Cellular Networking Perspectives

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Look forward to your next issue on: November 4, 1996

Guest's Cell: P.J. Louis on ATM - "Quest For Speed & Volume"

During the last two years ATM (which stands not for *Automatic Teller Machine*, but for *Asynchronous Transfer Mode*) has become a serious topic of discussion in wireless forums like the TIA TR-45.4 Subcommittee, where it has been proposed as a future high performance transport mechanism for signaling between Mobile Switching Centers (MSC's) and Base Stations (BS's).

ATM is a flexible, high capacity switching method that was developed to support Broadband-ISDN (B-ISDN); combining packet switching with traditional switching concepts. It is one of a class of packet technologies that relay traffic using an address contained within each packet's header. ATM is also characterized by its use of short fixed length packets or cells (each 53 bytes long, 48 bytes of data and 5 bytes of overhead). ATM is connection oriented, with packets from one connection multiplexed with packets from other connections traveling on the same links.

ATM Benefits in Wireless Networks

1. Granular Control and Network Flexibility

   The processing of fixed size cells provides greater network control over routing, error control, flow control, copying, and assigning priorities. In an ATM network each cell can be assigned a delay or loss priority, allowing the service provider to exercise control over one traffic class relative to another.

2. Dynamic Bandwidth Allocation

   ATM has the ability to dynamically allocate bandwidth to different types of cell traffic based on the priority of each type of traffic.

3. Service Transparency

   ATM is service application transparent. The cell size is small to allow efficient transmission of both the short repetitive frames of voice and the generally longer and less frequent bursts of data (each burst often requiring many cells to be transmitted). Consequently, ATM allows for mixing data, voice, and video within an application and on a single facility.

4. Scaleable

   Above minimum bandwidth requirements, an ATM cell can be carried over a 45 Mbps link to a switch and then merged into a 2.4 Gbps SONET link. ATM is blind to bitrates and framing.

All of these advantages are perfect reasons for supporting ATM. In a world where there are a multiplicity of networks, ATM appears to be a good candidate for integrating these networks and their services, including wireless networks and services.

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Disadvantages of ATM

Two big disadvantages of ATM are:

1. ATM lacks conventional congestion control therefore new types had to be developed.

   The purpose of congestion control is to detect packet congestion and enable reaction to minimize its duration and impact. To simplify the protocol and ensure high speed transmission, ATM does not include conventional link-level feedback based flow control. ATM networks are capable of sending cells into the network fabric at such a high speed that feedback control systems would simply not be able to detect and react to congestion. This means new types of data flow controls had to be developed and are still being developed. Some of the congestion control functions that have been developed are Selective Cell Discarding and Explicit Forward Congestion Indication. In Explicit Forward Congestion Indication, congestion is detected and identified in the headers of the cells being transmitted. Explicit Forward Congestion Indication is a control mechanism that operates across the networks. Selective Cell Discarding acts on individual cells when congestion occurs. This selective mechanism can be implemented using a buffering scheme. This buffering is partial in nature. ATM assigns priorities to each cell; the cells are either priority 0 or 1, 0 is higher than 1. In the buffering scheme, only the high priority cells are admitted when a threshold is reached while cells are queued. The low priority cells are rejected. Network congestion eventually clears.

2. ATM can also suffer from variable cell delays and even packet loss caused by queuing problems at each switch if cell scheduling or capacity engineering is inadequate.

   It is essential that buffered cells be scheduled for transmission. If cell scheduling is not done properly then cells may be discarded if cells are not transmitted according to the assigned schedule.

   Utilizing ATM in a wireless network will enable wireless providers to haul large volumes of data across their networks. The limiting factor will be the air interface itself. There does not appear to be enough bandwidth in the RF portion of the wireless carrier's network to support any of the broadband services the industry is envisioning. We do not necessarily need to support data rates at the OC-12 level (at this time). We may be able to support compressed video and data services. ATM will be able to integrate different types of services for transport. Therefore we will be able to more efficiently utilize our network resources for multiple service applications. An ATM network could be built to stand along side our existing SS7 networks.

Given our new telecommunications regulatory environment, wireless access to homes and businesses is growing. We are going to need to look at faster and larger volume protocols.

In my opinion, the benefits of ATM far outweigh the disadvantages. The need to go to ATM will be driven by market demands for more speed, more volume, more services, and better network management.

