Cellular Networking Perspectives

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In This Issue ...

Comments welcome!

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Next issue due: July 7, 1997

Lawfully Authorized Electronic Surveillance Ballot (SP-3580) Ends… With a Thud

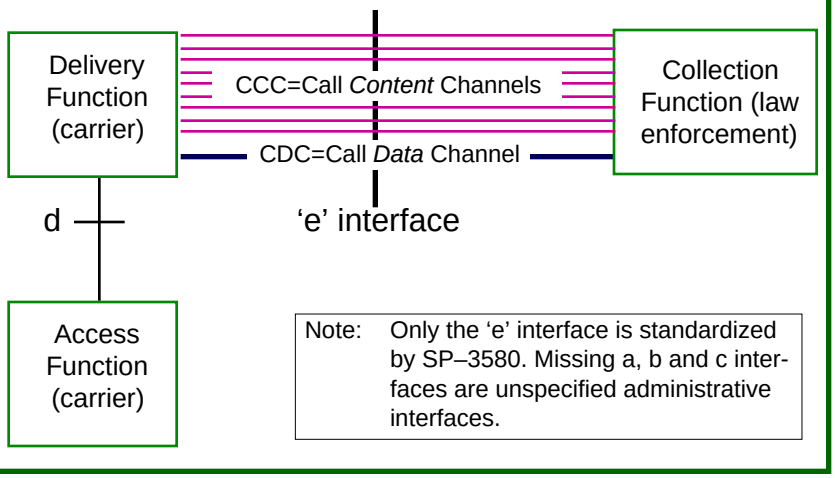
A thud is the sound that a 7 inch pile of paper makes when it hits the floor. To the surprise of TIA TR-45.2 subcommittee members, that was the height of the pile of comments returned for the TIA and ATIS ballots on SP-3580. And the ANSI ballot has not even been completed yet!

SP-3580 defines a protocol between a public telecommunications system (whether cellular, PCS or wireline) and law enforcement agencies (see Figure 1). It is designed to meet the requirements of the 1994 US Communications Assistance for Law Enforcement Act (CALEA). In most cases, only call identifying information (calling number, called number, time etc.) will be transmitted over the Call Data Channel (CDC). In a small percentage of cases, the actual contents of the call (voice or data) will also be provided over a pair of Call Content Channels (CCC); one for the calling party, the other for the called party.

Even if SP-3580 is approved, to define the *capability* for electronic surveillance, there is still considerable disagreement over the *capacity* required, especially the number of simultaneous surveillances per switch which will require call contents. Also, adequate funding for the legislation (which requires funding for switches installed before 1995) has not yet been provided. Without this funding, all pre-'95 switches would be considered to be in legal compliance without any capability.

Voting was clearly split, with 30 companies from the telecommunications industry, except US West, voting "Yes"

Figure 1: Law Enforcement Electronic Surveillance (SP-3580) Network Reference Model



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and 34 law enforcement agencies voting "No". It should be noted that US West voted No for the opposite reason from law enforcement. They stated that any provision of location information in the standard is outside the scope of the US CALEA law that drove the development of SP-3580. Note that, due to TIA rules, the number of votes given to any industry segment may be limited.

The height of the stack of paper turned out to be misleading, as most law enforcement agencies turned in exactly the same 60 pages of comments. The exceptions were a few law enforcement agencies that voted "No" without comments (beyond a cover letter) and the RCMP (Royal Canadian Mounted Police) who submitted a version of the US law enforcement comments that was revised to remove US-specific references, such as to CALEA. The RCMP are apparently concerned that they may lose the more extensive capabilities they currently have, if manufacturers try to promote SP-3580 as a one size fits all solution to law enforcement surveillance needs.

"Mobile Telecommunications Networking With IS-41"

This is the first book ever published on the TIA IS-41 standard for intersystem operation, to our knowledge. One of the authors, Randall Snyder, may be familiar to readers from his December 1995 article on GSM/IS-41 interoperability. Both he and the other author, Michael Gallagher, work at Synacom Technology (http://www.synacom.com). They have had extensive experience on standards committees and also in the real world of product development. Not only that, but they are privileged to work at the same company as Kirk Carlson, the man who singlehandedly morphed IS-41 from a mouse to a mammoth. The book was published by McGraw-Hill (http://www.computing.mcgraw-hill.com).

