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The Future of TIA TR-45 Standards Development

Wayne Bowen, US Phoenix

The Telecommunications Industry Association (TIA) has been responsible for the development of many major cellular and PCS standards, including analog AMPS and N-AMPS, as well as digital TDMA and CDMA.

TIA TR-45 (Mobile and Personal Communications Systems) standards activities are approaching a historical juncture. Every wireless industry member should carefully question their current thinking and challenge their assumptions. Those who are speeding to a perceived competitive edge risk plunging over the edge of a cliff instead. Those assuming current plans will remain effective face other perils. Those assuming other vendors and operators will make the necessary changes to satisfy their own requirements may only find disappointment. Wireless operators could lose control of the defining wireless technical standards.

How did we get here?

Historically, TIA standards provided uniform specifications for cellular and PCS systems vendors and operators. For example, IS-41 (later TIA/EIA-41) MAP (Mobile Application Part) provided standard methods for automatic roaming and handoff. This stimulated growth in markets for both operators and vendors.

Over time, these TIA standards incrementally added new services such as call forwarding, three way calling, voice mail, call waiting, calling number id and SMS. The new PCS spectrum spurred the standardization of new TDMA and CDMA digital air interface standards. Even though the air interfaces diverged, the network standards remained stable, serving the multiple air interfaces well.

This new generation of standards evolved through careful deliberations by many of the same engineers that formulated the original standards. Difficulties in correcting handset problems mandated extreme care. Over-the-air activation and provisioning have reduced some difficulties, but TIA standards work has perpetuated the same cautious approach with good results.

As TIA standards expanded, some participants adopted strategies that migrated away from growing markets through robust, common standards with few carrier specific options. They moved instead to optimize their own company's competitive advantage. These participants believed that standards were not meeting their objectives, and consequently began forming outside forums organized along technology lines. TDMA companies formed UWC (which recently morphed into 3G Americas with a purely GSM focus), and CDMA companies formed CDG.

TIA standards bodies also began developing WIN services to support proprietary off-switch value-added services. The small vendor ability to base

Editor: David Crowe.
Accounts: Evelyn Goreham.
Distribution: Debbie Brandelli.
Production: Doug Scofield.

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service solutions on powerful, cost-effective computing and network platforms captured the imagination of many service providers. Individual carriers began exploring proprietary third party solutions based on minimally standardized interfaces. One example is location services. All were looking for more nimble and economical ways to grow revenue and reduce costs.

IP Protocol Development

Internet protocols have developed in a much more chaotic, *ad hoc* fashion – by choice. Anyone can draft a Proposed Standard specification. When two independent implementations demonstrate interoperability, it can become a Draft IETF Standard. After beneficial experience and maturity, a Draft Standard can become an Internet Standard. This does not happen very often, however. Of over 3,200 RFCs (Request for Comment), fewer than 70 are Internet Standards, and about the same number are Draft Standards.

The IETF approach fosters rapid evolution of innovative, diverse IP protocols. It does not mandate Internet-wide uniformity beyond their formal standards. This permits innovative improvements within individual subnetworks. But it also can result in incompatibilities. The internet is not one uniform network, but an amalgam of private and public sub-networks. These may interwork correctly for basic packet transport (e.g. IP, UDP and TCP), but they may be rife with incompatibilities between individual sub-networks when using higher level protocols. For example, while IPv4 defines the Type of Service (TOS) field, it leaves specific TOS values and their usage to the discretion of vendors and sub-network policy.

More importantly, because independent sub-networks may choose different protocol suites, scrupulous RFC acceptance review by all vendors and network operators may not always occur. Many protocol specifications originate within topical Working Groups that do not always present a complete cross-section of the internet industry.

Typically, interworking compatibility cannot be assured without thorough conformance testing. Even then, this may only certify compatibility for specific implemented protocol elements.

Such chaotic, diverse protocol implementation can be tolerated for static, local computer systems, where fixes can be loaded into systems that are then rebooted. Even with PC capabilities for downloading and installing system fixes, this is a continuing management headache, and frequently it can require down time and knowledgeable manual intervention.

This level of disruption will be totally unacceptable for telecommunications systems where continuous availability is expected.

IP meets Telephony

Wireless data modems, SMS datagram delivery, increased mobile handset functionality, and PDAs have already blurred the distinction between handsets, PDAs and computers – a trend that is accelerating with the increasing inclusion of wireless capabilities in computing devices.

