

# Cellular Networking Perspectives

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## In This Issue...

### *Update Your Link!* .....p. 1

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### *Is IMSI Dead?* .....p. 1

The AMPS, TDMA and CDMA industries have been aiming to replace MIN by IMSI since 1994, yet this effort appears to have been stalled following the publication of most, but not all, standards. Is this situation going to change in the near future?

### *TIA TR-45.5/3GPP2 TSG-C CDMA Radio Interface Standards* .....p. 5

The latest status of standards that have been developed, or are being developed, by TIA standards subcommittee TR-45.5 and, for the first time, a cross reference to 3GPP2 TSG-C specifications.

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**Next Issue: June 4<sup>th</sup>, 2001**

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## Correction

The email address for Jim O'Neill printed in an article on number pooling in our April, 2001 issue was not correct. It should have been reported as:

[joneill@ix.netcom.com](mailto:joneill@ix.netcom.com)

## Is IMSI Dead?

IMSI, the International Mobile Subscription Identity defined in ITU-T Recommendation E.212, has been recognized as a better identifier for wireless subscriptions than the MIN since the TIA Joint Experts Meeting on International Roaming in 1994. Yet, implementations in AMPS, TDMA and CDMA systems, if they exist at all, have not yet displaced MIN. Below, we describe a number of reasons for this sad state of affairs.

Figure 1 compares the format of the 15 digit (or less) IMSI and the 10 digit MIN identifiers.

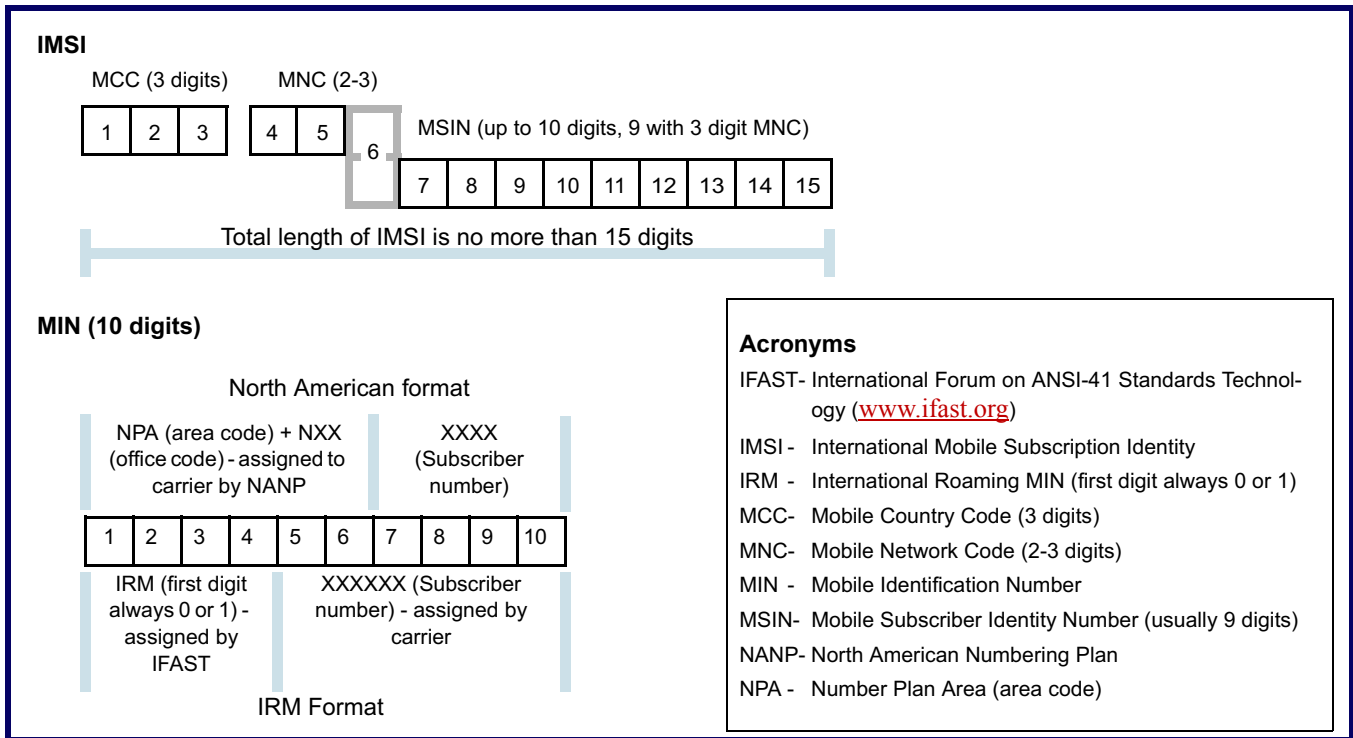
### *An Aside: Subscription versus Equipment Identifiers*