WIN Part III: A Partly Polished Protocol

With every protocol standard, the words that do not directly specify the encoding of a message are just that: words. They can only fulfil their promise if the protocol delivers the goods. This is particularly relevant for the Wireless Intelligent Network standard which promises so much flexibility, power and openness. In the first two parts of this series (March and April, 1997) we discussed many of the higher level issues, particularly the call model and the network reference models. In this issue we discuss the current status of the WIN protocol definition, and some of the implementation issues that it raises. This part of the WIN standard is the least well developed, although by earlier schedules the entire standard was supposed to be finished in mid-1996. Note that, as with all developing standards, there is no guarantee that the protocol specification will not be significantly changed before publication.

WIN Acronyms

Features

CNAP - Calling Name Presentation / Restriction
ICS - Incoming Call Screening
VCS - Voice Controlled Services

Network Elements

HLR - Home Location Register
IP - Intelligent Peripheral
MSC - Mobile Switching Center
SCP - Service Control Point
SN - Service Node

We will discuss all of the capabilities that the current protocol promises in order to support the three WIN feature suites: Calling Name Presentation (CNAP), Incoming Call Screening (ICS) and Voice Controlled Services (VCS), referring to specific protocol messages where appropriate. Table 1 lists the current IS-41 operations that have been modified or added to support WIN. Figure 2 maps the messages onto the WIN interface that they are most likely to be used on.

Calling Name Capability

The Calling Name capability (CNAP) stands apart from the rest of WIN. Once the CNAP SCP is queried to translate a calling number into a calling name, the remainder of the capability just requires that IS-41 messages transport this name around the network. It should be noted that, in many cases, the calling subscriber will not be a wireless subscriber, so access to the SCP will not be defined solely by wireless standards, such as WIN. Table 1 illustrates that it is mostly existing IS-41 messages that have been modified to support CNAP, and then simply by the addition of new parameters to transport the calling name.

Not only is this capability much like the already existing Calling Number capability (currently in IS-41 Rev. C), but developing this service does not appear to provide a foundation for future services. The major infrastructure capabilities of WIN (e.g. triggers, remote control of resources, distribution of intelligence) are not required by the incorporation of CNAP.

It is not surprising then, that a new project was initiated in TIA subcommittee TR-45.2 in April, 1997 that will provide the CNAP feature (and the related CNAR - Calling NAme Restriction) using simple extensions to IS-41.

Distribution of Capabilities

WIN demands that capabilities be distributed in order to support a model where each MSC concentrates on switching and basic call processing, each HLR manages its subscriber database, each SCP remotely controls advanced features and services and each IP manages specialized resources (such as speech recognition). Many of the new WIN operations are dedicated to managing the complexities that arise from this model.

Distribution of Labor

The new *ConnectResource* and *DisconnectResource* operations allow an SCP to tell an MSC to establish a trunk to an

IP in preparation for use of a specialized resource. The *SeizeResource* message completes the circuit by allowing the SCP to tell the IP which resource should be connected to the trunk. These messages are required to support the restrictions on network elements imposed by WIN. An MSC does not know about advanced services, so cannot determine when a specialized resource is required. An SCP does not have switching capabilities, and therefore cannot directly connect a trunk anywhere. Lastly, an IP cannot know about the service logic required to allocate resources and must wait for commands before allocating its resources.

Distributed Databases

Distributed logic also leads to distributed databases, particularly between the HLR with the traditional subscriber database, and the SCP which may have information regarding more advanced services. For truly flexible services, the SCP must be able to query the status of the HLR database (using the Search message). Consider a user speaking voice commands to find out what their current call forwarding number is. Since this number could have been programmed using non-WIN capabilities (e.g. *XX codes), the SCP must ask the HLR for this information when it needs it.

A distributed database capability is provided, just barely, by WIN. Because no data model is defined, databases can only be queried with the *Search* operation or updated with the *Modify* operation if a private agreement is available that defines the structure of the data elements within these messages. The best that can be hoped for is that each HLR manufacturer will provide a description of their private extensions to WIN that will be required to access selected parts of their database. HLR manufacturers may be reluctant to do this for obvious business reasons, but also for technical reasons relating to HLR performance, reliability and information security.

