

# Cellular Networking Perspectives

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Phase II of the US FCC Emergency Services mandate will require more accurate location information to be delivered to the emergency services network. J-STD-036 is the standard emerging to meet this mandate.

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The latest list of standards and projects from TR-45.5, and its companion 3GPP2 TSG-C, which are responsible for defining CDMA digital cellular and PCS standards.

## **Huh?**

If there are any acronyms or terms that you are unfamiliar with, check our website glossary, you will probably find them defined there:

[www.cnp-wireless.com/  
glossary.html](http://www.cnp-wireless.com/glossary.html)

**Next Issue: June 1, 2000**

## **Canada's Numbering Plan Plans**

Canada initiated a proceeding in April 2000 to find solutions for the pending exhaustion of the North American Numbering Plan (NANP). The Canadian authority's (CRTC) public notice does not even consider rate center consolidation and plunges right into 11 or even 12 digit dialing.

The public notice states that the capacity of the North American Numbering Plan is 6.4 billion numbers (actually, they state that it is 6.4 million, but we assume that this is a typographical error). They do not even consider how so many phone numbers can be used in a continent of less than one-half billion people. Inefficiencies in the allocation of numbers are not even addressed.

It may be that the CRTC has decided that rate center consolidation would cause too many problems for Canada's landline telephone companies (although these are not detailed), but expansion of the numbering plan will be far, far worse. First, it will be necessary to eliminate 7 digit dialing. 10 digit dialing will become the only way to make a phone call. It may even be necessary to temporarily eliminate 1+ dialing, depending on the alternative chosen.

## **11 or 12 Digit Dialing?**

The choice that the CRTC is presenting is what variant of 11 or 12 digit dialing should be adopted – which is rather like a sailor being given a choice of which

Cat 'o 9 Tails to be whipped with. No consideration is given for methods to retain 10 digit dialing, even though these do exist. The extra digit (or digits in the 12 digit dialing plan proposal) can be added to the current NANP country code (currently "1"), to the area code (making it four digits) or to the CO code. But, no matter which choice is taken, Canadian dialing habits will have to change dramatically.

## **D Digit Expansion**

The fourth digit of current NANP 10 digit numbers (known as the "D" digit) is currently restricted to between 2 and 9. By allowing it to also be 0 or 1 each area code can be expanded by about 20% – but this expansion comes at a price. 7 digit dialing can no longer be allowed because when the first dialed digit is a 0 or 1, telephone switches assume that a long distance or international call is being initiated.

## **1000's Block Pooling**

NANP routing is currently based on 6 digit analysis – the 3 digit area code and the 3 digit CO code. The remaining four digits are not examined for routing, except where number portability is implemented. 1000's block pooling allows a block of 10,000 numbers to be shared by up to 10 small carriers for use within a single rate center. For proponents of number portability, this is seen as a way to maximize the use of an expensive infrastructure, but for carriers that are not currently mandated to sup-

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port number portability it simply comes with major additional costs and management headaches. Also, it is necessary for all carriers sharing a pool of numbers to adhere to the rate center concept, meaning that wireless carriers could no longer allocate numbers for customers within a larger geographical area than landline carriers.

## A Wireless Perspective

Cellular and PCS carriers stand to lose from this proposal, and similar proposals in the US, much more than other carriers because:

- Wireless carriers do not usually adhere to rate center boundaries, but this is a necessity for number pooling,
- Wireless carriers are not under a number portability mandate, yet number portability infrastructure is required for pooling, and
- Wireless carriers usually keep the phone's MIN the same as the subscriber's phone number (MDN), something that will be impossible if a phone number is more than 10 digits.

## Conclusions

Just as in the United States, Canada's regulators are ignoring a technically and financially sensible solution (expanding rate centers, or possibly even eliminating the concept entirely) in favor of solutions that are more amenable to the regulators that control rate center boundaries and for the large landline telephone companies that are cemented to the obsolete rate center concept. Unfortunately, these political calculations may come unglued as people using phones within the NANP start to understand what the future might hold and decide that they do not like it at all. Perhaps some carriers, particularly wireless, will start to revolt when they determine the impacts.

A discussion of Rate Centers can be found in our July, 1999 issue and a broad discussion of US number conservation is provided in the January, 1999 and February, 1999 issues.

