



State of Idaho NG9-1-1 Emergency Services IP Network Recommendation Report

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Final

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1. Introduction

The Idaho Public Safety Communications Commission (IPSCC) engaged Federal Engineering, Inc. (**FE**) to provide consulting services and assist the State in its efforts related to the migration of 48 Enhanced 9-1-1 emergency communications centers (ECCs), formerly referred to as public safety answering points (PSAPs) to a robust and scalable Next Generation 9-1-1 (NG9-1-1) system.

This Emergency Services Internet Protocol Network Recommendation Report contains a set of recommendations for the technical requirements, design and implementation of a statewide i3 compliant Emergency Services Internet Protocol (IP) Network (ESInet). The document also references the industry standards germane to the ESInet design.

It is based-on information obtained during ECC stakeholder meetings, weekly conference calls with the IPSCC, current 9-1-1 Service Providers as well as potential network infrastructure providers. This document provides a framework for more detailed requirements in later phases of future Requests for Proposals (RFPs) development.



2. Current System

2.1 Functional Description

The current Enhanced 9-1-1 (E9-1-1) system in Idaho is comprised of 48 ECCs as well as five additional sites that have E9-1-1 connectivity. The system provides all the typical features of an E9-1-1 system including selective routing, Automatic Number Identification/Automatic Location Identification (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 46 Idaho ECCs are Text-to-9-1-1 enabled.

All ECCs within the state are furnished with Centralized Automated Message Accounting (CAMA) trunks for voice processing and redundant data circuits for ANI/ALI delivery.

The connectivity to the E9-1-1 enabled sites (voice and data) are provided by two network providers:

- a) 34 sites are served by CenturyLink
- b) 13 sites are served by Frontier Communications
- c) 1 site (Idaho State Police North and South) are served by both CenturyLink and Frontier

Currently there are seven different Customer Premise Equipment (CPE) vendors providing the 9-1-1 call answer function at the ECCs with various degree of NG9-1-1 readiness. The list of CPE manufacturers includes the following:

- Motorola Solutions (21)
- West Public Safety (13)
- Zetron (7)
- ComTech (5)
- Solacom (3)
- Experient (1)
- Central Square (1)



3. Network Facilities Availability

3.1 CenturyLink Evaluation

CenturyLink is the second largest communications provider in United States with approximately 450,000 global route miles of fiber. CenturyLink is Metro Ethernet Forum (MEF) 2.0 certified for Ethernet and is a Tier 1 Multiprotocol Label Switching Internet Protocol (MPLS/IP) core provider with two separate cores allowing for carrier diversity. In the State of Idaho, CenturyLink currently delivers E9-1-1 connectivity to about 70% of all Emergency Communications Centers (ECCs). As of the writing of this report, it should be acknowledged that in addition to providing extensive network facilities across the State, CenturyLink is currently the only telco in Idaho that also offers Next Generation Core Services (NGCS).

During interviews with **FE**, CenturyLink provided an overview of their NG9-1-1 transition plans for Idaho. This included but was not limited to the following NG9-1-1 Core Elements:

- ESInet
- Next Generation Core Services (NGCS)
- Managed Emergency Call Handling (MECH)
- GIS
- Monitoring and NOC
- Public Safety Related Service
- Security

These Core elements are depicted in Figure 1 below:



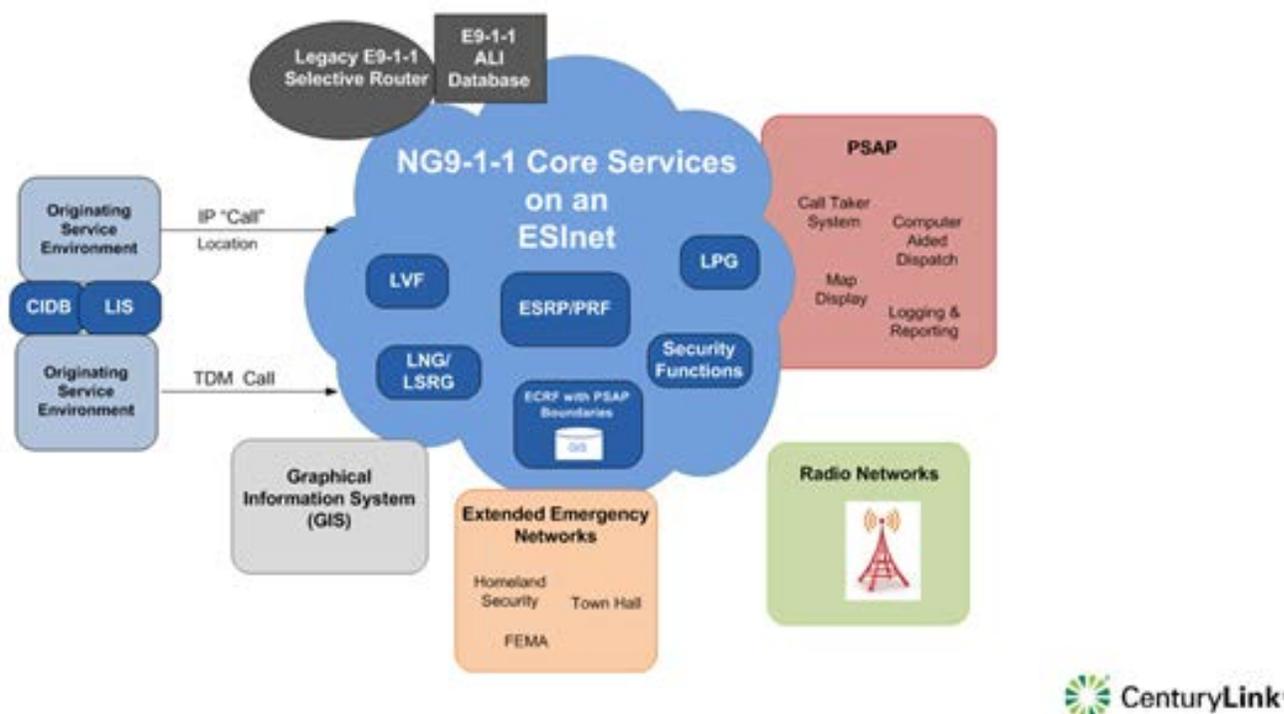


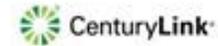
Figure 1 – CenturyLink Next Generation Core Services

The future ESInet offering by CenturyLink is NENA i3 compliant and is built on all the relevant standards listed in this document. The CenturyLink offering is also being presented as a fully redundant and resilient-designed ESInet. The CenturyLink ESInet technology employs a SD-WAN overlay and is completely managed by CenturyLink. It should also be noted that the use of SD-WAN overlays allows for enhanced network health monitoring including Mean Opinion Score (MOS).

This CenturyLink network is hardened for security with the cybersecurity elements built into the network as opposed to being an afterthought in the network design. CenturyLink’s SD-WAN platform also includes enhanced security features such as IDS, IPSec, IDP, Deep Packet Inspection which allows for specific and secure IP traffic flows throughout the network.

This ESInet will be monitored and managed on a 24 x 365 basis by a recently created NG9-1-1 NOCC strictly dedicated to NG9-1-1 traffic. The CenturyLink ESInet is fully compliant with FCC requirements for outage notification and reporting. Clients will be provided with access to a near real-time data dashboard.





Service Description: Access Options

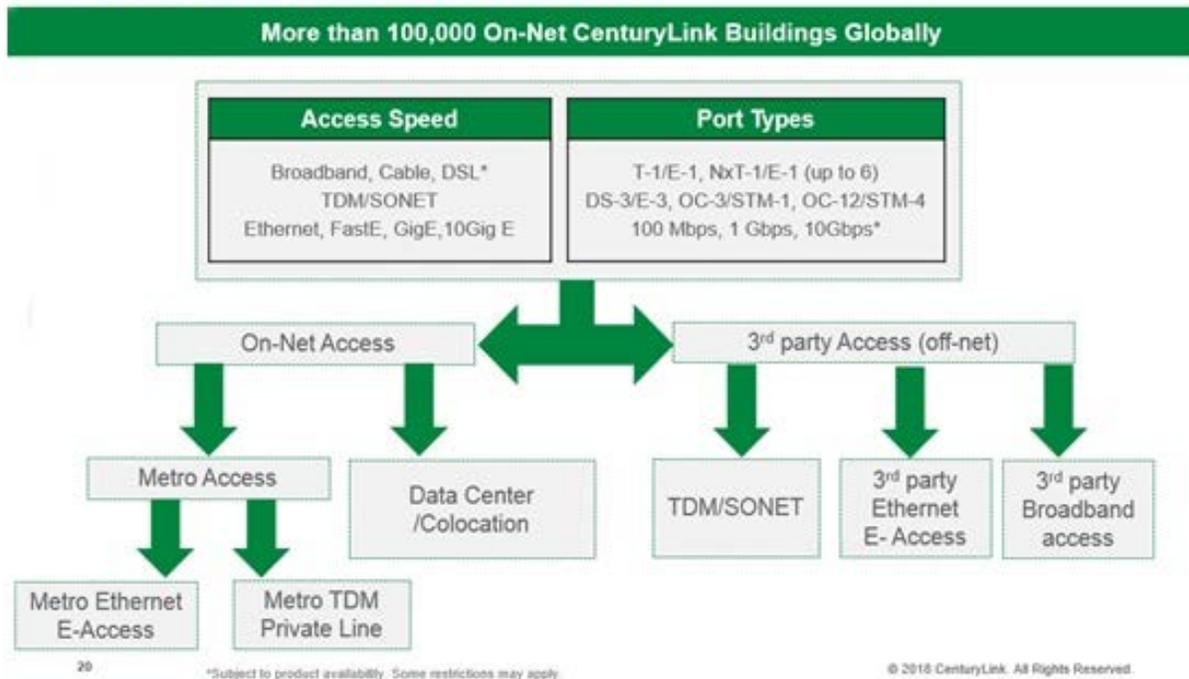


Figure 2 – ESInet Access and Connectivity Options

CenturyLink fully acknowledges that in certain locations, last-mile connectivity can only be achieved via agreements with local service and network providers with network facilities outside of the current CenturyLink footprint.

CenturyLink believes that their ESInet should be used not only for delivering the call from NGCS to the PSAP but also for Managed Emergency Call Handling (MECH). MECH bundled with Managed NG9-1-1 Core Services allows the State to move to NGCS and upgrade all PSAP call handling equipment.

