Cellular Networking Perspectives

Editor: David.Crowe@cnp-wireless.com Vol. 13, No. 3 March, 2004

In This Issue . . .

Next Issue: April 1st, 2004

Non-Dialable Numbers for Emergency Services

Number portability can cause problems for emergency services, particularly the ESRD and ESRK 'pseudo-ANI' numbers that are used to identify that the caller is a wireless phone. The US Industry Numbering Committee (INC) agreed in February 2004 to encourage the use of non-dialable (and therefore non-portable) numbers for these resources. Such numbers will be of the format NPA-211-XXXX or NPA-511-XXXX. The transition to these numbers will be managed by the ATIS Emergency Services Interconnect Forum (ESIF). For more information on this organization see:

www.atis.org/atis/esif/esifhome.htm

MEID Collisions

Last month we reported that a database indexed by ESN would have a guaranteed collision if there were 2^{24} or more pseudo-ESN (pESN) records. Although databases are more commonly indexed by a subscription identifier (MDN or MSID), a good example of a database that needs to be indexed by equipment identifier is one used for over-the-air activation.

Eric Denziger, a Network Technology Analyst with Bell Mobility, has calculated the probability of a collision. His calculations reveal that a database with 4,823 or more pseudo-ESN records would have a 50% probability of a having at least one collision. This result makes it important to ensure that databases currently indexed by ESN are among the first to be updated to full support for MEID.

Editor: David Crowe.
Accounts: Evelyn Goreham.
Distribution: Debbie Brandelli.
Production: Doug Scofield.

Cellular Networking Perspectives (ISSN 1195-3233) is published 11 times a year 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 wider distribution.

US FCC Reaffirms Analog/ESN Changes

In a February 12th 2004 order (FCC 04-22; WT Docket 01-108), the FCC has reasserted that there will be a 5-year transition period (ending February 18, 2008) before the first analog phase-outs can begin. AT&T Wireless Services had suggested that this period should be shortened, presumably because their spectrum is stretched thin and they often need to provide analog, TDMA and GSM service in the same spectrum allocation.

The FCC also reaffirmed its decision to remove rules on ESN hardware design. This is because ESN hardening is no longer a useful anti-fraud measure, superceded by authentication and other techniques. This may also allow the UIMID to eventually be called an ESN (which it is, for all intents and purposes). The placement of an ESN in a removable UIM was considered to be a technical violation of the rules because it made it appear as if the ESN of a phone was changing every time a different UIM was placed in it. AT&T Wireless had called for this rule to be retained for anti-fraud purposes, and the CTIA felt that the wording appeared to legalize cloning.

MMS – Multimedia Message Service

MMS is an attempt by the cellular industry to replace Short Message Service by a more advanced messaging service that is more attractive to consumers because it combines several different media – text, graphics, still photos, sounds and even video clips. If successful, this would be a major boost for 3G packet data networks and would foster even more innovation in phone technology.

How MMS Works

After an MMS user – perhaps a person with a camera phone, prepares an MMS message – it gets sent over the wireless packet data network and then an IP network to the MMS Relay/Server. If both mobiles use the same carrier, it then distributes the message to the destination mobile or, if the destination is on another network, to another MMS Relay/Server. Messages may also be received by mobiles from Value-Added Service Providers (VASPs) and to or from external servers for fax, email and voicemail.

The MMS network reference model is shown in **Figure 1**. This logical figure shows the types of devices in the network. There may be many of each type. An interface between a network element and itself represents an interface between two distinct devices of the same type.

MMS has 8 interfaces, named MM1 through MM8. The thick green lines in **Figure 1** show those being standardized first.

MM1 allows the mobile to communicate with the MMS Relay/Server and is clearly the most important. MM4 allows inter-carrier operations. MM3 supports communications with gateways for email and other services. MM7 allows Value Added Service applications to send MMS messages and MM8 supports the all-important communication with billing systems, which allows carriers (and, in some cases, third parties such as Value Added Service Providers) to be compensated for MMS services rendered. Standards for MM2, MM5 and MM6 do not yet exist.

MMS Design

MMS was designed to reuse existing wireless and IP protocols. SMS, by contrast, began life traveling over the SS7 network, but even these relatively small text messages (up to about 200 octets) were a burden for a network optimized for small, high-value signaling messages.