Redirection

One of the common requirements of advanced services is to route a single call to multiple destinations, in series. For example, an incoming call might first be connected to a call screening Service Node that listens for DTMF digits or recognized voice prompts before deciding whether to redirect the call to the mobile. Even after termination to the mobile, a further redirection may occur if call forwarding is triggered. Redirection capabilities were present in IS–41 Rev. A and B (the *RedirectionRequest* and *TransferToNumberRequest* operations), and were significantly enhanced in IS-41 Rev. C (the *RedirectionDirective* operation). WIN has added capabilities for this redirection to be handled remotely by an SCP using the *ConnectResource* operation, which commands an MSC to redirect a call to an IP.

Remote Actions

If WIN can be likened to a modern family, then the SCP has a firm grip on the remote control. Because it is supposed to embody only service logic (SCF - Service Control Function) and a database (SDF - Service Data Function) and has no physical telecommunications resources (e.g. trunks, announcements, voice recognition), its role is limited to interfering in the lives of other network elements; the MSC, HLR and IP. This capability requires extensive use of IS-41 operations that allow an SCP to issue commands to other network elements.

IS-41 Revision C defined the *RemoteUserInteractionDirective (RUIDIR)* operation to allow an HLR to command an MSC to perform an action (limited to playing an announcement and collecting DTMF digits). WIN allows an SCP to initiate this message and an IP to respond to it. WIN has also added the *InstructionRequest* message that differs in being initiated by an IP (or MSC), to re-

Table 1: Modified and New IS-41 Operations for WIN

Modified Operations	Interface	Features	Capability
LocationRequest	MSC-HLR	CNAP, ICS	Determine routing for call leg or mobile terminated call
OriginationRequest	MSC-HLR	VCS	Determine routing for mobile originated call
RedirectionRequest	MSC-MSC	CNAP	Determine re-routing for mobile terminated call
RegistrationNotification	MSC-HLR	VCS	Register & obtain profile for mobile
RoutingRequest	HLR-MSC	CNAP	Determine routing for call leg or mobile terminated call
RUIDIR	HLR/SCP-MSC/IP	CNAP	Tell MSC/IP what to do
New Operations			
ConnectResource	SCP-MSC	ICS, VCS	Command MSC to connect trunk to IP
DisconnectResource	SCP-MSC	ICS, VCS	Disconnect trunk to IP
InstructionRequest	IP/MSC-SCP/HLR	ICS, VCS	Ask SCP/HLR what to do
Modify	SCP-HLR	ICS, VCS	Modify a database (e.g. subscriber record in HLR)
ResetTimer	SN-MSC	ICS, VCS	Extend timer to avoid timeouts during user dialogs
Search	SCP-HLR	ICS, VCS	Read from a database
SeizeResource	SCP-IP	ICS, VCS	Attach resource to MSC-IP trunk
ServiceRequest	HLR-SCP	ICS, VCS	Request for instructions
TerminationRequest	MSC-SCP	CNAP, ICS	Enhanced 'LocationRequest' for WIN

quest guidance from an SCP (or HLR).

WIN also allows an HLR to request that an SCP make decisions regarding an incoming call by issuing a *ServiceRequest* operation. It can be used to extend the functionality of an HLR using specialized SCP service logic. On the negative side, this message requires both an HLR and SCP to participate in call processing, which increases the overhead of handling many WIN calls.

