

Cellular Networking Perspectives

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Comments

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Next Issue: September 6th, 2004

Wireless at Supercomm 2004

The big US telecom trade show Supercomm has been known primarily as showcase for wired technologies, but at **this year's show** – held June 20-24 in Chicago – wireless moved out of the shadows, especially in two areas: WiMAX and fixed-mobile convergence.

WiMAX is the name for broadband wireless networks based on the **ETSI HiperMAN** and **IEEE 802.16** standards. WiMAX is basically a souped-up version of Wi-Fi, but can choose from a wider variety of bands between 2 GHz and 11 GHz. Applications include portable broadband access, "last-mile" connections for cable and DSL, and backhaul for Wi-Fi hotspots and 2.5G/3G cell sites.

The 802.16 standard was ratified a week after Supercomm, and the initial crop of WiMAX products are expected to be available sometime in the first half of 2005. Motorola used Supercomm to **announce** that it had joined the **WiMAX Forum** as a principal member. The company plans to ship its first WiMAX products, for the 3.5 GHz band, in early 2005.

Redline Communications claimed the **first 802.16-compliant product** by adding TDM functionality to its existing AN-100. Several other vendors publicized customer wins rather than new gear. Aperto Networks, for example, recently **announced three carriers as new customers** for its 802.16-based systems. Such announcements may indicate that 802.16 (including WiMAX, even though it's not yet available) is revitalizing the formerly stagnant fixed wireless sector, which languished after **LMDS** and **MMDS** failed to take off. Cynics especially will remember that LMDS and MMDS generated plenty of buzz at Supercomm shows in the late 1990s before moving out of the spotlight and into bankruptcy courts.

The other hot wireless topic was fixed-mobile convergence, a concept to make voice and data services accessible across heterogeneous networks. The term is broad enough that a wide variety of technologies can easily fit the definition. One example is Materna Information & Communications' **Anny Way suite of products** which can transfer MMS messages between cell phones, wired phones and TV sets. Since November 2003 **ETSI** has been

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working on ten standards for MMS over wired networks, and **four have been published so far**.

Fixed-mobile convergence also can be interpreted as using a single platform to create and deliver voice and data services over heterogeneous networks. At Supercomm, several vendors said that wired service providers increasingly view 3GPP's IP multimedia subsystem (IMS) as an attractive foundation for creating and delivering services. One example demonstrated at Supercomm is Lucent Technologies' **Accelerate**, an IMS-based platform that delivers voice, video and data over 3G, Wi-Fi and wireline networks.

A week after Supercomm, ETSI held a **workshop** to resolve fundamental differences between wired and wireless networks, include incompatible approaches to quality of service (QoS) and to decide whether wired networks should support wireless voice codecs.

Another wireless highlight at Supercomm was Sprint PCS's announced launch of CDMA2000 1xEV-DO in a few cities by late 2004, followed by a larger roll-out in 2005. The company's original plan was to skip DO, which supports data in dedicated spectrum, and go straight from 1X to 1xEV-DV, which mixes high speed data with voice. Sprint PCS claimed that the DO decision was driven by growing customer usage of wireless data, but it was obviously also influenced by high-speed offerings from rivals, including AT&T Wireless with its EDGE service, now available for 220 million POPs, and Verizon Wireless' DO service, which is available in San Diego and Washington, DC, and expected to expand into other locations.

Sprint PCS' decision also may have been driven partly by Cingular Wireless' plans to **trial UMTS in Atlanta** this summer. Cingular Wireless reiterated that decision on June 22, when it announced that it had started taking **bids on a UMTS network**.

That announcement wasn't made at Supercomm, but it certainly was noticed there, particularly the timetable: Cingular Wireless previously said that it wouldn't be able to launch UMTS until 2006 and 2007 because vendors couldn't deliver the necessary infrastructure, which has to run at 850 MHz and 1900 MHz. "We've challenged the vendor community to **expedite it to 2005**" COO Ralph de la Vega told Reuters. Lucent Technologies, Motorola, Nokia and Nortel Networks said that they will **all be able to meet the new deadline**.

The All-IP Wireless Network

All-IP, known more formally as IMS (IP Multimedia System) or MMD (Multi-Media Domain) is a bold attempt by both 3GPP and 3GPP2 to forge a new wireless network based completely on IP, rather than the separate networks required for voice, data and signaling in the past.

Traditional telephony networks usually run signaling (control information) over an SS7 packet-switched network, voice over circuits on time-division multiplexed facilities such as T1 or E1 and data on yet a third network (e.g. IP).

All-IP specifications were first developed by 3GPP. They have been adopted by 3GPP2 which simply edited the specifications to convert support from UMTS/W-CDMA to cdma2000, keeping compatible parts unchanged. The complete list of specifications is shown in **Table 1**. Note that the TIA equivalent of the X.S0013 series is TIA-873.

Major Protocols

The most important protocols in the All-IP network are the Session Initiation Protocol (SIP) and Session Description Protocol (SDP) for VoIP call control, Diameter for "triple A" (Authentication, Authorization and Accounting (Billing)) and Mobile IP for packet transmission while roaming. The system is supposed to work with both IPv4 and IPv6, although today most networks are exclusively IPv4.

Network Elements

The most important Network Elements of the All-IP network are illustrated in **Figure 1** and described below.

Access Gateway. Interfacing between the All-IP network and the Access Network. The Foreign Agent is likely to be embedded if Mobile IP is supported.

Access Network. The radio portion of the All-IP network (e.g. cdma2000 or Wideband CDMA).

Border Router. A router that interfaces to those in other networks using the EBGp protocol according to IETF **RFC 1771**.

Breakout Gateway Control Function. Controls the assignment of resources to All-IP sessions, including the selection of the Media Gateway Control Function (MGCF). The term 'breakout' refers to the point of interconnection between the All-IP network and the PSTN (Public Switched Telephone Network).