MIN and IMSI are examples of subscription (or subscriber) identifiers. They identify the person or corporation responsible for paying the bill for wireless phone calls. The first few digits also identify the home carrier, the one that is responsible for billing the subscriber.

This role of the MIN and IMSI has been disguised by poorly chosen names. The IMSI used to be called the International Mobile *Station* Identity, which was misleading because it was implemented by GSM in the SIM (Subscriber Identification Module or 'Smart Card'); it was not implemented in the Mobile Station. International Mobile *Subscriber* Identity is a better name, and this has been used since 1998.

MIN, the Mobile Identification Number, unfortunately still has a misleading name

**Figure 1: Format of IMSI and MIN**



because it too identifies a subscription, and not a mobile.

There are also equipment identifiers in all technologies, which adds to the confusion. The ESN (Electronic Serial Number) is important in AMPS, TDMA and CDMA because it is used for both current validation and authentication methods. The GSM IMEI (International Mobile Equipment Identity) plays a lesser role, largely being applicable in inventory control or in identifying malfunctioning or stolen mobile equipment.

It is common for multiple subscription identifiers to be associated with one equipment identifier. In AMPS, TDMA and CDMA phones, people with multiple subscriptions may have multiple Number Assignment Modules (NAM), each of which has a separate MIN (and, if supported, IMSI), but which all use the ESN of the phone.

GSM systems allow any smart card to be used with any phone. Consequently, one phone may, over time, have many subscription identifiers associated with it, particularly phones used for rental purposes or used as a pool by a corporation.

In all technologies, the subscription identifier will change when a subscription is

changed. If a person changes carriers, they must have a MIN or IMSI (or both) programmed in their AMPS, TDMA or CDMA phone. GSM customers must obtain a new SIM with a new IMSI, under the same circumstances.

### Why is IMSI Better than MIN?

There are several reasons why IMSI is an inherently better identifier for subscriptions than IMSI:

- Independent National assignment.
- More identifiers.
- Separation from phone number.
- Compatibility with GSM

### Independent National Assignment

IMSI allows each nation to separately assign subscription identifiers. The first three digits of the IMSI are known as the Mobile Country Code (MCC), which identify the country where it was assigned. They have been pre-assigned by the ITU (values for major countries are shown in Table 1). Consequently, each nation's communications or number assignment authority merely needs to

**Table 1: Selected IMSI MCC Codes**

| MCC      | Country     |
|----------|-------------|
| 202      | Greece      |
| 204      | Netherlands |
| 206      | Belgium     |
| 208      | France      |
| 214      | Spain       |
| 218, 262 | Germany     |
| 222      | Italy       |
| 226      | Romania     |
| 228      | Switzerland |
| 232      | Austria     |
| 234-5    | UK          |
| 238      | Denmark     |
| 240      | Sweden      |
| 242      | Norway      |
| 244      | Finland     |
| 250      | Russia      |
| 260      | Poland      |
| 272      | Ireland     |
| 286      | Turkey      |

**Table 1 (Continued): Selected IMSI MCC Codes**

| MCC     | Country                      |
|---------|------------------------------|
| 302     | Canada                       |
| 310-316 | United States of America     |
| 334     | Mexico                       |
| 404     | India                        |
| 410     | Pakistan                     |
| 415     | Lebanon                      |
| 416     | Jordan                       |
| 417     | Syria                        |
| 418     | Iraq                         |
| 419     | Kuwait                       |
| 420     | Saudi Arabia                 |
| 425     | Israel                       |
| 440-1   | Japan                        |
| 450     | South Korea                  |
| 454     | Hong-Kong                    |
| 460     | China (People's Republic of) |
| 502     | Malaysia                     |
| 505     | Australia                    |
| 510     | Indonesia                    |
| 515     | Philippines                  |
| 520     | Thailand                     |
| 525     | Singapore                    |
| 530     | New Zealand                  |
| 602     | Egypt                        |
| 603     | Algeria                      |
| 604     | Morocco                      |
| 605     | Tunisia                      |
| 606     | Libya                        |
| 621     | Nigeria                      |
| 636     | Ethiopia                     |
| 639     | Kenya                        |
| 640     | Tanzania                     |
| 641     | Uganda                       |
| 648     | Zimbabwe                     |
| 655     | South Africa                 |
| 704     | Guatemala (Republic of)      |
| 706     | El Salvador (Republic of)    |
| 708     | Honduras (Republic of)       |

