Cellular Networking Perspectives

In This Issue ...

> **Next issue due: June 2, 1995**

Comments Welcome

We welcome comments on the contents and format of this newsletter, suggestions for future topics, letters, submissions and corrections. You may phone in your comments to 1–800–633–5514 (1–403–289–6609) or fax them to 1–403–289–6658.

TIA Standard IS-124 Part II: Anatomy of a Call Detail Record

Part I of this series introduced the purpose and history of the IS-124 standard for the near-realtime transfer of call records. It also described the structure of the logical IS-124 network. In this issue we focus on the protocol itself and on the issues that will be involved in field implementation of this standard. A table on Page 5 lists the vendors of IS-124 equipment, networks and services.

Protocol Layers

IS–124 is a multi-layered protocol. The top layer contains the call detail information, such as: times, durations, phone numbers, radio channel identification information and charge information. Below this layer is the ROSE standard (ITU-T Recommendation X.219 and X.229) for message structuring and for the control of Remote Operations. These remote operations allow the controlled transfer of information between network nodes. The lower layers can be virtually any combination of physical and transport protocols (e.g. X.25 or TCP/IP).

Call Detail Record Types

IS-124 specifies five types of call detail records that contain information about different aspects and portions of a single call. The relationships between these record types are shown in a simplified fashion in Figure 1. The purpose and contents of Audit Records, Leg Records, Segment Records, Activity Report Records and Event Report Records are described below.

Audit Records

An audit record provides an overall summary of a call. One audit record may cover a single call that covers multiple systems (e.g. inter-system handoff). In other cases, multiple audit records may be generated (e.g. inter-system call delivery and call waiting). The information in an Audit Record includes:

i. Unique record identification (system identification and a unique intra-system record serial number (BIN)).

ii. Subscriber identification (MIN and ESN).

iii. Time and duration of call.

iv. Number of associated leg and segment records and charge sub-records.

v. Type of call.

Leg Records

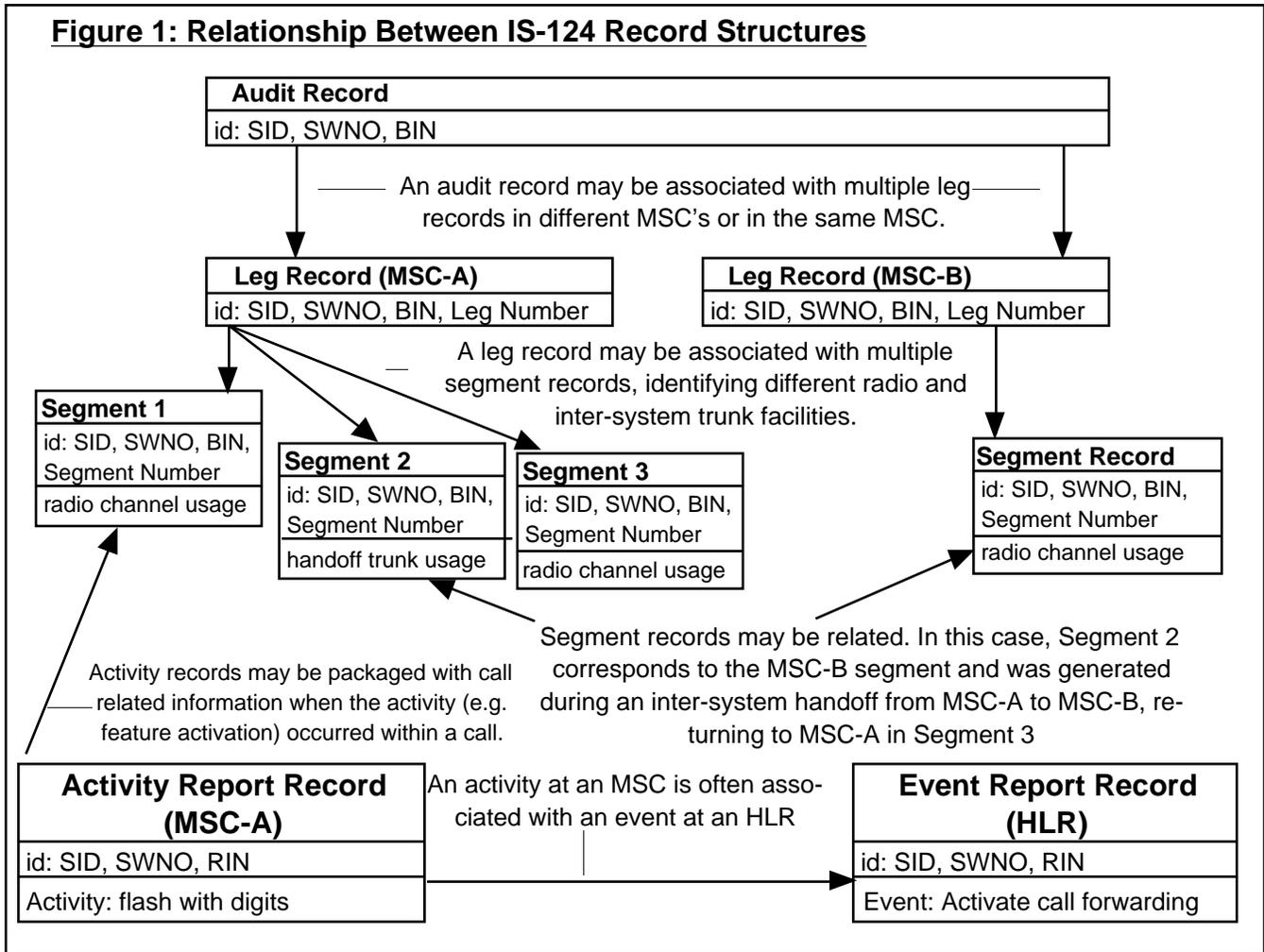A leg record provides information relevant to a single leg of a call. Calls have at least one leg record created in each MSC that supports the call. Calls may

