State of Montana

Baseline Next Generation 9-1-1 Principles

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1. Introduction

The State of Montana Public Safety Communications Bureau engaged Federal Engineering, Inc. (***FE***) to provide consulting services and assist the State in its efforts relating to the transition to Next Generation 9-1-1 (NG9-1-1). ***FE***'s current task for the Montana Public Safety Communications Bureau will culminate with the development of a set of recommendations for the technical requirements, design and implementation of a statewide i3 compliant Emergency Services Internet Protocol (IP) Network (ESInet) and Next Generation Core Services System (NGCS).

This document outlines high-level functional specifications and requirements for the Plan. It is based-on information obtained during stakeholder meetings held throughout December 2018 and January 2019, weekly conference calls with the Public Safety Communications Bureau, Originating Services Providers (OSPs) and the current 9-1-1 Service Provider. This document will provide framework for more detailed requirements in later phases of any subsequent RFP development.

Appendix A – Referenced Documents, contains a link to the NENA Master Glossary of 9-1-1 Terminology used throughout this document.

The Public Safety Communications Bureau received the initial draft of this document on April 30th, 2019, to verify supplemental information provided by the client and ensure accuracy.

2. Current System

Based on the information obtained by ***FE***, all areas of the state provisioned with access to telephone service (landline, cellular or VoIP) have access to 9-1-1, in other words, access to 9-1-1 is predicated on underlying service availability.

The Emergency service provides all the typical functions of an E9-1-1 system, including Selective Routing of all landline and Wireless Phase II calls for service. The State of Montana 9-1-1 Network is operated by CenturyLink with Vision Net being the designated subcontractor for all the services associated with delivering 9-1-1 functionality and including, in some cases, PSAP CPE support.

The current 9-1-1 system in Montana is comprised of 50 Certified Primary Public Safety Answering Points (PSAPs) along with the Yellowstone ICC (Yellowstone National Park).

Montana PSAPs handled approximately 500,000 9-1-1 calls for emergency services in the year 2018. It should be noted that there were several PSAPs that were unable to provide exact 9-1-1 call volume data; as a result, ***FE's*** methodology to derive the total number of 9-1-1 calls for the State of Montana was based on combination of the existing CAMA trunks capacity, statistical data obtained from CenturyLink, Vision Net, and the six busiest Montana PSAPs.

Currently there are seven different Customer Premises Equipment (CPE) vendors providing the 9-1-1 call answer function at the PSAPs. The list of CPE manufacturers includes the following:

- Motorola Solutions (24)
- WestTel (9)
- West Public Safety (5)
- Zetron (7)
- Solacom (2)
- Synergem (2)
- Experient (1)

2.1 Functional Description

Montana's 9-1-1 system provides all the typical features associated with E9-1-1 such as selective routing, ANI/ALI delivery, Reverse ALI and Wireless Phase II (including Rebid).

Text-to-9-1-1 is an additional feature of the existing 9-1-1 system. Currently 33 Montana PSAPs are Text-to-9-1-1 enabled.

2.2 Stakeholder Information

Refer to Appendix A – Referenced Documents (*MT PSAP Inventory Memorandum*) for a technical profile and high-level operations overview for each of the Montana Certified Primary PSAPs.

2.3 Technical Architecture

Montana's current 9-1-1 system is a hybrid network comprised of two networks; Vision Net MPLS based network and Legacy Qwest (LQ) network. 9-1-1 calls that originate in the State of Montana in areas where the PSAP is served by the Vision Net MPLS network are routed to the Selective Routers (SR) located at Missoula and Billings. The SRs are connected to Media Gateways located at the same sites over redundant IP network. The Media Gateways convert all the incoming calls (Wireline, Wireless, VoIP) to SIP prior to arriving or terminating at the appropriate PSAP.

9-1-1 calls that originate in the State of Montana in areas where the PSAP is served by the LQ network are routed to SRs located in Helena and Billings via dedicated CAMA trunks. CAMA trunk inventory is captured within the ESInet Maps and Inventory Summary document.

