

# Cellular Networking Perspectives

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### *FCC Tackles Number Conservation...Again.....p. 1*

The FCC recently released its views on number conservation. Number pooling is still at the top of the charts, but rate center consolidation is gaining favor. The FCC will allow new area codes to be assigned by splits or by (technology-neutral) overlays. The FCC has not (yet) mandated nationwide 10 digit dialing.

### *TR-45 and 3GPP2 Organization .....p. 4*

3GPP2 and TR-45 are jointly responsible for the development of standards for 3G systems based on cdma2000 radio technologies, and 2G standards compatible with the ANSI-41 network protocol, including analog, TDMA and CDMA.

### *TIA TR-45.3 TDMA Digital Air Interface Standards*

TIA subcommittee TR-45.3 develops standards for TDMA (D-AMPS, UWC-136) radio systems.

## Huh?

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

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

*Next Issue: April 2<sup>nd</sup>, 2001*

## FCC Tackles Number Conservation...Again

In December, 2000 the FCC released a second Report & Order regarding Numbering Resource Optimization – the conservation of the rapidly dwindling North American numbering resource. Although the FCC only has authority over US phone numbers, and even though it shares this authority with the States, any changes adopted by the FCC will have a big influence on Canada and the Caribbean nations that share this numbering space.

Wireless carriers will be heavily affected by the various initiatives being considered by the FCC, particularly number pooling.

## Obtaining the Report

The Report & Order is available at:

[www.fcc.gov/Daily\\_Releases/  
Daily\\_Business/2000/db1229/  
fcc00429.doc](http://www.fcc.gov/Daily_Releases/Daily_Business/2000/db1229/fcc00429.doc) (or .txt)

## Thousands-Block Pooling

The FCC is still enamored of thousands-block pooling, implying it is superior to other methods of number conservation. Unfortunately, number pooling works only if wireless carriers adhere to the same number assignment boundaries (rate centers) as landline carriers, and this will reduce the efficiency of number assignment considerably.

Thousands-block pooling allows the current basic number allocation unit — 10,000 numbers — to be shared between

up to 10 carriers. This could also be done by moving from a 6-digit to a 7-digit number analysis, but this has not been considered by the FCC, although it may have less impact on switching equipment.

It might seem unnecessary to share blocks of 10,000 numbers between carriers when there are hundreds of millions of phone numbers in use. There are two reasons for this:

- Competition in the local exchange market is resulting in more companies assigning numbers to phones. Note that competition in the long distance market did not have this effect because these carriers do not assign phone numbers.
- The rate centers are small; the rate center is the geographical area within which numbers are assigned by local exchange carriers. This means even large customers may not always be able to fill a block of 10,000 numbers.

Competition is only going to get more intense, but rate centers are artificial areas that could be merged together, allowing more carriers to obtain several thousand customers in each rate center, which would make pooling unnecessary.

The reason behind the FCC's enthusiasm may be because pooling makes use of the local number portability (LNP) infrastructure mandated by them, and it therefore may make the expense and complexity more palatable. Number pooling, however, has some important differences from LNP. Whereas LNP has to support the migration of single or

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small blocks of numbers to another carrier, number pooling starts with at least 1,000 numbers moving. Number portability systems (NPAC Release 3.0) have had to be modified to represent a pooled block by one record instead of 1,000. Straightforward implementations of LNP would collapse under the data storage requirements of number pooling.

### **Wireless Carriers and Pooling**

Wireless carriers cannot participate in number pooling unless they adapt their number assignment procedures to those of rate centers. Wireless carriers generally assign numbers in larger areas, resulting in a larger local calling area. If wireless carriers were to conform to rate center boundaries, their number allocations would instantly become much less efficient, and number pooling cannot be guaranteed to return wireless carriers to the level they started at!

### **Timing for Wireless Carriers**

The FCC has ruled wireless carriers must support number pooling as soon as they are able to support LNP. The FCC declined to give any transition interval, even though LNP and number pooling are not identical capabilities.

### **Rate Center Consolidation**

Rate centers are the fundamental unit of number assignment and billing in the NANP (North American Numbering Plan). Every number within a rate center is considered to be in the same location for billing purposes, meaning that toll cannot be charged within a rate center.