How to Subscribe

Phone us at **1-800-633-5514 (toll free)** or fax us at 1-403-289-6658. Tell us your name, company, mailing address, type of delivery (fax or mail), phone and fax numbers. We will invoice you for payment by cheque or American Express.

Figure 1: Relationship Between IS-124 Record Structures

Audit Record
id: SID, SWNO, BIN

— An audit record may be associated with multiple leg— records in different MSC's or in the same MSC.

Leg Record (MSC-A)
id: SID, SWNO, BIN, Leg Number

Leg Record (MSC-B)
id: SID, SWNO, BIN, Leg Number

A leg record may be associated with multiple segment records, identifying different radio and inter-system trunk facilities.

Segment 1
id: SID, SWNO, BIN, Segment Number
radio channel usage

Segment 2
id: SID, SWNO, BIN, Segment Number
handoff trunk usage

Segment 3
id: SID, SWNO, BIN, Segment Number
radio channel usage

Segment Record
id: SID, SWNO, BIN, Segment Number
radio channel usage

Segment records may be related. In this case, Segment 2 corresponds to the MSC-B segment and was generated during an inter-system handoff from MSC-A to MSC-B, re-turning to MSC-A in Segment 3

Activity records may be packaged with call — related information when the activity (e.g. feature activation) occurred within a call.

Activity Report Record (MSC-A)
id: SID, SWNO, RIN
Activity: flash with digits

An activity at an MSC is often asso-ciated with an event at an HLR

Event Report Record (HLR)
id: SID, SWNO, RIN
Event: Activate call forwarding

---

have multiple leg records within a sin-gle MSC for several reasons:

a. Inter-system handoff involving path minimization.

b. Call redirection due to no page re-sponse or no answer.

c. Three way calls (one extra leg for the add-on party).

d. Multi-party conference call (one leg for each add-on party).

e. Call waiting.

Information included in a Leg Record is:

i. Unique record identification (same as audit record plus a leg sequence number)

ii. Subscriber identification

iii. Time and duration of leg.

iv. Calling and called party identifica-tion, location and routing informa-tion, as available.

v. Type of leg.

Segment Records

Segment records provide information relevant to the usage of a single radio or inter-system trunk facility. A leg record will have no associated segment records for calls without any radio channels (e.g. the Originating MSC call record for call delivery and some types of call forwarding). Calls involving radio re-sources will generate at least one seg-ment record. Multiple segment records may be associated with a single leg re-cord under the following circumstances:

a. Handoff within a single MSC, if this level of detail is retained.

b. Handoff forward to another MSC.

c. Handoff back to the Anchor MSC.

d. A change in call mode from ana-log to digital or vice-versa.

e. A change in voice privacy status from encrypted to clear or vice-versa.

