March 2010 WORKING GROUP 4A

Best Practices for Reliable 9-1-1 and E9-1-1

Final Report

CSRIC Working Group 4A – Best Practices for Reliable 9-1-1 and E9-1-1

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1. Results in Brief

1.1 Executive Summary

The successful implementation of 9-1-1 and enhanced 9-1-1 (E9-1-1) for voice over IP (VoIP) services depends on the availability of, and adherence to, industry standards and best practices. In 2005, the FCC issued regulations requiring VoIP Service Providers (VSPs) to ensure that consumers of interconnected VoIP service have access to 9-1-1 and E9-1-1[1]. This capability is now available in nearly all parts of the country[2] (for fixed[3] and nomadic[4] interconnected VoIP service) due in large part to the availability of industry standards and best practices. However, a list of all currently applicable standards and best practices is not available in a single location.

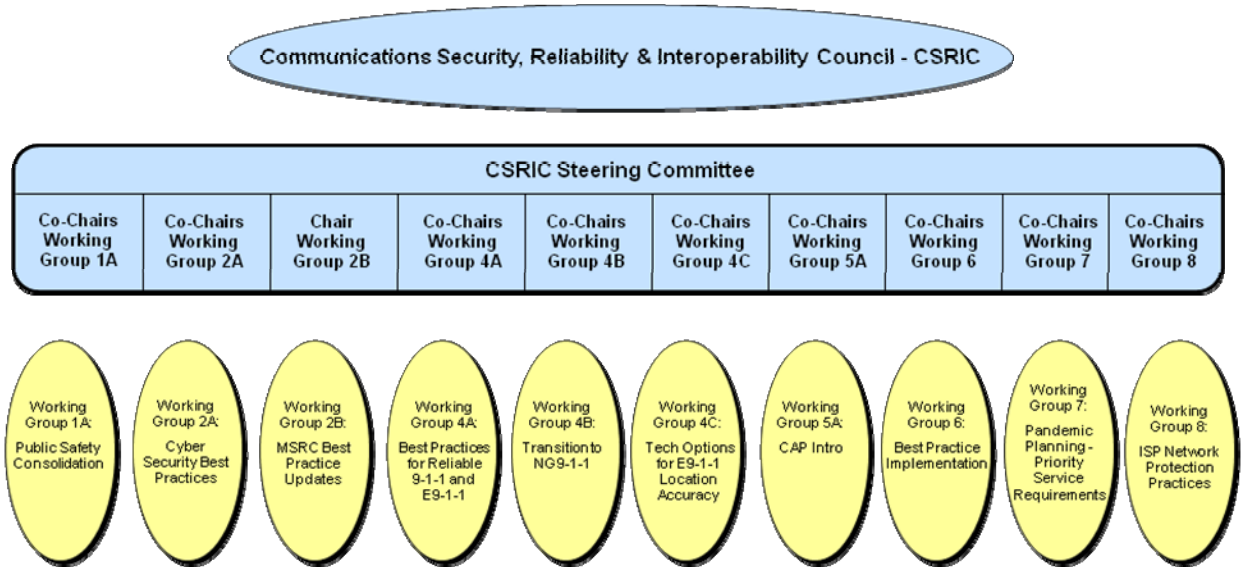
[1] *In the Matter of IP-Enabled Services; E9-1-1 Requirements for IP-Enabled Service Providers*, WC Docket Nos. 04-36 and 05-196, First Report and Order and Notice of Proposed Rulemaking, at ¶¶ 36-51, Rel. Jun. 3, 2005.
[2] The following is California specific availability data, to be seen as an example only;
a) For 2009, 95% of all California's Local Primary PSAPs are deployed with at least one VoIP Positioning Center (VPC) (373 of 393).
b) For 2009, less than 1% of calls in CA are VoIP (145K are VoIP of the total 24.8M E911 calls).
[3] In this context the term "fixed" refers to an IP end-point that cannot move, is always in same location and always accesses a network from the same point (extracted from NENA Master Glossary of E9-1-1 Terms).
[4] A user is said to be nomadic if they are constrained within an access network such that their location can be represented as a definitive civic address for that network attachment. The user may move from one network attachment to another but cannot maintain a session during that move (extracted from NENA Master Glossary of E9-1-1 Terms).

This report is a compilation of existing industry standards and best practices concerning the implementation of 9-1-1 and E9-1-1 for interconnected VoIP services. It also identifies gaps that need to be addressed and identifies the appropriate groups to address the gaps. The areas covered in the report were originally identified in Section 101 of the New and Emerging Technologies 911 Improvement Act of 2008 (codified at 47 U.S.C. § 615a-1(h)) which required the FCC to develop several best practices related to the implementation of 9-1-1 and E9-1-1 service for VoIP Service Providers. This report provides a list of best practices consistent with the requirements of the New and Emerging Technologies 911 Improvement Act.

2. Introduction

Section 101 of the New and Emerging Technologies 911 Improvement Act (codified at 47 U.S.C. § 615a-1(h)) requires the FCC to develop several best practices related to the implementation of 9-1-1 service for IP-enabled voice service providers, commonly known as VoIP Service Providers. While the FCC was tasked with developing several best practices, a significant amount of this information has already been developed. Therefore, Working Group 4A investigated and evaluated currently available 9-1-1 related VoIP standards and best practices related to E9-1-1 for completeness and identified gaps, including challenges related to implementation of such standards by interconnected VoIP Service Providers within the E9-1-1 system. This report presents the results of an evaluation of currently available standards and best practices and recommends to CSRIC how to resolve any incomplete work and gaps and identifies and recommends what groups should perform that work.

