

# Cellular Networking Perspectives

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### ***TIA TR-45.3 TDMA Digital Air Interface Standards.....p. 5***

A tabular summary of all TIA TDMA cellular/PCS standards, including a list of the major parts of TIA/EIA-136 Revision 0, and a list of parts that will be modified during the development of TIA/EIA-136 Revision A.

## **Wireless LNP Deadline Extended: Standards Not Affected**

The FCC has extended the wireless local number portability (WNP) deadline by 9 months from June 30, 1999 to March 31, 2000. This does not affect the need for wireless switches to route to ported wireline numbers (Phase I), but does give more breathing room for wireless switches to accept ported customers from other wireless or wireline switches, and to be able to support the porting of their customers to other carriers (Phase II & III).

This delay will not effect the schedule for standardization of WNP Phase II, in fact the length of the standardization, development and testing process is one of the main reasons the FCC cited for extending the deadline.

In August 1998, the standard for Phase II of number portability (TIA TR-45.2 project PN-4186) was approved for ballot. Barring a need to rebalot, it should be published at the end of 1998, or early in 1999.

Phase II WNP will provide the basic ability for TIA/EIA-41 systems to support the separation of the MIN and the mobile directory number (MDN). Phase III is not mandated by the FCC, but will ensure that all advanced features work in a number portability environment (including short message service) and that number portability database queries are suppressed when not required (e.g. for a call delivery TLDN, which is never portable).

## **A Quartet of New Projects**

TIA standards subcommittee TR-45.2 has applied for four new standardization projects. Two were actually initiated by other groups within TR-45, but are now being handled by TR-45.2 which has the responsibility for all Stage I ("user level") feature descriptions:

- Wireless Number Portability Phase III (see previous article).
- Automatic Code Gapping (ACG). A method of reducing network and switching overload by deleting selected network messages (e.g. from randomly selected groups of mobiles). It may find application in number portability and the Wireless Intelligent Network (WIN).
- Group III fax and CDMA wireless local loop systems. The description of a service that will allow a Group III 'analog' fax machine to connect to a CDMA wireless local loop system.
- Enhanced security. Requirements for a second, more robust, generation of authentication and encryption algorithms initiated by the TR-45 *ad hoc* Authentication Group (AHAG).

**Next issue: October 1, 1998**

## Enhanced Wireless 9-1-1 & Location Technology Survey

Through a survey of location technology vendors, we have obtained information about the technology being developed for E911 and other applications, and the progress that has been made.

Table 1 describes the location technologies being developed by various vendors. All of the information was provided by the vendors and has not been independently validated. Information that is not shown is either not applicable to a technology, not available yet or is considered proprietary.

This table shows the divide between GPS-based systems and network based (“triangulation”) systems. GPS systems benefit from greater accuracy, and will work with only one cellsite visible. However, they may take longer to determine location and are unlikely to work in buildings or in dense urban areas. Also, they require phone modifications and may not meet the FCC mandate for Enhanced Wireless 9-1-1. Network based systems are likely to work better in urban areas where a dense network of cellsites exists with a customer base sufficient to finance the technology and will work with existing phones. Can either technology provide a complete solution, or will a combination be required? Only time, and further technology developments and demonstrations will tell.

Table 2 provides information on E911 location trials that have been completed or that are ongoing. Organizations participating in the trial can be contacted for alternate views on the success of the trial, and may also supply field trial reports.

Table 3 provides a list of commercial location services that at least one of the vendors is considering. It is likely that carriers that spend millions of dollars on a location network that can only be used to assist 9-1-1 callers will soon want to find commercial outlets to help pay for their investment.

Table 4 provides contact information for all companies that completed our survey, including SCC, SignalSoft and XYPoint, that do not provide location technologies, but that provide network intelligence necessary to take raw location data and turn it into useful information for the PSAP.

The accompanying glossary explains some of the acronyms and technical terms that are used throughout this article.

If any vendors have been missed, please contact the editor for a copy of the survey. An update may be published in the future, or made available to subscribers, if enough additional information is obtained.