CenturyLink also provides Ingress aggregation services. This includes providing two diversified POIs per LATA/Region in Idaho for Originating Service Provider (OSP) connectivity. CenturyLink has access to more POIs in neighboring states to assist in the provision of diverse pathways.



CenturyLink currently interfaces with all CLECs and ILECs, as well as, the four main wireless carriers. This provider can currently support direct SIP ingress depending on the capability of the VoIP or wireless carrier.

On the Egress side, CenturyLink indicates that their aim is to always provide two IP-VPN circuits into every PSAP. However, the diversity depends on customers (ECCs) requirements and what their budgets can absorb. The IP-VPN circuits at each ECC are terminated on redundant Border Control Functions (BCF).

CenturyLink indicated that they are interested in collaborating with local service providers, as well as non-standard communication entities, to deliver ESInet connectivity. SD-WAN overlay is what enables CenturyLink to partner with third-party networks (underlay) including Long-Term Evolution (LTE) wireless for additional redundancy (where LTE is available).

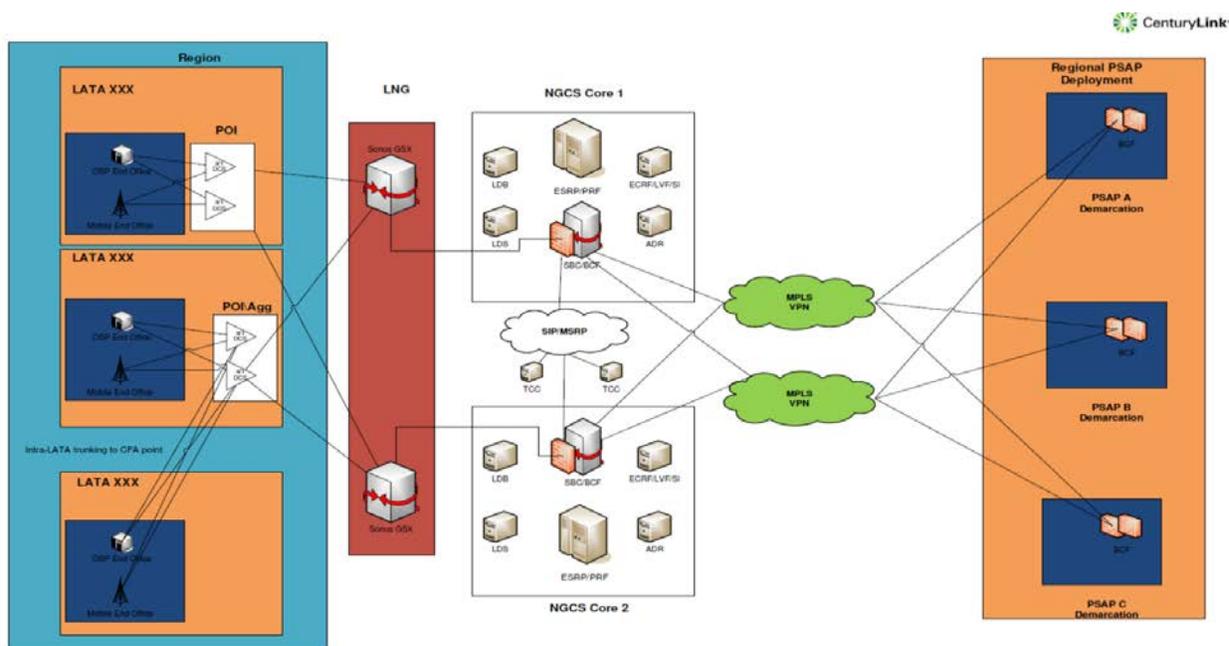


Figure 3 – CenturyLink NGCS Design for i3 Routing

3.1.1 POP Locations

Due to security concerns, CenturyLink was reluctant providing any details regarding their existing network layout or POP locations. CenturyLink focused on providing information on their NG9-1-1 products, services and transition plan in the State of Idaho.



3.1.2 Network Layout/Transport Fiber Map

Due to security concerns, CenturyLink was reluctant providing any details regarding their existing network layout or POP locations. CenturyLink focused on providing information on their NG9-1-1 products, services and transition plan in the State of Idaho.



3.2 Idaho Regional Optical Network (IRON) Evaluation

IRON is a regional optical network that focuses on serving research and education in the State of Idaho. The network is being used by the national laboratory system and the health sector. IRON was chartered as a not-for-profit, Idaho corporation established 2007. Its goal is to provide low cost bandwidth and high-speed access to the regional networks serving education, research and healthcare institutions.

IRON is not a service provider and it does not compete with Telecom or Private Internet providers. It is a private network that leverages existing local, regional, and national providers connectivity to deliver superior performance.

This secure and high capacity network has proven to be essential to the State's research and education sectors. The fiber-optic resources of the network allow it to compete for large federal grants where requirements for bandwidth, data security, and redundancy are of utmost importance. The primary investors in the IRON's fiber backbone are Boise State University, Brigham Young University–Idaho, Idaho Hospital Association, Idaho National Laboratory, Idaho State University, State of Idaho, University of Idaho, and Washington State University. The fact that the IRON's Charter associates (listed above) volunteer their time and expertise ensures that the costs associated with the network maintenance remain low and assure transparency and fiscal prudence.

It is IRONs mission to provide high-speed network access to the State in order to support education, healthcare and research initiatives, these criteria position IRON as a prime candidate to carry ESInet traffic.

