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REVCORD *Revolutionizing Voice Recording*

The 4-1-1 on NG9-1-1

Part I of III

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Overview

Next Generation 9-1-1 (NG9-1-1) has been talked about for years and articles abound on the subject. However in our view those articles are either too simplistic or general or they are simply too technical unless your native language is XML or WSDL. Our goal here is a "Goldilocks" approach. That is, not too much and not too little, but just right. It is more like snorkeling than a deep dive. We don't want to make this overwhelming.

NG9-1-1 is extremely complex and we won't go into any "nuts and bolts" of the various functions. For the purpose of recording every kind of media (voice, text, video, telematics, etc.) will be processed in a standard SIP method. All the outside communications intended for a PSAP, if not already SIP, will be converted to SIP by special devices called gateways at the edge of the NG9-1-1 network (ESInet). All recording will be done exclusively by the SIP Invite method, as opposed to port mirroring. Additionally, there will be many, many events along the route of an emergency call that must be recorded. That is, whenever any functional element "touches" the call, an event will be logged by the NG9-1-1 logger.

Where We Were, Where We Are Now, And Where We Are Going

It all started in 1968 when AT&T and the FCC agreed to create a 9-1-1 plan of action. But before AT&T could act, Bob Gallagher and Robert Fitzgerald of the Alabama Telephone Company beat them to the punch and the first 9-1-1 call was dialed from Haleyville, Alabama on February 16, 1968. However, it wasn't until 1980 when Enhanced 9-1-1 (E9-1-1) was first available which included ANI, ALI, Selective Routers and Selective Transfer. In 1998 Phase I wireless service was introduced which provided the cell phone number and the location of the receiving antenna tower. But, it wasn't until 2001 when Phase II wireless service debuted in a limited way in Illinois. Phase II wireless service provides the number of the cell phone and its location usually by longitude and latitude. And, then came VoIP. Up through 2004 many VoIP callers who tried to reach 9-1-1 were unsuccessful. And, many nomadic VoIP users did not re-register their VoIP phones when they moved causing the misrouting of first responders. In March 2005 the Texas Attorney General sued Vonage regarding the ability to reach 9-1-1 from VoIP phones. Shortly thereafter the FCC issued orders to compel VoIP providers to provide 9-1-1 services to their subscribers. In the ensuing few years NENA issued i2 specifications as an interim solution to the problems regarding VoIP and E9-1-1 calls. Today most states have comprehensive plans and procedures for routing VoIP calls to the correct PSAPs using Voice Positioning Centers (VPCs) and Emergency Service Gateways (ESGWs). Often location information is provided in connection with Shape Files or polygons.

There are more than 240 million 9-1-1 calls annually, placed by mobile devices. That is about two-thirds of all emergency calls. Now, location information for VoIP calls cannot be found by the traditional MSAG (Master Street Address Guide). Rather geospatial, longitude/latitude and polygon shape files determine which PSAP will point emergency response to a VoIP 9-1-1 call. This very complex issue will be dealt with in a separate whitepaper. In the NENA i2 specification

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(started in 2005 with final approval in 2010) a Location Information Server (LIS) is introduced further refining that all important criterion, location, of the person(s) in need of help.

Interestingly, according to some accounts, the genesis of NG9-1-1 began in the FCC in 2002. However most people involved in the project remember the Next Generation 9-1-1 Preliminary Concept of Operations document published by the Department of Transportation in 2005. NENA designated three stages of VoIP and E9-1-1 migration into PSAPs as i1, i2 and i3. NG9-1-1 Proof of Concept was tested by three laboratories and five PSAPs in 2008. Now we are working on release of standards and testing of NG9-1-1 Functional Elements in NENA ICE (Industry Collaboration Events).

Where We Were

Immediate Methods for Voice over Internet (i1) - Routes VoIP calls to the correct PSAP outside the current E9-1-1 system network, optionally with caller ID. That is, usually the wireless call was routed to a PSAP's administrative (7 digit) line. Location was provided by pANI (pseudo ANI) which was the identity of the cell tower closest and its sector.

Where We Are Now

Migratory (Interim) Solution for VoIP (i2) - Routes Voice over Internet and other types of VoIP calls into the current E9-1-1 systems and to the correct PSAP with correct ANI and ALI; accommodates both stationary and nomadic users; provides Master Street Address Guide (MSAG) valid location information. It provides a method for nomadic user location either through an automated process or user input via a service-prompted, web-based form or equivalent. Mobility (wireless VoIP) not supported beyond base station location identification. Provides a single industry adopted solution. In essence this phase two approach added "x" "y" data to the PSAP in addition to phase 1 data.