In many cases, there are multiple, adjacent rate centers between which long distance charges do not apply. These could be consolidated with minimal impact on billing. By doing this, all number blocks within the enlarged rate center would be available for assignment. The only potentially negative effect of this is that the calculation of charges based on distance would be slightly different — higher for some calls and lower for others. However, with distance insensitive billing for long distance increasing in popularity, and with the differences being small, this is probably not a serious problem.

Combining rate centers between which toll charges apply is more controversial, however any loss here could easily be handled by adjusting local rates such that consumers would not see an increase in the overall costs of telecom services.

The FCC is warming towards rate center consolidation. They would probably be more enthusiastic if rate center boundaries were under FCC control, rather than under State control. Number pooling, by contrast, is largely within FCC jurisdiction.

### **Thresholds**

The FCC requires carriers adhere to number utilization thresholds before being eligible for more numbering resources. The threshold will be set at 60% on March 29, 2001, and this will increase by 5% on June 30, 2002 and by another 5% each following year, to a maximum of 75% on June 30, 2004.

The calculation of thresholds is strictly:

Numbers assigned to customers  
Numbers assigned to carrier

Numbers used for testing, numbers used for administrative purposes, or numbers being aged (i.e. taken from one customer, but not eligible for reassignment to another customer for some time, to prevent confusion) are not counted as 'assigned to a customer'. Thresholds are calculated separately for each rate center.

### **Audits**

The FCC has claimed the right to audit carriers, randomly or for cause, to determine what their use of numbers really is.

### **Assigning New Area Codes: Splits versus Overlays**

When numbering resources within an area code are nearly exhausted, a new area code must be assigned. To maintain number conservation objectives, this should be done efficiently. The basic choices are:

- Splitting — assigning a new area code to some existing customers, and
- Overlaying — assigning a new area code for new numbers only.

### **Area Code Splits**

Splitting an area code is the traditional way to assign new numbering resources, but this results in half of existing phones being assigned new numbers. 7-digit dialing between the area codes can be preserved by 'protecting' certain office codes from assignment in the new area code, but this does not meet number conservation objectives. 10-digit dialing from one area code to another will be necessary, eventually, to allow all office codes to be utilized.

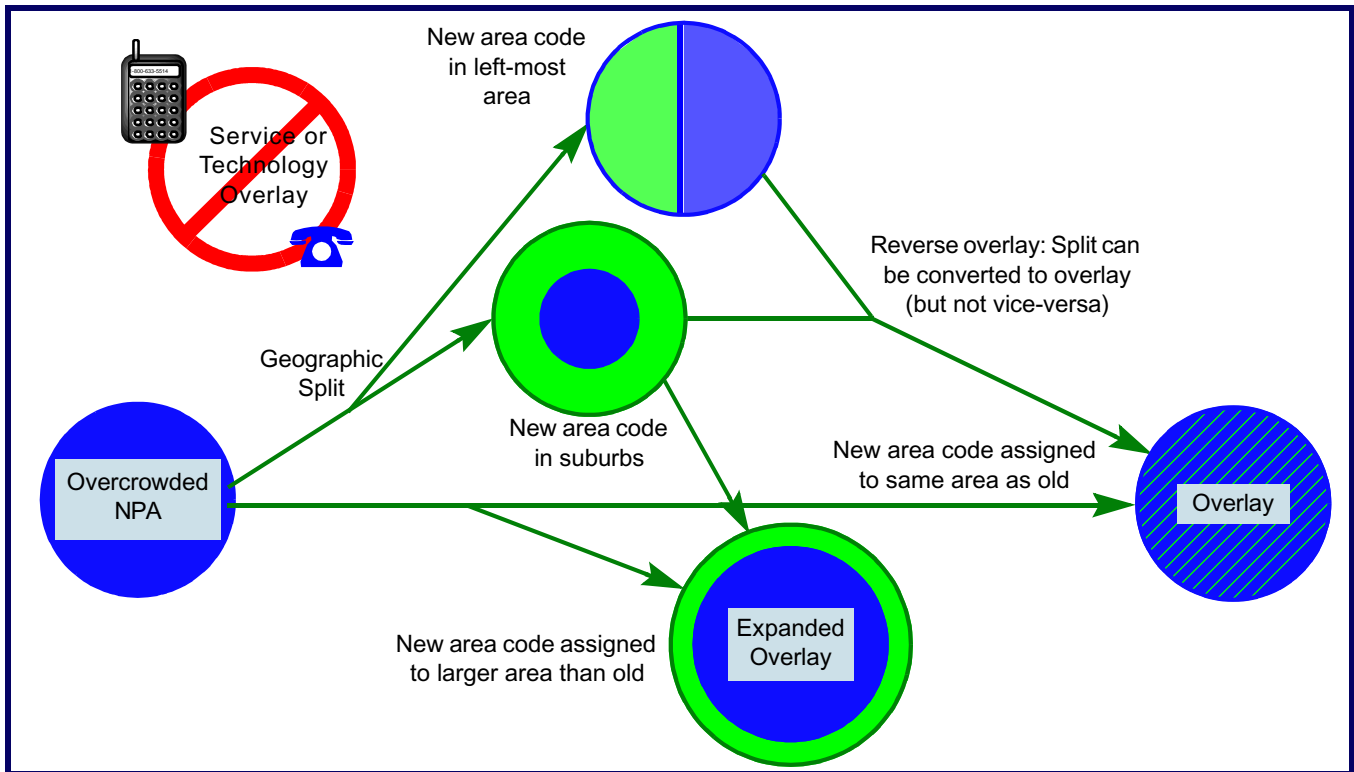
Figure 1 illustrates how splits can be performed. Often, the suburban area will receive the new area code (e.g. as in Dallas and Atlanta), but it is possible to split a region down the middle (e.g. a city straddling a river) or in any other way dividing the population approximately in half, with some consideration given to expected growth patterns.

