NCAS method (see June 2000 issue, Figure 3).

Updated Position

The FCC order only demands that the location of an emergency caller at the time the call is initiated be provided. However, some systems make it possible to obtain position during a call, which may be useful for some emergency situations, as well as for commercial location services.

An emergency services network can obtain updated position by issuing the same GPOSREQ used to obtain initial position at the beginning of a call (see Figure 3 in our June 2000 issue), but requesting current position instead. If a GPOSREQ is initiated in the middle of a call for initial position, the stored initial value will be sent, if it is available.

"Pushing" Position

The PDE, instead of waiting for position to be requested with a GeographicPositionRequest may be able to autonomously determine the position and then forward it to the MPC in a GeographicPositionDirective INVOKE (GPOSDIR). This technique may allow position to be obtained more quickly, but requires an unambiguous trigger that an emergency call has been initiated (e.g. from within the mobile in the case of mobile-assisted positioning, or based on detection of the digits "911" transmitted in a mobile origination).

Inter-MSC Handoff

Inter-MSC handoff complicates the delivery of position information to the emergency services network simply because more network elements are involved. There are several situations where inter-MSC handoff can occur:

- An emergency call is initiated as a 3-way add-on and then handed-off to another MSC.
- A normal call is handed-off to another MSC and then an emergency call is initiated as a 3-way call.
- An emergency call is handed-off to another MSC so soon after initiation that initial position has to be obtained in the new Serving MSC.
- After an emergency call is established in one MSC where initial position is obtained, an inter-MSC handoff occurs, followed by a request for updated position.

Figure 4 illustrates the delivery of position information between MSC's.

1. A mobile in a call that has handed off from the original ("Anchor") MSC to a second ("Serving") MSC initiates an emergency call.
2. The Serving MSC passes the flash digits to the Anchor MSC without interpretation.
3. The Anchor MSC initiates emergency call positioning with an ORREQ. Mobile Information (MobInfo) is not included because it is not known by the Anchor MSC.
4. The Anchor MPC initiates an ISPOSREQ transaction to obtain position back to the Anchor MSC (this appears to be redundant, but is necessary to establish a context at the Anchor MPC).
5. The Anchor MSC forwards this request.
6. The Serving MSC forwards the Mobile Information (e.g. current traffic channel) to the Serving MPC.
7. The Serving MPC initiates a GPOSREQ as normal to obtain position.

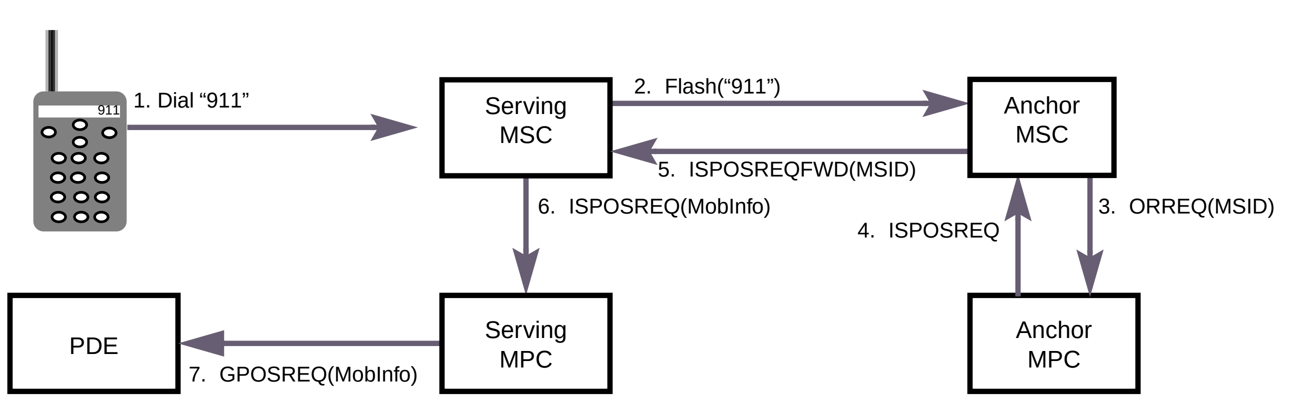
The position obtained by the PDE flows back in the reverse direction, and is provided to the emergency network by the Anchor MSC (if CAS is used) or by the Anchor MPC (if NCAS is used).