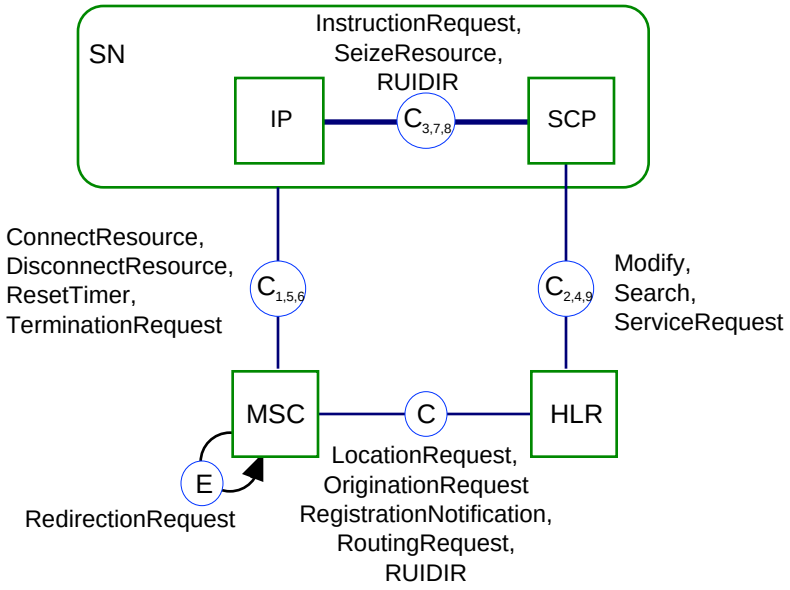
Triggers

Triggers have long existed in IS-41, although the concept was not formalized until Revision C. Terminating triggers existed in IS-41 Rev. A and B to allow redirection of calls terminating to mobiles that were busy, turned off, outside any service area or that were not answered. Originating triggers, added in Rev. C, are more complex, because they must be set off by patterns in the dialed digits - an open ended requirement. IS–41 Rev. C took the simple approach of allowing triggers based on a special first digit (e.g. '*'), a specific number of digits dialed (e.g. 3, 4 or 5 digits to activate a private dialing plan) or a specific call type (e.g. triggering on service codes or international numbers). WIN has not significantly extended the range of allowed triggers, but has allowed triggers to be handled by an SCP other than the HLR, which is a useful capability (embodied in the TriggerAddress parameter in the RegistrationNotification message).

Timer Management

A requirement imposed by human interactions is the need to extend the normal IS-41 timers, which were designed for machine to machine interactions. A previously existing IS-41 operation, such as LocationRequest, may cause a cascade of messages between the INVOKE and the RETURN RESULT. Some of the flurry of messages may be related to obtaining information from a human. Consequently, the overall transaction may take much longer than normal MSC timing will allow. The WIN standard takes the approach of allowing the SCP to extend MSC timers through the

Figure 2: WIN Operations & Interfaces



ResetTimer operation. An alternate approach would have been for the MSC to recognize that each time it receives a message with a transaction open, that the operation timer should be reset. This approach would avoid false timeouts without the addition of a new IS-41 operation.

To be continued

In the July, 1997 issue we will summarize the CTIA/TIA WIN standardization effort, trying to predict where WIN will succeed in its goals and where it will fall short.

TR-45.2 Standards Update

A flood of ballots is still washing over TIA subcommittee TR-45.2, responsible for network standards. The first wave consisted mainly of low level network enhancements (to support TDMA and CDMA capabilities), while the second contains more controversial US government mandates (emergency services, lawfully authorized electronic surveillance and wireless number portability). So far, TR-45.2 has managed to keep its head above water.

Documents within each category are listed in order of project number (PN- for TIA ballots, SP- for ANSI ballots), where one has been assigned. Note that many network standards rely on corresponding air interface standards to provide a complete solution.

In Press

International Applications (TSB–29 Rev. B, PN-3173) • 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. This version accommodates the IFAST 0-XXX and 1-XXX MIN format for use by countries outside the North American Numbering Plan. *Approved for publication in May, 1997.*

Online Call Record Transfer (IS-124 Rev. A, PN-3293) • This standard includes a variety of improvements and corrections over Revision 0, such as internationalization (i.e. support of IMSI). *In press.*

IS-41 Rev. C ANSI Ballot (ANSI/TIA/EIA-41, SP-3588) • The "IS-41 Rev. C" ANSI ballot review was completed at the September, 1996 TR-45.2 meeting. The document has been *approved for publication*, but the final edited version has not yet been submitted to the TIA for publication.

