Cellular Networking Perspectives

Editor: David.Crowe@cnp-wireless.com Vol. 12, No. 10 October, 2003

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Comments

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Next Issue: November 4th, 2003

US Number Portability: Too Late to Stop?

On September 5th the CTIA filed a 'Writ of Mandamus' as a last ditch attempt to stop the US Local Number Portability mandate, scheduled to take effect on November 24, 2003.

This ancient legal device is used by a higher authority (the US Court of Appeal in Washington, in this case) to command a lower authority (the FCC) to take a specific action. The CTIA requested that the Court force the FCC to address a number of outstanding issues regarding LNP before enforcing the mandate. These revolve around rate centers, porting intervals and service-level porting agreements.

According to Michael Altschul, CTIA counsel, the Court of Appeals ruled on September 24th that the FCC must respond to the CTIA petition by October 24th. The CTIA will then have 10 days to reply. There is no guarantee that the court will act before the LNP deadline.

ESN Recycling

TIA committee TR-45 is sending letters to manufacturers of cellular phones who were assigned ESN manufacturer codes many years ago, asking if there is any objection to using them as UIMID codes or reassigned as new ESN manufacturer codes. As long as the ESNs were originally assigned for use in analog-only or TDMA mobiles, there is little likelihood of an ESN conflict because the new codes will likely be used to identify CDMA mobiles, including those relying on an UIM, as is common in Asia.

The letter will also advise recipients that ESN manufacturer code 250, currently reserved for test purposes, may be reassigned for commercial use.

This program is necessary because the number of available ESN manufacturer codes had dropped to 34 (out of a total of 256) by September, 2003. This problem occurred because only 8 out of the 32 available bits were allocated to identify manufacturers. The more efficient 14-bit UIMID has alleviated some of the pressure, but 8-bit manufacturer codes continue to be assigned almost every month.

One of the difficulties of a reclamation program like this is that many early terminal manufacturers have

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Cellular Networking Perspectives (issn 1195-3233) is published monthly by Cellular Networking Perspectives Ltd, 2636 Toronto Crescent NW, Calgary AB, T2N 3W1, Canada. Phone: 1-800-633-5514 (+1-403-274-4749) Fax: +1-403-289-6658 **Email:** cnpsales@cnp-wireless.com **Web:**www.cnp-wireless.com **Subscriptions:**CDN$350 in Canada (incl GST), US$350 in the USA and US$400 elsewhere. Payment by cheque, bank transfer, American Express, Diners Club, MasterCard or Visa. **Delivery:**Email or 1st class mail. **Back Issues:**Single issues are $40 in the US and Canada and $45 elsewhere, or in bulk at reduced rates. **Discounts:**Educational and small businesses: 25% off any order. **Copies:**Each subscriber is licensed to make up to 10 copies of each issue. Contact us for rates to allow more.

either stopped manufacturing wireless phones, merged, changed their name and address, or gone bankrupt. Even if a company can be contacted, it can be difficult for it to know exactly what their ESNs were used for (if anything). Consequently, companies that do respond are likely to take the safe approach and request that their ESN codes not be re-used.

ESN conflicts are not a major problem (unlike MIN or MDN conflicts that will result in calls failing or being terminated to the wrong mobile). Two CDMA mobiles with the same ESN may have crosstalk because this code is used to generate the PLCM used to encrypt voice communications, but this will *only* occur when the mobiles are in the same cell, making it a rare problem.

Service failures may also occur (again only if two mobiles with the same ESN are in the same cell) with initial over-the-air provisioning of mobiles that do not have a subscribed MSID.

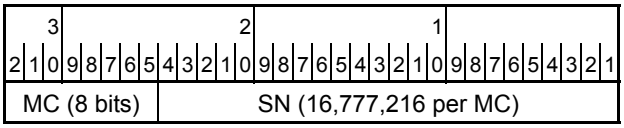
The PLCM problem is more serious as it involves everyday operations of a CDMA terminal. This problem will occur more frequently during the transition to MEID because the pseudo-ESN derived from MEID only has 24 variable bits (the first 8 bits are always the same value).

3GPP2 and TIA TR-45 are also examining permanent solutions to the PLCM problem that would guarantee uniqueness within a cellsite even if the ESN is not unique.