## E911 Phase II: Locating Wireless Emergency Callers

The US FCC mandate on enhanced emergency calling (E911) requires that wireless carriers (cellular, PCS and ESMR) provide the location of calling mobiles on emergency calls. Phase I requirements were merely for the cellsite and sector identification, while Phase II initially required location to be accurate within 125 meters (about 400 feet). When the location is obtained, it has to be delivered to the emergency service network, a job for which the joint ATIS/TIA standard J-STD-036 (also known as TIA project PN-3890) has almost been completed.

### Phase II Standards

Initially it was thought that Phase II location would be determined purely by the network using monitoring equipment utilizing TOA (Time of Arrival) or AOA (Angle of Arrival) techniques or both. The latitude and longitude information determined using this equipment can be delivered by protocols defined within J-STD-036 (PN-3890) for analog, TDMA, CDMA and GSM systems.

More recently, interest has grown in mobile assisted position determination by companies such as SnapTrack (now Qualcomm) and Sirf using partial GPS receivers built into wireless phones, or based on mobile assisted TOA (e.g. Cambridge Positioning System). Standards are being developed to allow transmission of positioning information from analog cellular phones (IS-817, being balloted), CDMA digital (IS-801, published in December, 1999), GSM (accepted as GSM Change Requests) and TDMA (as the SAMPS project, currently under development).

Even if the mobile is involved in determining its own position, J-STD-036 protocols are still required for delivering this information to the emergency services network. While the internal interfaces within this standard differ between GSM and the other radio technologies based on the TIA/EIA-41 network, the inter-

faces between wireless network entities and the emergency services network (known as the ESP, Emergency Services Protocol) are the same.

## The FCC Phase II Mandate

The US FCC mandate for Phase II location was initially 125 meters (400 feet) 67% of the time, with the implication that only network-based solutions would be acceptable. When the FCC opened the door to handset-assisted solutions, they produced two sets of requirements:

- Network based solutions must achieve an accuracy of 100 meters, 67% of the time and 300 meters, 95% of the time.

Carriers must provide coverage over 50% of their service area within 6 months and 100% within 18 months.

- Handset-assisted solutions must achieve an accuracy of 50 meters, 67% of the time and 150 meters, 95% of the time.

In addition, carriers must ensure that 50% of new activations are location capable by October 1, 2001 and 95% by October 2002. Within 6 months of an emergency services request (but not before October, 2001) they must achieve 100% location capable activations. Within 2 years of an emergency services request (but not before December 2004) they must attempt to ensure that all handsets are location capable (even those that were activated before the mandate took effect).

The initial FCC E911 mandate (First Report & Order) can be found at:

[www.fcc.gov/Bureaus/Wireless/Orders/1996/fcc96264.txt](http://www.fcc.gov/Bureaus/Wireless/Orders/1996/fcc96264.txt) (or [.wp](http://www.fcc.gov/Bureaus/Wireless/Orders/1996/fcc96264.txt))

The revised E911 mandate (known as the Third Report & Order) can be found at:

[www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99245.txt](http://www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99245.txt) (or [.wp](http://www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99245.txt) or [.pdf](http://www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99245.pdf))

The Second Report & Order covers issues such as cost recovery (or lack thereof) and the role of the local

exchange carriers in implementation, and is available at:

[www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99096.txt](http://www.fcc.gov/Bureaus/Wireless/Orders/1999/fcc99096.txt) (or .wp)

## J-STD-036 Network Reference Model

J-STD-036 is designed around the network reference model (NRM) shown in Figure 1 that defines logical network entities and interfaces between them.

### Logical Network Entities

**ALI** Automatic Location Information Database. For landline calls this stores name and address information for the duration of a phone subscription. For wireless, this will contain temporary records that contain mobile identification and location information for the duration of an emergency call. This is likely equivalent to the ESME.

**CRDB** Coordinate Routing Database. Maps a location onto an emergency services jurisdiction. Needed only if the MSC will be using Phase II location (latitude and longitude) to route emergency calls.

**ESME** Emergency Services Message Entity. Receives non-call associated signaling messages. Likely equivalent to the ALI.

**ESNE** Emergency Services Network Entity. Receives emergency calls. Likely a Selective Router (also known as a 911 Tandem).

**MPC** Mobile Positioning Center. Acts as a single interface for signaling messages crossing the wireless/emergency services boundary. May also perform some caching functions.

**MSC** Mobile Switching Center.

**PDE** Position Determining Entity. An access point with a standard interface to a proprietary emergency services network

(whether network based or mobile assisted).