Call Session Control Function (CSCF). Routes and controls All-IP session establishment. There may be a Proxy CSCF (P-CSCF) in the visited network, and a Serving CSCF (S-CSCF) or Interrogating CSCF

Table 1: All-IP Wireless Core Network Specifications from 3GPP and 3GPP2

3GPP	3GPP2	Description
n/a	X.S0013-000	Overview
TS 23.002	S.R0037	Network Architecture Model
TS 23.141	X.S0027	Presence Service
TS 23.218	X.S0013-003	Stage 2 for Session Handling and Call Model
TS 23.228	X.S0013-002	Stage 2 Signaling Flows for IP-based Call Control based on SIP and SDP.
TS 23.815	n/a	Charging Implications (was TR 23.915)
TS 23.864	n/a	Interoperability (was TR 23.964)
TS 23.867	n/a	Emergency Calls (being merged into TS 23.002, 23.060, 23.228)
TS 24.229	X.S0013-004	Call Control based on SIP and SDP
TS 29.198	X.S0017	Open Service Access (OSA) in 14 parts.
TS 29.228	X.S0013-005	Cx (CSCF-HSS) Interface Signaling Flows (and Dx for 3GPP only)
TS 29.229	X.S0013-006	Cx Interface based on Diameter (CSCF-HSS) and Dx (3GPP only)
TS 29.328	X.S0013-010	Subscription Data over the Sh Interface (OSA-HSS-SIP AS) and Dh (OSA-SLF-SIP AS; for 3GPP only).
TS 29.329	X.S0013-011	Charging Stage 3 based on Diameter
TS 32.200	X.S0013-007	Charging Architecture
TS 32.225	X.S0013-008	Call Control Stage 3 based on SIP and SDP

(I-CSCF) in the Home Network). When an MS contact a new system it first communicates with the P-CSCF, which contacts the I-CSCF in the home system, which then selects the appropriate S-CSCF, which has specific knowledge of the user's services and privileges.

One of the functions of the CSCF may be to act as a SIP proxy (i.e. interpreting and routing SIP messages on behalf of a mobile). The CSCF collects accounting information (e.g. for billing) and forwards it to the HSS over the Cx interface.

HSS (Home Subscriber Server). Contains the AAA and databases. It may include the HLR, or access to it, to allow integration between All-IP and the subscription data retained for circuit-switched networks normally accessed by GSM or ANSI-41 MAP. The HSS provides a repository of data related to a specific subscriber, including the services which the subscriber is entitled to, characteristics of those services, and information allowing authorization of an accessing mobile claiming to be that subscriber.

This network element also collects accounting information, and will be connected to billing systems and other entities that can make use of this (such as fraud and traffic analysis).

On 3GPP systems, another entity known as the SLF (Subscription Locator Function) may be involved.

Messages may be sent to this entity over the Dh interface, and then routed to the appropriate HSS.

Media Gateway (MGW) and MGW Control Function (MCF or MGCF). These entities control the interface between the All-IP network and the PSTN, including both transcoding of voice and signaling interoperability (e.g. SIP to/from ISUP).

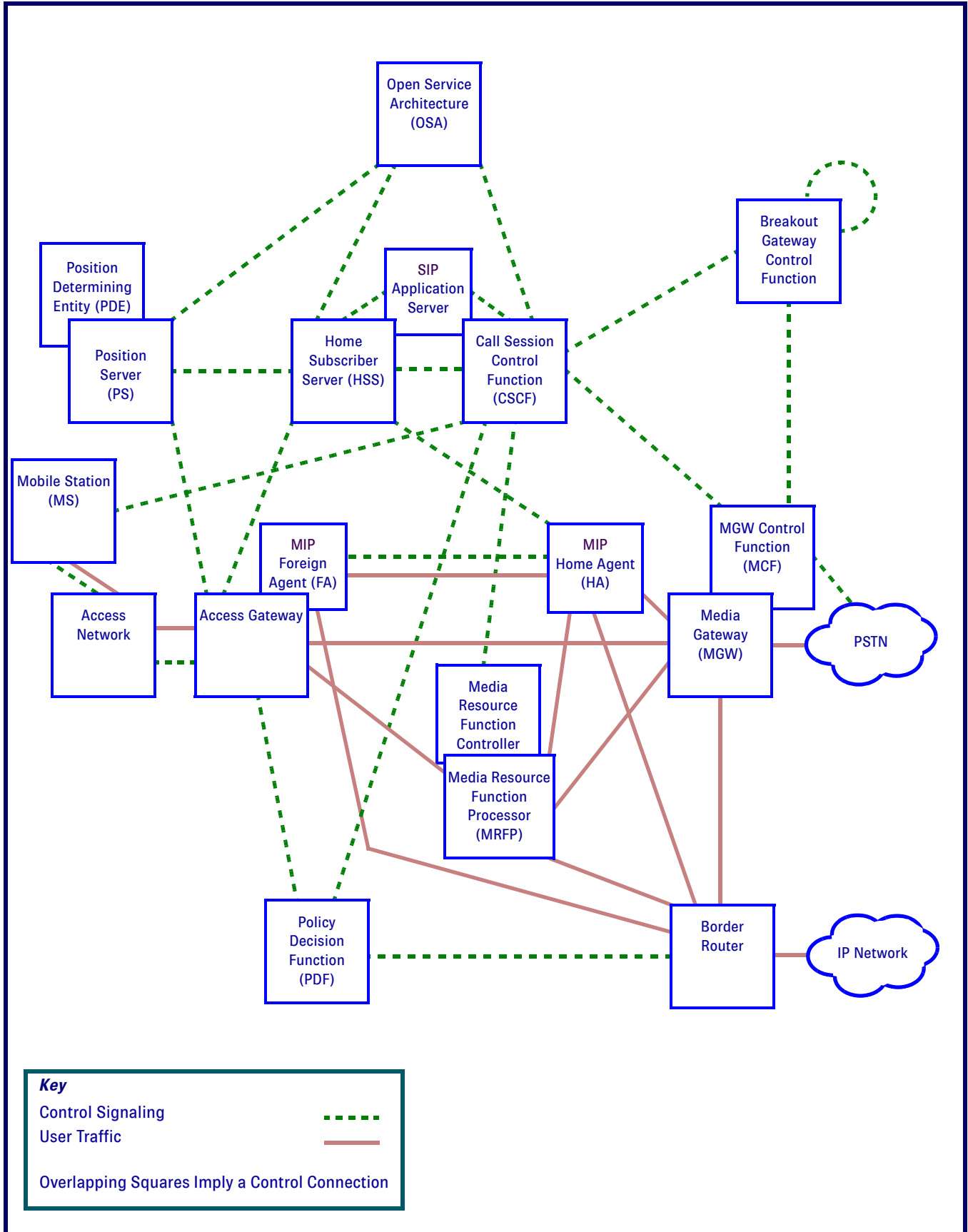
Media Resource Function Processor (MRFP) and Controller. These entities control the media streams (e.g. voice, video and other forms of user data) providing services such as mixing (e.g. for conference calls), tones and announcements, and transcoding (e.g. between different voice coders).