| MCC | Country              |
|-----|----------------------|
| 710 | Nicaragua            |
| 712 | Costa Rica           |
| 714 | Panama (Republic of) |
| 716 | Peru                 |
| 722 | Argentina            |
| 724 | Brazil               |
| 730 | Chile                |
| 732 | Colombia             |
| 734 | Venezuela            |
| 736 | Bolivia              |
| 740 | Ecuador              |
| 744 | Paraguay             |
| 748 | Uruguay              |

assign a 2 or 3 digit Mobile Network Code (MNC) to each carrier, without the need to coordinate with other countries.

The MIN, by comparison, does not contain a national identifier. North American carriers found it tempting to assign the mobile's 10 digit phone number (i.e. everything *except* the country code) to the mobile, causing a big problem for international carriers. Only the creation of the IRM ensured international roaming could occur, because of globally coordinated assignment by IFAST ([www.ifast.org](http://www.ifast.org)). IRM codes are simply MIN codes constrained to have a 0 or 1 in the first digit position. Because of this, they cannot be assigned as North American phone numbers, and therefore they can also not be used as MIN codes.

### More Identifiers

The IMSI is a 15 digit identifier, and even when a 3 digit MNC is used, it provides an address space of 1 billion numbers to each assignee. Consequently, an IMSI block (MCC+MNC) usually need only be assigned once to a carrier. Only very rarely will a (very fat and happy) carrier come back for more.

The MIN is only 10 digits in length. While this still provides 10 billion identifiers, inefficiencies in assignment could mean the resource is eventually

exhausted, particularly if they are assigned to Smart Cards or millions of data devices.

### Separation from Phone Number

The IMSI does not have the format of a phone number, and therefore the temptation to make it the same as the mobile's phone number is less. There are several disadvantages to making the MIN and phone number the same:

- North American MIN codes have to be assigned to carriers in blocks of 10,000, because that is the method used for assigning phone numbers. By comparison, IMSI codes are usually assigned in blocks of 1 billion numbers. Small assignment blocks dramatically increases the overhead of managing numbers.
- Area code changes require reprogramming the mobile.
- The majority of the MIN resource is stranded, with the corresponding phone number assigned to landline purposes or to wireless devices that do not require a MIN (such as pagers and GSM phones).

It is interesting to note that GSM does attempt to match up phone numbers and IMSI codes with their ITU-T E.214 kludge that maps an E.212 IMSI onto a pseudo-E.164 phone number to simplify their SS7 routing requirements. Like so many kludges, it worked well where it was first used (in Europe, which has a 1:1 correspondence between landline and mobile country codes), but it did not work in North America (which has one (1) landline country code, but over 20 MCC's).

### Compatibility with GSM

IMSI is the subscription identifier used in GSM, and its implementation could make roaming between ANSI-41 and GSM systems easier. This provides a reason for implementing IMSI, but will not, by itself, mean the end of MIN, which will still be required for use in systems – particularly analog – that have not implemented IMSI.

## Problems with IMSI

If the cellular industry was to start over, without question, IMSI would be chosen over MIN. The problems with IMSI are due to the many systems currently relying upon MIN and the difficulty of replacing it while maintaining compatibility with all existing systems.

### *Incomplete Standardization*

IMSI has been implemented in most applicable standards, but unfortunately, not in all. It is present in the ANSI-136 TDMA and ANSI-95 CDMA radio interface standards, as well as in the ANSI-41 network operations standard (when IS-751 is implemented). However, it has not been implemented in the EIA/TIA-553 analog air interface standard.

Analog is still the common operating mode, allowing wide-area roaming by digital mobiles in North America. Until either IMSI is implemented in analog (very unlikely) or until the vast majority of analog and dual-mode digital/analog terminals disappear, a MIN will be required for every terminal, if only for use when operating in analog.