Inter-System Link Protocol (ISLP) (PN-3660) • This new inter-MSC rate adaption protocol is required to support

the transmission of data from digital phones following an intersystem handoff. See PN-3770, below, which is still in the ballot process. *In press.*

Over-The-Air Service Provisioning (PN-3769) • OTASP will provide the ability to program, or re-program, digital (TDMA or CDMA) mobiles over the radio interface. *Approved for publication in May, 1997.*

Ballot

TDMA Digital Control Channel (DCCH; PN-3579) • Definition of network support for the IS-136 Rev. A features "User Group" and "Non-public mode service". Also contains enhancements to support manufacturer- or carrier-specific capabilities. *Ballot comments have been reviewed, and the publication version is being developed.*

Law Enforcement Intercept (LAES; PN–3580) • Squeezed between the cost concerns of the industry, the constraints of the US CALEA law and the demands of law enforcement, a new standard for intercept has been balloted. It will apply to both wireless and wireline networks. *TIA and ATIS ballot comments are being reviewed (see related article on Page 1). ANSI ballot comments are due June 24, 1997.*

Enhanced Wireless Emergency Services (E911; PN–3581) • A standard to use normal PSTN signaling (Feature Group D MF or SS7 ISUP signaling) to support the FCC-mandated Phase I for enhanced wireless 9-1-1 is complete. It will apply to both IS-41 and GSM based wireless networks. Both cell/sector location and mobile identification will be transmitted to the emergency services system. *Ballot review is ongoing*. The major change accepted so far is to remove MF/ISUP interworking in order to align with "proper" ISUP practices.

Advanced CDMA Capabilities (PN-3619) • The definition of advanced features based on IS–95 Rev. A capabilities was *approved for 60 day ballot in April, 1997.*

Digital Data Services (PN-3770) • Transmitting data from CDMA and TDMA digital phones is more complex because voice coders are incompatible with analog modem tones. *Ballot comments have been reviewed, and a pre-publication version is being developed.*

International Mobile Station Identity (IMSI; PN- 3892) • Support for the E.212 IMSI mobile identifier will resolve international roaming problems caused by the current 10 digit MIN identifier. Initially, these modifications were to be published as part of ANSI/TIA/EIA-41 Revision A, but as this standard has been delayed by the onslaught of separate annexes to Revision 0 (see above), it has been decided to a standalone document. *Approved for ballot in May, 1997.*

In Development

Interconnection (IS-93 Rev. A; PN-3295) • Modifications to this PSTN interconnect standard will include enhanced wireless emergency services (from PN-3581), definition of ANI II digits related to wireless calls and various enhancements and corrections from Revision 0. The draft standard is *in V&V until PN-3581 is completed.*

Subscriber Features (IS-53 Rev. B; PN-3362) • The status of this standard is still uncertain. Rather than gathering all feature descriptions under this one roof, they may remain in separate documents along with the network flows and protocol specification that traditionally were in IS-41.

Wireless Intelligent Network (WIN; PN-3661) • The description of intelligent networking for IS-41 based mobility networks is complete at a high level. The description of IS-41 operation and parameter modifications is ongoing. Since our last report, the schedule for *ballot has slipped from June, 1997 to December, 1997.*

ANSI/TIA/EIA-41 Rev. A (was IS-41 Rev. D) • A small amount of work has been completed on the next revision. Most is being done in separate documents that are already being balloted, to be incorporated later. *Scheduled for ballot in December, 1997.*

Call Detail/Billing Records (IS-124-B; PN-3725) • A new project has been initiated to study modifications to IS-124 to fully support data services and WIN.

Call Detail/Billing Records (SP-3816) • IS-124 Rev. A, with some additional corrections, will be prepared for an *ANSI ballot in December, 1997.*

Emergency Services, Phase II (E911-II; PN- 3890) • The second phase of enhanced wireless emergency services will extend ISUP signaling to provide enhanced location information to the emergency services system, required to an accuracy of 125 meters (67% of the time) by an FCC rule making.

Wireless Number Portability (WNP; PN-3980) • Wireless number portability will allow telephone subscribers to keep their directory number when transferring service from one service provider to another.Transfers are possible between any carriers, wireless or wireline. The wireless industry must support this capability in the 1998/1999 time frame. An aggressive schedule aims for *publication in November, 1997.*

New Project Applications

Authentication Enhancements (AUTH, PN-*pending*) • There are some theoretical (at this time) attacks on authentication that do not challenge CAVE, but simply use loopholes in the network to walk around the TIA authentication algorithm. These attacks can be prevented by relatively minor changes to the IS-41 authentication operations and procedures.