The Automatic Location Identification (ALI) information servers are owned and operated by CenturyLink. The CenturyLink database group is responsible for all landline Automatic Location Identification (ALI) information and any updates and corrections as submitted by PSAPs or LECs via web-based Database Management System (WebDBMS). As part of the maintenance contract with Vision Net, this team also updates the Master Street Address Guide (MSAG) and Selective Routers information related to call routing.

All queries for wireless, VoIP and other mobile services (SYNC, OnStar, etc.) are passed through CenturyLink ALI servers to West for Phase 2 and Latitude/Longitude information.

3. Goals, Objectives, and Rationale for New or Modified System

3.1 Project Purpose

Transition to an i3-Compliant ESInet

The Public Safety Communications Bureau, hereafter referred to as the Bureau, is investigating the implementation of a statewide i3 compliant 9-1-1 network.

In addition, the Bureau has expressed a preference for the development of a PSAP technical standard that defines what each PSAP requires to become i3 compliant for:

- 9-1-1 call processing;
- Logging Recorder functions; and
- Future Next Generation functions such as text, multimedia, and telematics.

3.2 Project Scope

The primary subsystems encompassed by this project include:

- i3 Compliant ESInet
- I3 Compliant Next Generation Core Services
- I3 Compliant CPE (call handling and logging Functional Elements)

3.3 High-Level Functional Requirements

ESInet Recommended High-Level Requirements

NG9-1-1 networks must meet or exceed industry standards. To maintain and improve 9-1-1 reliability, all NG9-1-1 stakeholders must adhere to the following standards, design principles and considerations.

3.3.1 Standards

The State of Montana expects the NG9-1-1 network provider(s) to develop their ESInet/NGCS based on recognized standards and best practices listed under Section 4.1, including but not limited to the current NENA i3 standard. The NG9-1-1 network provider(s) must also review the most current standards at the time of deployment and ensure compliance.

Sources such as NENA recommendations for ESInet design and applicable recommendations for 9-1-1 networks by the U.S. FCC Communications Security, Reliability, and Interoperability Council (CSRIC) may further improve the resiliency and redundancy of the infrastructure and interconnections.

3.3.2 Grade of Service Objective

For E9-1-1, NENA 03-006 standard recommends that service providers engineer E9-1-1 trunk groups to provide a P.01 grade of service or no more than 1% call blocking.

For NG9-1-1, the network shall be designed to perform at least to this level. Maximum concurrent calling will no longer be limited by trunk groups; capacity will be a function of bandwidth. The NG9-1-1 network will be able to support the maximum capacity/call concurrency of the PSAPs.

3.3.3 Dedicated 24X7 Support and Real Time Monitoring

A dedicated 9-1-1 support center with 24X7 live answer single point of contact for all PSAPs and interconnecting parties allow for rapid and expert analysis and action as it relates to 9-1-1 issues caused by network failures, PSAP troubles and carrier interconnection issues. This team also coordinates, communicates, escalates and prioritizes all 9-1-1 restoration activities across 9-1-1 Service Provider network as well as various stakeholders which include PSAP Operations, IT, shared services, security as well as other carriers and originating networks.

3.3.4 Service Resiliency (Redundancy and Diversity)

The overall goal for NG9-1-1 networks is to maintain service resiliency, in the face of failures of individual components in that network. The resilient components making up that network address this through a combination of redundancy and diversity. Resilient components are built for high-availability and stability.

Redundancy provides a second component to take over the functionality of an individual failed element.

Diversity refers to physical separation of equipment, power systems and cabling paths to ensure that no single failure or outage should remove all redundant components from network availability at any one time.

Attainment of Resiliency, Redundancy and Diversity is subject to availability of facilities, capacity, feasibility, cost and overall risks.

Although PSAP LANs are beyond the demarcation point of the 9-1-1 network, the NG9-1-1 Service Provider should provide LAN design options and guidelines for interconnection to the future ESInet.