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. ❒

Fractionating IS-41

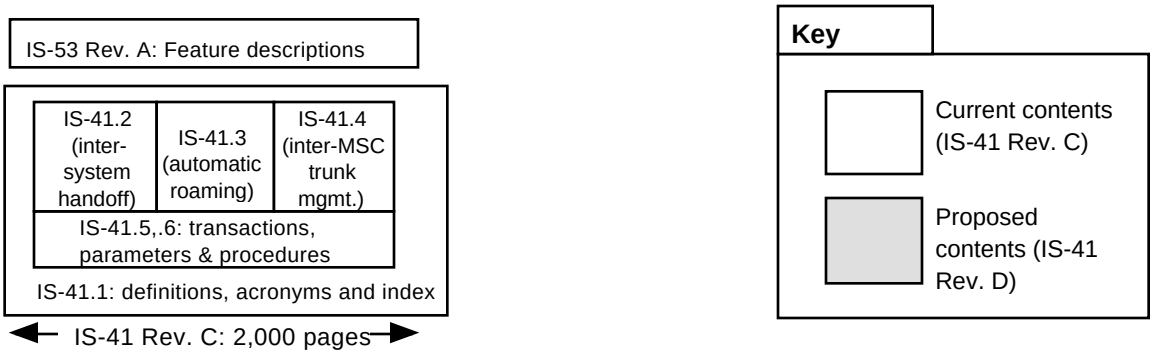
IS-41 (inter-system operations) is too big, bulky and unwieldly, and IS-53 (feature descriptions) is not helping. That appears to be the opinion of the TIA TR-45.2 subcommittee. IS-41 Revision C weighs in at about 2,000 pages and, unless something is done, IS-41 Rev. D will weigh in at about double that. Not only will the standard be dangerous to lift without assistance, but (more importantly for the standardization committee), it will be next to impossible to maintain, and features that are not desired by some manufacturers will be unavoidably embedded in the document, like it or not.

There are several ideas being discussed, that may result in a major restructuring of the document. Figure 1 (next page) illustrates some of the possibilities. Figure 1 Option 1 shows the current document, with 3 sections that describe fundamental inter-system capabilities (sections 2 for inter-MSC handoff, 3 for automatic roaming and 4 for inter-MSC trunk management) and three generic sections (1 for definitions, acronyms, etc., 5 for encoding of transactions and parameters and 6 for procedures). If no rearrangement is performed, several new sections will have to be added (although some features may be able to be merged into existing sections). This will result in a mammoth document, perhaps topping 4,000 pages, accompanied by a similar increase in size for the IS-53 features document, as illustrated in Figure 1 Option 2.

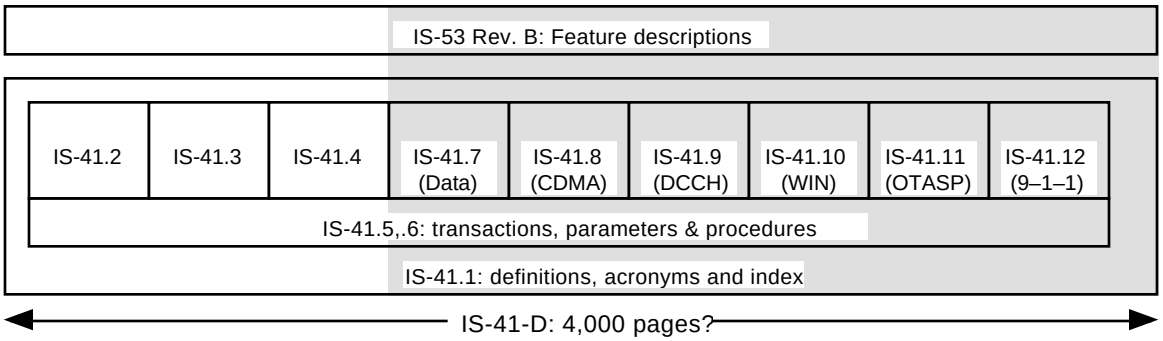
A conservative rearrangement (Figure 1 Option 3) would be based on vertical feature descriptions encompassing the Stage I user perspective currently defined in IS-53 and the Stage II network perspective, including message flow diagrams. These descriptions would be published as separate interim standards (or possibly TSB's). New and modified transactions and parameters, and the procedures to send and receive them, would be added to IS-41 sections 5 and 6. IS-41 would still increase significantly in size, but new applications (such as data and over-the-air service

Figure 1: Fractionating IS-41 (TIA/EIA-689)