Where We Are Going

IP-based full E9-1-1 solution (Long Term, i3) = NG9-1-1 - Enable end-to-end, IP-based E9-1-1 design, supporting VoIP-originated call delivery, and the transition of current wireline and wireless service providers to IP interface technology. Support IP mobility users and all capabilities of i2. Utilize extended capabilities of IP to provide location and other information with the call, as well as other subsets of relevant data. Provide a standard NG9-1-1 solution that incorporates all requirements of E9-1-1 and the potential to easily support future IP-based communications devices. All of this is done on a SIP-only network of networks.

The i3, NG9-1-1 standards include:

- NENA 08-751 – Requirements
- NENA 08-002 – Architecture (Stage 2)
- NENA 08-003 (soon to be released) – Detailed interface & functions

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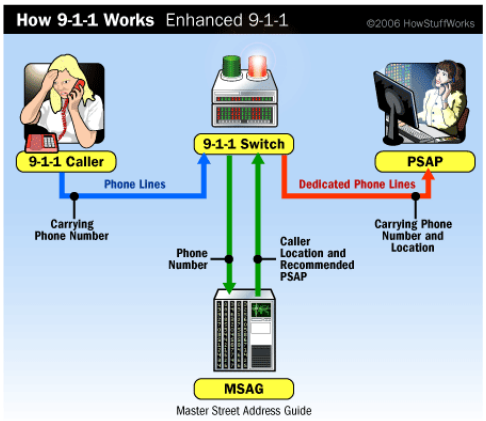
Simple Definition of NG9-1-1

NG9-1-1 is a completely new all IP SIP based network of networks that accepts voice, text, video, telematics and sensor data requests for help generally from police, fire or ambulance services. That is, it is the environment for a SIP based PSAP. From outside the SIP NG9-1-1 network all non-SIP analog, digital TDM, text, video and other legacy communications will be translated into SIP by gateways at the edge of the NG9-1-1 network.

Location, Location, Location

Just like in real estate the most important thing is location. That is, where is the person that needs immediate help? In the good old days of fixed location phones on copper POTS (Plain Old Telephone Service) lines location was derived from 9-1-1 call made to the PSAP. That call was routed through a special tandem switch then that switch routed the call to the selected PSAP via a CAMA (Centralized Automatic Message Accounting) trunk that was originally designed for providing cost accounting of calls. For public safety purposes the caller's number, ANI (Automatic Number Identification) is presented before the first ring in MF (Multi-Frequency) format. That number was then routed to an ALI (Automatic Location Identification) database that delivered the civic address to the PSAP. The ALI database input was from a MSAG (Master Street Address Guide) that tied phone numbers to a physical street address.



Obviously, that won't work for cell phones or other mobile communications devices, as indicated above. Fortunately SIP has fairly recently provided "presence" information that includes PIDF-LO (Presence Information Data Format Location Object). The current version, as used by NG9-1-1, provides either civic (street address) or geodetic location data, which is very accurate. This very complex subject will be covered in a separate whitepaper.

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Some Important Components of NG9-1-1

Spatial Information Function (SIF)

The Spatial Information Function is a special Geospatial Information System. It is the base database for NG9-1-1. Almost all location data is derived from the SIF.

MSAG Conversion Service (MCS)

Historically the Master Street address Guide (MSAG) was the repository of correlation of telephone numbers to street addresses and the MCS is a method to provide information to or get data from a legacy system. The conversion is to and from PDIF-LO in XML format.

LIS –Location Information Server

What is important to know is that i2 introduced the concept of a Location Information Server (LIS). LIS location data is provided outside of the NG9-1-1 network, known as the Emergency Services IP Network (ESInet), an IP-based inter-network (network of networks) shared by all agencies which may be involved in any emergency. All calls presented to the ESInet must be SIP signaled.

The LIS (outside of the ESInet) stores a wiremap (database) of the relationship between a unique identifier for a physical endpoint termination and a location, described as either geo-coordinates or a civic address). The administrator of the LIS is responsible for maintaining this wiremap, and for ensuring that civic location data is pre-validated by a Validation Function. The LIS may be used during location determination. LIS is also a vital part of new wireless technology. LIS is actually outside of the NG9-1-1 network.

LoST – Location to Service Translation

Another vitally important component of NG9-1-1 is the LoST (Location to Service Translation). LoST, XML based, is the protocol that is used for both call routing and location validation. LoST is used by the Emergency Call routing Function (ECRF) to route calls where ever they need to go. For location validation LoST uses the Location Validation Function (LVF)

Location Validation function (LVF)

The LVF does, as the name implies, validate location information by interacting with such functions as LoST and LIS. Rather than go into all the technical details, the LVF is a good example of how the logging service (voice logger) takes on new functions in NG9-1-1. That is, each of the NG9-1-1 functional elements functions and activities relating to an emergency call is defined as an event. In addition to voice, video, text (all transmitted as SIP) media recording, the logging service is required to log events throughout the NG9-1-1 environment. Taking directly from NENA document 08-003 for i3, full NG9-1-1 implementation, the logger must also capture these kinds of events. This is just an example. The Logging Service will be required to log the same kind of events from every component of NG9-1-1 in addition to the media.