3.3.5 Survivability/Contingency Planning

Several Standards Development Organizations (SDOs), including NENA, encourage multiple levels of contingency planning including:

- Pandemic Planning
- Business Continuity Planning
- Disaster Recovery Planning
- PSAP Contingency Planning

PSAP Contingency Plans should be developed through collaboration between all PSAPs and NG9-1-1 Service Provider. The development of individual contingency plans uses a multitude of network and operational processes to reroute and restore service in the event of a 9-1-1 service interruption which could occur because of PSAP equipment, network failure, environmental emergency, and localized evacuation for example.

Periodic testing of all Continuity of Operations (COOP) and Contingency plans will ensure successful execution of the plan in the event of an actual failure.

3.3.6 Service Availability Measurement

Service availability is the key performance indicator and goal of network redundancy and diversity.

Although network failures do occur (e.g., temporary loss of redundancy), they typically do not interrupt the delivery of 9-1-1 calls or PSAP operations. Accordingly, while assessment of network availability is important, the primary measure should be service availability – the ability to deliver a 9-1-1 call to an appropriate PSAP.

3.3.7 Auditing and Monitoring

Routine "network audits" to verify the targeted Resiliency, Redundancy and Diversity goals should be performed by the NG9-1-1 Service Provider on regular basis.

The following active monitoring and management policies should also be audited on regular basis:

- **Forecasting tools** should be utilized up-front when building the NG9-1-1 network to ensure they are scaled appropriately for the services they will carry.

- **Network utilization reporting** should be performed to ensure appropriate sizing of active networks for fluctuating traffic volumes.

- **Auditing of PSAP and transport circuits** should be performed on a routine basis to verify records as well as to maintain physical and logical path diversity relationships.

- **Post-Mortem analysis** should be undertaken for any failures regardless of the effect on 9-1-1 service, to ensure adherence to Change Management policies and that required network resiliency functions as designed.

- **Outage Notification** of NG9-1-1 Service Provider must establish a robust, well documented outage and maintenance notification process, communicated to all stakeholders.

3.3.8 ESInet-to-ESInet Interconnection

To facilitate seamless transfer of the 9-1-1 calls between bordering states, the future Montana ESInet must be able to interconnect to the following current E9-1-1 and future NG9-1-1 networks:

- North Dakota ESInet/E9-1-1
- South Dakota ESInet/E9-1-1
- Washington ESInet/E9-1-1
- Wyoming ESInet/E9-1-1
- Idaho ESInet/E9-1-1
- Province of Alberta ESInet/E9-1-1
- Province of British Columbia ESInet/E9-1-1
- Province of Saskatchewan ESInet/E9-1-1

Montana's NG9-1-1 network provider(s) will interconnect the state ESInet in a manner that provides high availability and survivability in the event of planned or unplanned outage.

All physical devices and components providing ESInet-to-ESInet interconnections will be architected to comply with carrier-grade standards, including but not limited to the following:

- A minimum of two geo-diverse physical interconnects with a separation of at least 100 miles are required between them
- Support of Dual Stack IPv4/IPv6
- Utilization of dynamic routing protocols (mechanisms to achieve efficiencies for multi-path routing)
- Network surveillance, monitoring and management functions to enable proactive monitoring, in real time, the status of the interconnections and provide a timely resolution to trouble conditions
- NG9-1-1 networks backing up each other
- NG9-1-1 Service Provider sized bandwidth based on ESInet-to-ESInet call transfer requirements
- NG9-1-1 Service Provider monitoring of this interconnection for bandwidth utilization scale to meet growth, expansion and demand, with considerations to performance

3.3.9 Transitional Consideration (E9-1-1 to NG9-1-1)

NG9-1-1 Service Provider should provide a clear plan/documentation explaining the management and transition of the E9-1-1 to an i3 compliant NG9-1-1 in a manner of optimum efficiency and minimum disruption to service and operations.

3.3.10 Quality of Service (QoS)

There are many benefits in implementing a cohesive end-to-end Quality of Service (QoS) strategy for IP traffic across the NG9-1-1 ecosystem. In order to avoid emergency calls being negatively impacted and potentially dropped, it is necessary for all interconnected stakeholders to collaborate on development and implementation of such strategy.