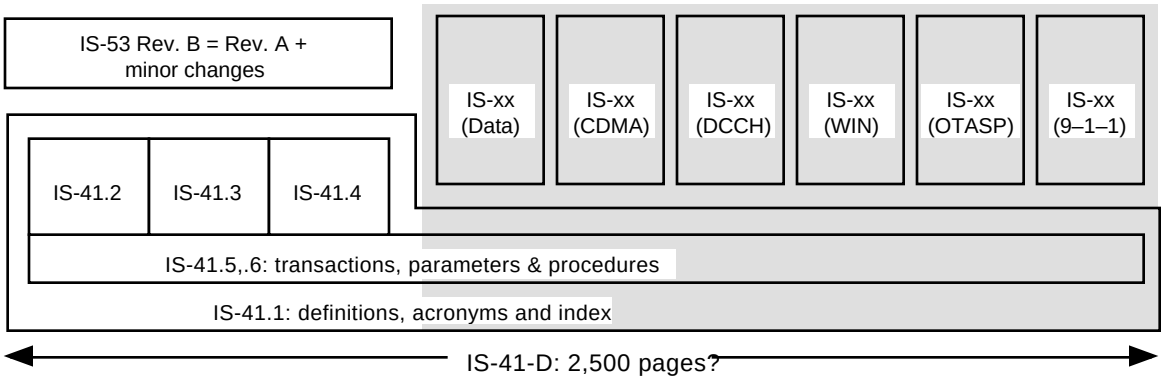
1. Today (IS-41 Rev. C and TIA/EIA-689)



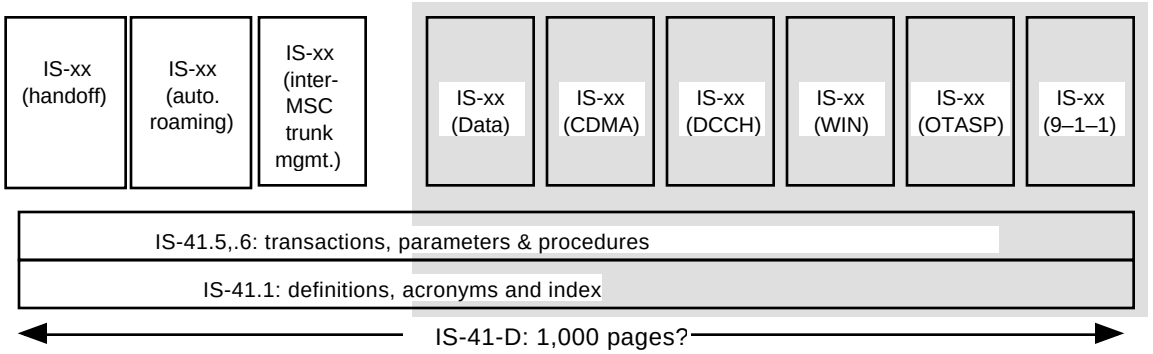
2. Following the Current Model Leads to…



3. Major Restructure: New Vertical Standards



4. Total Reworking: Breaking IS-41 Apart



provisioning) can be handled relatively independently and modularly.

A more radical rearrangement (Figure 1 Option 4) would remove the basic inter-system capability descriptions from IS-41 sections 2, 3 and 4, along with the appropriate sections of IS-53. The result would be a number of independent feature and capability descriptions, that include both the user perspective and the network perspective. IS-41 would be limited solely to a list of transactions and parameters, along with the accompanying parameters.

No rearrangement will reduce the number of pages that require publication, in total. Independently of rearranging and splitting the standard, it is possible that some of the redundancy in IS-41 may also be eliminated. For example, procedures are described up to 3 times in IS-41, lists of parameters enumerated up to 3 times and transaction flow diagrams shown twice. Each repetition is at a different level of detail, but if IS-41 (or the family of standards resulting from the breakup) is to be only a protocol specification and not also an educational tool, perhaps one complete description of procedures, parameters and message flows will suffice. ❒

IS-129: A Standard for GSM to IS-41 Interworking Part I

IS-129 was recently published (July, 1996) as an interim standard by the TIA (Telecommunications Industry Association). It purports to provide "Interworking/Interoperability Between DCS 1900 [GSM] and IS-41 Based MAPS", but given the differences between these standards, does it live up to its title?