With Web usage exploding, wireless companies felt compelled to duplicate the same Web interfaces over limited bandwidth air interface bandwidth, leading to protocols such as WAP and SOAP.

Glossary

For any terms you are unfamiliar with, please consult:

www.cnp-wireless.com/glossary.html

These protocols achieved limited successes, probably largely due to the limited bandwidth and restrictive user interfaces.

The promise of increased handset bandwidth through new 3G air interfaces has further spurred interest in IP-based wireless telecommunications. A common IP protocol makes more sense, and this, in turn, should speed common wireless IP capability development for mobile handsets, PCs and PDAs.

All-IP, All the Time

The packetized nature of voice transmission on digital air interfaces, along with interest in replacing circuit switching voice with packet switching, is encouraging a major technology shift. Many have claimed improved economics for packet switched telephony. Recognizing this, IP network vendors and many small companies seized the opportunity to inject disruptive IP technology into wireless networks – this was done for their competitive advantage against the traditional dominant wireless system vendors. New industry forums, most notably MWIF, focused on new wireless, All-IP network architectures.

Currently, engineers within the IP domain are busily inventing IP telephony without the benefit of either a generous development interval or abundant telephony experience. They may find enormous challenges lie ahead, because what made sense in the circuit domain may not make sense for the packet domain.

Wireless IP standards exist today. A user can establish a mobile call with the appropriate service option, initiate a PPP connection, much as with wired access, and connect to the web. Beyond that point, the user is free to use the IP connectivity for applications that may include VoIP, and streaming audio and video. What has not been fully demonstrated is adequate air interface bandwidth and Quality of Service for these services. IP is notorious for dropping packets and delivering them out of order and with significantly varying latencies (‘jitter’).

IP mobile call control – to fully replace TIA/EIA-41 and GSM MAP – does not exist. How do operators transition from an existing MAP to an IP equivalent in a continuous operating environment? How do conventional and All-IP handsets work in the same mobile area without separate overlays? Success is not assured. A historical analogy of a technology that failed because of a lack of backward compatibility is ISDN.

TDMA and CDMA succeeded precisely because phones were available with analog to provide backward compatibility while roaming.

QoS and Security

With the advent of wireless IP mobility and associated services, trouble may arise. Adequate Quality of Service (QoS), security and service applications immediately come to mind. A user traversing multiple networks may suddenly experience difficulties, such as the loss of previously negotiated security, lost application services or an unacceptable call quality. More dangerously, the user may not even be made aware of the renegotiated protocols, which might continue for some time. After-the-fact problem discovery may prove unacceptable. What wireless IP viruses, trojan horses and worms may be lurking in the future?

Many examples for potential difficulties exist. Two of them are: Quality of Service (particularly for delay sensitive voice); and security. Within IP, various protocols exist for QoS – INTSERV, DIFFSERV, RSVP, MPLS. Numerous security alternatives also exist. In both these areas, new protocols are also under development.

What happens when service providers hastily roll out new wireless voice IP services, only to learn critical operational and security inadequacies exist within some mobile environments? NTT DoCoMo has already recalled handsets to fix problems with their 3G (Wideband CDMA) rollout.

Beyond IP to XML and Then What?

To the IETF's credit, IP networks have been very dynamic, resulting in timely and beneficial innovations. Every time a new PC or server technology is introduced, it probably includes improved IP protocol software. For example, XML IP – where conventional IP headers and packets are replaced by XML entities –has suddenly become a "must have" technology for some environments and applications.

What service provider has contemplated the magnitude and complexity of managing such dynamism within a customer base that has learned to expect good service and high reliability? Will consumers and businesses accept yet another round (or rounds) of handset replacements? What consumer benefit(s) will persuade them to accept this change?

Harmonization?

Two years ago, some telecommunications industry experts were forecasting the conclusion of TIA wireless standards work. ANSI-41-E was approaching completion. Major service providers were choosing GSM, GPRS, and EDGE as an evolutionary path to UMTS (Wideband CDMA). Harmonization would move the existing CDMA and GSM standards to one common body of global standards. Once UMTS capabilities were completed within two years, as some believed, the globe was open for boundless carrier services. Carriers that chose UMTS began paying less attention to CDMA standards and the standardization activities of 3GPP2. This happened even while some industry experts disagreed. CDMA offered a much more reasonable migration growth path, particularly for North America and Asia. Others focused on the IETF standards, to the detriment of wireless standards.