The NENA i3 specification states that the Quality of Service mechanism is to be implemented inside, and across the ESInets. It should be noted that the current NENA i3 standard (NENA-STA-010.2-2016) text surrounding QoS has been expanded upon in version 3 (currently under review) and it should be taken into consideration by the NG9-1-1 Service Provider.

3.3.11 Security

The network design must include network security in accordance with standards referenced under Section 4.1 and any security policy as recommended by the 9-1-1 Advisory Council. The Advisory Council may modify the recommended security policy at any time.

3.3.12 GIS Data Provisioning

An essential element of NG9-1-1 is geospatial call routing via the Emergency Call Routing Function (ECRF) Core Service.

The NG9-1-1 system being contemplated by the State of Montana will use a dynamic Geographic Information System (GIS) to make ECRF and Location Validation Function (LVF) decisions. Not only will any planned NG9-1-1 system need this data, but local, regional and Statewide Public Safety GIS datasets will be of immense value to virtually all aspects of Public Safety in Montana.

Currently, numerous jurisdictions and 9-1-1 authorities throughout the State maintain GIS location data at the local level or within regionalized areas. This GIS map data will eventually replace the traditional Master Street Address Guide (MSAG) databases as the primary database for location-based call routing and location validation ECRF/LVF functions within the NG9-1-1 system being planned.

To enable geolocation services and geospatial routing through a fully functional ECRF/LVF, it will be necessary for the State and local PSAP jurisdictions to begin working towards reconciling the legacy location validation and routing databases (MSAG/ALI) to the GIS-based database and have in place a process to coordinate timely updates to future aggregated GIS dataset(s).

The State recently completed an initial GIS data audit with DDTI, Inc. as a means of establishing a baseline of GIS data at the PSAP or County level throughout the State. This assessment provides a valuable snapshot in time of the relative accuracy of the GIS data required for fully functional NG9-1-1 call routing.

As the State continues to plan for NG9-1-1 it will be imperative that local PSAP jurisdictions continue to routinely update and maintain the synchronization of their GIS, MSAG and ALI data. Local PSAP jurisdictions should recognize the fact that the on-going process of assessment, improvement and maintenance of their GIS data will benefit both their current 9-1-1 systems but additionally help prepare them for the future migration to NG9-1-1.

Industry standards related to the development, maintenance and provisioning of the required GIS data have been provided to the State in the *NG9-1-1 Uniform Standards Memorandum* document referenced under Appendix A.

Additional information and details pertaining to the GIS data flow within NG9-1-1 will be described in further detail in the future *Statewide ESInet Design and Implementation Plan*.

4. Factors Influencing Technical Design

This section describes the standards, assumptions, and constraints that influence the technical design of the proposed system.

4.1 Relevant Standards

Where applicable, all equipment and network components must comply with applicable national industry standards to allow for the implementation of technology components. This includes the appropriate cabling, electrical and wiring standards. Furthermore, the governing standard for the operation of the ESInet and NG9-1-1 is NENA STA-010.2-2016. Industry standards have been provided to the State in the *NG9-1-1 Uniform Standards Memorandum* document referenced under Appendix A.

4.2 Network Facilities Availability

Much data and voice traffic in Montana feeds through a statewide fiber optic network managed by Vision Net.

Of the Montana PSAPs that were surveyed, there are 43 PSAPs with MPLS connectivity. The availability of network facilities options for the remaining 18 Legacy Qwest PSAPs vary considerably, and therefore will require further investigation.

4.3 PSAP CPE Readiness

The state of CPE readiness at the PSAPs is still under investigation and will be expanded upon in the PSAPs Needs Assessment deliverable.

[1] www.broadbandmt.com

Appendix A - Referenced Documents

Document Name
ESInet Maps and Inventory Summary Memorandum 20190627 Revised Final.pdf
MT NG911 Uniform Standards Memorandum 20190410 Revised Final.pdf
MT PSAP Inventory Memorandum 20190627 Revised Final.pdf
NENA Master Glossary of 9-1-1 Terminology (NENA-ADM-000.22-2018)[2]

[2] www.nena.org/page/Glossary