2.1 Structure of CSRIC



2.2 Working Group 4A Members

Working Group 4A consists of the following 25 members:

- Anand Akundi, Telcordia
- Steve Barclay, Alliance for Telecommunications Industry Solutions (ATIS)
- Tom Breen, AT&T
- James Byrd, Washington, DC Office of Unified Communications
- Ann Marie Cederberg, Qwest
- Craig Donaldson, Intrado
- Brian Fontes, National Emergency Number Association (NENA) (Working Group 4A Co-Chair)
- John Garner, AT&T
- Roger Hixson, National Emergency Number Association (NENA)
- Tim Hogle, Sprint Nextel
- Randy Hughes, Bureau of Indian Affairs, Office of the CIO
- Doug Jones, Verizon
- Rick Kemper, CTIA
- Rick Krock, Alcatel-Lucent
- Danny Lovett, Charlotte-Mecklenberg Police Department
- John Merklinger, City of Rochester, NY
- Christian Militeau, Intrado
- Bob Moseley, Grand Lodge of the Fraternal Order of Police (FOP)
- Peter Musgrove, Alliance for Telecommunications Industry Solutions (ATIS) (Working Group 4A Co-Chair)
- Steve O'Conor, West Palm Beach Police Department
- Donna Pena, State of California, 9-1-1 Office
- Greg Riddle, Association of Public-Safety Communications Officials (APCO), International
- Greg Schumacher, Sprint
- Norbert Snobeck, U.S. Department of Agriculture
- Jerry Theuns, Motorola

3. Objectives, Scope and Methodology

3.1 Objective

The objective of Working Group 4A was to investigate and identify currently available standards and best practices concerning the implementation of 9-1-1 and E9-1-1 for interconnected VoIP services. Where no current standards or best practices are available, the objective of the report is to identify gaps that need to be addressed and the appropriate groups to address the gaps.

3.2 Scope

The scope of this report is limited to standards and best practices related to the implementation of 9-1-1 and E9-1-1 service for fixed and nomadic VoIP Services. The report does not address any issues related to implementation of 9-1-1 and E9-1-1 for mobile VoIP services and applications.[5] The Working Group recognizes that mobile VoIP services and applications are becoming increasingly available and 9-1-1 capabilities for such services must be considered. However, the Working Group determined that mobile VoIP services were beyond the scope of this report because currently there are no FCC 9-1-1/E9-1-1 requirements concerning mobile VoIP services (which are beyond the reach of the FCC's current rules applicable to interconnected VoIP Service Providers). The Working Group also determined that any standards or best practices related to the internal functions of 9-1-1 System Service Providers (SSPs) responsible for completing 9-1-1 calls originated by a VoIP provider are beyond the scope of this report.

3.3 Methodology

To develop the contents of this report, Working Group 4A first determined the meaning and scope of the six subjects identified in the New and Emerging Technologies 911 Improvement Act for which the FCC was directed to develop best practices. Once there was agreement upon the meaning and scope of each subject, Working Group members researched existing 9-1-1 standards and best practices from any sources that may have applicability to the identified areas. A list of current standards developed by the National Emergency Number Association (NENA), the Alliance for Telecommunications Industry Solutions (ATIS), the Internet Engineering Task Force (IETF) and through the FCC's Network Reliability and Interoperability Council (NRIC) was created. Working group members discussed each of the identified standards to determine their applicability to the areas identified in the New and Emerging Technologies 911 Improvement Act. Those current standards and best practices that were deemed applicable are identified in this report. Standards or best practices that were beyond the Working Group's scope were omitted. Finally, based on this research and review, the Working Group was able to determine where gaps exist and to recommend who should address the gaps.

4. Background

As described above, the catalyst for the work done by Working Group 4A was language included in federal legislation directing the FCC to develop several best practices related to the implementation of 9-1-1 and E9-1-1 service for VoIP Service Providers. Specifically, Section 101 of the New and Emerging Technologies 911 Improvement Act (codified at 47 U.S.C. § 615a-1(h)) requires the FCC to develop several best practices related to the implementation of IP-enabled voice service providers.[6] The statute states as follows:

[5] In the context of location information to support IP based emergency services: A user is said to be mobile if they are able to change access points while preserving all existing sessions and services regardless of who is providing the access network, and their location may be definitively represented by a geographic co-ordinates but only indicatively represented by a civic address (extracted from NENA Master Glossary of E9-1-1 Terms).

[6] As used in this document, the term IP-enabled voice service provider and Voice over-IP service provider are synonymous.

‘‘(h) DEVELOPMENT OF STANDARDS.—The Commission shall work cooperatively with public safety organizations, industry participants, and the E–911 Implementation Coordination Office to develop best practices that promote consistency, where appropriate, including procedures for—

‘‘(1) defining geographic coverage areas for public safety answering points;

‘‘(2) defining network diversity requirements for delivery of IP-enabled 9–1–1 and enhanced 9-1-1 calls;

‘‘(3) call-handling in the event of call overflow or network outages;

‘‘(4) public safety answering point certification and testing requirements;

‘‘(5) validation procedures for inputting and updating location information in relevant databases; and

‘‘(6) the format for delivering address information to public safety answering points.”

5. Analysis, Findings, and Recommendations

5.1 Defining Geographic Coverage Areas for Public Safety Answering Points

For the E9-1-1 system to properly function, every PSAP must have a jurisdictional service boundary in order for originating service providers (wireline, wireless, VoIP) to determine where to route calls. For nomadic VoIP[7], which currently uses an interface method similar to CMRS E9-1-1 service, boundaries are contained in GIS shape files that are utilized for 9-1-1 call routing. However, some PSAPs that are not yet wireless E9-1-1 Phase II capable[8] or lack a GIS system may not have shape files. The process to develop and access shape files was a significant problem with the initial deployment of VoIP E9-1-1 service.

5.1.1 Standards

The following standards already developed apply to this issue and should be implemented by VoIP service providers:

02-010 NENA Standard Data Formats for ALI Data Exchange & GIS Mapping (see sections on MSAG and GIS Model data)

-http://www.nena.org/st http://www.nena.org/general/custom.asp?page=DataFormats

This document sets forth NENA standard formats for data exchange between Service Providers and Data Base Management System Providers, a GIS data model, a Data Dictionary, and formats for data exchange between the ALI Database and PSAP Controller equipment.

02-014 NENA GIS Data Collection and Maintenance Standards

-http://www. http://www.nena.org/general/custom.asp?page=gisdatacollection

[7] Cable based VoIP uses civic addresses and interfaces to E9-1-1 similarly to wireline service, requiring only the normal MSAG based routing control. Shape files are not needed for this form of VoIP.

