Cellular Networking Perspectives

David Crowe [Editor] • Phone: 1-800-633-5514 • Fax: 403-289-6658 Vol. 5, No. 8, August 1996

In This Issue...

Look forward to your next issue on: September 9, 1996

CTIA Plans Funeral for Non-Authenticating Phones

The CTIA "views Mobile Station Authentication as the wireless industry's long-term solution for controlling cloning fraud." Because of this, the CTIA announced in a July 3, 1996 memorandum, that it encourages "all manufacturers of mobile phones after September 1, 1996, to only manufacture phones which conform to the appropriate TIA standards supporting Authentication." While the CTIA cannot force manufacturers to follow this suggestion, they do have a lot of clout, as they represent most US and Canadian cellular carriers.

While authentication is an exciting anti-cloning technology, discussions of it have always been tempered with gloom due to the huge numbers of existing mobiles in the field, and the perceived impossibility of ever getting rid of all the old non-authenticating phones. How long would it take to get more authenticating phones into the field than non-authenticating? Using some conservative figures, and a rough back-of-the-envelope calculation we come to the surprising conclusion that if the industry takes the CTIA mandate seriously (model 'x'), authenticating mobiles could easily outnumber non-authenticating in 2 years, and represent 90% of phones in 7 years. If the response is only lukewarm (model 'y'), it could take 4 years to break the 50% barrier and 10 years to reach 90% authenticatable.

Common Model Assumptions:

1. 45 million cellular phones in the US by the end of 1996.
2. Only 2 million authenticating phones by the end of 1996.
3. Growth rate of 30% in 1997, declining by 5% every 2 years.
4. 10% of existing phones are lost to attrition every year.

Model 'x' Assumptions:

1. All phones manufactured after 1996 are authentication capable.

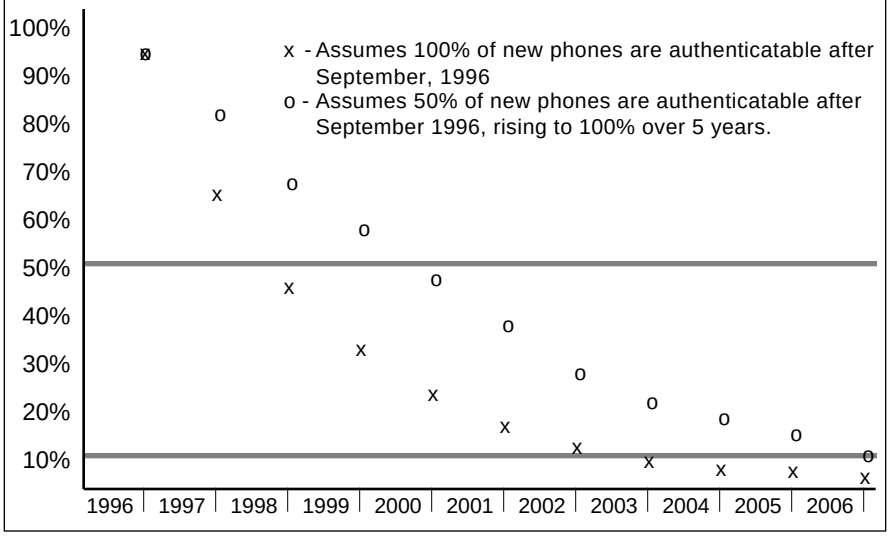
Model 'o' Assumptions:

1. 50% of phones manufactured in 1997 are authentication capable, with the percentage rising by 10% a year for 5 years before reaching 100%.

Figure 1 (see over) shows how quickly the percentage of non-authenticating phones can plummet with the optimistic model ('x'), and how much slower the process is with the pessimistic model ('o'), which reaches the same milestones years later! A lot of fraud can happen in those years, fraud that can be prevented if manufacturers and carriers take the CTIA's lead (as many are doing) and take authentication seriously. ❒

Cellular Networking Perspectives (issn 1195-3233) is published monthly by Cellular Networking Perspectives Ltd., 2636 Toronto Cr. NW, Calgary AB T2N 3W1, Canada. Phone: 1-800-633-5514. Fax: 403-289-6658. Subscriptions: CDN$300 in Canada (incl. GST), US$300 in the USA and US$400 elsewhere. A surcharge of up to US$200 per year is required for faxing to international subscribers. Payment by cheque, money order or American Express. Issues are faxed or mailed 1st class. Copies: Subscribers may make up to 10 copies of each issue. Rates available for more copies. Discounts: Educational & Small business 25% off any order, by mail only. Back Issues: Phone for price list and list of contents.