**PSAP** Public Service Answering Point. An agency that receives emergency calls.

**S/R** Selective Router. Routes calls to the appropriate PSAP based on the available information (cell/sector or latitude/longitude).

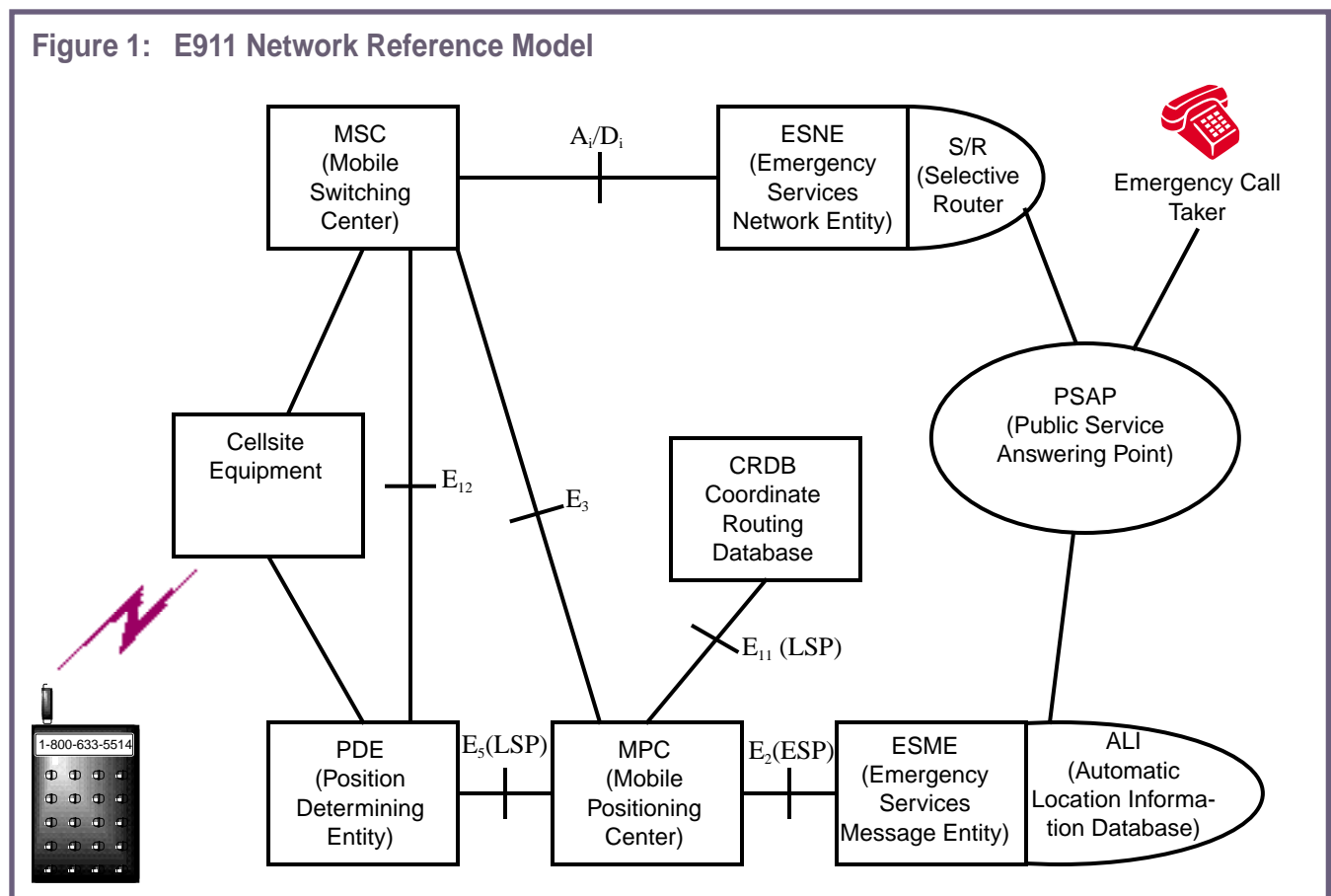
### Named Interfaces

**ESP** Emergency Services Protocol. Standard interface to emergency services network.

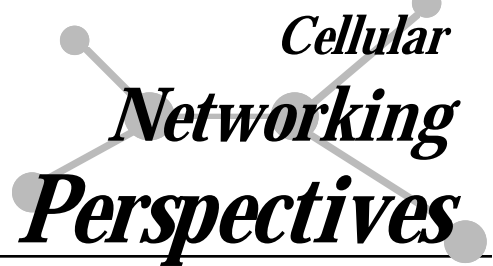
**LSP** Location Services Protocol. Interface to new location related network elements.