FE, as part of the research was able to establish the following facts as they relate to engaging IRON as an ESInet participant:

1. Potential ESInet stakeholder;
2. Not an application provider but rather a data-traffic mover;
3. 100Gb backbone throughout the state with about 5% utilization;
4. Used primarily for university networking and moving big data;
5. Anticipating 1Gb connectivity to the ECCs with dedicated tunnel for each ECC;
6. Respectful of Quality of Services (QoS) settings;
7. Respect the provided/incoming DSCP values;



8. The ownership of the last mile is not defined. IRON is willing to work with ECCs to determine responsibility and costs; and
9. Committed to improving redundancy in order to increase reliability and meeting client's needs.

3.2.1 POP Locations

The following counties have IRON Points of Presence (POPs):

- Kootenai
 - NIC Campus, Coeur D'Alene (CDA)
- Latah
 - Moscow City Hall, Moscow
 - UI Campus – Library, Moscow
- Nez Perce
 - LCSC Campus, Lewiston
 - St. Joseph's RMC, Lewiston
 - LCSC Workforce Training Center, Lewiston
 - Nez Perce County (July 2018)
- Gem
 - Emmett, ID (June 2018)
- Canyon
 - West Ada School District, Meridian
- Ada
 - Zayo POP – Federal Way, Boise
 - Level3 POP – McGregor Ave, Boise
 - Boise State University (BSU) Campus, Boise
 - Water Center, Boise
 - GAR/Capitol Annex, Boise
 - Zayo Hut, Post Falls



- Twin Falls
 - CSI Campus, Twin Falls
- Power
 - Zayo Hut, American Falls
- Bannock
 - ISU Campus, Pocatello
- Bonneville
 - City of Ammon, Ammon
 - Falls Valley Elementary, Idaho Falls
 - Bonneville 9-1-1 Center, Idaho Falls
 - Idaho National Laboratory (INL), Engineering Research Office Building (EROB), Idaho Falls
 - Center for Advanced Studies, Idaho Falls
 - University Place, Idaho Falls
 - College of Eastern Idaho, Idaho Falls

IRON indicated that there are potential Points of Presence (POPs) connection points at the following counties:

- Clearwater
- Idaho
- Lewis
- Madison
- Bear Lake
- Franklin
- Oneida
- Caribou
- Fremont
- Boise



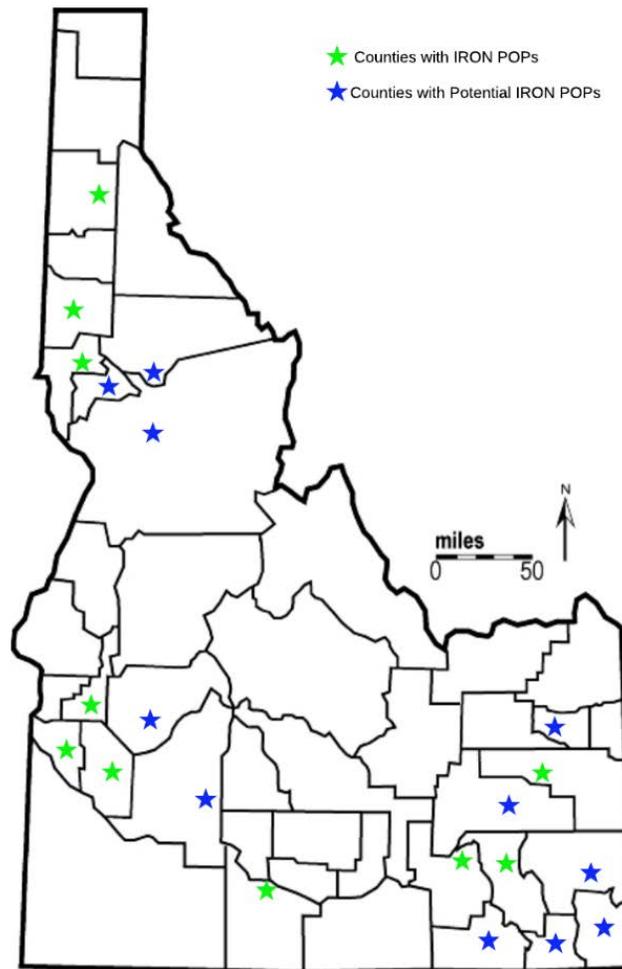


Figure 1 – IRON Locations by County¹

3.2.2 Network Layout/Transport Fiber Map

Note that IRON indicated that they would be providing the information in the form of a presentation at the DIGB4 meeting on April 1st, 2020

FE did request access to this presentation prior to the meet in order to include its contents in this report.