### Wireless & Location Technology Glossary

AMPS	- Analog cellular technology defined by standards EIA/TIA-553 and IS-91.
AOA	- Angle of arrival technology. Measures the angle that a signal approaches from at different sites. Theoretically, two angles define a mobile's position, but inaccuracies and site alignment mean that sufficient accuracy requires more sites.
CDMA	- Code division multiple access. A digital access technology, defined by the standard TIA/EIA/IS-95.
Control Channel	- A channel reserved for signaling messages. Used by mobiles that are not assigned to voice or traffic channels.
D-AMPS	- A time division multiple access technology, defined by TIA/EIA/IS-54 and IS-136.
DCCH	- Digital control channel used by IS-136 TDMA systems.
E911	- Enhanced 9-1-1 calling capabilities, including callback and cell/sector identification (Phase III) and positioning with 125 meter location accuracy (Phase II).
GSM	- Global System for Mobility. European TDMA cellular/PCS access and network technology.
GPS	- Global Positioning System. Based on a number of US military satellites. Has high accuracy, but only when sufficient satellites are visible. May not work in urban and in-building situations.
NAMPS	- An analog cellular technology that squeezes three 10 khz voice channels into one AMPS 30 khz channel.
PSAP	- Public Safety Answering Point. The place where 9-1-1 calls are answered.
TDMA	- Time division multiple access. A digital access technology used by GSM and D-AMPS.
TDOA	- Time difference of arrival technology. Measures the time of a mobile's signal at multiple, time synchronized sites. Minute differences define the distance of the mobile. Theoretically, two measurements define two points, and three measurements a single point, but inaccuracies due to multipath and other causes mean that more sites may be required for sufficient accuracy.
Traffic Channel	- Channel used to transmit digitized voice to/from a mobile.
Voice Channel	- Channel used to transmit analog voice to/from a mobile.

**Table 1: Characteristics of Location Technology Offerings**

		Cell-Loc	Corsair	Grayson Wireless	KSI	Sigma One	Snap- Track	Tendler Cellular	True Position
Location Technology		TDOA	TDOA+ AOA	TDOA+ AOA	AOA	TDOA+ AOA	GPS	GPS	TDOA
Network and/or Mobile based		network	network	network	network	network	both	mobile	network
<b>Accuracy</b>	Urban 'canyons'				125m	▲	30-40m	50m	125m
	In-building	140m				↑	20-90m		
	Suburban	100m			125m	90m *	20-30m	50m	125m
	Vehicle (speed)	100m @ 30mph			125m		20-25m @ 65mph	50m @ 60mph	125m
	Low density rural				125m	▼	5-10m	50m	
Seconds to determine location		2-10			0.1	0.5	2-3	10-12	< 3
<b>Mobile Radio Access Technology</b>	AMPS	- control		field trial ongoing	field trial ongoing	field trial 05/98	field trials ongoing		comm.
		- voice	comm. 12/98	field trial ongoing	field trial 3Q'98	field trial ongoing 05/98		Audiovox 505	comm.
	NAMPS	- voice			field trial ongoing			Audiovox 506	comm.
	D-AMPS	- DCCH		field trial ongoing	field trial 4Q'98	field trial ongoing 12/98	field trial 12/98		field trial 4Q'98
		- voice	comm. 12/98	field trial ongoing	field trial 4Q'98	field trial ongoing 12/98	field trial 12/98		field trial 4Q'98
	GSM	- control		research		field trial 10/99			field trial 4Q'99
		- voice	research	research		field trial 10/99			field trial 4Q'99
	CDMA	- control		research		field trial 06/99	field trial 1Q'99		field trial 2Q'99
		- voice	field trial 04/99	research	field trial 1Q'99	field trial 06/99			field trial 2Q'99

\* - Type of area for accuracy measurements not specified.

**Table 2: E911 Location Trials**

Vendor	Trial locations and completion dates	Partners
Cell-Loc	Calgary, Alberta, Canada (02/98)	Telus Mobility
Corsair	confidential (throughout 1998)	confidential
Grayson	information not available	confidential
KSI	Annandale, Virginia, USA (ongoing)	Observers only
SCC	New Jersey (01/97) and Harris County, Texas (12/96)	Comcast, Houston Cellular, State of New Jersey, Harris County, TruePosition
SigmaOne	Southern California (ongoing since 04/98)	confidential
SignalSoft	Denver & Adams Counties, Colorado	US West, SCC, SnapTrack
SnapTrack	San Francisco (12/97), Tokyo (12/97), Kyoto (1/98), Denver (8/98)	NTT DoCoMo, US West Wireless, City of Denver, Adams County Colorado, SignalSoft, SCC
Tendler	Boston, Walnut Creek CA, Austin TX, Bedminster NJ, Redmond WA, Atlanta	GTE, AirTouch, Southwestern Bell, Bell Atlantic, AT&T, BellSouth
TruePosition	New Jersey (04/97), Houston Texas (12/96)	Comcast, GTE Wireless, State of New Jersey, City of Houston, HBF, SCC, Rockwell, KML, MapInfo, On-Target Mapping
XYPoint	confidential	confidential