Figure 1: The Decline & Fall of Non-Authenticating Phones



Wireless Around the World

GSM is often spoken of as a global wireless standard, and yet in terms of the number of subscribers, AMPS is by far the dominant technology. Even TACS systems (an AMPS derivative for the 900 MHz band) have more subscribers than GSM. The statistics in Table 1 were extracted from a database maintained by Stephanie McCullough of the US Department of Commerce, last updated in March, 1996.

These statistics show that improving international roaming, one of AMPS' weaknesses and GSM's strengths, will be a critical factor in the future of AMPS. If US carriers ignore international issues, they could end up as an island of AMPS in an rising ocean of GSM. ❐

Quote of the Month:

"Effective May 1 1996, Mobile Station Authentication was incorporated into the CTIA Mobile Phone Certification Program." – Art Prest, CTIA

Table 1: Global Wireless Penetration

Wireless Technology	Subscribers (millions)	% of Market	# of Nations	Description of Technology
AMPS	42.8 M	51%	82	Analog and digital technology based on AMPS, NAMPS, D-AMPS (TDMA) and CDMA (IS-95)
TACS	13.6 M	16%	27	Analog AMPS adapted to the 900 MHz band
GSM	11.9 M	14%	97	Digital in the 900/1800/ 1900 MHz bands
Japan	9.7 M	12%	1	Several different technologies
NMT	4.5 M	5%	41	European analog system (450/900 MHz)
Other	0.9 M	1%	10	
Total	83.4 M			

Guest's Cell: Competing Interconnection Standards

Wireless network interfaces to the PSTN are defined by the Telecommunications Industry Association (TIA) standard IS-93 and Bellcore's TR-NPL-00145 (known as TR-145). While similar in many ways, these two documents represent very different perspectives on network interconnection.

Although TR-145 has long been accepted as the guide for interconnection agreements, its future is somewhat more precarious. IS-93 is an industry standard, published by an ANSI accredited standards body most heavily influenced by wireless carriers, whereas TR-145 is published by a research consortium that is owned by wireline carriers.

TR-145 Interfaces

TR-145 supports the following interfaces:

1. Dial Line Connections.
2. Direct Inward Dialing (DID) Connections.
3. Type 1 Interconnections (MF).
4. Type 1 Interconnections (ISDN).
5. Type 2A Interconnections (MF).
6. Type 2A Interconnections (SS7).
7. Type 2B Interconnections (MF); similar to a high usage trunk group.
8. Type 2B Interconnections (SS7).
9. Private-line connections.
10. Type 2C Interconnections (emergency services interface).
11. Type 2D Interconnections (operator services interface).
12. Type S Interconnections (SS7 signalling link).

IS-93 Interfaces

IS-93 supports 18 trunk and signaling interconnections. For the most important interfaces, IS-93 can be used to provide the same type of interconnection as TR-145.

Comparison

Both documents say nearly the same things, but use different names for the same interconnections. TR-145 describes interconnection from the perspective of the landline telephone company; it does not recognize bidirectional signaling, assuming that some networks (e.g. wireless) are subservient to others (e.g. local exchange carriers). This is an unrealistic view of the world. As common channel signalling becomes prevalent, a hierarchy of carriers is not required.

IS-93 sees the signaling relationship between two types of carriers as bidirectional, recognizing a "co-carrier" relationship. This is not a tiny difference. The bidirectional signaling relationship is key to understanding how interconnection will evolve. TIA TR-45.2 subcommittee recognized the significance in the signaling relationship back in 1992, and therefore should continue to take the lead in standardizing future interconnection via IS-93.

Telecom Reform

Given the new regulatory environment established by the US Telecommunications Reform Act of 1996 and by potential FCC decisions like "Bill and Keep" (i.e. if it originates from my network I keep the money), perhaps mutual compensation is not far behind. Network interconnection must change to keep pace.