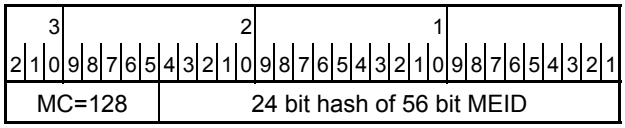
See our ***August, 2001 issue*** for more details on the ESN. **Figure 1** illustrates the varieties of the ESN that exist at present.

Figure 1: ESN Formats

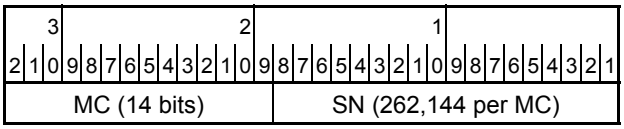
Standard ESN Format



Pseudo-ESN Format



UIMID Format



The ESN is an equipment identifier, like an Ethernet MAC address or MEID. It permanently identifies a piece of hardware, unlike subscription identifiers such as MIN, IRM and IMSI, that are associated with a single subscription, but possibly multiple devices over time.

The International Roaming MIN (IRM)

Evolving technologies often have legacy issues, especially those, like cellular, that are more successful than initially dreamed possible. Evolution allows for good aspects of older technologies to be retained, and for the introduction of newer technologies before widespread support is in place. However, often less desirable aspects of an old technology are also inherited.

The first wildly successful cellular technology was AMPS in the United States, beginning in 1983. Its designers did not anticipate it would be adopted around the world, and so chose the 10-digit US national phone number to uniquely identify each mobile on the radio interface. This MIN (Mobile Identification Number) was later also adopted by TDMA and CDMA digital systems as well as narrow-band analog (N-AMPS).

The use of the same type of Mobile Subscription Identifier (MSID) simplified the introduction of dual-mode operations, but it also made it difficult to move from MIN to the more capacious and flexible IMSI.

What about IMSI?

The problem that carriers face migrating to 15-digit international-ready IMSI is that there are few current benefits, and significant headaches. Dual-identifier operation would have to be supported until all the carrier's roaming partners had also migrated and all MIN-only terminals had been phased out.

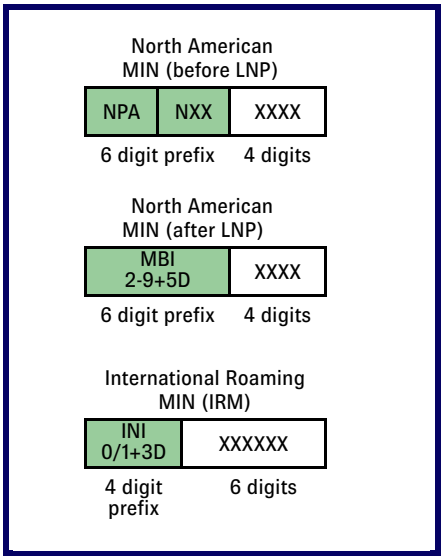
IMSI would simplify ANSI-41 to GSM interworking, but so far, this capability has not yet been widely implemented.

The major benefit of a carrier moving to IMSI would be the assurance that their network would continue to work if the MIN resource did become exhausted, which, outside of North America, may happen within the next few years, making IMSI a necessity.

The MIN

The MIN (see **Figure 2**) uniquely identifies a subscription, and the first 4-6 digits identify the home system (HLR), facilitating the routing of ANSI-41 signaling messages to the HLR. These are essential for validating and authenticating roamers and for obtaining their profile.

Figure 2: Types of MIN



When AMPS spread to countries outside the United States in the mid to late 1980's, these new international carriers had to decide how to program the MIN codes in their customer's phones. They often chose to base it on the local phone number, just as American carriers had done.

Few countries outside North America had 10 digit numbering plans, so carriers had to choose filler digits to pad the MIN out to exactly 10 digits. Mexican carriers, for example, used their ITU E.164 country code (52) to fill the first two digits of the MIN, as their national phone numbers were only 8 digits long. Other countries used their 3-digit IMSI Mobile Country Code (MCC). These schemes were implemented without international coordination.

The first international cellular systems were standalone, but soon, roaming between systems was implemented. The lack of coordination between national MIN numbering plans loomed as a barrier, especially with the most desirable market – the United States. If two carriers used the same MIN prefix, ANSI-41 message routing to the HLR would be difficult, if not impossible.

Organizing for Solutions

An organization named the JCCR (Joint Committee on Cellular Roaming) was established by Mexican, US and Canadian organizations in the mid 1990s to find a solution. Two were studied: Double-Dipping and the International Roaming MIN (IRM).