**Table 3: Potential Commercial Location Services**

Service	Description	Potential vendors
Location sensitive billing	Billing charges are reduced close to home/office locations.	Corsair, SignalSoft, XYPoint
Enhanced 4-1-1	Directory assistance uses the callers location to find the nearest service in a category.	Corsair, SignalSoft, Tendler, XYPoint
Navigation	Current position is used to provide directions.	Corsair, SignalSoft, Tendler, XYPoint
Roadside assistance	Tow truck or other assistance is dispatched to the correct location.	Corsair
Vehicle/Equipment Tracking	Trucks or large pieces of equipment can be tracked	Corsair, Tendler, XYPoint
Lost/Stolen phones	The location of lost or stolen phones can be determined	Corsair, XYPoint
Medical patient/law enforcement tracking	Medical patients, people under house arrest, or people under surveillance can be tracked	Corsair, Tendler
Intelligent Routing	Routing to a map-enabled call center, and routing to pre-recorded voice reports	SignalSoft
RF Optimization	The RF measurement capabilities of a location network can be applied to measuring coverage of a wireless network	TruePosition

**Table 4: Vendor Contact Information**

Vendor	Contact	Phone/Fax	Email/Website
Cell-Loc Inc.	Jim George	403-569-0760x237 403-569-0762	jrgeorge@cell_loc.com www.cell_loc.com
Corsair Communications	Julie Gupta	650-842-3207 650-493-2821	jpgupta@corsair.com www.corsair.com
Grayson Wireless Division of Allen Telecom Inc.	Bob Ewald	703-787-7944x107 703-787-8007	bob_ewald@grayson.com www.grayson.com
KSI Inc. *	Harvey W. Conner	703-941-5749 703-941-5786	hconner@ksix.com www.TeleSentinel.com
SCC Communications Corp.	Eric Sorensen	303-581-5765 303-581-0900	esorensen@scc911.com www.scc911.com
SigmaOne Communications	Sandy Mayer	818-348-3300 818-348-0900	smayer1@ibm.net
SignalSoft Corp.	Steve Nowak	303-381-3084 303-381-3001	snowak@signalsoftcorp.com www.signalsoftcorp.com
SnapTrack Inc. *	Ellen M. Kirk	408-556-0461 408-556-0404	ekirk@snaptrack.com www.snaptrack.com
Tendler Cellular, Inc.	Bob Tendler	617-720-1339 617-723-7186	rtendler@fonefinder.com www.fonefinder.com
TruePosition Inc. *	Thomas Ginter	610-631-7517 610-631-7501	tginter@trueposition.com www.trueposition.com
XYPoint Corporation	Lawrence J. Corvari	206-674-1028 206-674-1080	lcorvari@xypoint.com www.xypoint.com

\* Field trial report available from contact (KSI, SnapTrack) or website (TruePosition)

# TIA TR-45.3 TDMA Digital Air Interface Standards

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### First Generation - IS-54

IS/TSB	ANSI	Description	Status
IS-54-B	TIA/EIA-627	Original TDMA Dual-Mode Air Interface Standard	ANSI pub. 09/96
	<b>TIA/EIA-627-1</b>	<b>Addendum to TIA/EIA-627</b>	<b>Published 04/98</b>
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

### Second Generation - IS-136 Revision 0 (Digital Control Channel)

Standard	PN/SP	Description	Status
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-136.1-1		Addendum to IS-136.1 Rev. 0 (DCCH)	Published 12/94
IS-136.2 Rev. 0		FSK control channel, analog voice channel, TDMA traffic channel	Published 12/94
IS-136.2-1		Addendum to IS-136.2 Rev. 0 (Analog voice channel and FSK control channel)	Published 12/94
IS-137-0		TDMA/analog mobile minimum performance standards	Published 12/94