Mobile IP Home Agent (HA) and Foreign Agent (FA).

Mobile IP allows packets destined to a roaming mobile to reach it, and allows packets from that mobile to be routed as if they originated within the home system. There is a single Home Agent for each MS. It keeps track of the current Foreign Agent and forwards terminating packets to it. The Foreign Agent advertises its services to mobiles in its area and can forward packets from that mobile either to the Home Agent (via a tunnel) or directly to the destination.

For more information on Mobile IP consult our **May 2003** issue.

Figure 1: All-IP Network Architecture Model (Simplified)



Mobile Station (MS). A wireless phone, also known as UE (User Equipment) or MT (Mobile Terminal, an MS without the UIM, which contains subscription data). An MS may be a traditional cellular phone, or a wireless-enabled PDA, or even a card within a computer, providing the computer with wireless capabilities.

Open Service Architecture (OSA). An application programming interface (API) for access to All-IP network functions. This allows application developers to incorporate telephony functionality into their software. In concept it is similar to the Intelligent Network (e.g. WIN or CAMEL) that separate the high level control of traditional telephony from the low level control and management of the actual traffic (e.g. voice paths) through the use of SCPs containing the 'service logic'.

Policy Decision Function (PDF). IP-networks differ from telephony networks in their assignment of resources to sessions (calls). Telephony networks usually assign a fixed amount of bandwidth to each call (anywhere from 8 to 64 Kbps), ensuring that a call, when established, has enough resources to continue as long as necessary, without degradation. Calls may fail to be set up, but rarely fail once set up. IP networks, by contrast, assign resources in real-time. The function of the Policy Decision Function is to allocate those resources equitably, ensuring that all sessions that are set up have adequate resources, and providing more capacity to sessions that have a higher QoS.

Position Determining Entity (PDE) and Position Server (PS). These entities provide location services. All-IP systems push more intelligence to the mobile, so these servers will perform fewer functions than the equivalent entities in circuit-switched location service networks. Some phones may even have the ability to determine location independently, requiring only occasional downloads of almanac data from the network to minimize the amount of time that a GPS position fix takes.

SIP Application Server. SIP is the replacement for ISUP in the All-IP network, a protocol for call control. SIP application servers are like a special case of OSA, more focused, but more powerful for this particular

application. A SIP application server provides a platform that allows applications such as conference calling or voice mail to be hosted. This provides a more convenient environment for development and testing, and provides services that would be difficult and complex to provide in each SIP-based application.

What This Really Means

The All-IP network standards are much more high level than traditional telecom standards. They provide a basic infrastructure for communications, and leave many details through the IETF standards that they incorporate.

However, with an undertaking of this magnitude, especially with the need for reliable interfacing to legacy networks, excruciatingly precise protocol details must at some point be provided. The sum total of All-IP specifications is not yet at this level of detail.

A problem that can arise is that the specifications can be correctly interpreted to make a workable system, but there are multiple interpretations so that systems designed by different vendors or carriers will not fully interwork. This is a particularly difficult problem when proponents of other wireless protocols such as WiFi and WiMAX are also trying to adapt IETF protocols to an environment with full roaming and mobility capabilities.

The All-IP network relies on protocols such as Diameter and Mobile IP that are still relatively young. The viability of the concept will gain momentum as these protocols gain maturity and acceptance in the industry.

The first carrier to fully implement an All-IP network will be one that has minimal needs to interface with other carriers, perhaps one with a brand new national license. This will minimize the problems of interworking with legacy networks and legacy equipment. Even with this, there will be a long process of refining the details to achieve the same level of robustness, functionality and interoperability that is provided by today's more traditional wireless networks – those based on GSM and ANSI-41 MAP.

3GPP TSG-T Update

The 3GPP Technical Specification Group for Terminals (TSG T) specifies logical and physical interfaces, capabilities (such as execution environments), performance criteria and testing sequences for terminals (UE). The group leaves the specification of radio aspects of terminals up to TSG RAN, and definition of speech and multimedia codecs to TSG SA4.

The most important recent discussion has been whether TSG T is even needed any more. One suggestion is to shift what work has not already been moved to OMA into TSG CN, TSG RAN and TSG SA. The 3GPP Project Coordination Group is investigating this, but no decision has yet been reached.