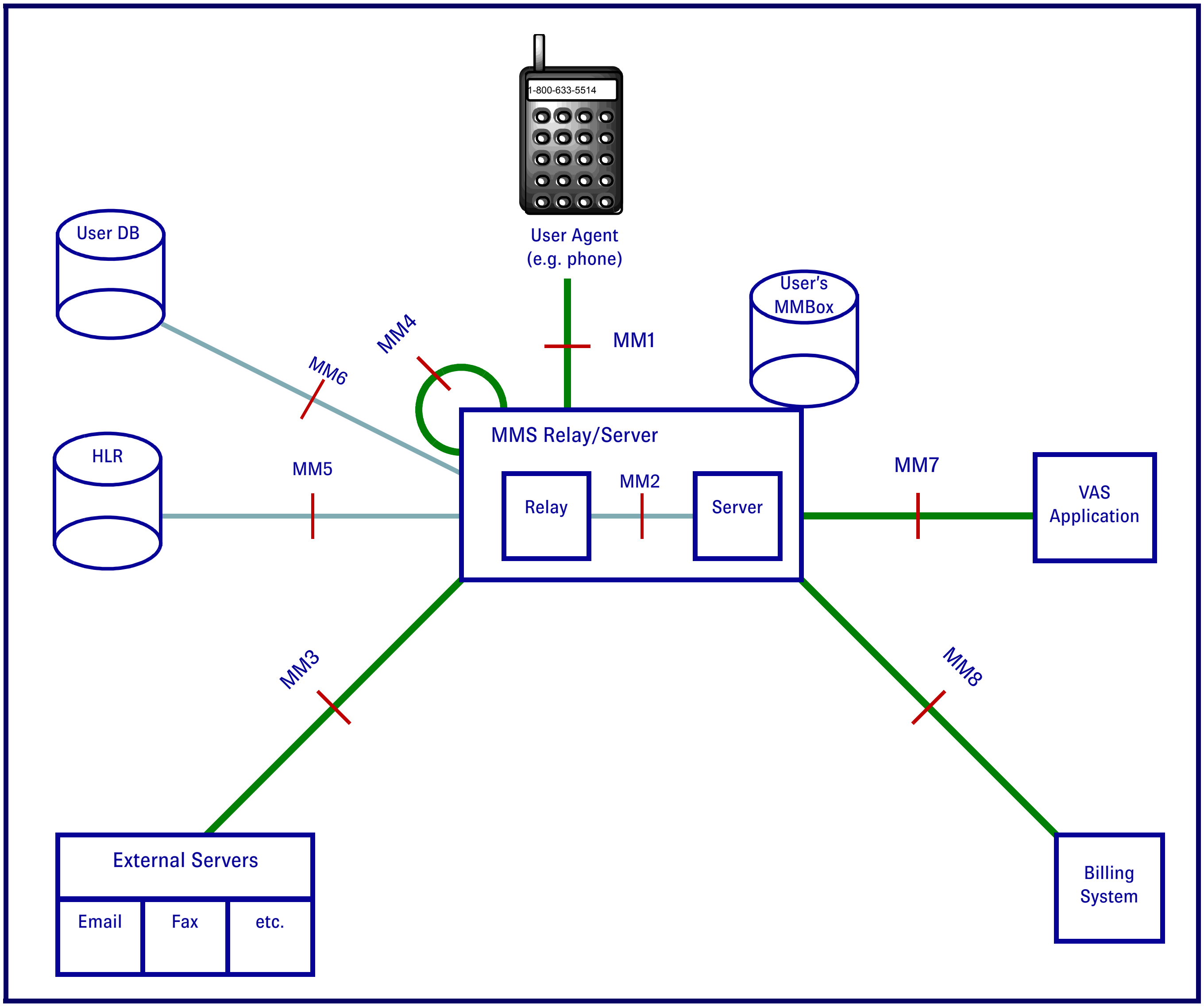
IP is really the only choice for MMS. MIME was chosen as the method of packaging the different media components of the message. The MMS session is managed by WAP, IMAP or SIP, all of which run over IP. This fits nicely into existing wireless packet data technologies (e.g. GPRS and CDMA 1X or DO) which are all IP-based.

Inter-Carrier Messaging

Mobile-to-mobile MMS messages are sent from the User Agent (i.e. the wireless device) to the user's home MMS Relay/Server. If the two mobiles are not served by the same carrier, the message is then forwarded over the MM4 interface to the receiving mobile's MMS Relay/Server using SMTP (Simple Mail Transmission Protocol). This terminating Relay/Server then sends a notification to the destination mobile. The mobile then may retrieve the MMS message from its MMS Mailbox (MMBox) on the server at its leisure. Before actually receiving the message, the destination mobile will negotiate the best acceptable media formats with its MMS Relay/Server, which will perform content adaptation if necessary.