Double-Dipping requires that several HLRs are queried until a match is found with both the MIN and its associated ESN. This solution was rejected because it could not be guaranteed that even two queries would suffice, and it would require all ANSI-41 MSCs and VLRs to be upgraded.

The alternative International Roaming MIN concept was to use MIN codes that are not valid North American phone numbers, specifically those that begin with the digit '0' or '1'. This solution was found to be compatible with virtually all cellular hardware and software, requiring only the provisioning of the IRM codes in roamer agreement tables – an activity that is required for regular MINs as well.

The JCCR chose the IRM. Eventually the organization evolved into IFAST (www.ifast.org) and was opened to carriers using ANSI-41 networks anywhere in the world. Assigning IRM codes became the fledgling organization's first role.

Enter the IRM

The IRM uses the first four digits of the MIN as an 'IRM Network Identifier' (INI), with the remaining 6 digits being assigned by the carrier. This allows 2,000 distinct network identifiers, each able to uniquely identify one million subscriptions.

The IRM is still often related to local directory numbers. Mapping between the IRM and the MDN is performed by stripping several digits from the IRM and replacing them by a directory number prefix that is the same for a large group of mobiles. Although many systems can support true MIN/MDN separation, many cannot – particularly legacy billing systems.

Lack of MIN/MDN separation can restrict the choice of IRM. Where restrictions on numbering plans and billing systems are severe, competition for an IRM has led to carriers sharing an IRM block, with the actual carrier not being determined until the fifth digit is examined. This is not a problem, because US MIN codes require the examination of the first 6 digits to determine the home carrier.

Current IRM assignments can be found on the IFAST web site (www.ifast.org). The tables are updated every two weeks.

IRM Administration

Like most solutions, the acceptance of the IRM concept created the need for an administrator.

One of the first challenges of managing the IRM was 'grand-fathering' – obtaining information about unofficial IRM usage

established before IFAST existed. Several US-based data systems had utilized many IRM Network Identifiers, not realizing this numbering resource would eventually become essential for international roaming. The right of companies to hold these codes was recognized even when the assignment efficiency was low and when they were based in North America (which controls the other 80% of the MIN resource). IFAST decided that trying to reclaim IRMs from these companies would create conflict and threaten the acceptance of central IRM administration. It is hoped that these companies will eventually rearrange their numbering plans to make better use of the IRM resource.

All companies that use IRM codes now recognize the role of the IFAST in administering the resource. Although it has no legal authority, chaos would result without this coordination, and the ability of carriers to sign roaming agreements would be threatened.

To fund the administration of IRM codes, it was agreed to impose one-time assignment and annual maintenance fees (currently US$175 each). An advantage of charging a fee for IRMs is the annual contact with each carrier, which encourages the reclamation of codes that are no longer required.

Future of the IRM

About two-thirds of the IRM resource has been utilized. Large CDMA systems outside North America, such as those in China, South Korea, Japan and India, account for most new assignments. The resource could be exhausted in 5-10 years. The ability to continue to identify mobiles uniquely relies on Reclamation, Expansion or Migration.

The best hope for reclamation of IRM resources would be from reorganizing the numbering plans for US data systems used by Aeris, Cellemetry and UPS, which were established without knowledge of the global IRM numbering plan.

Expansion of the resource may be possible now that North American wireless carriers are proceeding with MIN/MDN separation. Blocks of North American MIN codes that are not desirable for local assignment (e.g. MIN codes beginning with toll-free prefixes like 800 or service codes like 611 and 911) could, in theory, be added to the IRM pool and assigned to international carriers without causing any technical problems. This would require an agreement with the MBI (MIN Block Identifier) administrator (mbiadmin.com) and the North American cellular industry.

The only long term solution to the MIN problem is to migrate to IMSI. IMSI is not only a much larger address space, but it can be assigned independently by each country, because the first 3 digits are a Mobile Country Code (MCC).

It would be wise for carriers to start provisioning both MIN and IMSI for each subscriber now. This will enable them to verify that all their equipment is compatible with IMSI, and will allow a quick transition at the point that the IRM resource is exhausted.

Conclusions

The IRM is critical to international roaming by carriers with CDMA, TDMA and analog systems.

About the Author. David Crowe is the editor of *Cellular Networking Perspectives* and also the IFAST IRM administrator.

3GPP TSG T Update

3GPP TSG Terminals (TSG T) specifies terminal interfaces (logical and physical), capabilities (such as execution environments), performance and testing. It does not specify the radio aspects of terminals, which are the responsibility of TSG RAN, nor does it specify speech and multimedia codecs, which are the purview of TSG SA4.