The changing regulatory environment will promote the rapid integration and convergence of entertainment, news, telephony, wireless voice communications, satellite communications, the Internet and non-voice data systems. These wide ranging information systems will themselves be integrated, with some carriers providing network and interconnection capabilities for services offered by other carriers. Infrastructure support is an old idea that has been kicked about for years, and may be given new life in this new regulatory environment.

Landline Carriers Attitude

Some landline carriers have sought to use TR-145 as the basis for developing new infrastructure support services and pricing (to the advantage of the landline carrier). These carriers still say "The wireless carriers are lucky to be allowed to interconnect to us. Furthermore, TR-145 is an accurate representation of their relationship with us." These carriers believe that the signaling relationship between the wireless carrier and the landline carrier is unidirectional, as it is with PBX's. They believe that wireless carriers are nothing more than big PBX companies. This attitude is used to justify why cellular carriers should continue to pay the landline carriers for interconnection, and to oppose any form of bidirectional compensation.

The Future of Interconnection

As network technologies are merged or modified to support new information businesses, the interconnection boundary becomes less distinct. The distinction between wireless and landline will disappear, for one example. The user will not deal with a cable TV company, a local exchange carrier or a wireless carrier; they will deal with an information services provider with a wide range of services available. Networks will be overlaid, rather than merely interconnected.

The economics are justifying the investment of vast sums of money in new information ventures. Current wireless networks can serve as a medium for new methods of access and transport for entertainment, news and data providers. IS-93 can be updated to reflect this convergence of network technologies and serve as a vehicle for network interconnection and integration.

IS-93 should be modified to incorporate higher speed and broadband transport technologies, even internet access. These steps will take us even closer to what I envision; an Information Network. My goodness, maybe I mean an Information Highway. I will stop here, before I get carried away and start babbling about an information super-highway!

About the Author

P.J. Louis is well known in the wireless telecommunications industry for his expertise on standards and interconnection. This article was written by him after resigning from Bellcore and before joining NextWave. ❐

Enhanced Wireless 9-1-1, Part I: An Emergency History Lesson

Emergency calling is very important to users of cellular phones. For some subscribers, the ability to make a call whenever and wherever an emergency occurs is the prime reason for having a wireless phone. Cellular phones are also important to people that handle emergency calls, as an increasing fraction of 9-1-1 calls are made from cellular phones. All is not rosy in the land of 9-1-1, however. People calling 9-1-1 from a cellular phone often do not realize that the call takers have little idea where they are calling from. The ALI database used to cross reference a phone number to a street address simply does not work with mobile phones. Other problems include 9-1-1 calls that drop off due to the nature of wireless, and that cannot be reconnected easily, and the inability to identify the phone that is being used to make the call.

In June 1996, the FCC recently mandated that some of these problems be fixed, based largely on a February, 1996 joint agreement between the CTIA and the emergency services community (represented by NENA, NASNA and APCO). The only exception to the agreement is that the FCC has mandated that all 9-1-1 calls be delivered, "without any credit checks or validation." Even calls from phones that do not have a mobile identification (i.e. a PCS-1900 phone without a SIM card) are to be delivered, if the PSAP wants them. The agreement will be imple-

mented in two phases, the first being completed within 12-18 months of the effective date of the rules, and the second within 5 years:

Phase I: 12-18 Month Requirements

- Within 12 months, all wireless 9-1-1 calls should be delivered to the appropriate PSAP without credit checks or validation and (at the discretion of the PSAP) from phones without a mobile identification.
- Presentation of the caller's telephone number to the PSAP, to allow call-back.
- Identification of the cellsite to the PSAP to narrow down the location of the caller.

Phase II: 5 Year Requirements

- Identification of the caller's location, within 125 meters, 67% of the time.

This new mandate from the FCC did not come as a surprise to the cellular industry, as both the TIA and CTIA have been working with the emergency community for several years. The development of standards started in 1994 when two Joint Experts Meetings were held to discuss requirements for enhancing wireless emergency calling. The TIA subcommittee TR-45.2 proceeded to discuss these issues. When their preliminary work was vetted at the NENA Telco/Vendors conference in Fort Worth, Texas in February, 1996, considerable simplifications were made. This work (identified as TIA project PN-3581) conforms closely to Phase I of the FCC mandate.