It might seem that the use of multiple MM1 access methods in 3GPP2 (see **Table 1**) would cause inter-carrier problems. However, this is not actually the case because this interface is between the mobile and its home system. The protocol being used on MM1 is transparent to the lower layer protocols that transport it across the packet data network even when a mobile is roaming.

Figure 1: MMS Network Reference Model



MMS will not just be used between mobiles. The MM7 interface is designed to connect with Value Added Service Providers. A news summary could be sent to a mobile from a media outlet, containing a mixture of text, audio clips, still pictures and video clips. Content may be sent by a VASP on a schedule, or when a certain event occurs (such as traffic congestion, a weather warning or a news break) or upon request from the mobile user.

Another common interaction will be over the MM3 interface between an MMS device and external servers providing email, fax, voice mail or other services.

Store and Forward: The MMBox

MMS and SMS are both ‘store and forward’ services, where an intermediate device keeps a copy of the message at least until it is delivered. With SMS, however, the user has no direct control over their mail box. With MMS, control over the MMBox (Multimedia Mailbox) is not just possible, it is essential. Messages can be deposited at the MMBox and distributed at different times to different destinations. This is important for MMS because the large size of many messages makes it inefficient to retransmit them from the originator if they have to be sent multiple times.

Media Types

Every media type, from voice to video, has to be defined. This includes a coded format for the digital information, as well as a method of encapsulation. This generally does not require new wireless standards, but does require the selection of acceptable media types and a method of marking them so that they can be recognized.

Formats that are currently acceptable for MMS include video (e.g. MPEG-4 and H.263), audio (e.g. MPEG-4, AMR and AMR-WB for both 3GPP and 3GPP2 and, for 3GPP2 only, EVRC, QCELP and SMV), text and graphics (e.g. GIF, JPEG, PNG, Bitmap). MMS devices must also support at least one presentation language such as SMIL, XHTML or cmf (Compact Multimedia Format). This allows a mixture of media to be presented in a controlled fashion.

Content Adaptation

The many media types that can possibly be wrapped in an MMS message creates one of the big challenges for MMS: interworking between devices and networks. If a GSM/GPRS terminal uses the native GSM AMR voice coder as part of an MMS that it sends to a CDMA terminal that only supports EVRC and QCELP voice coders, content adaptation will be necessary or the message transmission will fail. Similarly, a photograph might be produced in PNG format, but may be delivered to a terminal that supports only JPEG.

Content adaptation could become a significant cost for the network, requiring bigger and more powerful MMS Relay/Servers than would just be required for storing and forwarding messages unchanged. This is also a problem for SMS, but to a much lesser extent. SMS only needs to worry about mapping between the bit formats for GSM, TIA-136 and cdma2000 and imposing the lowest common denominator maximum message length. MMS is less constrained by the size of messages, and more by the significantly larger number of more complex conversions.

Addressing

The two main ways to address an MMS message are with a phone number (MDN – Mobile Directory Number) or an email-like address. An email-address works well with a service carried over IP networks, like MMS, but is harder to enter from a wireless phone. It also means that carriers have to maintain an email address for each MMS customer, and coordinate their address plans.

A phone number is also a useful address, although there are significant problems in countries, like the United States after November 2003, that require wireless carriers to participate in number portability. The number portability database was intended to be queried from the SS7 network and from a system that was in the same region as the destination number. This will not work for MMS because the challenge is to route to the destination MMS Relay/Server, meaning that the Home Relay/Server will have to do the number portability query. However, this device may be in a different country and can hardly be expected to perform this service. It might not even be allowed to. Solving this may require introducing another network element, at least for international MMS transmissions, to perform number portability queries at an intermediate point.

Billing

The simplest billing model for MMS will ask customers to pay a monthly service fee, plus charges for each message. The sender and recipient may both be charged, or just one of them. In the case of VAS messages, the carrier may apply premium charges to each such message, and return an agreed-upon portion as revenue to the VASP. Some VAS messages, such as advertising, may be paid for by the VASP, resulting in no charges to the mobile subscribers.