[8] As of March 2, 2010, 88.3% of 3,135 counties, covering 96.5% of the population, have PSAPs capable of receiving Phase II wireless 9-1-1 calls. 94% of primary PSAPs are Phase II capable. (Source: NENA)

This document is the NENA recommended standard for GIS data collection and GIS data maintenance. The document is meant to provide PSAP management, vendors, and other interested parties necessary guidelines for collecting and maintaining GIS data.

5.1.2 Best Practices

No current best practices were identified that apply to this issue.

5.1.3 Related Documentation

56-504 NENA VoIP Deployment and Operational Guidelines (see section 3.7)
-http://www.nena.org/opera http://www.nena.org/?page=VoIP911_Stnd
This document has been developed as a best practice for the deployment of VoIP E9-1-1 service. As such, its primary goal is to set expectations and improve communications among the parties involved in the deployment process. The intent of this document is to offer guidance to VoIP Service Providers, 9-1-1 Governing Authorities and PSAP Managers/Administrators prior to and during the process of VoIP E9-1-1 deployment. This document specifically addresses VoIP E9-1-1 deployments using dynamic ALI. It does not cover static VoIP using traditional wireline ALI.

57-001B "PSAPs Guide to GIS – NENA White Paper (addressing wireless E9-1-1 implementation issues)
-http://www.nena.org/ http://www.nena.org/?page=WirelessGIS_Guide
This paper includes information on how to best process wireless information coming into the PSAP. Any PSAP that is now, or will be, receiving wireless calls will find this paper useful. This focus of this paper is how to best utilize GIS for wireless calls in the PSAP.

NOTE: 57-001B is applicable herein, with the understanding that only the shape file generation content is applicable to VoIP calls (the rest is wireless-specific).

5.1.4 Gaps

5.1.4.1 CSRIC WG 4A was unable to identify any existing Best Practices that apply specifically to this item. This is seen as a gap that should be filled.

5.1.4.2 VoIP Geocoded Address Inaccuracies – Issue/Gap:
When a traditional 9-1-1 call handled by a VSP is received at the PSAP, sometimes the latitude/longitude (lat/lon) does not correlate exactly to the actual address. Some PSAPs may be receiving the VPC geocoded lat/lon with the VoIP calls from the registered address of fixed and nomadic customers, but this has proved inaccurate in the PSAP mapping equipment. At the PSAP, the CAD or GIS plots the lat/lon but sometimes it does not align with the address provided.

WG 4A recognizes a need to update or create applicable documents to promote best practices to avoid this situation.

The BP could be based on this example:
For VoIP class of service calls, the lat/lon geocoded from the subscriber address should

not be sent to the PSAP, until a completely accurate and synchronized street layer is commonly used between the PSAP and the VPC. This reduces confusion for the call taker and only presents the most accurate and reliable information for dispatching.

5.1.4.3 Common Baseline Imagery for Routing and Mapping – Issue/Gap: VoIP routing is based upon GIS and mapped jurisdictions which are not always accurately based upon a common set of imagery. Currently 9-1-1 Authorities need to use self-obtained imagery to align GIS maps with actual accurate data to align streets and jurisdictional boundaries. This is costly and requires updates depending on the cultural development. In addition, this common imagery can be used at the PSAP's mapping equipment to help with emergency response. Working in a win-win environment, National Geospatial-Intelligence Agency could provide timely and accurate imagery and in return can obtain the accurate PSAP jurisdictional boundaries for their Homeland Security Infrastructure Protection (HSIP) Program.

The BP could be based on this example:
Allow public safety authorities access to DHS – NGA (Dept. of Homeland Security – National Geospatial-Intelligence Agency) data that can be provided on a monthly basis or as needed. Promote that 9-1-1 is of importance for public safety and to National Intelligence.

5.1.5 Recommendations

CSRIC WG 4B should use the input provided by WG 4A (above and herein as applicable) to update existing NRIC BPs to make it clear that the appropriate stakeholder(s) should consider adopting them. Also WG 4B should create new BPs where WG 4A has identified there are no existing BPs to cover specific subject matter applicable to reliable delivery of 9-1-1 calls in a VoIP environment.

5.2 Defining Network Diversity Requirements for Delivery of IP-enabled 9-1-1 and Enhanced 9-1-1 Calls

There are numerous NENA and NRIC standards and best practices that address network diversity. There are no known diversity requirements unique to VoIP service from the service provider to the Selective Routing switch. Therefore current standards, though not written specifically for VoIP, apply equally to VoIP. However, some NRIC best practices may need to be updated to specifically refer to VoIP as type of originating service. From the Selective Router to the PSAP, there is no need for VoIP only trunks since VoIP 9-1-1 calls route over current trunk types. Therefore, standards and best practices for wireless or wireline 9-1-1 diversification apply to VoIP as well.

5.2.1 Standards

The following existing standards apply to this issue and should be implemented by VoIP service providers:

03-006 NENA Standards for E9-1-1 Call Congestion Management: NENA E9-1-1 Technical Standard that defines network diversity requirements (see section 2.3)

-http://www.nena.org/?page=E911CallCongestion-management

This document provides a framework for consideration of the various factors impacting the management of call congestion and traffic engineering for E9-1-1 networks. A network reference model is provided for use in referring to generic E9-1-1 network entities. This is followed by a section that outlines generally accepted industry practices for traffic engineering for E9-1-1 networks. This document is intended to provide greater parity among all any type of E9-1-1 call, regardless of the source of its origination (wireless, traditional landline, VoIP, PBX/MLTS, etc.).

57-001 Wireless E9-1-1 Overflow, Default and Diverse Routing Operational Standard

-http://www.nena.org/?page=WirelessRoutingStnd

This document was developed to provide guidance in the routing development associated with wireless Phase I and Phase II deployment efforts. This document provides recommended terminology definitions, describes each call routing scenario, and associated routing recommendations.

NOTE: 57-001 is applicable for item 5.2 with the caveat that only the diverse routing content is applicable to VoIP calls (the rest is wireless-specific).

03-008 NENA Standard for E9-1-1 Default Assignment and Call Routing Functions

-http://www.nena.org/?page=CallRoutingFunctions all-routing-functions

This document provides an overview of various database and network specifications and requirements related to Default Routing of 9-1-1 calls. It is intended to help local authority; database and/or network administrators select a model for the development of standard default routing arrangements. It identifies and defines methods used to assign defaults and route 9-1-1 calls when circumstances prevent normal selective routing.