### **Overlays**

Overlays assign the new area code to the same geographical area as the old area code. The FCC has banned the use of service-specific or technology-specific overlays (e.g. all wireless phones in the new area code) as discriminatory. Overlays are used, instead, for new numbering requirements. This puts newer customers at a disadvantage, because the majority of customers need to dial 10 digits to reach them (and vice-versa). Consequently, mandatory 10-digit dialing may be applied so that everyone may suffer for the benefit of the minority.

A variant on the overlay is the *Expanded Overlay*; in this instance, the new area code applies to a larger geographical area. This allows one area code's resources to provide relief to two existing areas, which is useful when growth is expected in suburban areas. Another variant, a *Reverse Overlay*, allows the conversion of an area code split into an overlay; assignment of both area codes is allowed over the entire area — a useful approach when population growth projections proved to be invalid.

**Figure 1: Area Code Splits and Overlays**



**No Nationwide 10 Digit Dialing**

The FCC will not force nationwide 10-digit dialing, but it will creep in as area codes get smaller with splits, and as areas affected by overlays mandate 10-digit dialing.

**'D' Digit Expansion**

The fourth digit of a NANP number (when expressed in its 10-digit format), known as the 'D' digit, is restricted to "2" through "9" to allow 7-digit dialing. If this digit was a "0" or a "1", some switches would be confused, not being able to differentiate between local call-

ing and Operator/Long Distance services.

Expanding the 'D' digit would expand the capacity of each area code by about 25%, but nationwide 10-digit dialing would be a prerequisite. The FCC decided not to mandate this step...yet.