MMS is compatible with both monthly billing and prepaid models. In both cases, carriers must determine what customers are paying for. Per-message charges will not be equitable, because messages may vary dramatically in size. Per-byte charges, on the other hand, will be very fair, but will be confusing to the consumer. Somehow carriers have to create a billing model that consumers will understand and be willing to pay for. It should be one that roughly reflects resource usage. An example could be a flat fee for sending an MMS containing one JPEG-encoded photograph, with the carrier limiting the maximum size of the photograph to stop abuse. This is something that consumers can understand, and that maps into a small range of transmission sizes, so that carriers can ensure they earn a profit from their packet data networks.

Billing raises additional inter-carrier issues. Both carriers must have a contractual agreement and a method for exchanging call detail records on a regular basis (at least once a month, if not closer to real-time). MMS also presupposes the existence of packet data roaming and billing arrangements between carriers.

Standardization

MMS represents a truce in the technology wars between 3GPP and 3GPP2. In November, 2003 an agreement was reached between OMA (www.openmobilealliance.org), 3GPP (www.3gpp.org) and 3GPP2 (www.3gpp2.org) to share responsibility for the future evolution of MMS. Following the current release of MMS specifications, OMA will assume responsibility for the air-interface independent aspects of the protocol, leaving 3GPP and 3GPP2 to develop specifications that are access-dependent, including the definition of accounting (billing), media types and coder/decoders (codecs).

Table 1 shows the current standards being developed by 3GPP and 3GPP2. This will change as the migration to OMA occurs, expected some time in 2004.

MMS: A Work in Progress

MMS is not a service like SMS; it is an entirely new infrastructure. New media types can be added as they are invented and supported by Relay/Servers and mobiles. MMS, building on the availability of higher speed packet data protocols, will enhance the user experience by providing an integration of newer phone capabilities, such as color graphics and photographs with sound and text.

There will be some frustrations at first, as interworking problems are worked out. But carriers are aware that parochialism is not an option with services like this. Technological barriers prevented SMS from growing in North America, and the removal of those barriers resulted in an explosion in usage. Consumers will expect that they can send an MMS message to any wireless customer, no matter which carrier they purchase services from, no matter what brand of phone they are using and no matter where in the world they are.

Table 1: MMS Specifications

Specification Area	3GPP (www.3gpp.org)	3GPP2 (www.3gpp2.org)
Wireless Technology	GSM, GPRS, EDGE, W-CDMA	cdma2000, 1X, EV-DO, EV-DV
Stage 1 (Service Description)	TS 22.140	S.R0064
Stage 2 (Network Flows)	TS 23.140	X.S0016-200
MM1 Interface (User Agent)	TS 23.140 (WAP, MexE)	X.S0016-310 (WAP) X.S0016-311 (M-IMAP) X.S0016-312 (SIP)
MM2 Interface (Relay-Server)	No standards	
MM3 Interface (External Services)	No standard.	X.S0016-330 (Internet Mail Exchange)
MM4 Interface (Inter-Carrier)	TS 23.140 (based on SMTP; IETF RFC 2821)	X.S0016-340
MM5 Interface (HLR)	No standards	
MM6 Interface (User Databases)	No standards	
MM7 Interface (Value Added Service Providers)	SOAP (www.w3.org/TR/SOAP)	
MM8 (Billing)	TS 32.200 and TS 32.235	N.P0039/N.S0026-A
Codecs and Media Formats	TS 26.140 and TS 26.234	C.P0045/C.P0050