Two TSG T meetings (#23 and #24) have been held since the last publication of this update. Highlights of TSG #23 include:

- Many changes request for the maintenance of the existing releases (Rel 99, Rel 4, and Rel 5) were approved.
- Much of the maintenance was related to Multimedia Message Service (MMS) specifications. MMS Rel 6 will add a new interface for on-line charging and support for hyperlinks.
- TSG T reconfirmed that the preferred bearer protocol for high bandwidth communications between the USAT and other network elements is the Bearer Independent Protocol (BIP). The other candidate was MMS.

TSG T #24 determined the criteria for inclusion of features in Rel 6 versus Rel 7 (or later):

- Features completed by TSG T#25 (September 2004) will belong to Release 6.
- Features not estimated to be completed until TSG T#26 (December 2004) will only be included in Release 6 if agreed to by TSG SA at their September 2004 meeting.
- Features to be completed after TSG T#26 will belong to Release 7 or higher.

TSG T Working Group 1 Mobile Terminal Conformance Testing

TSG T Working Group 1 (T1) defines UE (terminal) conformance tests based on requirements defined by RAN4 for radio tests and by RAN2 and CN1 for signaling and protocols. T1 has two subgroups: RF and Signaling.

Highlights of recent meetings include:

- The misalignment of Inter-Radio Access Technology test cases between T1 and GERAN is still a concern. GERAN3 will adopt the T1 Tree and Tabular Combined Notation (TTCN) approval methodology to try to keep GERAN and T1 tests aligned and T1 will track progress closely to prevent any potential conflicts.
- TR 34.902 (Test Tolerances for Radio Resource Management (RRM) Background Analysis) should be 90% complete by July 2004. WG1 is giving high priority tests a target completion date of November 2004 to allow validation and approval by the Global Certification Forum (GCF) before the end of 2004, although some question whether this is possible. T1 has asked for more contributions and participants to help meet this deadline.
- The Rel 5 version of the TS 34.108 signaling test specification was published, including the Radio Access Bearer configurations to support High Speed Downlink Packet Access (HSDPA). The Rel 99 and Rel 4 versions will now point to Rel 5.
- A joint *ad hoc* meeting was held with RAN4 to discuss the feasibility of testing and measuring throughput in a Fading Channel.
- A method for statistical testing of HSDPA receiver performance was added to TS 34.121 in Annex F 6.3
- New generic test procedures for HSDPA RF testing cases were added to TS 34.108.
- Default messages for HSPDA were included in TS 34.108 and existing protocol test cases in the TS 34.123-1 were aligned with the latest core specifications changes.
- Eleven new HSDPA test cases were added to TS 34.123-1.

TSG T Working Group 2 – Mobile Terminal Services & Capabilities

TSG T Working Group 2 (T2) defines Services and Capabilities to be delivered by mobiles to ensure that they meet 3GPP objectives. It is responsible for Terminal-based Applications, Terminal Features and Terminal Interfaces. T2 is organized into 3 subgroups, although only the first survived this meeting and it is dormant:

- SWG1 - MExE.
- SWG2 – User Equipment (UE) Capabilities and Interfaces.
- SWG3 – Messaging.

Table 2: 3GPP TSG T Working Group 1 (MT Conformance Testing) Specification Updates

Document	Title	Status
TS 34.108	Common Test Environments for User Equipment (UE) Conformance Testing	Rel 99 and Rel 4 are now pointers to the newly published Rel 5 version.
TS 34.121	Terminal Conformance; Radio Transmission and Reception (FDD)	Rel 5 being revised.
<i>UE (User Equipment) Conformance Specification</i>		
TS 34.123-1	Part 1: Protocol Conformance Specification	
TS 34.123-2	Part 2: Implementation Conformance Statement <i>pro forma</i> specification	
TS 34.123-3	Part 3: Abstract Test Suites (ATSS)	

Highlights of T2 meeting #23 were:

- The transfer of non-network dependant MMS work to the Open Mobile Alliance after MMS Release 6 was discussed but most companies felt it was too early to make this decision. A liaison was sent to OMA showing that 95% of TS 23.140 is bearer agnostic and highlighting many procedural issues that would need to be resolved before the transfer of MMS to OMA.
- Now that the Rel 6 version of Generic User Profile (GUP) has been published (TS 23.241 and TS 24.241) it will be transferred to CN4.
- SWG2 and SWG3 were dissolved. T2 will now operate as a plenary but Josef Laumen will still lead the MMS Rel 6 work.
- Three options were discussed for the future of T2:
 1. Continue to meet.
 2. Dissolve T2 and transfer work within 3GPP.
 3. Become a virtual group with leadership and working practices retained.
 4. Meet at the same time and place as TSG T.

This discussion was urgent because Alcatel, Ericsson, Motorola, Nokia, Qualcomm, T-Mobile, and Vodafone had submitted a contribution to close T2 at TSG T#26 in December 2004 and to transfer all T2 specification to the TSG T plenary. No decision was made on the T2 structure, as some companies asked for time to review the options.

- The following corrections were made to MMS specifications:
 - » Correction to erroneous OMA reference (Rel 5 and Rel 6).
 - » Addition of recipient list to MM4.
 - » Correction to erroneous mapping Annex 1.
 - » MM Size indication added to MMS User Agent.
 - » Delivery condition added to MM7.
- Other MMS issues discussed include:
 - » A new interface was proposed between the MMS Relay/Server and the new Messaging Service Control Function for Private Addressing.
 - » The WAP implementation of user-to-user deferred messaging will also be used for SIP based addressing.
 - » MM4 is suitable for multiple Relay/Servers within an Multimedia Messaging Service Environment (MMSE) but the details require further analysis.
 - » There is a proposal to add status text for MM1 delivery.
 - » A working assumption for MM4 bundling and support for multiple recipients has been agreed to.
 - » A proposal was made to enable an MMS Relay/Server to indicate that a user is roaming to a Value Added Service Provider (VASP).
- A CR for TS 23.040 will allow voice mail systems to use SMS to convey enhanced information regarding messages and voice mailbox status, including the list of voice messages, the time each voice message was left, who it was from and the message duration.
- Nicola Vote of NTT DoCoMo was elected as second T2 vice-chair.

