ADVANCING GLOBAL COMMUNICATIONS

White Paper on the Exhaust of Electronic Serial Numbers (ESNs) and Migration to Mobile Equipment Identifiers (MEIDs)

November 2007

1   DOCUMENT USE

Items considered in this ESN Migration to MEID Whitepaper:

- ESN and exhaust.

- ESN migration to MEID and status (MEID migration is <u>not</u> optional since ESN numbers will exhaust.)

- UIM_ID migration to E-UIM_ID *(e.g*., SIM card-type applications)

- MEID information resource

2   BACKGROUND

In the early 1980s, the Federal Communications Commission ("FCC") required that each wireless Commercial Mobile Radio Service ("CMRS") handset in the United States have a unique identification number embedded or inscribed on the microchip in a wireless phone by the manufacturer known as an **Electronic Serial Number ("ESN")**. Shortly thereafter, analog capacity was in high demand and digital technology was introduced with Time Division Multiple Access ("TDMA") and Code Division Multiple Access ("CDMA") standards and technologies as two options developed, with ESNs later essentially becoming a global numbering resource as the use of CDMA and TDMA standards spread internationally. The use of a **Removable User Identity Module "UIM" ("R-UIM";** *i.e.,* similar to a Subscriber Identity Module or SIM card) is an optional use with CDMA technology, primarily in non-US markets at this time.

The FCC administered global ESN pool assignments operating under the FCC Section 22.919 until delegating this administrative function to TIA in September of 1997. TIA developed and published ESN Assignment Guidelines and Procedures on March 22, 1997 in preparation for the transition of the administrative function.

The wireless industry, as reflected by TIA's engineering committee TR-45, published updated guidelines on March 15, 2000 requiring annual audit and compliance forms ("Form G") returns by ESN Manufacturer Code Assignees for audit purposes and on June 1, 2001 revised the guidelines to allow 14-bit Manufacturer "MFR" codes for more ESN pool opportunities and greater flexibility with assignments. *[There are sixty-four (64) blocks of 262,144 within each 8-bit ESN MFR Code of 16,777,216 numbers].*

Any finite numbering resource can reach an exhaust point (*i.e.*, all available numbers are used or assigned). **ESN exhaust is presently projected to be as early as the January or February of 2008 (1Q2008).** This date should not be a surprise to anyone at this late juncture as service providers and manufacturers have been on notice of ESN exhaust for many years and should have started planning long ago for the transition to MEIDs and **Expanded UIMs ("E-UIM_IDs").** The timeframe of ESN exhaustion has been forecasted and delayed for many years as a result of superb administrative conservation and recovery actions by the TIA ESN Administrator under the guidance of TIA Engineering Committee TR-45: Mobile and Personal Communications Systems Standards.

The CDMA R-UIM serial numbers (UIM_IDs) are a separate pool of numbers but are currently derived from the ESN pool, and use the same 32-bit structure as the ESN. They are presently derived primarily from recoveredl Analog/TDMA code ranges (non-CDMA codes). Thus, the exhaust timeframe for the present generation of R-UIM numbering resources (UIM_ID) somewhat tracks with the ESN exhaust date. However, even with the voluntary ESN assignment block returns to the ESN Administrator, efforts to ascertain actual use and deployment of all historically allocated ESN MFR Code resources are tedious, and often result in incomplete or uncertain findings. The successful efforts yield minimal unused ESN code range resources to be considered for ESN use following the virgin ESN MFR Code exhaust or substantial amounts of Analog/TDMA code ranges for the increasing demand of UIM_ID needs worldwide. This is not solely due to the unavailable records from the early days of ESN assignments, but also from the lack of responses via certified letter from previous ESN assignments to manufacturers contacted as part of the aforementioned recovery effort. Many of these manufacturers are most likely not in business anymore and in some cases probably used little or any of their assigned ESNs from the over 4 billion universe of ESN numbering resources. However, prudence needs to be exercised, and assumptions about past usage are not made without verifiable historical data and without consulting with service providers and clearinghouse/mediation vendors.

Given the severe consequences of ESN exhaustion to the industry and mobile customers, solutions were developed to introduce an expanded device-level serial number to replace the ESN which is known as **a Mobile Equipment Identifier or "MEID"** during an April, 2002 Numbering Joint Experts Meeting (JEM). Similar R-UIM solutions were developed to replace the UIM_ID with Expanded UIM_IDs, known **as "E-UIM_IDs"** and Stage 1 requirements for E-UIM_IDs were published in March, 2004.