Major activities at the TSG T meetings (#20 and #21) since our ***last report*** were:

- Completion of UE testing for Rel 99, Rel 4 and Rel 5. This is still in progress because work on testing follows the completion of the main specification.
- Maintenance work on the existing releases of Multimedia Messaging Service (MMS) specifications.
- The scope of the Rel 6 work item for enhancements to MMS was refined.
- Work on the Generic User Profile (GUP) is progressing. It will provide easy access and sharing of end-user profile data, including listing the user's devices, services, billing arrangements, address, calendar and preferences.
- At TSG T#20, the topic of improving cooperation with the Open Mobile Alliance (OMA) was discussed, but no consensus reached. Proposals have been made to continue all bearer agnostic MMS work beyond Rel 6 in OMA and to restructure TSG-T. This might result in the dissolution of T2, with maintenance of its specifications inherited by the TSG T plenary. In the absence of a decision, TSG T advised T2 to focus its work on Rel 6. An agreement on which group will develop specifications beyond this should be reached no later than the completion of Rel 6.

- TSG T Working Group 3 decided to change its name from *Universal Subscriber Identity Module (USIM)* to *Smart Card Application Aspects,* to indicate that it maintains more than one application.
- At TSG T#21, Kevin Holley of O2 was appointed as the single Workshop Organizing Committee member of 3GPP.
- TSG T has approved Terms of Reference for a Joint 3GPP/3GPP2/OMA Workshop on MMS Standardization Management.

TSG T WG1 (Mobile Terminal Conformance Testing)

TSG T Working Group 1 (T1) is responsible for User Equipment (terminal) conformance testing specifications, based on requirements defined by other groups such as RAN WG4 for the radio tests, and RAN WG2 and CN WG1 for the signalling and protocol tests. T1 is organized into an RF subgroup and a Signalling subgroup.

- Work on the Radio Resource Management (RRM) Background Analysis is progressing. T1 will create a technical report (TR 34.902) to capture the work done on measurement uncertainty for the more complex RRM test cases.
- Rel 99 RRM test specifications are nearly complete, but the Rel 4 specifications are still at early stages.
- Nokia is maintaining a database on the maintenance of R99 specifications. It helps track changes to core specifications that are not covered by relevant test specification Change Requests (CRs).
- T1 is working on the Single Version Release of TS 34.121 "Terminal Conformance Specification; Radio transmission and reception (FDD)". This is the result of a study on the best method to maintain a single release document to cover Rel 99, Rel 4 and Rel 5. T1 will also start on a multi-release version of TS 34.122. This is expected for approval at TSG T#22 (December 2003).

Table 1: 3GPP TSG T Working Group 1 (T1) Mobile Terminal Conformance Test Specification Update

Document	Title	Status
TS 34.108	Common Test Environments for User Equipment (UE) Conformance Testing	Rel 99 and Rel 4 being revised.
TS 34.121	Terminal Conformance Specification; Radio Transmission and Reception (FDD)	Rel 99, Rel 4, and Rel 5 being revised.
TS 34.122	Terminal Conformance Specification; Radio Transmission and Reception (TDD)	Rel 4 version revised.
TS 34.123-1	Mobile Station (MS) Conformance Specification; Part 1: Protocol Conformance Specification	Rel 5 version revised.
TS 34.123-2	User Equipment (UE) Conformance Specification; Part 2: Implementation Conformance Statement (ICS) Pro forma specification	Rel 5 version revised.
TS34.123-3	User Equipment (UE) Conformance Specification; Part 3: Abstract Test Suites (ATSs)	Rel 99 version revised.

TSG T WG2 (Mobile Terminal Services & Capabilities)

TSG T Working Group 2 (T2) is responsible for the Services, Capabilities, Applications and Interfaces to be delivered by 3GPP Terminal Equipment. They also ensure that terminals meet 3GPP objectives. T2 is organized into:

- **SWG1** - **MExE** (Mobile Execution Environment). Recently dissolved. Remaining responsibilities will be handled by T2.
- **SWG2** – User Equipment (UE) Interfaces and Capabilities. Prem Sood of Sharp was recently re-appointed as Chair.
- **SWG3** – Messaging. Josef Laumen was recently re-appointed as Chair.