Table 3: TSG T Working Group 2 (Mobile Terminal Services & Capabilities) Specifications

Document	Title	Status
TS 23.040	Technical realization of the Short Message Service (SMS)	Rel 5 and Rel 6 being revised.
TS 23.140	Multimedia Messaging Service (MMS); Functional Description; Stage 2	
TS 23.241	3GPP Generic User Profile (GUP); Stage 2; Data Description Method (DDM)	Rel 6 being revised.
TS 27.007	AT command set for User Equipment (UE)	

TSG T Working Group 3 – Universal Subscriber Identify Module (USIM)

TSG T Working Group 3 (T3) specifies the Subscriber Identity Module (SIM) for 2G systems and the USIM (Universal Subscriber Identity Module) for 3GPP systems; with the exception of the security algorithms which are developed by SA WG3. It also maintains specifications and associated test cases for the 3G USIM, and its interface with the Mobile Terminal.

Highlights of T3 meetings at TSG T#24 were:

- There was a proposal to take advantage of the migration to mini Universal Integrated Circuit Card (mini-UICCs) to allow Mobile Equipment (MEs) supporting mini-UICCs only to discontinue the support of 3V and only support 1.8V.

Some companies objected to this. They noted that mini-UICCs can easily become plug-in UICCs by use of an adapter, and therefore this change would introduce backward compatibility issues.

No decision was reached on this, a discussion paper is expected at the next T3 meeting.

- A proposal was made to add network measurement information for UTRAN in the PROVIDE LOCAL INFORMATION message. Some operators believe that location services comparable to those in 2G networks cannot be offered without this feature. Others questioned how accurate terminal measurement results would be in determining location. T3 agreed that more justification for the use-cases and measurement parameters being proposed is needed.
- A decision on the SA1 service requirement to display Multimedia Message from the USIM was postponed until SA1 clarifies it.

Table 4: TSG T Working Group 3 (USIM) Specification Updates

Document	Title	Status
tbd	WI for Test Specification for (U)SIM API for Java Card	New work items approved at TSG T#23.
tbd	WI on Alignment with Requirements Regarding USSD Usage	
TS 11.11	Subscriber Identity Module – Mobile Equipment (SIM - ME) Interface	Rel 99 being revised
TS 11.14	Specification of the SIM Application Toolkit (SAT) for the SIM-ME Interface	
TS 21.111	USIM and IC card requirements	Rel 6 being revised.
TS 31.102	Characteristics of the USIM Application	Rel 99, Rel 4, Rel 5 and Rel 6 being revised.
TS 31.103	Characteristics of the ISIM Application	Rel 5 and Rel 6 being revised.
TS 31.111	USIM Application Toolkit (USAT)	Rel 99 and Rel 6 being revised.
TR 31.919	2G/3G Java Card™ API Based Applet Interworking	Rel 6 available.
TS 51.011	Mobile Equipment (SIM - ME) Interface	Rel 6 being revised.

Meetings

The most recent plenary meeting of TSG T was held from June 2nd to 4th 2004 in Seoul, Korea.

Future plenary meetings are:

- September 8th – 10th 2004 in the USA.
- December 8th – 10th 2004 in Athens, Greece.
- March 9th – 11th 2005 in Tokyo, Japan.
- June 1st – 3rd 2005, September 7th – 9th 2005 and November 30th – December 2nd 2005 in locations tbd.

2004 T1 meetings are planned for:

- August 26th – 30th 2004 in Canada.
- November 1st – 5th 2004 in Europe.

2004 T2 meetings are planned for:

- August 23th – 27th 2004.
- November 8th – 12th 2004.

2004 T3 meetings are planned for:

- August 10th – 13th 2004 in Sophia Antipolis, France.
- November 16th – 19th 2004 in Sophia Antipolis.

A complete list of 3GPP meetings is at:

www.3gpp.org/Meetings/meetings.htm#calendar

3GPP2 TSG-C/ TIA TR-45.5 cdma2000 Standards

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- Note:
1. IS- Interim Standard, TSB- Telecommunications Systems Bulletin, PN- Project Number, SP- ANSI Standards Proposal.
 2. TSG-C standards are identified as C.[PRIS]dddd-[0|A..Z] vX.Y where P=Project, R=Report, S=Specification, dddd=Document number, 0,A,Z is the revision number (0 sometimes omitted), X is the publication number (0 for pre-publication) and Y the internal editing revision (which we omit).
 3. Published TIA standards can be obtained from Global Engineering Documents at 1-800-854-7179.
 4. **Bold Type** indicates a modification since the previous publication of this information.
- Thanks to Lisa Collichio (Qualcomm) for her assistance compiling the information in this table.