¹ IRON's June 2018 presentation to the IPSCC

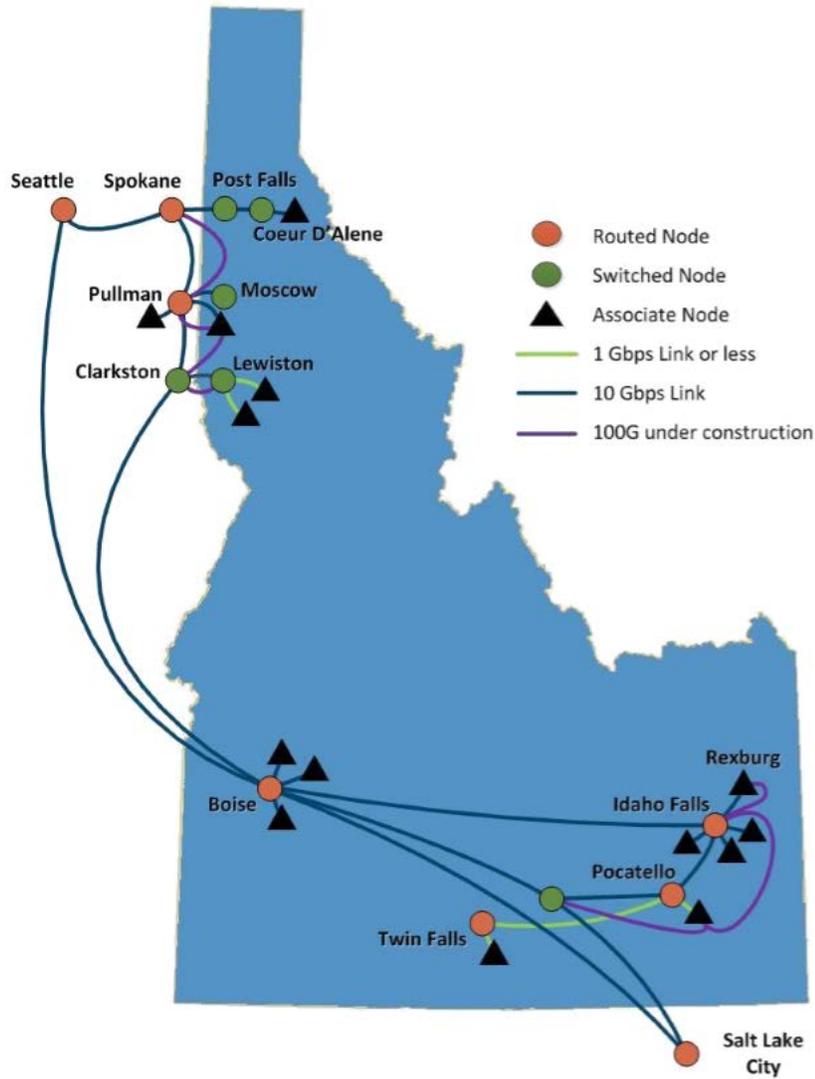


Figure 2 – IRON Network Map



3.3 Syringa Networks Evaluation

Syringa Networks owns and operates a facilities-based, self-healing fiber optic communications network. It is designed for performance and reliability. Syringa indicated that their network has virtually unlimited capacity and incorporates both physical and electronic redundancy schemes. The network is safeguarded by using a ring protected network architecture.

Syringa Networks currently provide services to Bonneville County 9-1-1 System and assisted with the design and servicing of their 9-1-1- system.

Their network services include:

- Dedicated Internet Access,
- Dark Fiber,
- Ethernet Services,
- On-Net Colocation, and
- MPLS WAN Solutions.

Syringa's existing MPLS-WAN Service with "any-to-any" connectivity lends itself well to ESInet deployment as the "any-to-any" connectivity solution with traffic prioritization provides a fully meshed, next-generation network delivered over MPLS core.

This network is monitored 24x7x365 by a dedicated network surveillance center.



3.3.1 POP Locations

ALBNIDXC	208-673	225 WEST NORTH STREET	ALBION	IDAHO	83311	ATC COMMUNICATIONS
AMFLIDMR	208-226	MAYER & HWY 37	AMERICAN FALLS	IDAHO	83211	ZAYO/LEVEL 3
BOISID15	208-331	1020 W. MAIN ST	BOISE	IDAHO	83702	VERIZON BUSINESS
BOISIDPZ	208-947	10452 W. EMERALD ST	BOISE	IDAHO	83704	INTEGRA TELECOM
BOITIDHJ	208-321	12877 W. MCMILLAN RD	BOISE	IDAHO	83713	VERIZON WIRELESS
BOISID37	208-331	1501 FEDERAL WAY	BOISE	IDAHO	83705	ZAYO
BOIUIDKZ	208-472	2223 AIRPORT WAY	BOISE	IDAHO	83705	TW TELECOM
BOISID96	208-331	435 W. MCGREGOR DR	BOISE	IDAHO	83705	LEVEL 3
BOISIDMA	208-331	619 W. BANNOCK ST	BOISE	IDAHO	83702	CENTURYLINK/AT&T
BOITIDGD	208-229	3795 S. DEVELOPMENT AVE	BOISE	IDAHO	83705	SYRINGA NETWORKS FACILITY
CMBRIDXC	208-257	130 SUPERIOR ST	CAMBRIDGE	IDAHO	83610	CTC TELECOM
CHLSIDXC	208-879	1111 S. MAIN ST	CHALLIS	IDAHO	83226	CUSTER TELEPHONE COOPERATIVE
CRALIDXX	208-664	2115 N. GOVERNMENT WAY	COEUR D'ALENE	IDAHO	83814	FRONTIER COMMUNICATIONS
DRGSIDMA	208-354	LITTLE AVE & 2ND & MAIN	DRIGGS	IDAHO	83422	SILVER STAR COMMUNICATIONS
DUBSIDXC	208-374	165 W. MAIN	DUBOIS	IDAHO	83423	MUD LAKE TELEPHONE
FILRIDAA	208-326	400 MAIN ST	FILER	IDAHO	83328	FILER MUTUAL TELEPHONE
FRLDIDXX	208-452	209 S. IOWA AVE	FRUITLAND	IDAHO	83619	FARMERS MUTUAL TELEPHONE
GLFYIDCO	208-366	892 W. MADISON AVE.	GLENNS FERRY	IDAHO	83623	RURAL TELEPHONE COMPANY
MCCLIDXC	208-634	201 LENORA ST	MCCALL	IDAHO	83638	FRONTIER COMMUNICATIONS
MDVAIDXC	208-355	2205 KEITHLY CREEK ROAD	MIDVALE	IDAHO	83645	MTE COMMUNICATIONS
RKLDIDXC	208-548	269 W. CENTER	ROCKLAND	IDAHO	83271	DIRECT COMMUNICATIONS
RPRTIDXC	208-434	638 5TH ST	RUPERT	IDAHO	83350	PROJECT MUTUAL TELEPHONE
STATIDMA	208-458	29 E. MAIN	ST ANTHONY	IDAHO	83445	FREMONT COMMUNICATIONS