A Segment Record contains the follow-ing information:

i. Unique record identification (same as audit record plus a segment se-quence number).

ii. Subscriber identification.

iii. Time and duration of segment.

iv. Identification of radio channel, in-ter-system (handoff) trunk or other facility.

v. Type of segment.

Activity Report Records

Activity records describe subscriber ac-tivity that is associated with radio con-tact, but not with the long term alloca-tion of a facility, such as registration and deregistration. An Activity record generated at an MSC may be associated with an Event Record (see below) gen-erated at an HLR. Activity records may also be included with call related infor-mation. Information included in

Activity Report Records is:

i. Unique record identification (system identification plus a record identification number (RIN)).

ii. Type of activity (e.g. registration, feature activation).

iii. Time of activity.

iv. Subscriber identification.

v. Activity-specific details.

Event Report Records

Event records describe an operation that is not directly a result of subscriber or terminal radio contact. These may be generated by an HLR, for example, to record all changes to a subscriber profile whether due to a remote activity by the subscriber (which will generate an Activity record elsewhere) or due to a service order. The information included in an Event Record is:

i. Unique record identification (system identification plus a record identification number (RIN)).

ii. Type of event.

iii. Time of event.

iv. Subscriber identification.

v. Event-specific details.

Remote Operations

IS-124 defines message delivery packages using the ROSE remote operations protocol (ITU-T recommendations X.219 and X.229). This layer of the IS-124 protocol resides above the physical/transport layers and below the application layer containing call information.

Remote operations are structured in a very similar way to the TCAP used in IS–41. Each operation consists of an INVOKE message to initiate the operation, followed (except in the case of Uncertified Delivery) by a RETURN RESULT to indicate successful completion of the operation or a RETURN ERROR to indicate a failure. REJECT messages can be used to respond to incorrectly structured messages. Also as in TCAP, parameters within an operation message are prefixed by parameter identification and length information. Figure 2 provides a somewhat artificial example of

how these operations might be used.

IS–124 message structuring is more sophisticated than IS–41 in its use of structuring to combine multiple call records into one operation (e.g. an audit record, 2 leg records and 3 segment records all relating to the same call may be sent as one CertifiedDelivery or UncertifiedDelivery operation). This allows records to be logically separated in the standard, but included together on the data link to improve throughput and reduce the processing and storage necessary to recombine records. Efficiency is further increased by eliminating redundant identification information that is the same in all records associated with the same call.

The Remote Operations defined in IS–124 are listed below.

Aggregate Delivery

This remote operation sends aggregate call record information (i.e. cumulative totals and record number ranges) from a CDGP to a CDCP (over the J interface).

Aggregate Request

This remote operation allows a CDCP to request aggregate information from a CDGP (also over the J interface).

Certified Delivery

A remote operation that allows the reliable transfer of information over the J interface (from CDGP to CDCP). Messages that are not acknowledged will be retransmitted.

<table>
<tr><td colspan="2" align="center">IS-124 Acronym Confusion</td></tr>
<tr><td colspan="2">IS-124 is complicated enough, but it is surrounded by acronyms that refer to subsets or different versions. Consult the table on Page 5 for a summary of IS-124 equipment, network and service vendors, along with the subset of IS-124 that they support.</td></tr>
<tr><td>CIBER</td><td>The fixed record formats that have been used for several years for the exchange of roamer billing records. Maintained by the CTIA subsidiary Cibernet.</td></tr>
<tr><td>DMH</td><td>Just another name for IS-124. It stands for Data Message Handler.</td></tr>
<tr><td>DMH-lite</td><td>A fraud related subset of IS-124 based on pre-publication documents. For this reason its lifespan is limited and incompatibilities with IS-124, as published, exist.</td></tr>
<tr><td>NSDPF</td><td>Non-Signaling Data Protocol for Fraud. A subset of IS-124 being developed under the auspices of Cibernet for fraud detection applications. Initially this was to be restricted to *uncertified* (i.e. unreliable) delivery, but recently certified delivery has been added as an option.</td></tr>
<tr><td>IS–124 Rev. 0</td><td>The current published version.</td></tr>
<tr><td>IS–124 Rev. A</td><td>The proposed next version. Major changes are likely based on errors and omissions discovered during the definition of the NSDPF subset. Implementation of IS-124 Rev. A may be necessary to achieve the desired level of information consistency required for billing and settlement applications.</td></tr>
</table>

Uncertified Delivery

This remote operation transfers the same information as a CertifiedDelivery, but does not require a response. It is more efficient, but only acceptable if the information being transmitted is not considered critical.