08-001 NENA Interim VoIP Architecture for Enhanced 9-1-1 Services (i2) (see section 2.8)

-http://www.nena.org/?page=Interim_VoIP_i2

This document is the NENA recommended standard for the i2 architecture to support the interconnection of VoIP domains with the existing Emergency Services Network infrastructure in support of the migration toward end-to-end emergency calling over VoIP networks between callers and PSAPs.

5.2.2 Best Practices

The following existing best practices apply to this issue and VoIP Service Providers should consider adopting them (although some may need modification to specifically include VoIP or VSPs):

BP 7-7-0566

Network Operators and Service Providers should consider placing and maintaining 9-1-1 circuits over diverse interoffice transport facilities (e.g., geographically diverse facility routes, automatically invoked standby routing, diverse digital cross-connect system services, self-

healing fiber ring topologies, or any combination thereof).
[Also see Gap statement 5.2.4 below.]

BP 7-7-0567
Network Operators and Service Providers should spread 9-1-1 circuits over similar pieces of equipment to avoid single points of failure (SPOF). They should also mark each plug-in level component and frame termination with a red tag to notify maintenance personnel that the equipment is used for critical, essential services and is to be treated with a high level of care.
[Also see Gap statement 5.2.4 below.]

BP 7-7-0575
Network Operators and Service Providers should deploy Diverse Automatic Location Identification systems used in Public Safety (e.g., Automatic Location Identification and Mobile Positioning Center systems) in a redundant, geographically diverse fashion (i.e. two identical ALI/MPC data base systems with mirrored data located in geographically diverse locations).
[Also see Gap statement 5.2.4 below.]

BP 7-7-3224
E9-1-1 Dedicated Trunking: Network Operators and Service Providers should use dedicated Signaling System 7 (SS7) or Multi Frequency (MF) controlled trunk groups for the normal routing of E9-1-1 calls from originating switching entities to E9-1-1 Selective Routers rather than using shared Public Switched Telephone Network trunking.

5.2.3 Related Documentation

03-501 NENA Network Quality Assurance
-http://www.nena.o http://www.nena.org/?page=NtwkQualityAssurance
This Technical Information Document (TID) details NENA's recommendations on how to design and deploy fault tolerant networks that eliminate, to the greatest extent possible, single points of failure that will prevent the successful routing of 9-1-1 calls. (See especially section 3)

03-508 NENA Impacts of Using a Common Trunk Group to Carry Calls of Multiple Service Types Into a Legacy Selective Router http://www.nena.org/?page=MultipleSvcTypeCalls
The purpose of this document is to discuss the impacts upon the E9-1-1 system when multiple service types of E9-1-1 calls are delivered over one common E9-1-1 trunk group. PSAP and E9-1-1 operations may be impacted if calls from multiple service types (i.e. wire-line, wireless, WiFi, cable, etc) are combined on a single trunk group from a carrier's or aggregator's network to the E9-1-1 service provider's selective router or E9-1-1 tandem.

5.2.4 Gaps

The following gaps exist for this issue and should be addressed:

5.2.4.1 CSRIC WG 4A believes BP 7-7-0566, 7-7-0567 (and others) need to be reviewed and investigated to determine applicability to VoIP, and then updated as needed to specifically address VoIP and VSPs.

5.2.4.2 CSRIC WG 4A believes BP 7-7-0575 needs to be modified to clarify its applicability to VoIP by stipulating that VoIP Positioning Center systems (VPC) should also be considered as covered elements, along with ALI and MPC.

5.2.4.3 See section 5.4.4, ESGW Testing gap, which may also apply here.

5.2.5 Recommendations

CSRIC WG 4B should use the input provided by WG 4A (above and herein as applicable) to update existing NRIC BPs to make it clear that the appropriate stakeholder(s) should consider adopting them. Also WG 4B should create new BPs where WG 4A has identified there are no existing BPs to cover specific subject matter applicable to reliable delivery of 9-1-1 calls in a VoIP environment.

5.3 Call-handling in the Event of Call Overflow or Network Outages

At a minimum VoIP service should be handled in the same manner and with the same quality of service as other classes of service, including call overflow and network outage conditions.

5.3.1 Standards

The following existing standards apply to this issue and should be implemented by VoIP service providers and their related ESGW network providers:

03-006 NENA Standard for E9-1-1 Call Congestion Management:
NENA E9-1-1 Technical Standard that defines network diversity requirements (see section 2.3)
-http://www.nena.org/?page=E911CallCongestion stion-management
This document provides a framework for consideration of the various factors impacting the management of call congestion and traffic engineering for E9-1-1 networks. A network reference model is provided for use in referring to generic E9-1-1 network entities. This is followed by a section that outlines generally accepted industry practices for traffic engineering for E9-1-1 networks.http://www.nena.org/?page=WirelessRoutingStnd 1804.pdf

03-008 NENA Standard for E9-1-1 Default Assignment and Call Routing Functions
-http://www.nena.org/?page=CallRoutingFunctions uting-functions
This document provides an overview of various database and network specifications and requirements related to Default Routing of 9-1-1 calls. It is intended to help local authority; database and/or network administrators select a model in the development of standard default routing arrangements. It identifies and defines methods used to assign defaults and route 9-1-1 calls when circumstances prevent normal selective routing.

57-001 Wireless E9-1-1 Overflow, Default and Diverse Routing Operational Standard
-http://www.nena.org/?page=WirelessRoutingStnd
This document was developed to provide guidance in the routing development associated with wireless Phase I and Phase II deployment efforts. This document provides recommended

terminology definitions, describes each call routing scenario, and associated routing recommendations.

NOTE:57-001 is applicable for item 5.3 with the caveat that only the diverse routing content is applicable to VoIP calls (the rest is wireless-specific).

5.3.2 Best Practices

The following best practices already developed apply to this issue and VoIP service providers should consider adopting them (although some may need modification to specifically include VoIP or VSPs):

BP 7-7-0574
Network Operators and Service Providers should remotely monitor and manage the 9-1-1 network components using network management controls, where available, to quickly restore 9-1-1 service and provide priority repair during network failure events.
[Also see Gap statement 5.3.4 below.]