Calling Name Presentation/Restriction (CNAP,CNAR; PN-*pending*) • Calling name presentation and restriction features are now being developed outside the scope of WIN, using a stripped down version of the WIN design for CNAP and CNAR. *Scheduled for ballot in July, 1997 and publication in September.*

TIA TR-45 Committee for Cellular/PCS "AMPS" Standards Development

Cellular Networking Perspectives

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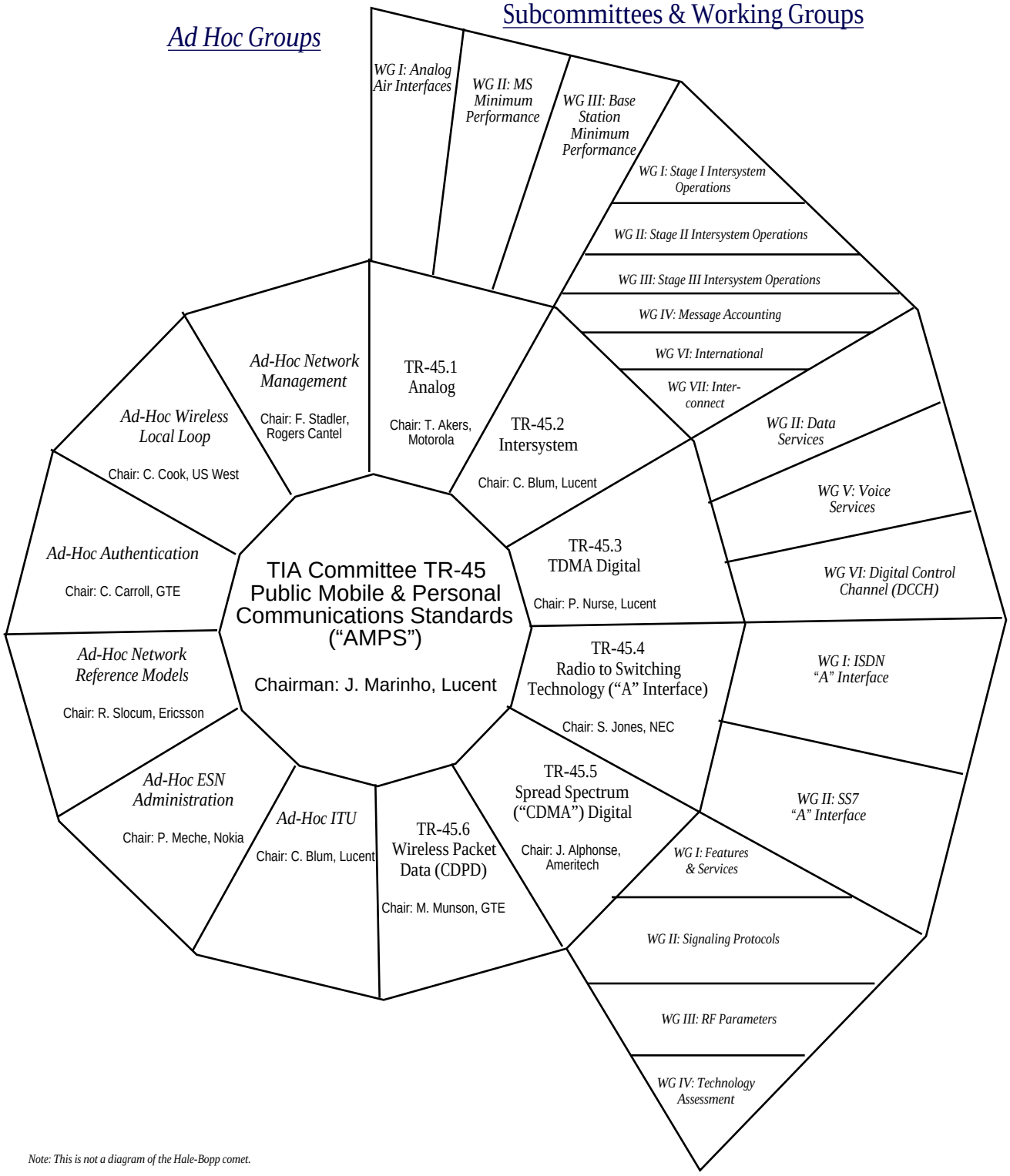

Note: This is not a diagram of the Hale-Bopp comet.