### To be continued...

We will continue with a discussion of the technical capabilities of J-STD-036.



# TIA TR-45.5 CDMA Digital Air Interface Standards



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## First Wave - Cellular

Standard	Description	Status
IS-95	CDMA Dual-Mode Air Interface Standard (Authentication Appendix Nov. 1992)	Published 07/93
IS-96	CDMA Option 1: Voice Coder (Speech Service Option)	Published 04/94
IS-97	Base Station minimum performance standards for IS-95-A	Published 12/94
IS-98	Mobile Station minimum performance standards	Published 12/94
IS-126	Service option 2: Loopback	Published 12/94

## Second Wave - Cellular and PCS

Standard	Description	Status
J-STD-008	IS-95 adapted for 1.8-2.0 Ghz frequency band. Note: published in 1996, but not released until 1998.	Published 07/96
J-STD-018	Mobile minimum performance standards (for J-STD-008). Note: published in 1996, but not released until 1998.	Published 07/96
J-STD-019	Base station minimum performance standards. Note: published in 1996, but not released until 1998.	Published 07/96
IS-95-A	IS-95 Revised (Authentication Appendix "A" Nov. 1994)	Published 05/95
IS-96-A	CDMA Voice Coder	Published 05/95
IS-97-A	Base Station minimum performance standards for IS-95-A	Published 07/96
IS-98-A	Mobile minimum performance standards for IS-95-A	Published 07/96
IS-98-A-1	Additional tests for IS-95 mobile stations	Published 09/97
IS-99	Data Services (9.6 kbps Fax and Circuit Switched Data)	Published 07/95
IS-125	Voice coder minimum performance standards	Published 05/95
IS-126-A	Mobile station loopback service option	Published 07/96
IS-637	Short message service (rate set 1)	Published 12/95
TSB-58	Parameter value assignments	Published 12/95

## Third Wave - Integrated Cellular and PCS

Standard	Project	Description	Status
TIA/EIA-95-B	SP-3693	IS-95 for 800 MHz and 1800 MHz frequencies (including J-STD-008)	Published 03/99
TIA/EIA-96-C	SP-4138	CDMA Voice Coder (8 kbps)	Published 08/98
TIA/EIA-97-B	SP-3814	Minimum performance standards for base stations	Published 08/98
TIA/EIA-97-C	SP-4384	Minimum performance standards for base stations (merges TIA/EIA-97-B and J-STD-019)	Published 09/99
TIA/EIA-98-B	SP-3815	Minimum performance standards for mobile stations	Published 08/98
TIA/EIA-98-C	SP-4383	Merges TIA/EIA-98-B and J-STD-018	Published 06/99
TIA/EIA-126-B	SP-4136	ANSI version of IS-126 (MS loopback option)	Published 08/98
TIA/EIA-637-A	SP-4391	Short message service (including service negotiation, 14.4 kbps transmission, PCS and TIA/EIA-95 support)	Published 09/99
IS-96-B		CDMA Voice Coder (8 kbps)	Published 07/96
IS-127		Option 3: enhanced variable rate voice coder (EVRC)	Published 01/97
IS-127-1	PN-4146	Addendum #1 to IS-127	Published 08/98
IS-127-2		Addendum #2 to IS-127: TTY/TDD capabilities	Published 09/99
IS-657		Packet data services (Internet, CDPD)	Published 07/96
IS-658	PN-4374	Data Services Interworking Function Interface (e.g. modem pool)	Published 07/96
<b>IS-658-1</b>		<b>Addendum 1 to IS-658. Extends the ability to perform interface status exchange at times other than call setup</b>	<b>Published 05/99</b>
IS-683	PN-3569	Over the air activation (OTA) and service provisioning (Authentication Appendix A published 03/96)	Published 02/97
IS-683-A	PN-3889	OTA update: Roaming system selection and programming lock	Published 06/98
IS-707	PN-3676	14.4 kbps data services (including asynch. data, fax, STU-III and packet data)	Published 02/98
IS-707-A	PN-4145	Revision to IS-707 to be consistent with TIA/EIA-95 capabilities	Published 04/99
IS-718	PN-3648	Minimum performance standards for EVRC voice coder	Published 07/98
IS-733	PN-3972	High rate CDMA voice coder (13 kbps)	Published 02/98
IS-733-1		Addendum #1 to IS-733: TTY/TDD capabilities	Published 09/99
IS-736	PN-3973	Minimum performance specification for IS-733 (13 kbps voice coder)	Published 11/98
<b>IS-736-A</b>	<b>PN-4653</b>	<b>Corrections to testing procedures in IS-736</b>	<b>Development</b>
TSB-58-A	PN-4158	Parameter value assignments for TIA/EIA-95-B	Published 04/99
TSB-74		14.4 kbps radio link protocol and inter-band operations	Published 12/95
TSB-79	PN-3823	IS-637 update for 14.4 kbps SMS, service negotiation and Year 2000	Published 02/97