Table 1 – Syringa Points of Presence Locations²

3.3.2 Network Layout/Transport Fiber Map

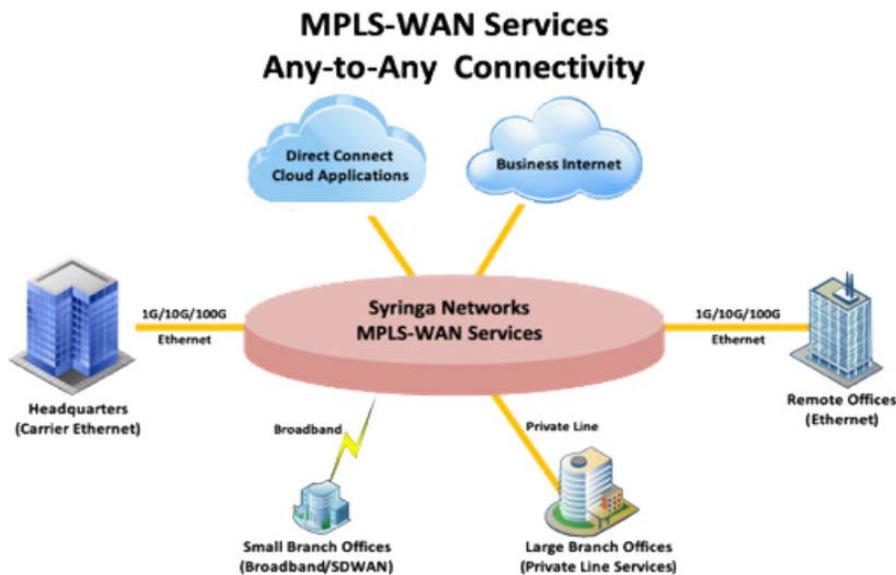


Figure 3 – Syringa MPLS-WAN Service³

² https://www.syringanetworks.net/resources/our_network/pops/

³ https://www.syringanetworks.net/solutions/by_service_type/mpls-wan/



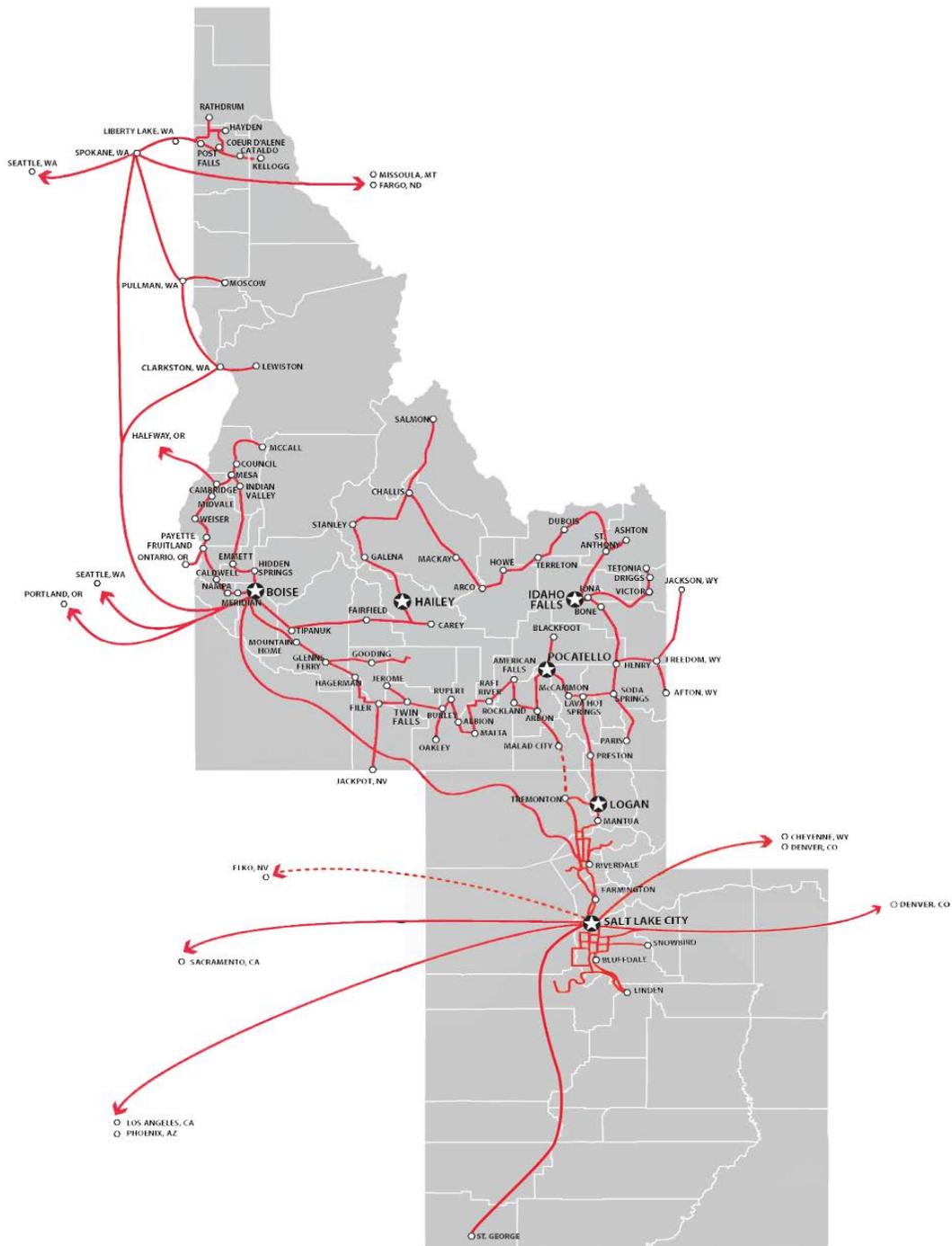


Figure 4 – Syringa Idaho and Utah Network Map⁴

⁴ <https://www.syringanetworks.net/Documents%20and%20Settings/27/Site%20Documents/2019/Maps/Map%203.pdf>



4. ESInet Technical and Operational Requirements

NG9-1-1 networks should meet or exceed industry standards. To maintain and improve 9-1-1 reliability, all NG9-1-1 stakeholders should adhere to the following standards, design principles and considerations. The following subsections describe technical and operational criteria with which the statewide ESInet should comply with as well as tasks and responsibilities of the ESInet provider.

4.1 ESInet Core Requirements

The following is the summary of the ESInet requirements as per NENA-STA-010 Detailed Functional and Interface Specification for the NENA i3 Solution – Stage 3. These represent the minimum core requirements that should be met by the ESInet provider.

- The network between the ECC and an ESInet will be a private or virtual private network based upon TCP/IP
- It will have scalable bandwidth to support new enhanced services
- The Emergency Services IP Network shall be a conventional routed IP network
- Multiprotocol Label Switching (MPLS) or other sub-IP mechanisms are permitted as appropriate
- The ECC should use redundant local area networks for reliability
- ECC Local Area Network (LAN) to an ESInet must be resilient, secure, physically diverse, and logically separate

ESInet shall be engineered to sustain real time traffic, including data, audio, and video

- Connections between the ECC and an ESInet Wide Area Network (WAN) shall be secured Transmission Control Protocol (TCP)/IP connections
- ESInets should be capable of operating on IPv4 and IPv6 network infrastructures
- ESInets should consider how the Domain Name System (DNS) is designed and managed



- ESInet implementation should consider coordination efforts to understand Autonomous System (AS) number implications for statewide deployments
- ESInet configurations may impact Voice Quality and shall be designed to support the minimal acceptable levels defined by NENA-STA-010

4.2 ESInet Recommended High-Level Requirements

4.2.1 Standards

The NG9-1-1 network provider(s) must develop their ESInet based on recognized standards and best practices listed under Section 5, 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.