If telephony history has any lessons, one is that while CDMA and UMTS can be made more similar than dissimilar, they will never be made identical. They already have too many fundamental differences. And strong regional economic interests make full harmonization undesirable for some powerful companies. As one historical example, while the E1 interface is basically uniform across the globe, regional variations (such as North American T1) continue to exist. As another example, after ISDN and SS7 had been standardized within ITU, North America then adopted its own variations. The forces behind regionalization of technology are not likely to disappear, even with globalization, although the barriers may not always be geographical or geopolitical. They may reflect the business interests of powerful companies, instead.

One big pot. Who Stirs?

So now, IETF, TIA by way of 3GPP2, ETSI by way of 3GPP, and other regional bodies are all playing in the same sandbox – North American All-IP Wireless Telephony. It will be impossible for 3GPP to conclude Harmonization without TIA help, although 3GPP still has a tendency to define harmonization as a one-way, temporary bridge from TIA standards to 3GPP (matches included).

Service providers can follow the IETF lead without putting industry-wide conformance standards in place, and they can hope consumers will find benefits, rather than just trauma, during the transition.

Wireless technology has become more complicated than ever. Standardization reflects the complexity of the technology, along with the political and business interests. The industry is standing on the threshold of the most ambitious technology transition ever undertaken. A lot depends on the answers to two questions:

- Which organizations control the standardization?
- Are adequate support and resources being applied to this enormous task?

About the Author

Wayne Bowen is Vice-Chair for the TIA TR-45.6 subcommittee on Wireless Packet Data. He has over 30 years of experience in telecommunications and information technology and its application. His education includes a BS from the University of Kentucky and an MS and MBA from the University of Chicago.

For a Good Chuckle...

www.cnp-wireless.com/acronyms.html

…has a collection of humorous definitions for common telecom and computer acronyms. If you suspect that one has been contributed by a competitor to belittle your favorite technology, get back at them by submitting your own barb directed at theirs!

3GPP/3GPP2 Harmonization

In the technology wars, 3GPP and 3GPP2 are sometimes seen as representing the two opposing armies. But, both realize it is unlikely that their opponents will be eliminated, meaning they will have to work together.

3GPP and 3GPP2 both plan to migrate from the current circuit-switched telephony networks, based on SS7 signaling, to a pure Internet Protocol (IP) network where IP packets will be used to transmit not only user data, but also voice and signaling. As much as is possible, this will rely on existing or developing IETF protocols.

This new system is known as the IP Multimedia System. Because the core network is somewhat independent of radio interfaces, it is a logical place for 3GPP (proponents of Wideband CDMA) and 3GPP2 (proponents of cdma2000) to work together.

IP Core Network Harmonization Workshop

An IP Core Network Harmonization Workshop was held on April 3rd and 4th, 2002 in Toronto, Canada. It was hosted by ITU and MWIF. Approximately 110 people participated in the workshop, with 3GPP2 delegates outnumbering 3GPP.

Impact on 3GPP

The delegates of this workshop were aware the recommendations will not affect the schedule or contents of 3GPP release 5. If the recommendations are accepted by 3GPP, they will be incorporated in Release 6 and later.

Major Recommendations

- Harmonization of 3GPP and 3GPP2 IP Multimedia Core Networks is worthwhile and achievable. It should be pursued urgently by both groups, particularly where synergies exist. Priority will be given to harmonization in the areas of:
  - OSA/PARLAY based service APIs based on Parlay 3.1 and 3GPP Release 5 OSA.
  - IP Multimedia Subsystem (IMS) based on 3GPP IMS and 3GPPS MMD (Multi-media Domain).
- Based on the considerable alignment between 3GPP IMS and 3GPP2 MMD, it was agreed that the groups should adopt:
  - The same reference model at a high level of abstraction, to be extended within the 3GPP or 3GPP2.
  - Consistent terminology to describe common IMS functional entities. See **Table 1**.

  3GPP IMS is more developed, and therefore it will be used as the basis of the common reference model and terminology.

Table 1: Alignment of Terms

Old	New
MMD Subset	IMS
CQM	PDF
PCF	
P-SCM	P-CSCF
I-SCM	I-CSCF
S-SCM	S-CSCF
L-SCM	BGCF
NCGW	OSA-SCS

- 3GPP and 3GPP2 should work to ensure:
  - Interoperability between 3GPP and 3GPP2 IMS mobiles.
  - Application-level roaming between 3GPP and 3GPP2 IMS.