The Global Hexadecimal Administrator ("GHA") assigns MEID Hexadecimal code prefixes. The TIA, which already acts as the ESN Administrator, also acts as the GHA. MEID assignments are also coordinated with the Global Decimal Administrator ("GDA") for devices that also operate in GSM or UMTS modes needing to acquire decimal ranges for MEID multimode Mobile Equipment ("ME") assignments. The ESN assignment and MEID assignment processes are both done in parallel today to ensure a smooth migration from ESNs to MEIDs. **Once ESNs exhaust, only MEIDs will be assigned and there will be no virgin ESN resources to assign for manufacturing of mobile equipment. Similarly, the impending exhaust of UIM_IDs will require a migration to E-UIM_IDs for use in CDMA R-UIM mobile equipment.**

During the transition, before "all" systems that a customer may roam onto are capable of processing MEIDs, a "pseudo ESN" is derived from an MEID via a hashing algorithm for

backward compatibility with legacy systems infrastructure and back-office systems capable of processing only ESNs. (This pseudo-ESN has been in use since the introduction of phones that only use an MEID, since circa second half 2006.)[1] for backward compatibility with legacy systems infrastructure and back office systems capable of processing only ESNs. The pseudo-ESN is a stop-gap measure and is not intended for a long term delay of MEID system implementations. Since the "pseudo ESN" cannot be uniquely assigned, collisions can occur between MEID-equipped mobile devices. We hope the approach of implementing a pseudo-ESN will result in an extremely low probability of any collision problems during this transition, although the probability of such collisions is related to the number of pseudo-ESNs used in a particular geographic area. The Collisions Whitepaper found at http://www.tiaonline.org/standards/resources/esn/documents/Collisions_pESN_wp.pdf discusses the effects of such collisions and the frequency at which they are likely to occur.

CURRENT STATUS

A two-prong approach (*i.e.,* Industry Awareness and Standards development) to assure the smooth transition from ESN to MEID has been implemented. The current status is as follows:

- First, the ESN Administrator has contacted (or attempted to contact) ESN MFR Code assignees to recover a portion or portions of ESNs that had been assigned but possibly not used previously, and which could now be re-assigned or used for UIM_ID derivation. Some companies in the industry have provided details on which ESNs have gone unused within ESN blocks that were previously allocated or have provided information as to which technology type those ESNs were used with.

- Second, the ESN Administrator has changed the method of allocating ESN codes, using only the 14-bit ranges (smaller blocks of codes) to extend the availability of virgin ESN codes during the migration to the new MEID numbering method.

- Third, TIA TR-45, along with its ESN/UIM/MEID Ad Hoc group working with other TIA Engineering Committees and 3GPP2 groups, has worked diligently completing and adopting standards and specifications for ESN transition to MEID. The MEID-related standards are completed and publicly available. Additional information is available on the TIA web site (http://www.tiaonline.org). The MEID's dramatically larger 56-bit structure should provide enough serial numbers, barring any unforeseen event, to last for many years to come. *[The MEID universe consists of approximately 16 million blocks of 16 million numbers, compared to the ESN universe of 256 blocks of 16 million numbers].*

- Finally, recent outreach correspondence with executive targeting at the CTO level is yielding increased global awareness with fast-track scheduling of global education campaigns under the auspices of the CDMA Development Group (CDG). Additionally, the Wireless Clearinghouse and Mediation vendors are believed to be ready and work

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[1]   The pseudo-ESN is not intended for a long-term delay of MEID system implementations. Since the "pseudo ESN" cannot be uniquely assigned, these types of collisions can occur between MEID-equipped phones. This industry approach will result in an extremely low probability of any collision problems during the transition, although the probability of such collisions is directly related to the number of pseudo-ESNs used in a particular geographic area. The collisions Whitepaper found at http://www.tiaonline.org/standards/resources/esn/documents/Collisions_pESN_wp.pdf discusses the effects of such collisions and the frequency at which they are likely to occur.

closely with TIA and the industry toward full industry-wide implementation of MEID and E-UIM_ID.