### *Implementation Problems*

Details have not been made public, but some terminals apparently do not implement IMSI correctly, and fail to operate correctly when base stations request this identifier. This problem was allowed to mushroom because mobiles with IMSI support were activated prior to networks, and were therefore not tested properly.

Another problem, particularly with older CDMA mobiles, is that there was no clear distinction made between a mobile with no IMSI programmed (but capable of having one programmed) and with an IMSI. This resulted in these terminals transmitting random digits in the IMSI.

Some older CDMA terminals also support only a 2 digit MNC. This can be resolved by using the MNC '00', which has been reserved by several IMSI authorities (including the USA, Canada and Mexico) to identify these phones. These then get most all of the advantages of having IMSI.

## Compatibility

Even if the problems with IMSI were resolved, it could not completely displace MIN for a long time. Mobiles cannot be provisioned with *only* IMSI until every base station, MSC, HLR and other wireless network element supports IMSI. If mobiles have to be provisioned with a MIN, carriers may perceive little additional benefit in also providing it with an IMSI.

Even when IMSI is implemented throughout the ANSI-41 network, support for MIN will still have to be maintained as long as a swap-out of MIN-only terminals involves too many phones to be cost-effective.

## Palatable Alternatives

The major alternative to the IMSI has been the IRM. This solved the international roaming identification problem with MIN, at least temporarily, allowing carriers to sign international roaming contracts without fear that duplicate mobile identifiers would occur. The problem with this approach is the IRM address space is already more than half used. On the positive side, the use of IRM codes is not growing rapidly because, since 2000, there have been charges associated with their use; several carriers have returned their IRM codes, presumably to avoid charges for unused identifiers assigned to them.

The new 'MBI' (MIN Block Identifier) assignment initiative by the CTIA (see our April, 2001 issue) will result in the assignment of MIN blocks separately from directory numbers in the US by early 2002. This will free up billions of MIN codes, by allowing those corresponding to landline phone numbers or service codes (e.g. 800+7D, 911+7D) to be used to identify wireless subscriptions. Enough spare numbers exist that they could be assigned to international carriers, once the IRM address space is exhausted, although this is not current policy.

## Undersized Carrot and Stick

New features are implemented because there is either a significant advantage

(e.g. new revenue) or because failure to implement them will result in significant problems (e.g. fraud losses). The implementation of authentication, although it was much delayed, was an example of a 'stick', pushing carriers to implement a feature that added costs and complexity without bringing in new revenues. As fraud losses rocketed above US\$500 million annually for US carriers alone, authentication eventually became a financial necessity. On the other hand, expansion of the ESN stalled because the industry found work-arounds to significantly delay its exhaustion, and these were orders of magnitude cheaper than changing the format of the identifier.

Implementation of IMSI will not, in the short or medium term, provide carriers with new revenues, nor will its absence cause significant costs to be incurred.

In the long run, there are several possible factors that could stimulate implementation of IMSI:

- When MIN codes near exhaustion, perhaps as the number of data devices incorporating cellular or PCS connectivity increases.
- When SIM cards are widely implemented.
- When roaming with GSM becomes more important to carriers, forcing implementation of IMSI, even if just for inter-technology roaming.
- In 3G systems, where roaming with older systems is not considered important.

## Conclusion

IMSI is the standard subscriber identifier for GSM. Implementation in ANSI-41 will occur eventually, but there is no compelling 'carrot' to encourage carriers to implement it, nor is there a 'stick' to force them — at least at present. With all its shortcomings, the wireless industry will be living with MIN as the prime subscription identifier for several more years, and for years after that, it will still play an important role alongside IMSI.



# TIA TR-45.5/3GPP2 TSG-C CDMA Digital Air Interface Standards

## Cellular Networking Perspectives

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Note: 1. IS- Interim Standard, TSB- Telecommunications Systems Bulletin, PN- Project Number, SP- ANSI Standards Proposal.  
2. Bold Type indicates a modification since the previous publication of this information.  
3. Published TIA standards can be obtained from Global Engineering Documents at 1-800-854-7179.

Thanks to Sam Broyles (Ericsson) and Jack Nasielski and Lisa Collichio (Qualcomm) for their assistance compiling the information in this table.