BP 7-7-0758
Network Operators and Service Providers should, upon restoration of service in the case of an outage where 9-1-1 call completion is affected, make multiple test calls to the affected PSAP(s) to ensure proper completion.

5.3.3 Related Documentation

03-501 NENA Network Quality Assurance
-http://www.nena.org/s http://www.nena.org/?page=NtwkQualityAssurance
This TID details NENA's recommendations on how to design and deploy fault tolerant networks that eliminate, as much as possible, single points of failure that will prevent the successful routing of 9-1-1 calls. (See especially section 3)

56-504 NENA VoIP Deployment and Operational Guidelines: minimum requirements for VoIP E9-1-1 Implementation Guidelines – defines minimum testing, training and technical maintenance issues required for providers to interconnect to the E9-1-1 system (see especially section3.7.3)
-http://www.nena http://www.nena.org/?page=VoIP911_Stnd onal-guidelines
This document has been developed as a best practice for the deployment of VoIP E9-1-1 service. As such, its primary goal is to set expectations and improve communications among the parties involved in the deployment process. The intent of this document is to offer guidance to VoIP Service Providers, 9-1-1 Governing Authorities and PSAP Managers/Administrators prior to and during the process of VoIP E9-1-1 deployment. This document specifically addresses VoIP E9-1-1 deployments using dynamic ALI. It does not cover static VoIP using traditional wireline ALI.

5.3.4 Gaps

The following gaps exist for this issue that should be addressed:

5.3.4.1 Upon CSRIC WG 4A's first look into NRIC BP 7-5-0569 it appeared that it may apply to item 5.3 (Call-handling in the Event of Call Overflow or Network Outages). However, further analysis determined this BP should not be applicable to any 9-1-1 call delivery stakeholders "as written". CSRIC WG 4A does not want any 9-1-1 call delivery stakeholders, VSP or otherwise, bypassing acceptable congestion control techniques. Therefore, this is a gap in the NRIC BPs, because it is not worded correctly and needs to be updated.

5.3.4.2 CSRIC WG 4A believes BP 7-7-0574 (and others) need to be reviewed and investigated to determine applicability to VoIP, and then updated as needed to specifically address VoIP and VSPs

5.3.5 Recommendations

CSRIC WG 4B should use the input provided by WG 4A (above and herein as applicable) to update existing NRIC BPs to make it clear that the appropriate stakeholder(s) should consider adopting them. Also WG 4B should create new BPs where WG 4A has identified there are no existing BPs to cover specific subject matter applicable to reliable delivery of 9-1-1 calls in a VoIP environment.

5.4 Public Safety Answering Point Certification and Testing Requirements

Minimum requirements and testing requirements are usually determined by local 9-1-1 governing authorities working in connection the 9-1-1 System Service Provider (SSP). Generally, minimum requirements are established over an entire service area by the SSP, but there may be additional requirements established by the 9-1-1 Governing Authority.

5.4.1 Standards

No existing standards were identified that apply to this issue.

5.4.2 Best Practices

The following best practices already developed apply to this issue and VoIP service providers should consider adopting them (although some may need modification to specifically include VoIP or VSPs):

BP 7-7-0577
Network Operators, Service Providers and Public Safety Agencies responsible for PSAP operations should jointly and periodically test and verify that critical components (*e.g.*, automatic re-routes, PSAP Make Busy keys) included in contingency plans work as designed.

NOTE: BP 7-7-0579, 7-7-0599, 7-7-3211 are also applicable, but highly redundant to 7-7-0577. They all address disaster planning and testing of such plans on a routine basis. Perhaps those four BPs should be reevaluated to see if they could be combined into one comprehensive BP covering this subject. CSRIC WG 4A stops short of describing this as a "gap", but does feel it deserves consideration as other BP related gaps might be addressed in the future.

BP 7-7-0655
Network Operators, Service Providers and Property Managers should coordinate hurricane and other disaster restoration work with electrical and other utilities as appropriate.

BP 7-7-0780
Network Operators and Service Providers should consider including coordination information of Public Safety Authorities when developing disaster restoration and prioritization plans.

NOTE: BP 7-7-0655 and 7-7-0780 don't exactly fit item 5.4, but it appears to be the most appropriate section.

5.4.3 Related Documentation

56-504 NENA VoIP Deployment and Operational Guidelines: minimum requirements for VoIP E9-1-1 Implementation Guidelines – defines minimum testing, training and technical maintenance issues required for providers to interconnect to the E9-1-1 system. (see sections 3.5 and 5.1)

- http://www.nena.org/?page=VoIP911_Stnd tional-guidelines

This document has been developed as a best practice for the deployment of VoIP E9-1-1 service. As such, its primary goal is to set expectations and improve communications among the parties involved in the deployment process. The intent of this document is to offer guidance to VoIP Service Providers, 9-1-1 Governing Authorities and PSAP Managers/Administrators prior to and during the process of VoIP E9-1-1 deployment. This document specifically addresses VoIP E9-1-1 deployments using dynamic ALI. It does not cover static VoIP using traditional wireline ALI.

ATIS-0500009: High Level Requirements for End-to-End Functional Testing (*ESIF Technical Report*)

- http://www.atis.org/docstore/product.aspx?id=22695

This document concerns wireless (cellular) E9-1-1 testing, but does have information on testing that relates to all elements of the emergency services network and the PSAP CPE/ALI network, so some parts may be applicable to those common system elements also used by VoIP E9-1-1 service.

5.4.4 Gaps

The following gaps exist for this issue that should be addressed:

5.4.4.1 BP 7-7-0488 is not directly applicable to VoIP, but the concepts as written for wireless can be applicable to VSPs. Therefore, this NRIC BP, like others really constitutes a gap in the NRIC BPs because as written it is wireless specific. CSRIC WG 4A believes this BP (and others) need to be reviewed and investigated to determine applicability to VoIP and then updated as needed to specifically address VoIP and VSPs.

5.4.4.2 WG 4A recognizes a need for a new CSRIC sanctioned BP supporting the notion that VSPs should consider following the NENA recommendation to test all ESQKs before use. Such a BP should also address the gap surrounding the need for an up to date provisioned ESQK list to allow the VPC operators to know which ESQKs to test.