**Conclusions**

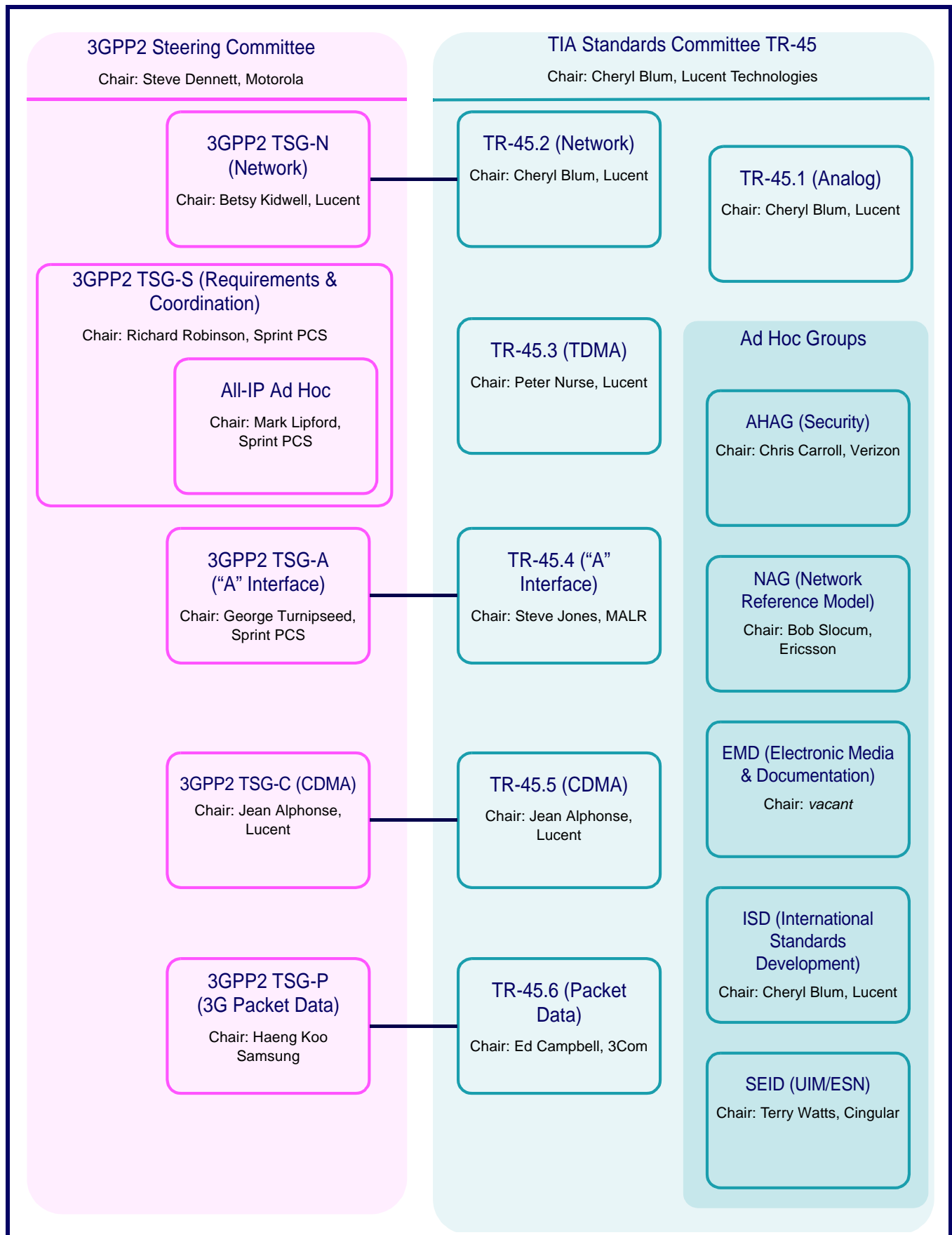
The FCC still favors thousands-block pooling, even though this may waste as many numbers as it saves, and it will cause wireless carriers significant costs, and it could cause them to fail to assign numbers as efficiently as they do today.

Table 1 compares the major forms of number expansion and conservation being promoted by the FCC. Splits and Overlays are required when numbering resources are exhausted and when the choice between them is not straightforward. Number pooling is inferior to Rate Center because of its reliance on local number portability, with its cost and reliability issues, and because carriers will be forced to adhere to rate center boundaries which, unless rate center consolidation occurs, cannot be done efficiently. Additionally, if rate center consolidation does occur, the need to share pools of less than 10,000 numbers may not exist.

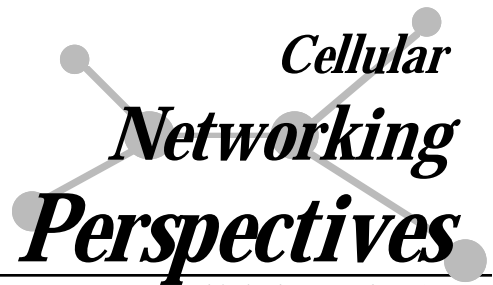
**Table 1: Comparison of Number Conservation and Expansion Methods**

|                                  | Does not require LNP? | Wireless carriers can define local calling areas? | Customers keep current numbers? | Optimized use of existing resource? | Preserves 7 digit dialing? |
|----------------------------------|-----------------------|---|---------------------------------|-------------------------------------|----------------------------|
| <b>Area Code Split</b>           | ✓                     | ✓   |                                 |                                     | partially                  |
| <b>Overlay</b>                   | ✓                     | ✓   | ✓                               |                                     |                            |
| <b>Number Pooling</b>            |                       |   | ✓                               | ✓                                   | ✓                          |
| <b>Rate Center Consolidation</b> | ✓                     | ✓   | ✓                               | ✓                                   | ✓                          |