### 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 (MS) minimum performance standards                         | Published 12/94                    |
| IS-126   | Service option 2: Loopback  | Published 12/94<br>Rescinded 04/99 |

### 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<br>Rescinded 11/99         |
| <b>J-STD-018</b> | <b>Mobile minimum performance standards (for J-STD-008).<br/>Note: published in 1996, but not released until 1998.</b> | <b>Published 07/96<br/>Rescinded 02/01</b> |
| <b>J-STD-019</b> | <b>Base station minimum performance standards. Note: published in 1996, but not released until 1998.</b>               | <b>Published 07/96<br/>Rescinded 02/01</b> |
| 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                            |
| <b>IS-99</b>     | <b>Data Services (9.6 kbps Fax and Circuit Switched Data)</b>  | <b>Published 07/95<br/>Rescinded 11/00</b> |
| IS-125           | Voice coder minimum performance standards  | Published 05/95<br>Rescinded 10/00         |
| IS-126-A         | Mobile station loopback service option   | Published 07/96<br>Rescinded 04/99         |
| 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. 4th revision being balloted 12/00                                      | Published 11/99                                  |
| <b>TIA/EIA-98-D</b>  |                    | <b>MS minimum performance standards</b>   | <b>In press</b>                                  |
| <b>TIA/EIA-125-A</b> | <b>SP-4682</b>     | <b>Correction of errors in speech service option 1</b>  | <b>Published 08/00</b>                           |
| TIA/EIA-126-B        | SP-4136            | ANSI version of IS-126 (MS loopback option)   | Published 08/98                                  |
| <b>TIA/EIA-126-C</b> | <b>SP-4578</b>     | <b>Mobile Station loopback test</b>   | <b>Published 08/00</b>                           |
| 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                                  |
| <b>IS-127-3</b>      | <b>PN-3292-AD3</b> | <b>Addendum #3 to IS-127</b>  | <b>Ballot 05/01</b>                              |
| <b>IS-657</b>        |                    | <b>Packet data services (Internet, CDPD)</b>  | <b>Published 07/96</b><br><b>Rescinded 10/00</b> |
| IS-658               | PN-4374            | Data Services Interworking Function Interface (e.g. modem pool)   | Published 07/96                                  |
| <b>IS-658-1</b>      |                    | <b>Extends the ability to perform interface status exchange at times other than call setup</b>            | <b>Published 04/99</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            | Option 17: High rate CDMA voice coder (13 kbps)   | Published 03/98                                  |
| IS-733-1             |                    | Addendum #1 to IS-733: TTY/TDD capabilities   | Published 09/99                                  |
| <b>IS-733-2</b>      | <b>PN-3972-AD2</b> | <b>Addendum #2 to IS-733</b>  | <b>Ballot 05/01</b>                              |
| 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                                  |
| 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<br>Rescinded 04/99               |
| 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, 1xEVDO)