Highlights of the recent meeting were:

SWG2 – UE Interfaces and Capabilities. All but one supporting company that initiated the Work Item Description (WID) have stated that they have no intention to help progress Generic User Profile (GUP) work in 3GPP, although they claim to still support it. Luckily, some companies who were not the original supporters are providing contributions.

SWG3 – Messaging . The main focus of this group is on the Multi-media Messaging Service (MMS). This includes minor enhancements to Rel 5 and Rel 6:

- Enhancements to Digital Right Management (DRM) support.
- Within a retrieval request, the recipient MMS User Agent may restrict the size of the returned Multimedia Message.
- A more detailed MM3 specification for the interface between MMS and external messaging services.
- Extension of the MM4 interface (between MMS Relay/Servers) to enable the originating MMS Relay/Server to request a delivery report for the Multimedia Message.
- Reply charging in case of forwarding.

The following items have been removed from the Work Item:

- Enhancements to Interworking and Transcoding.
- User profile mechanism.
- Streaming Enhancements.
- MMBox (Network-based Storage) enhancements.

Two outstanding issues have been solved with the Cell Broadcast Service (CBS).

- Discrepancies between the GSM and UMTS Service Area Lists has now been resolved. A liaison has been sent to RAN WG3 supporting their proposed modification of this parameter in TS 25.419 to become the Cell-List parameter (as defined in TS23.041) for Rel 5.
- The inadequate definition of Cbdata field format for UMTS is now resolved, and CRs are being drafted for presentation by TSG T#22.

Table 2: 3GPP TSG T Working Group 2 Mobile Terminal Services & Capabilities Specification Update

Document	Title	Status
TS 23.038	Alphabets and language-specific information	Rel 6 being published
TS 23.057	Mobile Execution Environment (MeXe); Functional Description; Stage 2	Rel 6 being revised
TS 23.140	Multimedia Messaging Service (MMS); Functional Description; Stage 2	Rel 5 and Rel 6 being revised.
TS 27.007	AT command set for User Equipment (UE)	Rel 4, Rel 5, and Rel 6 being revised.

3GPP TSG T WG3 (Smart Card Application Aspects)

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

Highlights of the recent T3 meetings were:

- A new WID was approved for optional USIM Enhancements for WLAN interworking. Particular attention will be paid to security and provisioning.

- It was agreed to make support for Short File Identifiers (SFI) in the Dedicated File Phone book (DF_Phonebook) mandatory, even though this limits it to a maximum of 30 Elementary Files (EF). It is hoped that this limitation can be removed from Rel 6 and onwards.
- Discussions continued with SA WG3 on the usage of USIM for Multimedia Broadcast Multicast Service security and its impact on T3 specifications.
- Test specifications for GSM Subscriber Identity Module (SIM) Application Toolkit (SAT) will be stabilized before similar work for the USIM (TS 11.10-4 R99) is allowed to begin.
- A WID for Universal Subscriber Identity Module Application Toolkit (USAT) Testing will be reviewed at the next meeting.

Meeting Schedule

The last plenary meeting of TSG T was held September 16th – 19th, 2003 in Berlin, Germany.

Future meetings will be held:

- December 9th – 12th, 2003 in Hawai'i.
- March 10th – 12th, 2004 in Phoenix, Arizona.
- June 2nd – 4th, 2004 in Seoul, South Korea.
- September 8th – 10th, 2004 in the United States.
- December 8th – 10th, 2004 in Athens, Greece.

For a complete schedule of 3GPP meetings consult:

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

Table 3: TSG T Working Group 3 USIM Specification Update

Document	Title	Status
tbd	USIM Enhancements for WLAN Interworking	New Work Item.
TS 11.10-4	Mobile Station (MS) Conformance Specifications; Part 4: SIM Application Toolkit (SAT)	Rel 99 being revised.
TS 31.102	Characteristics of the USIM Application	Rel 99, Rel 4, Rel 5, and Rel 6 being revised.
TS 31.111	USIM Application Toolkit (USAT)	Rel 4, and Rel 5 being revised.
TS 31.121	UICC-Terminal Interface; USIM Application Test Specification	Rel 99 and Rel 4 being revised.
TR 31.900	SIM/USIM Internal and External Interworking Aspects	Rel 5 being revised.
TS 51.011	Mobile Equipment (SIM - ME) Interface	Rel 4 being revised.
TS 51.014	SIM Application Toolkit	Rel 4 being revised.

TIA TR-45 and 3GPP2 Organization

Last Published March, 2001