As an aside, the term MAP means Mobile Application Part, and refers to the inter-system operations protocol found within the GSM standard and, for AMPS-compatible mobiles, defined by the TIA IS-41 standard (soon to become ANSI standard TIA/EIA-689).

The IIF: What is it and can it Stand Alone?

The IIF is a term used in IS-129 to define an Interworking and Interoperability Function that connects an IS-41 HLR to a GSM HLR for each subscriber to both GSM and IS-41 services. It is very important to note that the operations of the IIF are *not* defined by the IIF standard.

The IIF is shown as a (possibly) standalone entity in the standard's network reference model. Obviously, the standard also allows the IIF to be merged into either the GSM or IS-41 HLR. However, the interoperability scenarios show the IIF and both HLR's as a single entity, so the assertion that the IIF can be standalone, although plausible, is not proven by this standard.

Parameter Mapping

Parameter mapping is not shown in the IS-129 standard. However, it is obvious that this mapping will require a complete subscriber database within the IIF at least to perform the mapping between the distinct subscriber and terminal identity parameters (i.e. MIN versus IMSI) required by the two technologies. Mapping between profile parameters will also be required.

Standalone IIF: Another Subscriber Database

If the IIF does stand alone, then the subscriber database will have to be managed in three different places which may not be a technical problem, but will require yet another interface from the central subscriber database (usually in a customer service or billing computer) to another box in the network.

Registration and Authentication Operations

Location tracking interoperability is provided through generation of registration cancellation operations (Registration Cancellation for IS-41 and Cancel_ Location for GSM) when a mobile registers in one system after being in a system using the opposite technology. Unfortunately, the most interesting part of the scenario (the translation of an IS-41 RegistrationCancellation to or from a GSM Cancel_Location) is not shown.

Authentication operations are not translateable between the two technologies, and must be handled by separate technology-dependent authentication centres.

Call Waiting and Calling Number Identification

Call waiting to a roaming subscriber can be provided, and is shown in IS-129 scenarios. As the call waiting tone is applied by the serving system, it is an internal operation. The originating system and HLR cannot see the difference between a call waiting scenario and normal call delivery to an idle mobile (in fact, Call Waiting could come as a surprise even to the Serving System if a mobile originates a call between the time that a TLDN is allocated and the call actually arrives). The interoperability comes in the translation of profile parameters between the technologies, and this is not shown in IS-129. Calling Number Identification is similar to call waiting, in that it involves operations between the PSTN and the serving system, and does not involve the originating MSC and HLR, except for the translation of profile parameters.

To be continued

In the next issue we shall complete our discussion of interoperable features, with a discussion of the level of support provided in IS-129 for call delivery, inter-system handoff and short message service. We also list companies with products that are IS-129 compatible and finally provide our conclusions on the IS-129 standard. ❒

TR-45.2 Standards Update

New standards work is still being delayed by the review of comments from 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. Even though all ballot comments have been reviewed, and either incorporated or rejected, the final version of both documents, including extensive ballot modifications still has to be reviewed before publication.

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.*

Ballot

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

- The "IS-41 Rev. C" ANSI ballot review was completed at the September, 1996 TR-45.2 meeting. The changes approved have not shaken the foundation, but have been extensive throughout the document.

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

- Ballot review was completed in September, for this proposed update to the 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) and support of data. Not included are major changes to support intelligent network peripherals. These will be incorporated in a subsequent TSB or IS-124 Rev. B (PN-3725).

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

- *Approved for 90 day 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. The ballot has not yet been distributed due to internal TIA delays. The unusual length of the TSB ballot period reflects the desire to receive input from non-traditional sources, particularly carriers outside the USA and Canada.

In Development

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

- A major change in direction for this standard is being considered, which may see Rev. B published with only minor enhancements from Rev. A, and with no new features. The schedule is currently under review.

TDMA DCCH (PN-3579)

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

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

- A new inter-MSC rate adaption protocol is required to support the transmission of data from digital phones following an intersystem handoff. Scheduled for ballot in November 1996.

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

- OTASP will provide the ability to program, or re-program, a mobile over the radio interface. Ballot is scheduled for November 1996.

Data Services (PN-3770)

- Transmitting data from CDMA and TDMA digital phones 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 intersystem handoff are being developed for publication as a standalone document in November 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. There are some (!) differences between the views of law enforcement (i.e. the FBI) and the industry (see front page article in September 20, 1996 *New York Times*). The scheduled date for ballot is *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. At a high level, WIN will be compliant with ITU CS-2 and CS-3 IN standards, and at a low level compatible with IS-41. The schedule for ballot has slipped to June, 1997.