4.2.2 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 ECCs.

4.2.3 Dedicated 24X7 Support and Real Time Monitoring

A dedicated 9-1-1 support center with 24X7 live answer single point of contact for all ECCs and interconnecting parties allow for rapid and expert analysis and action as it relates to 9-1-1 issues caused by network failures, ECC 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 ECC Operations, IT, shared services, security as well as other carriers and originating networks.

4.2.4 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 ECC 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.

4.2.5 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
- ECC Contingency Planning

ECC Contingency Plans should be developed through collaboration between all ECCs and ESInet 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 ECC 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.

4.2.6 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 ECC 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 ECC. NG91-1- system availability is the top priority when selecting a system architecture.

Although, the formulas for availability and reliability can be found in referenced standards, the following table is a good representation of availability in terms of downtime per year.

Availability	Downtime
90% (1-nine)	36.5 days/year
99% (2-nines)	3.65 days/year
99.9% (3-nines)	8.76 hours/year
99.99% (4-nines)	52 minutes/year
99.999% (5-nines)	5 minutes/year
99.9999% (6-nines)	31 seconds/year

Table 1 – Service Availability Measurements

It is a common practice to accept the “five nines” availability (also known as telco-grade reliability) objective as a standard for NG9-1-1 system. Achieving the five nines is technically possible, however, impediments such as funding often disallow achieving this objective. There are several mitigating techniques to overcome these obstacles, such as implementation of strict and detailed Service Level Objectives (SLO) and Service Level Agreements (SLA).



4.2.7 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 ECC 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.

4.2.8 Network Architecture

The following section illustrates the most commonly utilized ESInet Architecture, as described and depicted in NENA Emergency Services IP Network Design Information Document (NENA-INF-016.2-2018). Its similarities, if used, with the existing E9-1-1 network deployment could allow for simplified and expedited transition to NG9-1-1 in the State of Idaho.