5.4.4.3 VSP Campus Testing – Issue/Gap:
When campus or enterprise systems convert to VoIP, the customer address provisioning performed by installers can be inaccurate and result in misrouted E9-1-1 calls. As such, WG 4A recognizes a need to update or create applicable documents to promote best practices for VoIP that are similarly used for legacy PBX environments, and encourage VoIP service and equipment providers to perform additional testing for large or higher risk environments. We recommend that VPCs include additional testing. The BP should recognize that the Campus end user customer is an important stakeholder in this effort, and should encourage them to participate in testing with the VSP and equipment providers.

The BP could be based on this example:
VPCs can require additional testing for environments that have a high user capacity. This immediately reduces the risk of misrouting a block of callers at a particular facility and in turn reduces the liability for entities.

5.4.4.4 ESGW Testing – Issue/Gap:
When a VPC changes an ESGW provider, end-to-end testing is not always performed, which creates a risk of not delivering E9-1-1 calls.

WG 4A recognizes a need to update or create applicable documents to promote best practices to avoid this situation

The BP could be based on this example:
VPC shall coordinate and perform necessary testing of all new paths with ESRNs to make sure E9-1-1 calls are being delivered.

5.4.4.5 VSP Voice call compression – Issue/Gap:
VoIP calls do not come through as clearly as traditional analog or digital calls for E9-1-1. VSPs compress calls to maximize capacity within their networks, in which 9-1-1 calls are not given any priority or special treatment to ensure that all possible voice quality and background sounds are accurately heard by the PSAP call taker.

WG 4A recognizes a need to update or create applicable documents to promote reliable

and higher quality E9-1-1 Voice over IP for the PSAP. Specific considerations will need to be made based upon the available IP connection bandwidth in a fixed or nomadic environment.

The BP could be based on this example:
For 9-1-1 calls, the VSP shall prioritize the voice data and use the highest quality compression CODEC available. Since this only pertains to a small percentage of actual call volume, the VSP should be able to accommodate providing reliable and quality service.

ALTERNATE APPROACH TO VSP VOICE CALL COMPRESSION:
VSP UAC's must set priority on emergency calls (SIP resource priority – RFC 4412). They should also apply a toll quality CODEC (G.711 or better) and to the extent possible, apply prioritization of elements in their control (proxies, etc.) over call control aspects.

Additionally, the VSP should adhere to the recommendations in the IETF phonebcp for UAC design. Although it is still in draft, it is presumed to become an IETF RFC soon. Here is a link: http://tools.ietf.org/html/draft-ietf-ecrit-phonebcp-14

5.4.5 Recommendations

CSRIC WG 4B should use the input provided by WG 4A (above and herein as applicable) to update existing NRIC BPs to make it clear that the appropriate stakeholder(s) should consider adopting them. Also WG 4B should create new BPs where WG 4A has identified there are no existing BPs to cover specific subject matter applicable to reliable delivery of 9-1-1 calls in a VoIP environment.

5.5 Validation Procedures for Inputting and Updating Location Information in Relevant Databases

The exact intent of Congress is unclear in the language "validation procedures for inputting and updating location information in relevant databases." The location validation procedure for VoIP using a registered address would either occur when data is entered into the database of a VoIP provider or in a VPC database. The likely issue here is acquiring MSAG information and getting it to either the VoIP or VPC provider. In large part, the issue may be concerned with the process of obtaining MSAG data from the controller of the MSAG data, either a 9-1-1 System Service Provider or the 9-1-1 Governing Authority. This may be more of a business or process issue than a standards or best practices issue. Best practices/processes are being defined for location data in publishable databases maintained by public safety, accessible by authorized service providers, for NG9-1-1.

5.5.1 Standards

The following existing standards apply to this issue and should be implemented by VoIP service providers:

04-005 v1 NENA ALI Query Service (AQS) Standard
http://www.nena.org/sta http://www.nena.org/general/custom.asp?page=ALI_Query_Service
This document defines the NENA XML ALI Query Service (AQS) that specifies new protocols between the PSAP and the Next Generation Emergency Services Network (NGESN). It provides the rationale behind the AQS and how it relates to the current ALI protocol. It also provides an overview of implementation alternatives (bindings) described in detail within the document.

NENA Addressing Systems (physical book)
A TRAINING GUIDE FOR 9-1-1
www.nena.org/store (*at the above web page, select "Books", then scroll to find this item*)

The goal of any addressing system is to create an efficient system that is geared toward public safety, is usable and understandable, is easy to maintain, and can be used by everyone, even a child. This sounds easy, but as those who are involved with addressing will bear witness, it is not straightforward or a simple task to accomplish. It requires planning, organization, coordination, cooperation, and an eye for detail.

Most areas use a combination of addressing systems covered in this book. Some addressing schemes work better in urban areas, some work better in rural areas, and many are a hybrid of two or more addressing schemes. The factors that determine the approach to use for addressing always come down to a few basics. The addressing system used must be easy to follow, easy to understand, easy to update, and easy to maintain.

5.5.2 Best Practices

No existing best practices were identified for this issue.

5.5.3 Related Documentation

56-504 NENA VoIP Deployment and Operational Guidelines: minimum requirements for VoIP E9-1-1 Implementation Guidelines – defines minimum testing, training and technical maintenance issues required for providers to interconnect to the E9-1-1 system. See section 3.7 regarding validation.
http://www.nena.org/?page=VoIP911_Stnd
-http://www.nena.org/media/File/NENAVoIPDeploymentOIFinal060606a.pdf

This document has been developed as a best practice for the deployment of VoIP E9-1-1 service. As such, its primary goal is to set expectations and improve communications among the parties involved in the deployment process. The intent of this document is to offer guidance to VoIP Service Providers, 9-1-1 Governing Authorities and PSAP Managers/Administrators prior to and during the process of VoIP E9-1-1 deployment. This document specifically addresses VoIP E9-

1-1 deployments using dynamic ALI. It does not cover static VoIP using traditional wireline ALI.

5.5.4 Gaps

5.5.4.1 CSRIC WG 4A was unable to identify any existing Best Practices that apply specifically to this item. This is seen as a gap that should be filled.