Conclusions

J-STD-036 is expected to be published very soon, and will provide the long-awaited network solution for delivering E911 Phase II position from a location network or from a specially equipped mobile phone to the emergency network where it can be used to deliver police, fire, ambulance or other emergency assistance more effectively.

It is likely that a revision or addendum to J-STD-036 will be created to resolve any issues that may arise when the TDMA or analog SAMPS standards are published and to resolve any problems that may be detected during initial implementation.

Figure 4: Obtaining Position After Inter-MSC Handoff



TIA TR-45.1 Analog Cellular Air Interface Standards

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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.

First Generation: Basic Analog

Standard	Description	Status
EIA/TIA-553	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
IS-3-A,B,C,D	Original analog air interface standards (see EIA/TIA-553-0)	Rescinded 09/89
TSB-16	**Assignment of access overload classes**	**Published 03/85**
TSB-35	Cellular mobile receiver dynamic range	Published 04/92
TSB-39	Message type assignment for extended protocol	Published 03/93

Second Generation: NAMPS, In-Building, Residential, Authentication

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	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") interface between Wireless Residential Extension (WRE) and PSTN	Published 05/96
TSB-70	Cross reference for FSK control channel	Published 12/95
TSB-83-A	Additional modem options for IS-680 ("cordless")	Published 04/97

Third Generation: Isolation of “Core” Control Channel Capabilities

Standard	Description	Status
TIA/EIA-553-A	Analog air interface (including authentication, alert/flash with info, abbrev. alert, message waiting indicator and protocol capability indicator (PCI))	Published 11/99
TIA/EIA-690	Mobile minimum performance standards (previously IS-19-C)	In press
TIA/EIA-691	Enhanced analog ANSI version of IS-91-A (w/o Wireless Residential Extension)	Published 11/99
TIA/EIA-712	Base station minimum performance standards (prev. IS-20-A)	Published 09/97
IS-91-A	Revised IS-91 air interface (including IS-94 functionality and sleep mode)	Published 11/99
IS-713	1900 MHz upbanded AMPS (based on IS-91-A)	Published 11/99

TSB-39-A	Message type assignment for extended protocol (analog, TDMA and CDMA standards)	Published 10/94
TSB-70-A	Updated version of TSB-70 cross reference	Published 09/99
TSB-71	IS-94 enhancements and issues	Published 10/95

Fourth Generation: Advanced Capabilities

Standard	Project	Description	Status
TIA/EIA-89	PN-4658	Elevate IS-89 to ANSI standard	Development
TIA/EIA-90	PN-4659	Elevate IS-90 to ANSI standard	Development
IS-91-B	SP-3666	Revised version of IS-91 (including IMSI, OTA, priority access, 911, cryptosync and Expanded ESN)	Project cancelled
IS-788	PN-4205	Portable wireless phone to vehicle interface - Connector	Published 06/99
IS-788-A	PN-4660	IS-788 including IDB (ITS Data Bus)	Ballot
IS-788-A-1	**PN-4862**	**Geo-location for analog cellular phones, Addendum 1**	**Development**
IS-789	PN-4207	Portable wireless phone to vehicle interface - Electrical Interface	Published 07/99
IS-789-A	PN-4629	Modification to IS-789 to support SAE J2366 ITS Data Bus (IDB)	Ballot
IS-790	**PN-4208**	**Portable wireless phone to vehicle interface - Latch**	**Ballot**
IS-791	PN-4209	Portable wireless phone to vehicle interface - Test Specifications	Development
IS-798	PN-4527	Portable wireless phone to vehicle interface: Mounting Envelope	Ballot
IS-816	**PN-4630**	**IDB message set definition for IS-789**	**Ballot 06/00**
IS-817	**PN-4662**	**Geo-location for analog cellular phones**	**Ballot 07/00**
IS-822	**PN-4560**	**"+" (Plus Code) dialing for international calling from analog cellular phones**	**Development**
IS-xxx	PN-4204	Portable wireless phone to vehicle interface - Architecture	Development
TSB-16-A	**PN-4864**	**Assignment of access overload classes**	**Development**
TSB-119	**PN-4559**	**"Intelligent Retry" for improved access to emergency calling (formerly scheduled to be IS-821)**	**Ballot**
	PN-4373	Analog Air Interface Support of Expanded ESN (56 bit ESNX)	On hold
	PN-4375	**Analog Air Interface Support of International Mobile Station Identity (IMSI)**	**On hold**
	PN-4558	Interface between wireless phone and Telephony Device for the Deaf (TDD)	Development