### 3G Version (cdma2000, IS-2000, 1xRTT, 3xRTT)

Standard	Project	Description	Status
TIA/EIA-97-D		Minimum performance standards for IS-2000 base stations	Development
TIA/EIA-99	PN-4617	9.6 kbps data for IS-2000	Ballot
TIA/EIA-125-A	SP-4682	Correction of errors in speech service option 1	Ballot
TIA/EIA-126-C	SP-4578	Mobile Station loopback test	Ballot
<b>IS-2000.1</b>	<b>PN-4427</b>	<b>cdma2000 Introduction and Overview</b>	<b>Published 08/99</b>
<b>IS-2000.2</b>	<b>PN-4428</b>	<b>cdma2000 Physical Layer</b>	<b>Published 08/99</b>
<b>IS-2000.3</b>	<b>PN-4429</b>	<b>cdma2000 Media Access Control (MAC) layer</b>	<b>Published 08/99</b>
<b>IS-2000.4</b>	<b>PN-4430</b>	<b>cdma2000 Signaling Layer 2 Link Access Control (LAC)</b>	<b>Published 08/99</b>
<b>IS-2000.5</b>	<b>PN-4431</b>	<b>cdma2000 Signaling Layer 3</b>	<b>Published 08/99</b>
<b>IS-2000.6</b>	<b>PN-4432</b>	<b>cdma2000 Analog Operation</b>	<b>Published 08/99</b>
<b>IS-2000-A</b>	<b>PN-4693-8</b>	<b>cdma2000 (all 6 parts to be revised)</b>	<b>In press</b>
<b>IS-707-A-1</b>	<b>PN-4541</b>	<b>Adds cdma2000 radio link protocol 3E support to 14.4kbps data</b>	<b>Published 12/99</b>
<b>IS-707-A-2</b>	<b>PN-4692</b>	<b>Data support for IS-2000-A</b>	<b>Ballot</b>
IS-801	PN-4535	Position determination services (e.g. for E911 Phase II)	Published 10/99
<b>IS-834</b>	<b>PN-4707</b>	<b>Direct Spread Specification for Spread Spectrum Systems on ANSI/TIA/EIA-41 (DS41) Upper Layers Air Interface</b>	<b>In press</b>
TSB-58-B	PN-4691	Parameter value assignments for IS-2000	Ballot 06/00
TSB-58-C		Parameter value assignments for IS-2000-A	Development
TSB-2000	PN-4534	Capabilities requirements mapping for cdma2000 standards	Published 09/99
	PN-4575	Speech and capacity-sensitive voice coder (formerly EVRC)	Development
	<b>PN-4650</b>	<b>13k voice coder simulation (TTY/TDD update)</b>	<b>Ballot</b>
	<b>PN-4651</b>	<b>EVRC simulation (TTY/TDD update)</b>	<b>Development</b>

### GSM MAP and Smart Card Support

Standard	Project	Description	Status
<b>IS-820</b>	<b>PN-4690</b>	<b>R-UIM (Removable "Smart Card") - Out for a default ballot</b>	<b>Ballot 04/00</b>
<b>IS-833</b>	<b>PN-4706</b>	<b>Multi-carrier Specification for Spread Spectrum Systems on GSM MAP (MC-MAP) Lower Layers Air Interface</b>	<b>In press</b>

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 Global Engineering Documents at 1-800-854-7179.

Thanks to Jack Nasielski for his assistance compiling the information in this table.