5.5.4.2 VSP (CLEC) old/prior ALISA data – Issue/Gap:
Some PSAP CPE permits the calltaker to use a manual query, and when it is used on a VoIP call the old/prior address location presents on the ALI screen.

WG 4A recognizes a need to solve this problem at the source, and have ILEC/CLECs remove old data from legacy databases when VSPs transfer customers to a VPC from an ILEC. Eliminating the potential of PSAPs retrieving the wrong location data will improve the reliability to always use the correct address information.

The BP could be based on this example;
When CLECs migrate from legacy to dynamic ALI routing using a VPC, the old customer data in the legacy databases shall be removed. When old data records are removed, the database costs are reduced for the 9-1-1 Authority. PSAP training also helps to make sure call takers do not depend on a manual query for any call delivered with an ESQK (VoIP pANI) via a VPC. It is also possible to include parameters in CPE that do not allow manual queries when an ESQK is present.

5.5.4.3 Harassing VoIP Callers – Issue/Gap:
VSP – Traditional users who provide a "registered address" can intentionally provision the wrong address and spam E9-1-1 calls to the PSAP.

WG 4A recognizes a need to mitigate this problem to the extent possible through standards that provide aggressive methods to block these calls in the network today, as well as prepare for the future of controlling congestion in the emergency Services IP Network (ESInet) before getting to the PSAP.

The BP could be based on this example, but this decision should be made after a thorough review by the appropriate industry experts;

Proposed Practice 1: Upon contacting the VPC, the call should be blocked at the source being the VSP immediately. The VSP shall control the port and the IP of the caller and provide any and all exigent information about the location of the caller to the PSAP for enforcement purposes. If the VSP is outside the country, the VPC shall be permitted to notify and block all calls from the VSP until resolved.

Proposed Practice 2: Some VSPs that are in fixed locations are able to validate the address location along with GPS from the device (like a femtocell) and prohibit inaccurate address provisioning.

5.5.5 Recommendations

CSRIC WG 4B should use the input provided by WG 4A (above and herein as applicable) to update existing NRIC BPs to make it clear that the appropriate stakeholder(s) should consider adopting them. Also, WG 4B should create new BPs where WG 4A has identified there are no existing BPs to cover specific subject matter applicable to reliable delivery of 9-1-1 calls in a VoIP environment.

5.6 Format for Delivering Address Information to Public Safety Answering Points

For Internet-based VoIP service, which is a wireline-equivalent service, this issue primarily relates to the storage format in the ALI servers (often erroneously assumed to be the transmission format sent to the PSAP), which can vary among various E9-1-1 systems and SSPs. Optimally, VPC providers must match their dynamic update data field content to the established ALI storage process and structure, so that both the VoIP and wireline data field content in the ALI servers are the same. This may mean differences from one SSP to another. In addition, differences in data field content may be driven by scenarios based on whether the target PSAP has PSAP controller equipment that can or cannot reformat the data flow transmitted from the E9-1-1 system ALI servers. For PSAPs where the equipment cannot reformat the ALI server data transmission for screen display, PSAPs may have specific requirements for how the individual VoIP data items are to be displayed to the calltaker, which may then require that the VPC dynamic data field content differ between PSAPs. VoIP and VPC providers may view these differences as complicating and undesirable. From a standards perspective, the solution to these complications is to move to XML tagged data throughout the 9-1-1 system, rather than revise the current system structure and assignments in the short term. XML tagged data has been and is being addressed by the NENA Data Committee and Data Development WG.

5.6.1 Standards

The following existing standards apply to this issue and should be implemented by VoIP service providers:

02-010 NENA Standard Data Formats for ALI Data Exchange & GIS Mapping
-http://www.n http://www.nena.org/general/custom.asp?page=DataFormats
This document sets forth NENA standard formats for data exchange between Service Providers and Data Base Management System Providers, a GIS data model, and a Data Dictionary. The standard concerns exchange between originating service providers and system service providers (SSPs) and proposes a (future) XML format for transmission to the PSAP. See especially Exhibits 5 – 15.

RFC 4119 IETF: A Presence-based GEOPRIV Location Object Format

-http://tools.ietf.org/html/rfc4119

This document does not invent any format for location information itself. Numerous existing formats based on civic location, geographic coordinates, and the like, have been developed in other standards fora. Instead, this document defines an object that is suitable both for identifying and encapsulating preexisting location information formats, and for providing adequate security and policy controls to regulate the distribution of location information over the Internet.

NOTE: RFC 4119 IETF is applicable herein, with the understanding that XML-tagged data is more relevant within NG9-1-1 systems than current E9-1-1 systems. Inclusion of it here as an applicable Standard should not be seen as advocating support for XML tagging within E9-1-1 systems.

5.6.2 Best Practices

No existing best practices were identified for this issue.

5.6.3 Related Documentation

02-501 NENA Wireless (Pre-XML) Static and Dynamic ALI Data Content Technical Information Document

-http://www.nena.org/standards/technical/data/wireless-ali-data-content http://www.nena.org/general/custom.asp?page=wireless_ali_data

This TID identifies wireless ALI data content for dynamic and static ALI data field content definitions and recommendations. Concepts are generally applicable to both cellular and Internet VoIP.

http://www.nena.org/media/File/02-503_20070223_2.pdf**02-503 NENA Technical Information Document on XML Namespaces**

-http://www.nena.org/standards/technical/data/xml-namespaces http://www.nena.org/general/custom.asp?page=XML_Namespaces

This document is dedicated to namespaces as used in XML technologies. It is intended to provide a non technical introduction to the concept of namespace and a relatively complete overview of the specific characteristics of XML namespaces

NOTE: 02-503 is applicable herein, with the understanding that XML-tagged data is more relevant within NG9-1-1 systems than current E9-1-1 systems. Inclusion of it here as an applicable standard should not be seen as advocating support for XML tagging within E9-1-1 systems.