TSG-C Specification Cross-Reference

Specification	Description	Status
C.R1000-0	Requirements Mapping for CDMA2000	See TSB2000
C.R1001-0	Parameter value assignments	See TSB58-B
C.R1001-A	Parameter value assignments	See TSB58-C
C.R1001-B	Parameter value assignments	See TSB58-D
C.R1001-C	Parameter value assignments	See TSB58-E
C.R1001-D	Parameter value assignments	See TSB58-F
C.S0001-0	cdma2000 Air Interface: Introduction	See IS-2000.1
C.S0002-0	cdma2000 Air Interface: Physical Layer	See IS-2000.2
C.S0003-0	cdma2000 Air Interface: Medium Access Control (MAC)	See IS-2000.3
C.S0004-0	cdma2000 Air Interface: Signaling Link Access Control (LAC)	See IS-2000.4
C.S0005-0	cdma2000 Air Interface: Upper Layer (Layer 3) Signaling	See IS-2000.5
C.S0006-0	cdma2000 Air Interface: Analog	See IS-2000.6
C.S000X-1	cdma2000 Revision A (X=1-6)	See IS-2000.X-A
C.S0007-0	Direct Spread Spectrum on ANSI-41 (DS-41)	See IS-834
C.S0008-0	Multi-carrier Specification for cdma2000 Air Interface using GSM MAP (MC-MAP)	See IS-833
C.S0009-0	Speech Service Option	See TIA/EIA-96-C
C.S000X-D	cdma2000 Air Interface (in 6 parts: Introduction, Physical Layer, MAC, LAC, Layer 3, Analog)	See IS-2000-D
C.S0010-0	Base Station Minimum Performance	See TIA/EIA-97-C
C.S0010-A	Base Station Minimum Performance	See TIA/EIA-97-D
C.S0010-B	Base Station Minimum Performance	See TIA/EIA-97-E
C.S0011-0	Mobile Station Minimum Performance	See TIA/EIA-98-C
C.S0011-A	Mobile Station Minimum Performance	See TIA/EIA-98-D
C.S0011-B	Mobile Station Minimum Performance	See TIA-98-E
C.S0012-0	Minimum Performance for Speech Service Option 1	See TIA/EIA-125-A

C.S0013-0	MS Loopback Test	See TIA/EIA-126-C
C.S0013-A	MS Loopback Service Option	See TIA/EIA-126-D
C.S0014-0	Enhanced Variable Rate Voice Coder (EVRC)	See IS-127
C.S0014-0-1	EVRC Addendum to Remove 'bit exact'	See IS-127-1
C.S0014-0-2	EVRC Addendum to Add TTY/TDD Symbol Support	See IS-127-2
C.S0014-0-3	EVRC Addendum 3	See IS-127-3
C.S0014-A	Enhanced Variable Rate Voice Coder (EVRC)	Published 05/04
C.S0015-0	Short Message Service (SMS)	See IS-637-A
C.S0015-A	Short Message Service (SMS)	See TIA-637-B
C.S0015-B	Short Message Service (SMS)	See TIA-637-C
C.S0016-0	Over the Air Service Provisioning (OTASP)	See IS-683-A
C.S0016-A	Over the Air Service Provisioning (OTASP)	See IS-683-B
C.S0016-B	Over the Air Service Provisioning (OTASP)	See IS-683-C
C.S0017-0	14.4 Kbps Data, without STU-III	See IS-707-A
C.S0017-0-1	Radio Link Protocol (RLP) Modifications and Additional Packet Data Support	See IS-707-A-1
C.S0017-0-2	64 Kbps Data with TTY/TDD Support	See IS-707-A-2
C.S0017-0-3	Addendum 3 for IS-707 (High Speed Packet Data Service Option 33)	See IS-707-3
C.S0018-0	Minimum Performance for EVRC	See IS-718
C.S0019-0	Bit Exact Specification for EVRC	See IS-719
C.S0020-0	High Rate (13 Kbps) Speech Coder	See IS-733
C.S0020-0-1	TTY/TDD Support for High Rate Speech Coder	See IS-733-1
C.S0020-0-2	TTY/TDD Support for High Rate Speech Coder	See IS-733-2
C.S0020-A	High Rate (13 Kbps) Speech Coder	Published 05/04
C.S0021-0	Minimum Performance for High Rate Speech coder	See IS-736-A
C.S0022-0	Location Services	See IS-801
C.S0022-0-1	Location Services Addendum	See IS-801-1
C.S0023-0	Removable User Identity Module (R-UIM)	See IS-820
C.S0023-0-1	Removable User Identity Module (R-UIM)	See IS-820-1
C.S0023-A	Removable User Identity Module (R-UIM)	See IS-820-A
C.S0023-B	Removable User Identity Module (R-UIM)	Published 04/04
C.S0024-0	High Rate Packet Data Air Interface	See IS-856
C.S0024-0-1	High Rate Packet Data Air Interface (Addendum 1)	See IS-856-1
C.S0024-0-2	High Rate Packet Data Air Interface (Addendum 2)	See IS-856-2
C.S0024-A	High Rate Packet Data (HRPD) Air Interface	See IS-856-A
C.S0025-0	Markov Service Option (MSO) for Determining Frame Error Rates	See IS-871
C.S0026-0	Test Data Service Option (TDSO)	See IS-870
C.S0026-0-1	Test Data Service Option (TDSO)	See IS-807-1
C.S0028-0	TTY/TDD Minimum Performance Specification	See IS-889
C.S0029-0	Test Application Specification for High Rate Packet Data Air Interface (HRPD)	See IS-890
C.S0029-0-1	Test Application Specification for High Rate Packet Data Air Interface	See IS-890-1
C.S0030-0	Selectable Mode Voice Coder	See IS-893

C.S0031-0	Signaling Conformance Tests	See IS-898
C.S0032-0	Minimum Performance Standards for cdma2000 HRPD	See TIA-864
C.S0033-0	Minimum Performance for cdma2000 HRPD Access Terminal	See TIA-866
C.S0034	Selectable Mode Voice Coder Minimum Performance	See IS-894
C.S0035-0	cdma2000 Card Application Toolkit	See TIA-915
C.S0036-0	Minimum Performance Standards for GPS Equipped cdma2000 Mobiles	See TIA-98-E
C.S0037-0	Signaling Conformance for cdma2000 Wireless IP Networks	See TIA-918
C.S0038-0	Signaling Conformance for HRPD Air Interface	See TIA-919
C.S0039-0	Enhanced Subscriber Privacy for cdma2000 High Rate Packet Data	See TIA-925
C.S0040	IP-based Over-the-Air Handset Configuration Management (IOTA-HCM)	See TIA-1010
C.S0042-0	Circuit-Switched Video Conferencing Services	See TIA-926
C.S0047	Link Layer Assisted Robust Header Compression Service Option for Voice	See TIA-923
C.S0048	ME (Mobile Equipment) Conformance Testing	See TIA-1013
C.S0054	HRPD (High Rate Packet Data) BCMCS (Broadcast/Multicast)	Published 03/04
C.S0057-0	CDMA Band Classes	See TIA-1030
C.P0050	File Formats for Multimedia Services	See TIA-1015