Record Request

This remote operation allows a CDCP to request one or more records from a CDGP (over the *J* interface).

Figure 2: IS-124 Message Flow (Example)

Figure 2: IS-124 Message Flow (Example)
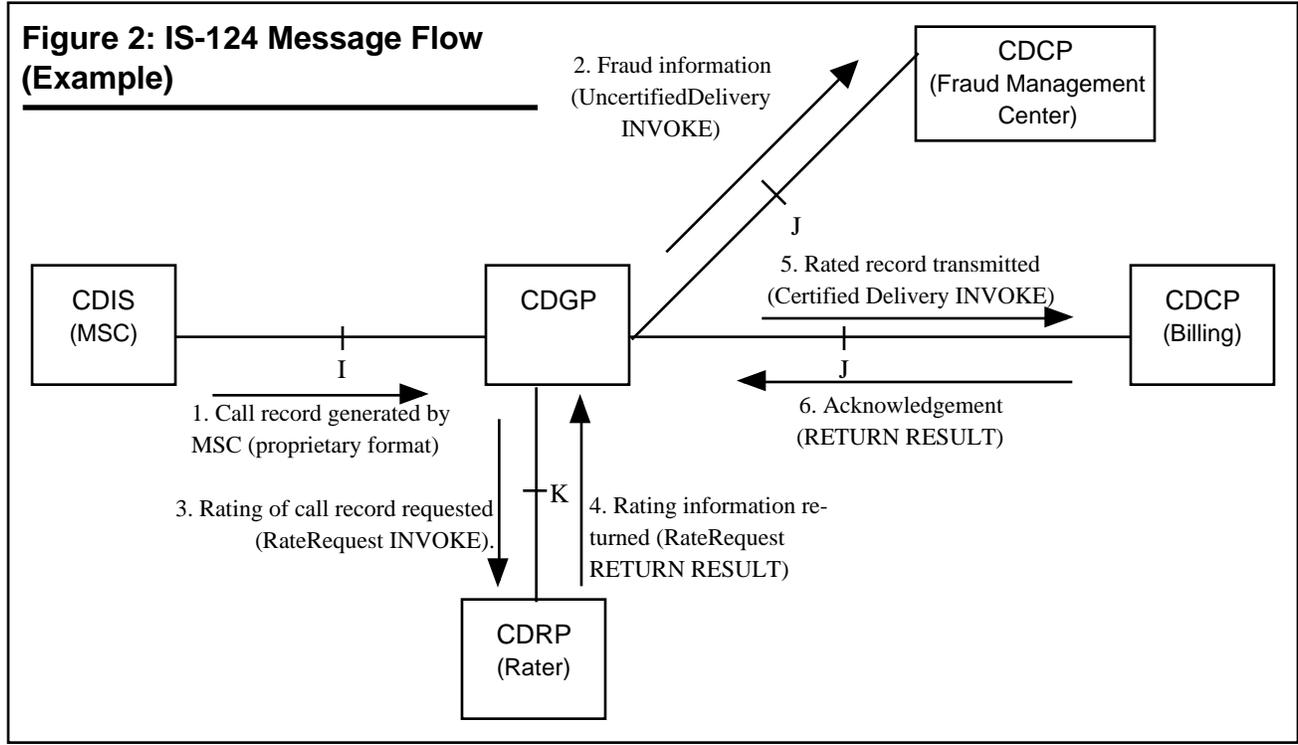
Retransmission Request

This remote operation allows a CDCP to request retransmission of one or more records from a CDGP (over the *J* interface).

Rate Request

This remote operation, the only one on the *K* interface (from CDGP to CDRP), requests rating information for one or more call records. This operation allows preliminary local rating to be performed at a CDRP, to be modified at will by the billing system attached to the CDCP associated with the home system

Field Trials

IS-124 was published by the TIA in September, 1993, yet it is still only in the early stages of implementation. Mc-Caw has DMH-lite implemented extensively for fraud management purposes and will likely migrate to NSDPF when that subset is finalized. US West has tested IS-124 and is ready to use it, but has no partner to connect to at present. We can expect their first connections to another carrier to be with their business partner AirTouch.