# TR-45 and 3GPP2 Organization



# TIA TR-45.3 TDMA Digital Air Interface Standards



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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 TIA at [www.tiaonline.org/standards/search\\_n\\_order.cfm](http://www.tiaonline.org/standards/search_n_order.cfm).

## First Generation (IS-54)

| Standard      | Description   | Status                             |
|---------------|---|------------------------------------|
| TIA/EIA-627   | ANSI version of TDMA Dual-Mode Air Interface Standard                       | Published 06/96                    |
| TIA/EIA-627-1 | Addendum to TDMA dual-mode air interface standard                           | Published 04/98<br>Rescinded 06/00 |
| TIA/EIA-628   | TDMA mobile station minimum performance standards                           | Published 06/96<br>Rescinded 06/00 |
| TIA/EIA-629   | TDMA base station minimum performance standards                             | Published 06/96<br>Rescinded 06/00 |
| TIA/EIA-635   | TDMA full-rate voice coder (3:1)  | Published 06/96<br>Rescinded 06/00 |
| IS-54-B       | Original TDMA Dual-Mode Air Interface Standard (replaced by TIA/EIA-627)    | Published 01/92<br>Rescinded 09/96 |
| IS-55         | TDMA mobile station minimum performance standards (Replaced by TIA/EIA-628) | Published<br>Rescinded             |
| IS-56         | TDMA base station minimum performance standards (replaced by TIA/EIA-629)   | Published                          |
| TSB-46        | Verification of Authentication for IS-54-B Mobiles                          | Published 03/93<br>Rescinded 10/00 |
| TSB-47        | IS-54 Implementation Issues   | Published 05/94<br>Rescinded 10/00 |
| TSB-50        | User Interface for Authentication Key Entry                                 | Published 03/93                    |

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

| Standard     | Description   | Status                             |
|--------------|---|------------------------------------|
| IS-130       | Data services radio link protocol (RLP)                         | Published 04/95                    |
| IS-135       | Asynchronous data and fax services                              | Published 04/95<br>Rescinded 04/00 |
| IS-137       | TDMA/analog mobile minimum performance standards                | Published 12/94                    |
| IS-138       | TDMA/analog base station minimum performance standards          | Published 12/94                    |
| IS-136.1     | Digital Control Channel (DCCH)                                  | Published 12/94                    |
| IS-136.1/2-1 | Addenda to IS-136 Rev. 0  | Published 12/94                    |
| IS-136.2     | FSK control channel, analog voice channel, TDMA traffic channel | Published 12/94                    |

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

| Standard       | Description  | Status                             |
|----------------|--|------------------------------------|
| IS-130-A       | Data Services Radio Link Protocol (RLP)  | Published 09/97<br>Rescinded 04/00 |
| IS-137-A       | Mobile minimum performance standards for IS-136-A  | Published 07/96<br>Rescinded 04/00 |
| IS-138-A       | Base station minimum performance standards for IS-136-A  | Published 07/96<br>Rescinded 04/00 |
| IS-641-A       | Enhanced full-rate (ACELP) voice coder, Revision A   | Published 05/96                    |
| IS-684         | Isochronous radio link protocol for data (for STU-III). Replaced by TIA/EIA-136-320                                    | Published 07/96<br>Rescinded 04/00 |
| IS-686         | Enhanced full rate voice coder performance standards   | Published 12/96<br>Rescinded 04/00 |
| IS-727         | Discontinuous transmission (DTX) with ACELP (IS-641) voice coder, including generation of comfort noise                | Published 07/98                    |
| IS-136.1-A     | Enhanced digital control channel (9-1-1, OTA, Calling Name ID, One-button Callback, Private Networks (enhanced), PACA) | Published 10/96<br>Rescinded       |
| IS-136.1-A-1/2 | IS-136 Rev. A corrections (two addenda)  | Published 11/96,<br>12/97          |
| IS-136.2-A     | FSK control channel, analog voice channel, TDMA traffic channel  | Published 10/96<br>Rescinded       |
| TSB-73         | IS-136 Rev. 0/Rev. A compatibility issues  | Published 07/96                    |
| TSB-77         | Interoperable Implementation Issues in IS-641 (ACELP voice coder)  | Published 07/97                    |
| TSB-105        | Audit order clarification  | Published 03/99                    |
| TSB-108        | Determining when R-DATA is encrypted   | Published 03/99                    |