First Wave - Cellular

Standard	Description	Status
IS-95	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 (MS) Minimum Performance Standards	Published 12/94
IS-126	Service Option 2: Loopback	Published 12/94 Rescinded 08/98

Second Wave - Cellular and PCS

Standard	Description	Status
J-STD-008	IS-95 Adapted for 1.8-2.0 Ghz Frequency Band	Published 07/96 Rescinded 11/99
J-STD-018	Mobile Minimum Performance Standards (for J-STD-008)	Published 07/96 Rescinded 02/01
J-STD-019	Base Station Minimum Performance Standards	Published 07/96 Rescinded 02/01
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 Rescinded 10/00
IS-125	Voice Coder Minimum Performance Standards	Published 05/95 Rescinded 10/00
IS-126-A	Mobile Station Loopback Service Option	Published 07/96 Rescinded 08/98
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	MS Minimum Performance Standards	Published 08/98
TIA/EIA-98-C	SP-4383	Merges TIA/EIA-98-B and J-STD-018	Published 11/99
TIA/EIA-125-A	SP-4682	Correction of Errors in Speech Service Option 1	Published 08/00
TIA/EIA-126-B	SP-4136	ANSI Version of IS-126 (MS Loopback Option)	Published 08/98
TIA/EIA-126-C	SP-4578	Mobile Station Loopback Test	Published 08/00
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-127-3	PN-3292-AD3	Addendum #3 to IS-127	Published 09/01
IS-127-4	PN-3292-AD4	Addendum #4 to IS-127	Development
IS-657		Packet Data Services (Internet, CDPD)	Published 07/96 Rescinded 10/00
IS-658	PN-4374	Data Services Interworking Function Interface (e.g. modem pool). Transferred to TR-45.4 for Revision A.	Published 07/96
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 Asynchronous Data, Fax, STU-III and Packet Data)	Published 02/98
IS-718	PN-3648	Minimum Performance Standards for EVRC Voice Coder	Published 07/98
IS-733	PN-3972	Speech Service Option 17: High Rate Voice Coder (13 Kbps)	Published 03/98
IS-733-1		Addendum #1 to IS-733: TTY/TDD Capabilities	Published 09/99
IS-733-2	PN-3972-AD2	Addendum #2 to IS-733	Published 09/01

IS-736	PN-3973	Minimum Performance Specification for IS-733 (13 Kbps Voice Coder)	Published 11/98
IS-736-A	PN-4653	Corrections to Testing Procedures in IS-736	Published 08/00
TIA-127-A	PN-3292-UGR	Upgrade EVRC to ANSI	See C.S0014-A
TIA-733-A	PN-3972-UGR	Upgrade 13 Kbps CDMA Voice Coder to ANSI	See C.S0020-A
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 Rescinded 04/99
TSB-79	PN-3823	IS-637 Update for 14.4 Kbps SMS, Service Negotiation and Y2K	Published 02/97

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

Standard	Project	Description	Status
TIA/EIA-97-D		Minimum Performance Standards for IS-2000 Base Stations	Published 06/01
TIA/EIA-97-E	SP-4384-RV5	Minimum Performance Standards for IS-2000 Base Stations	Published 02/03
TIA/EIA-97-E-1		Minimum performance standards for IS-2000 Base Stations (Supplement)	Published 03/04
TIA/EIA-98-D		MS Minimum Performance Standards	Published 06/01
TIA/EIA-98-E	SP-4383-RV5	MS Minimum Performance Standards	Published 02/03
TIA/EIA-126-D	SP-4578-RV4	Mobile Station Loopback Test	Published 06/01
TIA/EIA-637-B	SP-4391-RV2	Short Message Service	Published 01/02
IS-683-B	SP-4742	OTA Update, Including Preferred User Zone List	Published 12/01
IS-707-A	PN-4145	Revision to IS-707 to be Consistent with TIA/EIA-95 Capabilities	Published 04/99
IS-707-A-1	PN-4541	Adds cdma2000 Radio Link Protocol 3E Support to 14.4 Kbps Data	Published 12/99
IS-707-A-2	PN-4692	Data Support for IS-2000-A	Published 03/01
IS-707-A-3		Addendum 3 for IS-707 (High speed packet data service option 33) chapter 12	Published 02/03
IS-801	PN-4535	Position Determination Services (e.g. for E911 Phase II)	Published 11/99
IS-801-1	PN-4535-AD1	Addendum to Position Determination	Published 03/01
IS-801-A		Position determination services (e.g. for E911 Phase II)	Published 04/04
IS-834	PN-4707	Direct Spread Specification for CDMA on ANSI-41 (DS41) Upper Layers Air Interface	Published 03/00
IS-856	PN-4875	High Rate Packet Data Air Interface Specification (1XEV DO)	Published 11/00
IS-856-1	PN-4875-AD1	Addendum 1 to CDMA2000 High Rate Packet Data Air Interface Specification (1XEV DO/HRPD)	Published 01/02
IS-856-2	PN-4875-AD2	Addendum 2 to cdma2000 HRPD	Published 10/02
IS-870	PN-4877	Test Data Service Option (TDSO) for cdma2000	Published 04/01
IS-870-1	PN-4877-AD1	Test Data Service Option (TDSO)	Published 10/02
IS-871	PN-4876	Markov Service Option (MSO) for Determining Frame Error Rates	Published 04/01
IS-889	PN-4905	Minimum Performance Specification for Text Telephone (TTY) Signal Detector and Regenerator	Published 08/02
IS-889-A	PN-4905-RV1	Minimum Performance Specification for Text Telephone (TTY/TDD) Signal Detector and Regenerator	Published 12/03