Implementation of IS-124 will occur in two phases, first to tackle fraud and then billing and inter-carrier settlement. This does not imply that billing or settlement is less important, but just that the requirements are more stringent. While fraud detection systems can work well with imperfect information, billing systems have to achieve an extremely high level of accuracy. Carriers will want to be sure that (almost) no calls go unbilled, get billed twice or billed inaccurately. Requirements for inter-carrier settlement (bulk compensation for the sharing of facilities between carriers based on wholesale rates) will be almost as stringent.

Field trials of IS-124 fraud applications will occur following finalization of the NSDPF subset document (scheduled for June 1995). It will be published by Cibernet. Following that, the billing subset will be finalized, hopefully by the end of 1995. This document will have a significant impact on IS-124 Revision A, as several errors have been found in IS-124 Revision 0 during the development of NSDPF. Work on IS-124 Revision A may have to be well under way before billing application field trials of IS-124 can begin.

Another hurdle to be overcome before widespread implementation of IS–124 for billing will be upgrading the I interface from a CDIS (e.g. MSC). While this will remain a proprietary interface, it is the source of most IS–124 information. It is likely that all manufacturers of MSC's will require modifications to their AMA/CDR formats to allow accurate billing via IS–124.

IS–124 billing field trials will first begin between carriers within the US and within Canada. Following that US-Canada international field trials will occur, tackling the currency exchange problem. Only then will field trials outside North America (e.g. Mexico, South America and Asia) likely be considered. These will have to deal not only with currency exchange, but also with significant telecommunications differences between the North American Numbering Plan area and other parts of the world.

Summary

Once the very substantial implementation hurdles have been overcome, the IS–124 standard will prove to be as essential to the operation of cellular and PCS downstream processing systems as IS–41 has come to be for call processing. The table on Page 5 indicates substantial activity in this area.◊

Summary of
TIA IS-124 ("DMH")
Equipment & Service Vendors

Cellular
Networking
Perspectives

Editor David Crowe • Phone 403-289-6609 • Fax 403-289-6658

CDIS: Call Detail Information Source

Vendor	Description
Several	The most common information source is an MSC (MTSO). Others are MC, HLR, AC and VLR.

CDGP: Call Detail Generation Point

Vendor	Name	Comments	Version
Coral	FraudBuster GP		NSDPF
GTE	TransAction Manager	Collects data from Motorola, AT&T, Astronet, Ericsson, NT and NovAtel from tape or in real-time	NSDPF
Securicor Wireless Networks	SecuriNet CDGP	Full IS-124 stack, demonstrated at Wireless '95	IS-124
Systems/Link	Collector Box	Collects data from Ericsson, AT&T, Motorola and NTI in real-time	NSDPF, DMH-lite

CDRP: Call Detail Rating Point

Vendor	Name	Comments	Version
GTE	Cell-U-Rator	Message Rating Services	NSDPF
Securicor Wireless Networks	SecuriNet CDRP	IS-124 stack to feed rating engine	IS-124

CDCP: Call Detail Collection Point

Vendor	Name	Comments	Version
Coral	Churn Alert	Monitors calling and mobility patterns for customer care	NSDPF
	FraudBuster	Uses calling profile to detect fraud	NSDPF
GTE	ChurnManager	Proactive & Reactive Customer Retention System	NSDPF
	CloneDetector	Uses calling profile to detect cloning and subscription fraud	NSDPF
Securicor Wireless Networks	SecuriNet CDCP	IS-124 stack to feed custom applications. Demonstrated at Wireless '95 (February, 1995).	IS-124
Systems/Link	FraudTec	Uses calling profile to detect fraud	NSDPF, DMH-lite

Commercial Call Detail Networks

Vendor	Name	Comments	Version
GTE	IREC	Routes Call Detail Records to home carrier	NSDPF
Securicor Wireless Networks	SecuriNet RAMALink	Realtime CDR collection turnkey network development (in use within US West network)	IS-124
Systems/Link	RoamEx	Frame Relay Network connecting over 16 major carriers	NSDPF, DMH-lite

IS-124 Customizable Protocol Stacks

Vendor	Name	Comments	Version
Synacom	DMH PDE	TCP/IP based protocol stack with interfaces for custom applications and testing tools	IS-124, NSDPF