Major Emergency Calling Features

There are several major features that encompass an enhanced 9-1-1 call capability.

Ability to Dial 9-1-1

The FCC has mandated that all 9-1-1 calls be completed, even calls from PCS-1900 phones without a SIM card. This is relatively easy to accomplish, but may in the end cause some problems:

- Malicious 9-1-1 calls cannot be traced if made from an unregistered or cloned cellular phone. This is a big problem in some areas, and can result in the injury or death of emergency service workers on their way to investigate a false alarm.
- Unprogrammed cellular phones may have duplicate MINs, and calls may not always be possible. In particular, a new phone that has never been programmed with a MIN, has the MIN that was programmed by the manufacturer, which will probably be the same for all mobiles of the same model. Two phones with the same MIN attempting to make a call at the same time may end up on the same voice channel. While this is not a big problem today, with the new rules, more people may use unprogrammed phones.
- Some phones are designed not to allow calls to be made without a programmed identification number.
- There is no possibility to call back or identify the caller, in case further information is required to reach the emergency scene or in a subsequent investigation. Thus, users of unprogrammed phones will think that they are getting 9-1-1 calling for free, but they will necessarily get a lower grade of service than those who pay.

Callback Capability

Emergency service workers may need to contact a 9-1-1 caller after the call has been disconnected. This can be accomplished in two ways. Neither method is perfect and, in some cases, it may be impossible to complete a call back. In the case of callers who are not valid subscribers, callback will never be possible:

1. Dialing the subscriber's phone number

   This has the advantage of simplicity, but may result in long distance charges when calling roamers, as the call will be routed through the roamer's home system. Also, this type of callback is not guaranteed to work if the mobile subscriber has features like call forward immediate active. For phones that have a separate MIN and Directory Number (see the December 1994 issue for more information on this topic), only the MIN may be available, and in these cases, will not be a dialable number.

2. Using the local roamer port

   This is a more complex procedure, involving two-stage dialing, and will only work if the roamer is still in the system they made the 9-1-1 call from. It will work if the MIN is delivered to the PSAP and is not the same as the directory number (but not if the directory number is delivered).

Reconnect

If a wireless 9-1-1 call is disconnected, the system should attempt to repage the mobile and reconnect the call. This will occur without the intervention of the emergency call taker, who may just hear a special tone or announcement during the reconnect time. No attempt will be made to reconnect the call if the mobile moves across a system boundary.

Location

Phase 1 of the FCC rule-making mandates that the cell/sector be identified to the PSAP. This will provide a rough idea of the location of the caller, generally more accurate in urban areas with small cells and less accurate in rural areas with large cells. In some cases, mobiles will pick up a far away cell, and this information could be quite misleading. Phase 2 will require 125 meter accuracy, but this requires further developments of technology to achieve this goal the required 67% of the time (at a reasonable cost).

Three-Way Calls

For subscribers that have the ability to make three-way calls, it is possible to dial 9-1-1 as the add-on party. Likely this feature will be invoked by mistake in the heat of the moment, when a subscriber forgets to press END before dialing 9-1-1. However, some cool cats with a technological twist may have the presence of mind to add on an emergency call taker and even initiate a 3-way con-

versation! In this case, call processing should be slightly modified to prevent the 9-1-1 call taker from being disconnected.

To be continued...

In the next part of this series, we will describe how the TIA subcommittee TR-45.2 is planning to implement the features required by Phase 1 of the FCC rule-making. ❒

9-1-1 Terminology

ALI: Automatic Location Identification. A database that cross references (wireline) phone numbers to street addresses.

APCO: Association of Public Safety Communications Officials

CTIA: Cellular Telephone Industry Association

FCC: US Federal Communications Commission

GSM: Global System for Mobility

MIN: Mobile Identification Number

NASNA: National Association of State 9-1-1 Administrators

NENA: National Emergency Number Association

PCS-1900: US adaptation of GSM for the PCS frequency band.