IMS Harmonization Network Reference Model

The workshop agreed to a harmonized reference model for common parts of the IMS network reference model. This is shown in **Figure 1**. The acronyms for the network elements are listed in **Table 2**

Table 2: IMS Terms

Term	Definition
AAA	Authentication, Authorization and Accounting.
BGCF	Breakout Gateway Control Function. Selects the PSTN network to connect to.
CSCF	Call Session Control Function. See I-CSCF, P-CSCF, S-CSCF.
HSS	Home Subscriber Server. Provides functions similar to HLR, AC and billing systems.
I-CSCF	Interrogating CSCF. Main contact point for all IMS connections to a carrier's subscribers.
IMS	IP Core Network Multimedia Session Domain.
MGCF	Media Gateway Control Function.
MGW	Media Gateway. Connects circuit-switched calls to and from their packetized equivalent.
MMD	Multimedia Domain.
MRFC	Media Resource Function (MRF) Controller.
MRFP	MRF Processor. Provides tones, recordings, conference bridges, etc.
OSA-AS	OSA (Open Services Architecture) Application Server.
OSA-SCS	OSA Service Control Server.
P-CSCF	Proxy CSCF. First contact point for a terminal within the IMS.
PDF	Policy Decision Function. Controls the assignment of resources based on priority and characteristics of each session.
PDN	Packet Data Network.
PLMN	Public Land Mobile Network.
PSTN	Public Switched Telephone Network.
S-CSCF	Serving CSCF. Handles IMS session states.
SIP-AS	SIP (Session Initiation Protocol) Application Server.

These terms, and many others, are also defined at:

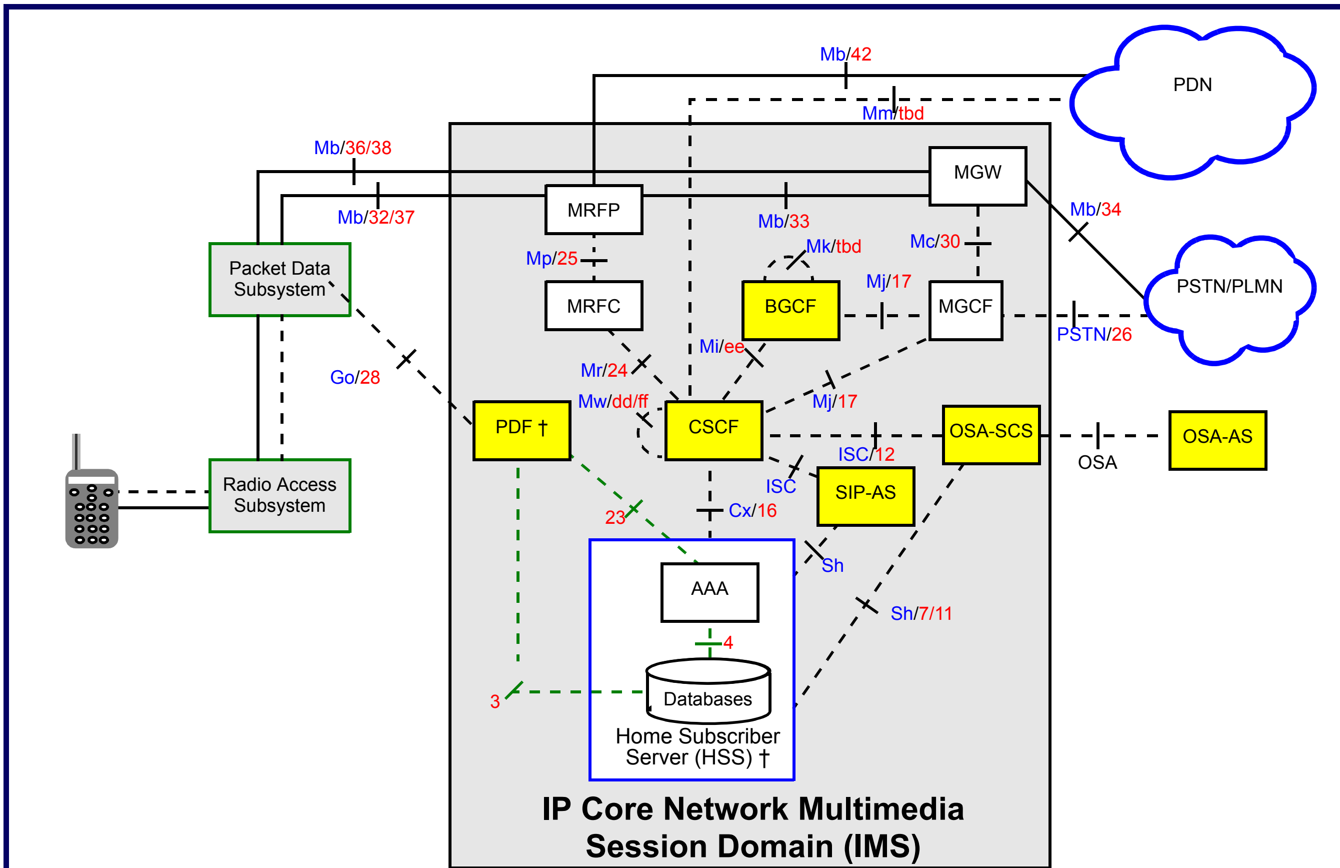
www.cnp-wireless.com/glossary.html

What Next?

Harmonization is a very political activity, and its success is not assured. There is concern by many within 3GPP2 that 3GPP will only participate if they control the process, creating at best a migration path from 3GPP2 standards to Wideband CDMA.

The balance of power does appear to be shifting. While 3GPP is definitely ahead in the definition of standards, 3GPP2's 3G standards (e.g. 1XRTT) are having more success in actual implementations. This could lead to 3GPP being more flexible in their approach to harmonization.

Figure 1: Harmonized 3GPP/3GPP2 Network Architecture Model



Control

Bearer

Interface (with name) xx/yy

Blue = 3GPP definition
Red = 3GPP2 definition
Black = common definition
Green = not common

Notes (†):

- For 3GPP, the PDF is within the P-CSCF. For 3GPP2, it is a standalone entity.
- For 3GPP, the HSS also contains HLR functionality (not shown). For 3GPP2, the AAA is standalone.
- Most interfaces that are *not* being considered for harmonization are not shown.

TIA TR-45.6 and TSG-P 2G and 3G Wireless Packet Data Standards

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Note:
1. IS- Interim Standard, TSB- Telecommunications Systems Bulletin, P.Sxxxx - 3GPP2 TSG-P Specification, P.Rxxxx - TSG-P Report, 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 the TIA at www.tiaonline.org/standards

CDPD - Cellular Digital Packet Data

Standard	Project	Description	Status
IS-732	**PN-4033**	**Cellular Digital Packet Data (CDPD) - multiple parts**	**Published 02/98 Being rescinded 01/02**
TSB87	PN-4001...	CDPD support services (Directory, Authentication, DNS, Testing, Identifiers, Numbering)	Published 02/98

CDPD - Cellular Digital Packet Data (Revised)

Standard	Project	Description	Status
TIA/EIA-732	SP-4033-UG	Revisions to CDPD and Upgrade to ANSI	Published 08/01

3G Packet Data

Standard	Project	Description	Status
IS-835	PN-4732	cdma2000 Wireless IP Network Standard	Published 12/00
IS-835-1	PN-4732-1	Addendum to IS-835	Replaced by IS-835-A
IS-835-A	PN-4732-RV1	cdma2000 Wireless IP Network Standard	Published 05/01
IS-835-B	**PN-4732-RV2**	**Supports IPv6, Dynamic Home Agent, QoS and Push Services**	**In press**
TSB115	PN-4286	cdma2000 Wireless IP Architecture based on IETF Protocols	Published 12/00

3GPP2 TSG-P Projects

3GPP2	Description	Status
P.R0001	Wireless IP Network Architecture based on IETF Protocols	Published 08/00
P.S0001	Wireless IP Network Standard based on IETF protocols (same as IS-835)	Published 12/99
P.S0001-A	Wireless IP Network Standard (same technical content as IS-835)	Published 08/00
P.S0001-A-1	Addendum to P.S0001-A	Published 01/01
P.S0001-Av3	Wireless IP Network Standard (same technical content as IS-835-A)	Published 07/01
P.S0001-B	Wireless IP Network Standard (in V&V)	See IS-835-B