ATIS-0500012: Location Acquisition for Internet Access in Support of Emergency Services

-http://www.atis.org/docstore/product.aspx?id=22766

This ATIS Technical Report is not intended to be seen as an American National Standard (ANS). Rather it is intended to be used as input to further decision-making processes leading to any necessary policy and/or American National Standard formulation. It will be used as a vehicle for communicating location acquisition concepts in liaisons with other relevant Standards. This document describes the specific areas of location acquisition in Internet Protocol (IP) access networks. It concerns itself with both the architectures and protocols for supporting these functions. In brief, this is about the manner in which IP devices such as VoIP clients obtain

location information from an access network – location acquisition. For emergency services to work as envisioned by the NENA defined i2 architecture for VoIP, location must be available to route the call to a PSAP and to provide the call taker with the caller's location. This information is required in the NENA i2 architecture and will continue to be required in the NENA i3 architecture. This document starts by describing the mechanisms by which a client might obtain location or by which a network might provide location to or on behalf of a client. There are a number of location acquisition protocols which might be used, including DHCP, LLDP-MED, LREP-SIP, HELD, RELO, and LCP. This document provides a targeted analysis of each, but it does not presume that any single protocol will be used universally.

5.6.4 Gaps

5.6.4.1 CSRIC WG 4A was unable to identify any existing Best Practices that apply specifically to this item. This is seen as a gap that should be filled.

5.6.4.2 VSP (IP/VRS) ALI Data – Issue/Gap:
For VSP (IP/VRS) calls, the ALI shall include an indication that a relay call is incoming to the PSAP. During the initial translation delays of a relay call, the call taker may hear silence and hang up on the caller resulting in the caller to call back.

WG 4A recognizes a need to update or create applicable documents to promote best practices and educate VSPs (IP/VRS).

The BP could be based on this example;
In the existing ALI subscriber name field, the IP/VRS company along with “Relay Caller” can be used to alert the PSAP call taker to initiate the appropriate SOP for handling relay calls along with expecting translation delays. This improves the reliably of handling the call by not mistaking it for an abandoned call. Also, the IP/VRS interpreter can incorporate additional operating procedures when relaying a 9-1-1 call and initiate an introduction immediately after the PSAP greeting, before interpreting back to the 9-1-1 caller.

5.6.5 Recommendations

CSRIC WG 4B should use the input provided by WG 4A (above and herein as applicable) to update existing NRIC BPs to make it clear that the appropriate stakeholder(s) should consider adopting them. Also WG 4B should create new BPs where WG 4A has identified there are no existing BPs to cover specific subject matter applicable to reliable delivery of 9-1-1 calls in a VoIP environment.

6. Conclusions

As shown in the gaps listed in this Report (above & below in Appendix A), CSRIC WG 4A recognizes a need to update or create applicable documentation to promote CSRIC sanctioned Best Practices, but those specific decisions should only be made after a thorough review by the appropriate industry experts. WG 4A believes that anchoring this responsibility within CSRIC

WG 4B will expose these gaps to a wide audience of appropriate industry experts. WG 4A also believes that it is in the best interests of Public Safety to grant WG 4B latitude to reach out to other subject matter experts as needed, such as (but not limited to) experts participating in other CSRIC Working Groups.

7. Appendix A

Gaps unrelated to the six items enumerated in section 101 of the New and Emerging Technologies 911 Improvement Act of 2008

CSRIC WG 4A wishes to draw attention to the following topics that may need to be reviewed by the appropriate industry experts to determine if there is a need for specific CSRIC sanctioned Best Practices to help ensure the reliability 9-1-1 calls initiated using VoIP services.

Routing and Network Reliability Areas Needing Attention

1) **ESQK Provisioned List**

- *Issue/Gap:* ESQKs requested by VPCs are not accurately provisioned in the ILEC network and E9-1-1 calls are either routed to the wrong PSAP or not routed at all.

2) **10-digit PSAP Backup Numbers**

- *Issue/Gap:* The VPCs do not have an accurate list of 10-digit numbers on which the PSAP would like to receive their VoIP calls when E9-1-1 routing is not available. This 10-digit number may be extremely unique to the PSAP depending upon how they set up their PSTN lines and is not necessarily their published emergency or non-emergency number.

3) **ESGW Provisioning**

- *Issue/Gap:* ESGWs that are a critical link between the VPC and the S/R entity run the risk of having congestion of VoIP service block legacy call if both technologies are combined on the same paths.

4) **VSP Mobile Application providers routing on x-y**

- *Issue/Gap:* Various VoIP mobile applications do not provide location data (lat/lon) to automatically route the 9-1-1 calls and instead go to call centers which send the call to the PSAP on PSTN or in the worst case the mobile application will do nothing.

5) **VSP Nomadic backup routing –**

- *Issue/Gap:* A VSP providing nomadic capability that chooses to provide backup routing via a wireless network when a subscriber does not provision an address is not accurately routing E9-1-1 calls. This type of routing also does not provide a call back number, or even an accurate estimate of the caller's address. None of these conditions provide nor promote reliable VoIP E9-1-1.

Data and Service Reliability Areas In Need of Attention

6) <u>VSP (IP/VRS) caller data</u>

- *Issue/Gap:* For VSP (IP/VRS) there should be basic standards for PSAPs to retrieve 9-1-1 caller data from relay service. The existing privacy interpreter FCC regulations do not address the fact that a caller gives up some privacy rights when calling 9-1-1.

8. Acronym Descriptions

ALI	Automatic Location Information
ATIS	Alliance for Telecommunications Industry Solutions
BP	Best Practice
CAD	Computer Aided Dispatch
CLEC	Competitive Local Exchange Carrier
ESGW	Emergency Service Gateway
ESQK	Emergency Services Query Key
ESRN	Emergency Services Routing Number
GIS	Geographic Information System
IETF	Internet Engineering Task Force
ILEC	Incumbent Local Exchange Carrier
IP/VRS	IP or Video Relay Service
MPC	Mobile Positioning Center
MSAG	Master Street Address Guide
NENA	National Emergency Number Association
NRIC	Network Reliability and Interoperability Council
PSAP	Public Safety Answering Point
RFC	IETF Requests for Comments
SSP	(9-1-1) System Service Provider

TID	Technical Information Document
VI	Video Interpreter
VoIP	Voice over Internet Protocol
VPC	VoIP Positioning Center
VSP	VoIP Service Provider
XML	Extensible Markup Language