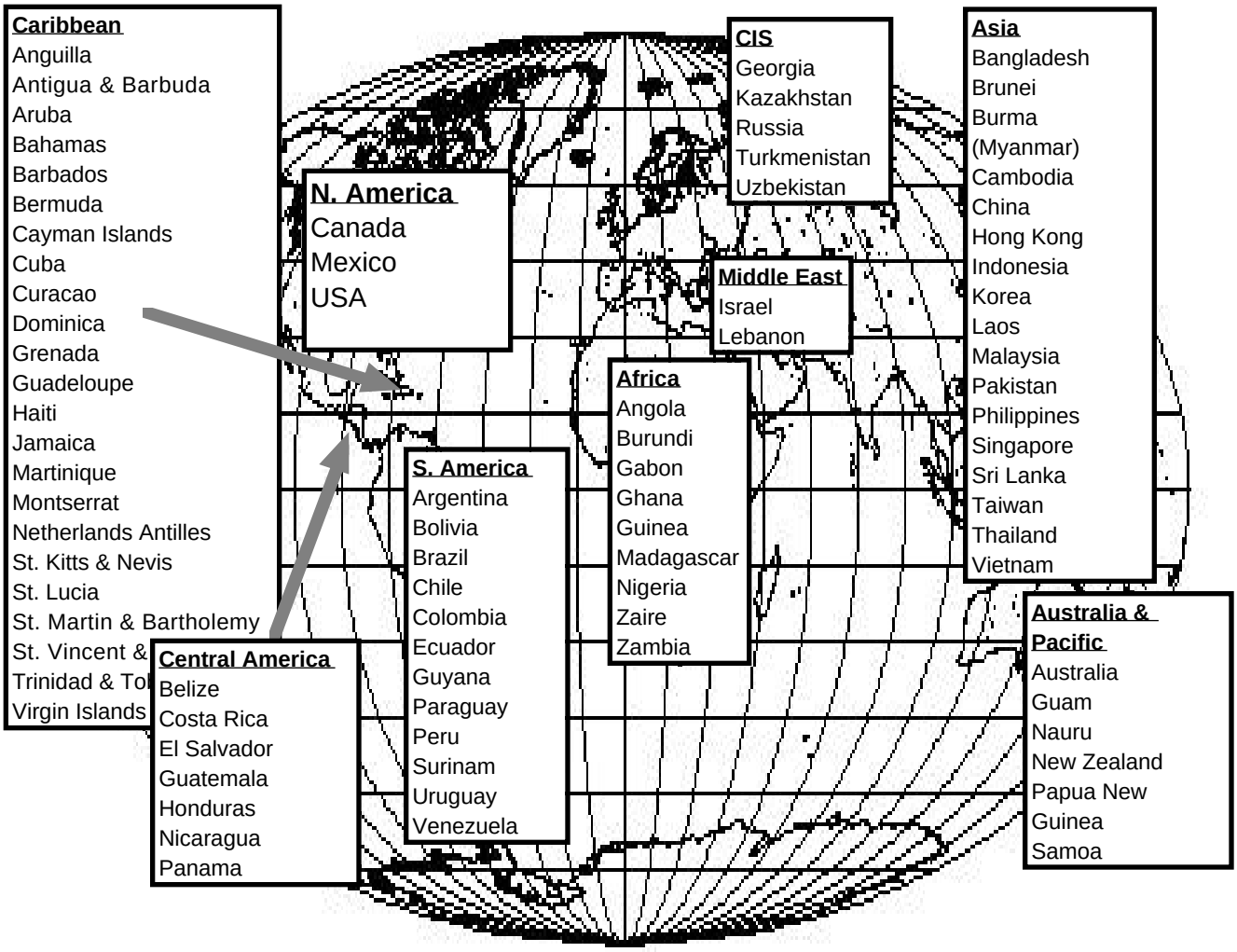
PN-: TIA project number.

PSAP: Public Safety Answering Point. The system that handles 9-1-1 calls.

SIM: Subscriber Identity Module ("Smart Card")

TIA: Telecommunications Industry Association

AMPS Cellular Around the World



Note: The information in this map was compiled from a database maintained by Stephanie McCullough of the US Dept. of Commerce, last updated in March 1996.

TR-45.2 Standards Update

New standards work has slowed down to review two major ballots: the ANSI ballot of IS-41 Rev. C (to be published as ANSI/TIA/EIA-689) and the TIA ballot for IS-124 Revision A.