### Third Generation - IS-136 Revision A (ACELP Voice Coder)

Standard	PN/SP	Description	Status
<b>IS-130-A</b>		<b>Radio Link Protocol 1 (data services)</b>	<b>Published 07/97</b>
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 (DCCH)	Published 11/96
IS-136.1-A-2		IS-136 Rev. A, second addendum: section 1 corrections (DCCH)	Published 12/97
IS-136.2-A		FSK control channel, analog voice channel, TDMA traffic channel	Published 10/96
IS-136.2-A-2		IS-136 Rev. A, second addendum: section 2 corrections	Published 12/97
IS-137-A	PN-3605	Mobile minimum performance standards for IS-136-A	Published 07/96
IS-137-A-1		Revised transmission tests for IS-137-A	Published 08/97
IS-138-A	PN-3606	Base station minimum performance standards for IS-136-A	Published 07/96
IS-641		Enhanced full-rate voice coder (ACELP)	Published 05/96
<b>IS-684</b>		<b>Radio Link Protocol 2 (for STU-III)</b>	<b>Published 07/96</b>
IS-686		Enhanced full rate voice coder performance standards	Published 12/96
<b>IS-727</b>		<b>Discontinuous transmission (DTX) with ACELP (IS-641) voice coder, including generation of comfort noise</b>	<b>Published 07/98</b>
TSB-73		IS-136 Rev. 0/Rev. A compatibility issues	Published 07/96
TSB-77	PN-3731	IS-641 implementation issues	Published 12/96

## Fourth Generation - TIA/EIA-136 Revision 0 (SP-4027)

TIA/EIA-136-0-	Description	Status
-0XX (in 4 parts)	Introductory sections, including contents, Optional Mobile Station Facilities and assignments for SOC, BSMC and Carrier Specific HLPI	In press
-1XX (in 10 parts)	Definition of RF channel assignments, digital control channel (3 layers), digital traffic channel (3 layers), analog (FSK) control channel and analog voice channel	In press
-2XX (in 5 parts)	Minimum performance requirements for mobile station (handset), base station and VSELP/ACELP voice coders	In press
-3XX (in 11 parts)	Data services, including RLP1 (circuit data), RLP2 (STU-III encrypted voice), packet data and data service control	In press
-4XX (in 4 parts)	Voice Coders (ACELP, VSELP and US1)	In press
-5XX (in 3 parts)	Authentication, Encryption of Signaling Information/User Data and Voice Privacy	In press
-6XX (in 4 parts)	Teleservice Transport (e.g. Short Message Service)	In press
-7XX (in 5 parts)	Teleservices (including short message service, over-the-air activation, over-the-air programming and general UDP transport)	In press
-9XX (in 3 parts)	Normative and Informative Annexes	In press

## Fifth Generation - TIA/EIA-136 Revision A

TIA/EIA-136 Revision A is based on Revision 0, with only the following parts being modified:

TIA/EIA-136-A-	Description	Status
-000	List of parts	Development
-005	Introduction to TIA/EIA-136 Revision A	Development
-010	Optional Mobile Station Facilities	Development
-020	SOC, BSMC and Carrier Specific HLPI assignments	Development
-100	Introduction to channels	Development
-110	RF channel assignments	Development
-121	Digital control channel (DCCH) layer 1	Development
-122	Digital control channel (DCCH) layer 2	Development
-123	Digital control channel (DCCH) layer 3	Development
-131	Digital traffic channel (DCCH) layer 1	Development
-132	Digital traffic channel (DCCH) layer 2	Development
-133	Digital traffic channel (DCCH) layer 3	Development
-140	Analog (FSK) control channel	Development
-150	Analog voice channel	Development
-270	Mobile station (handset) minimum performance	Development
-280	Base station minimum performance	Development
-420	VSELP voice coder	Development
-510	Authentication and encryption of signaling, user data and voice	Development
-511	List of messages and parameters subject to encryption	Development
-620	Teleservice segmentation and reassembly (TSAR)	Development
-630	Broadcast teleservice transport (BATS)	Development
-700	Introduction to teleservices	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.

Thanks to Al Sacuta (Next Generation) for his assistance compiling the information in this table.