## Fourth Generation - TIA/EIA-136 Revision 0

| Standard        | Description   | Status          |
|-----------------|---|-----------------|
| TIA/EIA-136     | SMS enhancements, double/triple rate channels (symmetrical/asymmetrical), EPE and charge rate indicator.  | Published 03/99 |
| TIA/EIA-136-010 | Optional mobile station facilities  | Published 03/99 |
| TIA/EIA-136-020 | SOC, BSMC and carrier specific HLPI assignments   | Published 03/99 |
| TIA/EIA-136-100 | Introduction to channels  | Published 03/99 |
| TIA/EIA-136-110 | RF channel assignments  | Published 03/99 |
| TIA/EIA-136-12x | Digital control channel (DCCH) layer 1 (136-121), 2 (136-122) and 3 (136-123)   | Published 03/99 |
| TIA/EIA-136-13x | Digital traffic channel (DTC) layer 1 (136-131), 2 (136-132) and 3 (136-133)  | Published 03/99 |
| TIA/EIA-136-140 | Analog (FSK) control channel  | Published 03/99 |
| TIA/EIA-136-150 | Analog voice channel  | Published 03/99 |
| TIA/EIA-136-2x0 | Minimum performance requirements for ACELP voice coder (136-210), VSELP voice coder (136-220), mobile station (136-270) and base station (136-280)                          | Published 03/99 |
| TIA/EIA-136-420 | VSELP voice coder   | Published 03/99 |
| TIA/EIA-136-510 | Authentication and encryption of signaling information, user data and voice   | Published 03/99 |
| TIA/EIA-136-7x0 | SMS: Introduction to teleservices (700), text/numeric messaging (710), Over-the-Air Activation (OATS; 720) and Over-the-Air Programming for intelligent roaming (OPTS; 730) | Published 03/99 |
| TIA/EIA-136-910 | Informative information   | Published 03/99 |

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

| Standard          | Description  | Status          |
|-------------------|--|-----------------|
| TIA/EIA-136-A     | Revised parts include 136-010, 020, 100, 121,131,133,140,150,270, 280, 510, 700, 710, 720 and 910. New parts are listed separately | Published 12/99 |
| TIA/EIA-136-310-1 | Radio link protocol 1 (for data services)  |                 |
| TIA/EIA-136-350-1 | Data services control  |                 |
| TIA/EIA-136-410-1 | ACELP voice coder, addendum 1  | Ballot 10/00    |
| TIA/EIA-136-430   | US1 voice coder (GSM compatible)   |                 |
| TIA/EIA-136-511   | List of messages subject to encryption   |                 |
| TIA/EIA-136-620-1 | TSAR: teleservice allowing segmentation and reassembly   |                 |
| TIA/EIA-136-630   | BATS: broadcast short message  |                 |
| TIA/EIA-136-730-1 | OPTS: over-the-air programming teleservice to support intelligent roaming  |                 |
| TIA/EIA-136-750   | GUTS: general UDP transport service  |                 |