In Press

PCS Multi-band (TSB-76, PN-3624)

- This TSB defines modifications to IS-41 messages and procedures to allow interoperability between Cellular and PCS systems, and between the different licensed frequency bands within Cellular and PCS systems. *In press as TSB-76.*

Ballot

IS-41 Rev. C ANSI Ballot (TIA/EIA-689, SP-3588)

- The "IS-41 Rev. C" ANSI ballot review is expected to be completed at the August, 1996 TR-45.2 meeting. So far, only minor changes from IS-41 Rev. C have been approved.

Online Call Record Transfer (IS-124 Rev. A, PN-3293)

- Ballot review started in July, and will probably complete in August, for this proposed call detail and billing record network standard. It includes a variety of improvements and corrections over Revision 0, such as internationalization (i.e. support of IMSI). Not included are major changes to support intelligent network peripherals and data. These will be incorporated in a subsequent TSB or in Revision B (PN-3725).

International Applications (TSB–29 Rev. B, PN-3173)

- *Approved for TIA ballot.* This revision adds lists of known non-NANP MIN usage, a list of applicable global titles and a recommendation to use ANSI TCAP even if ITU SCCP and MTP SS7 layers are used.

In Development

Subscriber Features (IS-53 Rev. B, PN-3362)

- A number of new features are under development, but a recent proposal to publish most features in separate documents, and not in IS-53, is being evaluated. If accepted, IS-53 may need only minor revisions.

TDMA DCCH (PN-3579)

- Definition of network support for new features inherent in the IS-136 digital control channel (IS-136). Scheduled for ballot as a standalone document in September 1996.

Inter-System Link Protocol (ISLP) (PN-3660)

- A new inter-MSC protocol is required to support the transmission of data from digital phones following an intersystem handoff. Its ballot date has recently slipped from July to October 1996.

Over-The-Air Service Provisioning (PN-3769)

- A new project has been started to provide a stand alone document for over the-air activation and service provisioning. This will provide the ability to program, or re-program, a mobile over the radio interface. Ballot is scheduled for October 1996.

Data Services (PN-3770)

- Transmitting data from CDMA and TDMA digital is more complex because voice coders are incompatible with analog modem tones. While air interface solutions have been published, solutions to allow automatic roaming and inter-system handoff are being developed for publication as a standalone document in October 1996.

Law Enforcement Intercept (PN–3580)

- The law enforcement document is shrinking to a standard that will provide for adherence to the CALEA legislation, no more and no less. Unfortunately, agreement on the tight-rope of adherence is not easy to obtain. The scheduled date for *ballot* has slipped from August to *November, 1996.*

WIN: Wireless Intelligent Network (PN-3661)

- An ad hoc group, meeting outside of TIA TR-45.2 subcommittee meetings, is developing a call model and IS-41 procedures to support WIN features. Currently, target features include Incoming Call Screening, Voice Controlled Services and Calling Name Presentation. Much discussion is currently occurring on the relationship of WIN with ITU IN standards CS-2 and CS-3. The schedule for *ballot is November-December, 1996.*

Enhanced Wireless Emergency Services (PN–3581)

- Development of internal and external message flows to support the recent FCC rule-making on wireless emergency services is well underway, and protocol encoding work has started. Ballot is scheduled for January, 1997. See related article on page 3 of this issue.

CDMA Capabilities (PN-3619)

- The definition of features based on IS–95 Rev. A capabilities. The schedule is currently undergoing review.

IS-41 Rev. D

- The scope and purpose of IS-41 Rev. D are currently under review. Proposals have been made to limit IS-41 to a 'core' protocol, and publish features in standalone documents. While this review is occurring, the schedule for completion of IS-41-D is on hold.

Interconnection (IS-93 Rev. A, PN-3295)

- On hold, at least for a while. Modifications will be required to support enhanced wireless 9-1-1 systems (PN-3581).

Call Detail/Billing Records (IS-124-B, PN-3725)

- A new project has been initiated to study modifications to IS-124 to support data services and intelligent peripherals. These modifications were not completed in time for IS-124-A. A workplan is being developed. Steve Larsen of METAPATH Corp. is the new editor.

On Hold

Multiple HLR Queries (PN-3528)

- On hold due to a relatively low priority, and rejection by Mexican carriers as the solution to their international roaming problems. ❐