Status of TIA-41 (ANSI-41) Implementations

Cellular Networking Perspectives

Editor: David.Crowe@cnp-wireless.com ***Last published December, 2002***

Intersystem Operations Capability	Alcatel	Ericsson			LG	Lucent			Motorola	
	CDMA	Analog	CDMA	TDMA	CDMA	Analog	CDMA	TDMA	Analog	CDMA
Authentication (CAVE)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Authentication Enhancements (IS-778)					◷					
Circuit Data (IS-737)	✔		✔	✔	✔		✔	✔		✔
CNAP/CNAR (IS-764)			✔	✔	✔			✔		
CNIP/CNIR	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
E911 Phase 1 (J-STD-034)		✔	✔	✔		✔	✔	✔		
E911 Phase 2 (J-STD-036)		✔	✔	✔		✔	✔	✔		
IMSI (IS-751)			✔	✔			✔	✔		
Inter-MSC handoff from analog		✔		✔		✔		✔	✔	
Inter-MSC handoff from CDMA	✔		✔		✔	✔	✔		✔	✔
Inter-MSC handoff from TDMA		✔		✔		✔		✔	✔	
International (IS-807)	✔		✔	✔	⚗		✔	✔		
International Dialing (IS-875)			**⚗**							
Hyperband handoff (TSB76)	✔			✔			✔	✔		✔
LNP Phase I (IS-756)	✔	✔	✔	✔		✔	✔	✔	✔	✔
LNP Phase II (IS-756-A)	✔	✔	✔	✔		✔	✔	✔	**✔**	**✔**
Message Waiting Notification (MWN)	✔	✔	✔	✔	✔		✔	✔	✔	✔
Origination Triggers	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Over-the-air Activation (IS-725-A)	✔		✔	✔	✔		✔			✔
Removable UIM (IS-808)										
Roamer DB Verification (IS-847)										
Segmentation (IS-812)	✔	✔	✔	✔		✔	✔	✔		
SMS – Broadcast (IS-824)			✔	✔			✔	✔		
SMS – MDN-Based (IS-841)	◷		✔	✔						
SMS – Origination	✔		✔	✔	✔		✔	✔		✔
SMS – Termination	✔		✔	✔	✔		✔	✔	✔	✔
Termination Triggers	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Voice Privacy - basic	✔			✔	✔		✔	✔		
Voice Privacy - EPE										
WIN Phase I (IS-771)	✔	✔	✔	✔	⚗	✔	✔	✔	**✔**	**✔**
WIN Phase II (Prepaid – IS-826)	✔	✔	✔	✔	◷	✔	✔	✔	**✔**	**✔**

Column group heading: Vendor and Radio Technology

Key: ✔ (available), ⚗ (in lab trial), ◷ (under development). Red/Bold indicates recent change.

Status of TIA-41 (ANSI-41) Implementations

Cellular Networking Perspectives

Editor: David.Crowe@cnp-wireless.com | ***Last published December, 2002***

Intersystem Operations Capability	NEC		Nortel (MSC/BS)			Telcordia	Telos			ZTE
	Analog	CDMA	Analog	CDMA	TDMA	(SCP)	Analog	CDMA	TDMA	CDMA
Authentication (CAVE)		✔	✔	✔	✔		✔	✔	✔	✔
Authentication Enhancements (IS-778)										
Circuit Data (IS-737)		✔		✔	✔			⏲		✔
CNAP/CNAR				✔	✔					
CNIP/CNIR	✔	✔	✔	✔	✔		✔	✔	✔	✔
E911 Phase 1 (J-STD-034)			✔	✔	✔					
E911 Phase 2 (J-STD-036)			✔	✔	✔					
IMSI (IS-751)				⏲	⏲					
Inter-MSC handoff from analog	✔		✔		✔		✔			
Inter-MSC handoff from CDMA	✔	✔	✔	✔			✔	✔		✔
Inter-MSC handoff from TDMA			✔		✔		✔		✔	
International (IS-807)				✔	✔			⏲		✔
International Dialing (IS-875)										
Hyperband handoff (TSB76)				✔	✔					✔
LNP Phase I (IS-756)			✔	✔	✔		✔	✔	✔	⏲
LNP Phase II (IS-756-A)			✔	✔	✔					⏲
Message Waiting Notification (MWN)	✔	✔	✔	✔	✔			✔	✔	✔
Origination Triggers	✔	✔	✔	✔	✔		✔	✔	✔	✔
Over-the-air Activation (IS-725-A)				✔	✔			✔	✔	
Removable UIM (IS-808)				**(not IS-808)**						
Roamer DB Verification (IS-847)										
Segmentation (IS-812)				⏲	⏲					
SMS – Broadcast (IS-824)				⏲						✔
SMS – MDN-Based (IS-841)				✔	**✔**					✔
SMS Origination		✔		✔	✔			✔	✔	✔
SMS Termination		✔	✔	✔	✔			✔	✔	✔
Termination Triggers	✔	✔	✔	✔	✔		✔	✔	✔	✔
Voice Privacy - basic		✔								✔
Voice Privacy - EPE										
WIN Phase I (IS-771)			✔	✔	✔	✔	✔	✔	✔	✔
WIN Phase II (Prepaid – IS-826)			✔	✔	✔	✔				✔

Key: ✔ (available), ⚗ (in lab trial), ⏲ (under development). Red/Bold indicates recent change.