## Sixth Generation - TIA/EIA-136 Revision B - UWC-136 - ITU-R 3G Specification

| Standard               | Description  | Status          |
|------------------------|--|-----------------|
| TIA/EIA-136-B          | Revision B. Only new parts are listed  | Published 03/00 |
| TIA/EIA-136-230        | US1 (GSM) voice coder minimum performance requirements                                     |                 |
| <b>TIA/EIA-136-290</b> | <b>RF minimum performance for 200 kHz and 1.6MHz bearers (136HS)</b>                       |                 |
| TIA/EIA-136-330        | Packet data service - overview   |                 |
| TIA/EIA-136-331        | Packet data service - physical layer   |                 |
| TIA/EIA-136-332        | Packet data service - medium access control (MAC)  |                 |
| TIA/EIA-136-333        | Packet data service - logical link control. Based on GSM 04.64.                            |                 |
| TIA/EIA-136-334        | Packet data service - subnetwork dependent convergence protocol. Based on GSM 04.65.       |                 |
| TIA/EIA-136-335        | Packet data service - radio resource management  |                 |
| TIA/EIA-136-336        | Packet data service - mobility management  |                 |
| TIA/EIA-136-337        | Packet data service - tunneling of signaling messages. Subset of GSM 09.18                 |                 |
| TIA/EIA-136-34X        | Outdoor high-speed packet data service: Overview (340), Physical layer (341) and MAC (342) |                 |
| TIA/EIA-136-36X        | Indoor high-speed packet data service: Overview (360), Physical layer (361) and MAC (362)  |                 |
| TIA/EIA-136-511        | Messages subject to encryption   |                 |
| TIA/EIA-136-610        | R-DATA/SMDPP Transport   |                 |
| TIA/EIA-136-760        | Charge-rate indication teleservice (CIT)   |                 |
| TIA/EIA-136-900        | Introduction to Annexes and Appendixes   |                 |
| TIA/EIA-136-905        | Normative information  |                 |
| TIA/EIA-136-932        | Packet data services - Stage 2 description   |                 |
| TIA/EIA-136-933        | Packet data services - Description of MAC layer  |                 |
| TIA/EIA-136-940        | Capacity and performance characteristics of UWC-136 (TIA/EIA-136-B)                        |                 |
| IS-823                 | Modification to ACELP voice coder to transmit TTY/TDD tones                                | Published 05/00 |
| <b>IS-839</b>          | <b>R-UIM Overview, Operation, and File Structure Support in TIA/EIA-136, Rev B</b>         | <b>In press</b> |
| IS-842                 | GSM Hosted SMS Teleservice (GHOST)   | Ballot 07/00    |

## Seventh Generation - TIA/EIA-136 Revision C

| Standard        | Description   | Status      |
|-----------------|---|-------------|
| TIA/EIA-136-C   | Revised parts include 000-C, 005-B, 010-C, 020-C, 100-B, 110-B, 123-C, 131-C, 133-C, 210-A, 270-C, 280-C, 290-A, 350-B, 610-A, 620-A, 700-C | In press    |
| TIA/EIA-136-030 | R-UIM (Smart Card) overview and operation   |             |
| TIA/EIA-136-033 | R-UIM/ME file structure   |             |
| TIA/EIA-136-034 | R-UIM/ME interface procedures   |             |
| TIA/EIA-136-036 | Personalization of mobile equipment (ME)  |             |
| TIA/EIA-136-037 | R-UIM/ME application toolkit  |             |
| TIA/EIA-136-240 | AMR (Adaptive Multi-Rate Vocoder) minimum performance   |             |
| TIA/EIA-136-250 | VAD (Voice Activity Detection) minimum performance  |             |
| TIA/EIA-136-351 | EGPRS-136 - AT commands   |             |
| TIA/EIA-136-370 | EGPRS-136 - Overview  |             |
| TIA/EIA-136-376 | EGPRS-136 - Mobility management   |             |
| TIA/EIA-136-377 | EGPRS-136 - Gs interface specifications   |             |
| TIA/EIA-136-440 | AMR adaptive multirate codec (also used in GSM and UMTS)  |             |
| TIA/EIA-136-670 | Broadcast teleservices over GSM SMS (TOGS)  |             |
| TIA/EIA-136-740 | SAMPS - System assisted MS positioning through satellite (i.e. GPS)   |             |
| TIA/EIA-136-972 | EGPRS-136 - Stage 2 descriptions  |             |
| IS-869          | Analog SAMPS support in TIA/EIA-136-C   | Development |

## Eighth Generation - TIA/EIA-136 Revision D

| Standard      | Description   | Status      |
|---------------|---|-------------|
| TIA/EIA-136-D | Enhanced authentication (EPE and AKA), GHOST, multilingual SMS, and handoff. Analog SAMPS and R-UIM | Development |