IS-890	PN-0018	Test Application Specification for HRPD	Published 07/01
IS-890-1	PN-0018-AD1	Test Application Specification for HRPD	Published 10/02
IS-893	PN-4575	Selectable Mode Voice Coder (Speech and Capacity-Sensitive, formerly known as EVRC)	In press
IS-893-1	PN-4575-AD1	Selectable Mode Voice Coder (Speech and Capacity-Sensitive, Formerly known as EVRC)	In press
IS-894	PN-0029	Selectable Mode Voice Coder Minimum Performance	Ballot 01/02
IS-2000.1-0	PN-4427	cdma2000: Introduction and Overview	Published 08/99
IS-2000.2-0	PN-4428	cdma2000: Physical Layer	Published 08/99
IS-2000.3-0	PN-4429	cdma2000: Media Access Control (MAC) layer	Published 08/99
IS-2000.4-0	PN-4430	cdma2000: Signaling Layer 2 Link Access Control (LAC)	Published 08/99
IS-2000.5-0	PN-4431	cdma2000: Signaling Layer 3	Published 08/99
IS-2000.6-0	PN-4432	cdma2000: Analog Operation	Published 08/99
IS-2000.X-0-1	PN-4698-AD2	First addendum for IS-2000. Revises all 6 parts	Published 05/00
IS-2000.X-0-2	PN-4698-AD2	Addendum for IS-2000. Revises all 6 parts	Published 08/01
IS-2000.X-A	PN-4693	cdma2000 (all 6 (X=1-6) parts revised)	Published 03/00
IS-2000.X-A-1	PN-4698-AD1	Addendum for IS-2000-A. Revised parts 2 through 5	Published 11/00
IS-2000.X-A-2		Second addendum for IS-2000-A. Revises all 6 parts.	Published 04/02
IS-2000.X-B		cdma2000. All 6 parts being revised (X=1..6)	Published 05/02
IS-2000.X-C		CDMA2000. All 6 parts being revised (X=1..6)	Published 05/02
IS-2000.X-D		cdma2000 Release D in 6 parts.	Published 03/04
TIA-683-C		Over-the-Air Service Provisioning (OTASP) for cdma2000	Published 03/03
TIA-856-2		High Rate Packet Data (HRPD) Air Interface Specification (1XEV DO) Addendum 2	Published 03/04
TIA-856-A		High Rate Packet Data Air Interface Specification (1XEV DO)	Published 04/04
TIA-864	PN-4913	Minimum Performance Standards for cdma2000 HRPD Base Station	Published 02/02
TIA-864-1	PN-4913	Addendum 1 of TIA-864	Published 01/04
TIA-866	PN-4916	Minimum performance for HRPD Terminal	Published 02/02
TIA-866-1	PN-4916	Addendum 1 for TIA-866	Published 01/04
TIA-870-1		Test Data Service Option (TDSO) for cdma2000	Published 01/04
TIA-890-1		Test Application Specification for High Rate Packet Data (HRPD) Air Interface	Published 01/04
TIA-898	PN-0031	Signaling Conformance Tests for cdma2000	Published 12/01
TIA-907	PN-0046	Video Streaming	Development
TIA-916	PN-0058	Minimum Performance Recommendations for IS-801-1 (GPS) Mobiles (e.g. Test Specifications)	Published 04/02
TIA-918	PN-0056	Signaling Conformance Tests for cdma2000 Wireless IP Networks	Published 05/02
TIA-919	PN-0057	Signaling conformance for HRPD	Published 05/02
TIA-923	PN-0069	Link Layer Assisted Robust Header Compression Service Option for Voice	Published 05/03
TIA-924	PN-0070	Packet Based Video Conferencing	Development
TIA-925	PN-0071	Enhanced Subscriber Privacy for HRPD	Published 09/02

TIA-926	PN-0072	Circuit Switched Video Conferencing Services	Published 12/02
TIA-1011	PN-0112	MMS Media Format and Codecs for cdma2000	Published 12/03
TIA-1013	PN-0114	Mobile Equipment (ME) Conformance Testing for cdma2000	Published 12/03
TIA-1015	PN-0116	3GPP2 File Formats for Multimedia Services	Published 12/03
TIA-1030		CDMA Band Classes	Published 03/04
TSB-58-B	PN-4691	Parameter Value Assignments for IS-2000	Published 12/99
TSB-58-C		Parameter Value Assignments for IS-2000-A	Published 05/00
TSB-58-D	PN-4691-RV4	Parameter Value Assignments for IS-2000-B	Published 05/01
TSB-58-E	PN-4619-RV5	Parameter Value Assignments for IS-2000-C	Published 01/02
TSB-58-F	PN-4691-RV6	Parameter Value Assignments	Published 12/03
TSB-2000	PN-4534	Capabilities Requirements Mapping for cdma2000 Standards	Published 09/99

GSM MAP and Smart Card Support

Standard	Project	Description	Status
IS-820	PN-4690	R-UIM (Removable "Smart Card")	Published 05/00
IS-820-1	PN-4690-AD1	CDMA Removable UIM Addendum 1	Published 06/01
IS-820-A	PN-4690-RV1	R-UIM (Removable "Smart Card")	Published 09/02
IS-833	PN-4706	Multi-carrier specification for CDMA systems on GSM MAP (MC-MAP) lower layers air interface	Published 03/00
TIA-820-B		R-UIM (Removable "Smart Card") for compatibility with TIA-41, IS-95-A and TIA-95-C	See C.S0023-B
TIA-915	PN-0051	CDMA Card Application Toolkit	Published 02/03