2.1   GLOSSARY

3GPP2 – Third Generation Partnership Project 2

CDG – CDMA Development Group

CDMA – Code Division Multiple Access

CMRS - Commercial Mobile Radio Service. A mobile service (or functional equivalent) that is (1) provided for profit, (2) an interconnected service, and (3) available to the public, or to such classes of eligible users as to be effectively available to a substantial portion of the public.

ESN - The Electronic Serial Number which uniquely identifies the mobile station. Each ESN is a 32-bit number consisting of two components: a manufacturer ID code field and a mobile serial number field. The MFR Code number range is 000 to 256.

E-UIM_ID - Expanded R-UIM Identity

FCC - Federal Communications Commission

GDA – Global Decimal Administrator

GHA – Global Hexadecimal Administrator

IMEI – International Mobile Equipment Identity. A number similar in purpose to an ESN or MEID that is unique and used with GSM or UMTS mobile equipment.

ME - Mobile Equipment. (See also Mobile station or R-UIM)

MEID - Mobile Equipment IDentifier, uniquely identifies the mobile station. Each MEID is a 56-bit number encoded in Hexadecimal (base 16) format .

MS - Mobile Station, Interface equipment used to terminate the radio path at the user side. The mobile station contains an Electronic Serial Number or other identification information, such as either a Mobile Identification Number (MIN) or an International Mobile Subscriber Identity (IMSI) numbering accordance with International Telecommunication Union Recommendation E.212.

R-UIM - Removable User Identification Module, often called the Subscriber Identity Module (SIM) card.

Serial Number - The portion of the MEID or IMEI that uniquely identifies the MS within the Manufacturer code allocation space.

TDMA – Time Division Multiple Access

TIA – Telecommunications Industry Association

2.2 Revision History

Version 0.1 – September 2007, TIA MEID Whitepaper Initial Draft

Version 0.2 – September 2007, TIA MEID Whitepaper updated Draft

Version 1.0 – TBD, TIA MEID Whitepaper

2.3 Related MEID Resources

Please see the TIA Website at http://www.tiaonline.org/standards/resources/esn and http://www.tiaonline.org/standards/resources/meid for related FAQ, documents and correspondence.

- CDG MEID and E-UIM_ID Migration Whitepaper (under development)

2.4 Required Actions

- Careful review of service provider "back office" systems to determine how the migration to MEIDs will affect their systems is essential. In particular, software for these systems may need to be updated and tested in advance of MEID implementation in systems.

- Service Providers should:

    o Investigate all internal uses of ESNs by application (Fraud, Revenue Assurance, IT, Repair and Customer Service, Network, Roaming, Service Contracts etc.).

    o Check with their infrastructure vendors for system update scheduling that may be necessary.

    o Make sure that their Rating and Billing Clearinghouse vendors have MEID scheduled for their implementation.

    o Ensure that roaming partners have also implemented MEID so that their customers will not experience problems when roaming on those partners' networks.

- Handset manufacturers should work closely with their service providers to ensure all newly introduced handsets are MEID-provisioned, with ESNs only being used to support existing models through their end-of-life.

Worldwide cdma2000® service providers add approximately 6 to 7 million new subscribers every month. Over 200 million cdma2000® handsets were sold last year. This highlights the urgency for service providers to migrate to MEID as well as E-UIM_ID derived from MEID resources rather quickly to avoid any negative impacts.

Though ESN migration to MEID is further along than UIM_ID migration to E-UIM_ID in implementations seen to date, the industry is encouraged to implement MEID without delay and the domestic and international deployments of MEID and E-UIM_ID need to be expeditious. **Every service provider/vendor should perform interoperability tests ASAP as part of their implementation of MEID and E-UIM_ID.**

2.5   Summary

This White Paper is intended to further the understanding of ESN exhaust. It is intentioned to provide accessible information to advance understanding among those who require this information, but who may not be engineers or experts in wireless technologies. This White Paper is also intended to clearly state that no intermediate solution exists should companies fail to implement and test MEID and E_UIM_ID solutions prior to the exhaust of ESNs. Recovery of previously issued numbers cannot meet increased global demand, and use of previously issued codes carries with it risk of service denial for customers and other back office issues for customers and service providers. Efforts have been made to consult with service providers and clearinghouses/mediation vendors to minimize these possibilities. The effort to inform decision makers of the need to move their companies into MEID technology has been taking place for many years. This White Paper is a continuation of the process to inform and educate as wide an audience as possible.