Enhanced Wireless Emergency Services (PN–3581)

- Baseline text has been prepared. A proposal to use a datalink to the ALI database, instead of enhancing the PSTN signaling, will have a major impact on the standard, and its delivery date, if accepted. Also, the impact of the FCC decision to require calls from non-service-initialized phones has not yet been determined. Ballot is scheduled for January, 1997.

CDMA Capabilities (PN-3619)

- The definition of features based on IS–95 Rev. A capabilities. Ballot is scheduled to start in January, 1997.

IS-41 Rev. D

- The scope and organization are currently under review. See the article entitled "Fractionating IS-41" in this issue.

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

- Modifications to PSTN interconnection to support enhanced wireless 9-1-1 are scheduled to be incorporated for a ballot starting in February, 1997.

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. Work has not yet begun on this revision, but it is estimated to be completed and ready for ballot in November, 1997."

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. ❐

TIA TR-45.2
Standards Report

Cellular Networking Perspectives

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Superseded Interim Standards and TSBs

IS/TSB	Description	Published
IS-41-B	Cellular Radiotelecommunications Inter-System Operations	12/91
IS-52-0	Cellular Subscriber Dialing Plan and Service Codes	11/89
IS-53-0	Cellular Features Description	09/91
TSB-41	Technical Notes for IS-41 Revision B	11/94
TSB-51	Inter-System Authentication, Signaling Message Encryption and Voice Privacy	05/93
TSB-55	IS-41 Rev. A/B Forward Compatibility	05/94
TSB-64	Wideband Spread Spectrum Intersystem Operations	02/94
TSB-65	Mobile Border System Problems	04/94

ANSI Standards

SP #	ANSI #	TIA IS-	Subject	Status
SP-3544	EIA/TIA-660	IS-52-A	Dialing Plan	Published 09/96
SP-3545	EIA/TIA-664	IS-53-A	Features	Published 09/96
SP-3588	EIA/TIA-689	IS-41-C	Intersystem Operations	Ballot

Completed EIA/TIA Interim Standards

IS	Description	Published
IS-41-C	Cellular Radio Telecommunications Intersystem Operations	02/96
IS-52-A	Uniform Dialing Procedures for use in Cellular Radiotelephone Systems	03/95
IS-53-A	Cellular Features Description	04/95
IS-93-0	Ai and Di Interfaces Standard (PSTN/MSC)	12/93
IS-124-0	Cellular Inter-System Non-Signaling Data Communications	11/93
IS-124-A	Cellular Inter-System Non-Signaling Data Communications	*ballot*

Completed Telecommunications Systems Bulletins (TSBs)

TSB	Description	Published
TSB-29-A	International Implementation of Cellular Systems Compliant with TIA-553	09/92
TSB-29-B	International Implementation of Wireless Systems	*ballot*
TSB-56-A	Application Level Testing for IS-41 Rev. B, IS-53 Rev. 0 and TSB-51	06/94
TSB-76	PCS Multi-Band Support	*in press*

Active TR45.2 Projects: (PN = TIA Project Number)

PN	Title	Editor	WG	IS/TSB
3295	Ai and Di Interfaces Standard	David Crowe	VII	IS-93-A
3362	Cellular Features Description (Rev. B)	Terry Watts	I	IS-53-B
3528	Multiple HLR Query ("Double Dipping")	Terry Jacobson	VI	n/a
3579	IS-41 Support for IS-136 (TDMA digital control channel)	Gustavo Pavón	II	IS-41-D
3580	Law Enforcement Intercept Requirements	Kirk Carlson	0	IS-xxx
3581	Enhanced Wireless 9-1-1 Emergency Services	Terri Brooks	0	IS-41-D
3590	Intersystem Operations	Terry Watts	II,III	IS-41-D
3619	IS-41 Support for IS-95-A (advanced CDMA)	Sam Broyles	II	IS-41-D
3660	Inter-System Link Protocol	Michel Houde	II	IS-41-D
3661	Wireless Intelligent Network	Terry Jacobson	II	IS-41-D
3725	Call detail/billing record transfer for data and enhanced services	Peter Larsen	IV	IS-124-B
3769	Over-the-air Service Provisioning	Chuck Ishman	II	IS-41-D
3770	Data services for digital terminals	Michel Houde	II	IS-41-D