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Logging Events

The logging service is actually a web service that records all kinds of media along with the NG9-1-1 events through a logging interface. Below, the LVF events are just a sample of what all functional elements must do.

Typical Event Types to be logged

- CallProcess
- StartCall/End Call
- TransferCall
- Route
- Media
- EndMedia
- Message
- AdditionalAgencey
- MergeIncident
- ClearIncident
- ECRFQuery
- ECRFResponse

Each of these events gets a universally unique LogIdentifier styled as a URI, not unlike an email address.

Event Logging Functions (LVF example)

5.4.3.6 Logging Interface

The LVF must be capable of logging every incoming validation request along with every recursive request and all response messages. In addition, the LVF must log all provisioning and synchronization messages and actions. In addition to the requirement for logging all the same data elements currently defined for logging by the ECRF, we have additional specific data logging requirements.

5.4.3.6.1 Validation query logging

The LVF logging mechanism must be capable of logging all input data elements for a validation query, including the specific input location and service URN. All logging transactions must be stored in the form of transaction detail records, and must be made external when warranted by implementation policy. The data elements logged include the following:

1. Date & Time of transaction
2. Request message type
3. Type of location received
4. Location elements received

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5. Service URN received.

5.4.3.6.2 Validation Response logging

The LVF logging mechanism must be capable of logging all output data elements provided in the validation response message, including the validation response status of each location element. All logging transactions must be stored in the form of transaction detail records, and must be made external when warranted by implementation policy. The data elements logged include the following:

1. Date & Time of transaction
2. Response message type
3. Validation attributes
4. Location element tokens
5. Error Code" values

5.4.3.6.3 Provisioning/Synchronization logging

The LVF logging mechanism must be capable of logging all provisioning input and output messages from an individual provisioning client or another LVF. All logging transactions must be stored in the form of transaction detail records, and must be made external when warranted by implementation policy. The data elements logged include the following:

1. Date & Time of transaction
2. Transaction type (e.g., Add, Delete, Modify)
3. Record information
4. Response acknowledgement

Other Important NG9-1-1 Functions

NG9-1-1 is an all IP SIP network of networks and therefore there are many components that do not exist in today's PSAPs. Now, most everything is still analog with a good percentage of digital TDM phones. In the not too distant future legacy functions will have to communicate with a SIP PSAP.

Border Control Function (BCF)

The BCF sits at the edge of the NG9-1-1 network (ESInet) and performs the functions of a border firewall and session border control.

Emergency Service Routing Proxy (ESRP)

The ESRP is the primary routing function for emergency calls. The "originating ESRP" is the first routing element to receive calls from the BCF in the ESInet and its function is to route the call to the next hop with the "terminating ESRP" being at the edge of the PSAP itself.

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Policy Routing Function

The Policy routing function is the determination of the next hop to which the call should be routed.

Emergency Call Routing function (ECRF)

The ECRF provides call routing to the correct PSAP based on location and then the PSAP will use ECRF to route first responders.

Bridging

All calls (voice, text, video, telematics etc.) are standard SIP in the NG9-1-1 environment. Bridging provides the method to transfer calls and create conferences. For example, recording of NG9-1-1 calls is provided by a SIP bridging. A bridge is required because most IP devices cannot mix media and the bridge provides a focus to mix and transfer. All emergency calls are answered at a bridge and the call leg between the caller and the bridge is maintained to eliminate the possibility of dropping the call. Other functions as required are sent SIP Invites from the bridge. For example, in order to record an NG9-1-1 call the recorder must accept a SIP Invite.

And, of course, the Voice Logger (Logging Service) itself:

Logging Service

Every important processing of an NG9-1-1 call is logged. Logging includes external events, internal events and, of course, media and messages. The logging service is essentially a web service and it also provides RTSP (Real Time Streaming Protocol) for playback. The events that must be logged include every event or process that “touches” the call in the NG9-1-1 environment. Some of the high level media logging indicia tags include CallID, IncidentID, Date Range, and Location along with other call details. An Instant Recall Recorder service is also required for all media types.

In subsequent follow up whitepapers we will explore in more detail the what, why and how of all of the functions of an NG9-1-1 logger and the basics of SIP (Session Initiation Protocol).