| Standard       | Project     | Description  | Status          |
|----------------|-------------|--|-----------------|
| TIA/EIA-97-C-4 | SP-4383-RV4 | 4th revision to TIA/EIA-97-C   | Ballot          |
| TIA/EIA-97-D   |             | Minimum performance standards for IS-2000 base stations                                    | In press        |
| TIA/EIA-99     | PN-4617     | 9.6 kbps data service option for IS-2000   | Published       |
| TIA/EIA-126-D  | SP-4578-RV4 | Mobile Station loopback test   | Rescinded 10/00 |
| TIA/EIA-870    | PN-4877     | Test Data Service Option (TDSO) for cdma2000 spread spectrum systems                       | Ballot 01/01    |
| TIA/EIA-871    | PN-4876     | Markov Service Option (MSO) for determining frame error rates                              | Ballot 01/01    |
| IS-683-B       | SP-4742     | OTA update   | Ballot          |
| IS-707-A-1     | PN-4541     | Adds cdma2000 radio link protocol 3E support to 14.4kbps data                              | Published 12/99 |
| IS-707-A-2     | PN-4692     | Data support for IS-2000-A   | Published 03/01 |
| 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   | Ballot 01/01    |
| IS-834         | PN-4707     | Direct Spread Specification for CDMA on ANSI-41 (DS41) Upper Layers Air Interface          | Published 03/00 |
| IS-856         | PN-4875     | cdma2000 High Rate Packet Data Air Interface Specification (1xEV DO)                       | In press        |
| IS-889         | PN-4905     | Minimum Performance Specification for Text Telephone (TTY) Signal Detector and Regenerator | Ballot 05/01    |
| IS-2000.1      | PN-4427     | cdma2000 Introduction and Overview   | Published 08/99 |
| IS-2000.2      | PN-4428     | cdma2000 Physical Layer  | Published 08/99 |
| IS-2000.3      | PN-4429     | cdma2000 Media Access Control (MAC) layer  | Published 08/99 |
| IS-2000.4      | PN-4430     | cdma2000 Signaling Layer 2 Link Access Control (LAC)                                       | Published 08/99 |
| IS-2000.5      | PN-4431     | cdma2000 Signaling Layer 3   | Published 08/99 |
| IS-2000.6      | PN-4432     | cdma2000 Analog Operation  | Published 08/99 |
| IS-2000-A      | PN-4693-8   | cdma2000 (all 6 parts to be revised)   | Published 03/00 |
| IS-2000-A-1    | PN-4698-AD1 | Addendum for IS-2000-A   | In press        |
| IS-2000-A-2    | PN-4698-AD2 | Addendum for IS-2000-A. Revises all 6 parts  | Ballot 05/01    |
| IS-2000-B      |             | cdma2000   | Development     |
| TSB-58-B       | PN-4691     | Parameter value assignments for IS-2000  | Published 11/99 |
| TSB-58-C       |             | Parameter value assignments for IS-2000-A  | Published 05/00 |
| TSB-58-D       | PN-4619-RV4 | Parameter value assignments for IS-2000-B  | In press        |
| TSB-2000       | PN-4534     | Capabilities requirements mapping for cdma2000 standards                                   | Published 09/99 |
|                | PN-4575     | Speech and capacity-sensitive voice coder (formerly EVRC)                                  | Development     |
|                | PN-4650     | 13k voice coder simulation (TTY/TDD update)  | Ballot          |
|                | PN-4651     | EVRC simulation (TTY/TDD update)   | Development     |

### GSM MAP and Smart Card Support

| Standard | Project     | Description   | Status          |
|----------|-------------|---|-----------------|
| IS-820   | PN-4690     | R-UIM (Removable "Smart Card")  | Published 09/00 |
| IS-820-1 | PN-4690-AD1 | CDMA Removable UIM Addendum 1   | Ballot 05/01    |
| IS-833   | PN-4706     | Multi-carrier specification for CDMA systems on GSM MAP (MC-MAP) lower layers air interface | Published 03/00 |

## TSG-C Cross-Reference

| TSG-C Spec  | 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.S0007-0   | Direct spread spectrum specification for spread spectrum systems on ANSI-41 (DS-41) | See IS-834        |
| C.S0008-0   | Multi-carrier specification for spread spectrum systems on GSM MAP (MC-MAP)         | See IS-833        |
| C.S0009-0   | Speech service option   | See TIA/EIA-96-C  |
| C.S000X-0   | cdma2000 (parts identified as C.S0001-C.S0006)                                      | See IS-2000-X     |
| C.S000X-1   | cdma2000 Revision A   | See IS-2000-X-A   |
| C.S0010-0   | Base station minimum performance  | See TIA/EIA-97-C  |
| C.S0010-A   | Base station minimum performance  |                   |
| C.S0011-0   | Mobile station minimum performance  | See TIA/EIA-98-C  |
| C.S0011-A   | Mobile station minimum performance  |                   |
| C.S0012-0   | Minimum performance   | See TIA/EIA-125-A |
| C.S0013-0   | MS loopback test  | See TIA/EIA-126-C |
| C.S0013-A   | MS loopback test  |                   |
| 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.S0015-0   | Short Message Service (SMS)   | See TIA/EIA-637-A |
| C.S0016-0   | Over-the air service provisioning (OTASP)   | See IS-683-A      |
| C.S0016-A   | Over-the air service provisioning (OTASP)   |                   |
| C.S0017-0   | 14.4 kbps data, without STU-III   | See IS-707-A      |
| C.S0018-0   | Minimum performance for EVRC  | See IS-718        |
| 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.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     | Removable user identity module (R-UIM)  | See IS-820        |
| C.S0024     | High rate packet data air interface   |                   |
| C.S0024v2.0 | High rate packet data air interface   |                   |
| C.S0025     | Markov service option (MSO) for determining frame error rates                       | See TIA/EIA-871   |
| C.S0026     | Test data service option (TDSO)   |                   |