“The state-level i3 core services are located at two (2) geographically-diverse sites – Host Site A and Host Site B. In order to assure high availability, redundant firewalls, Session Border Controllers (SBCs), ESRPs, and ECRFs are located at each of the state-level host sites. The i3 NGCS (e.g. ESRP, ECRF, and PRF) and the Legacy Network Gateways (LNGs) are outside the scope of the ESInet, but it was the consensus of the authors of this document that it would be advantageous to show how the i3 core services



should be connected into an ESInet. It is a best practice to build state-level host sites and regional host sites in highly available data centers.

Regional ESInet 1 is comprised of an MPLS network. The PSAPs⁵ have a single entrance facility through which all circuits are delivered. A single router that provides connectivity into the regional ESInet is in the backroom of each PSAP⁶. Each PSAP⁷ has one or more call-taker positions and a Border Control Function (BCF) which consists of a session border controller and a firewall. As discussed in section 3.4, reliability engineering calculations show the reliability and availability of Regional ESInet 1 to be on the order of two nines (99%). PSAPs⁸ utilizing this solution must therefore rely on traditional methods (i.e., backup PSAPs⁹ and 10-digit numbers) to achieve five nines (99.999%) availability for the overall 9-1-1 service in their region. The state-level ESInet, which transports call signaling message exchanges, call media streams that carry the call's audio, and data from the state-level i3 NGCS to the regional host sites, is designed to achieve five nines availability. Connections to Internet border controllers from outside an ESInets are shown at both the regional hosts and state-level host sites. Among other things these connections could be utilized to support requirements to receive emergency 9-1-1 calls via the Internet and/or to support remote access requirements for monitoring and maintenance. “

⁵ Referred to as emergency communications centers (ECCs) throughout this document and future legislation

⁶ Ibid.

⁷ Ibid.

⁸ Ibid.

⁹ Ibid.



Regional ESInet I

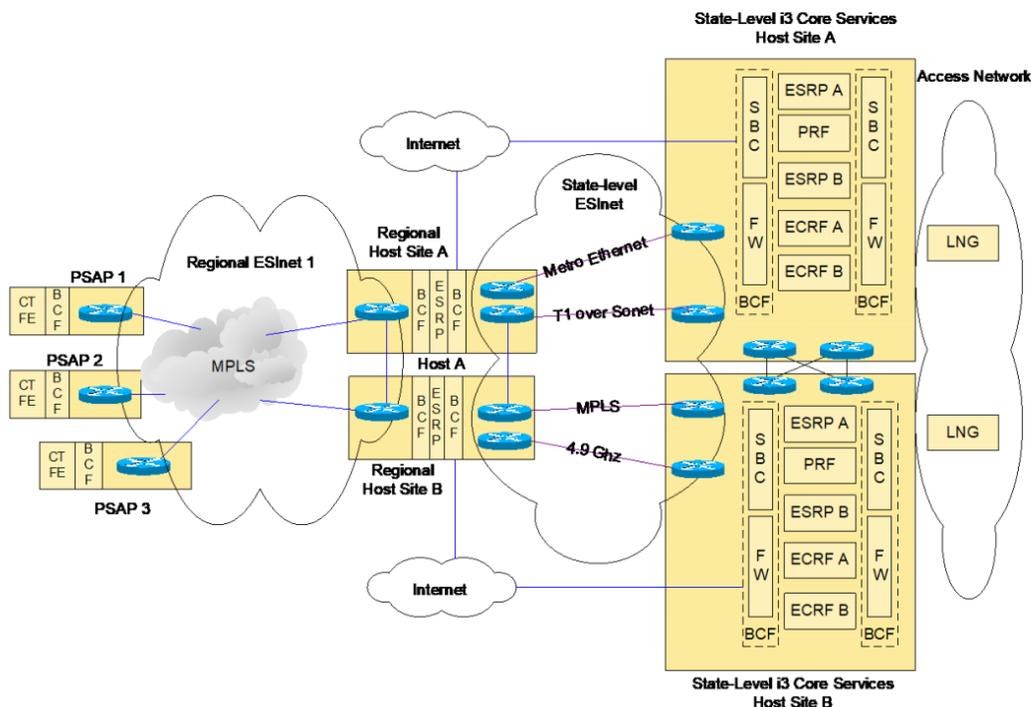


Figure 5 – Regional ESInet Example¹⁰

4.2.9 Interstate Interconnection Requirements

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

- Montana ESInet/E9-1-1
- Oregon ESInet/E9-1-1
- Washington ESInet/E9-1-1
- Wyoming ESInet/E9-1-1
- Nevada ESInet/E9-1-1
- Utah ESInet/E9-1-1

¹⁰ https://www.nena.org/page/i3_Stage3



- Province of British Columbia ESInet/E9-1-1

Idaho's NG9-1-1 network provider(s) should 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 should 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 Service Provider sized bandwidth based on ESInet-to-ESInet call transfer requirement
- NG9-1-1 Service Provider monitoring of this interconnection for bandwidth utilization scale to meet growth, expansion and demand, with considerations to performance

An example of how these ESInets might be interconnected is provided in NENA-INF-016.22018 and presented below. It should be noted that a detail design for this interconnection can only be achieved by working with the neighboring states ESInet providers and operating authorities.



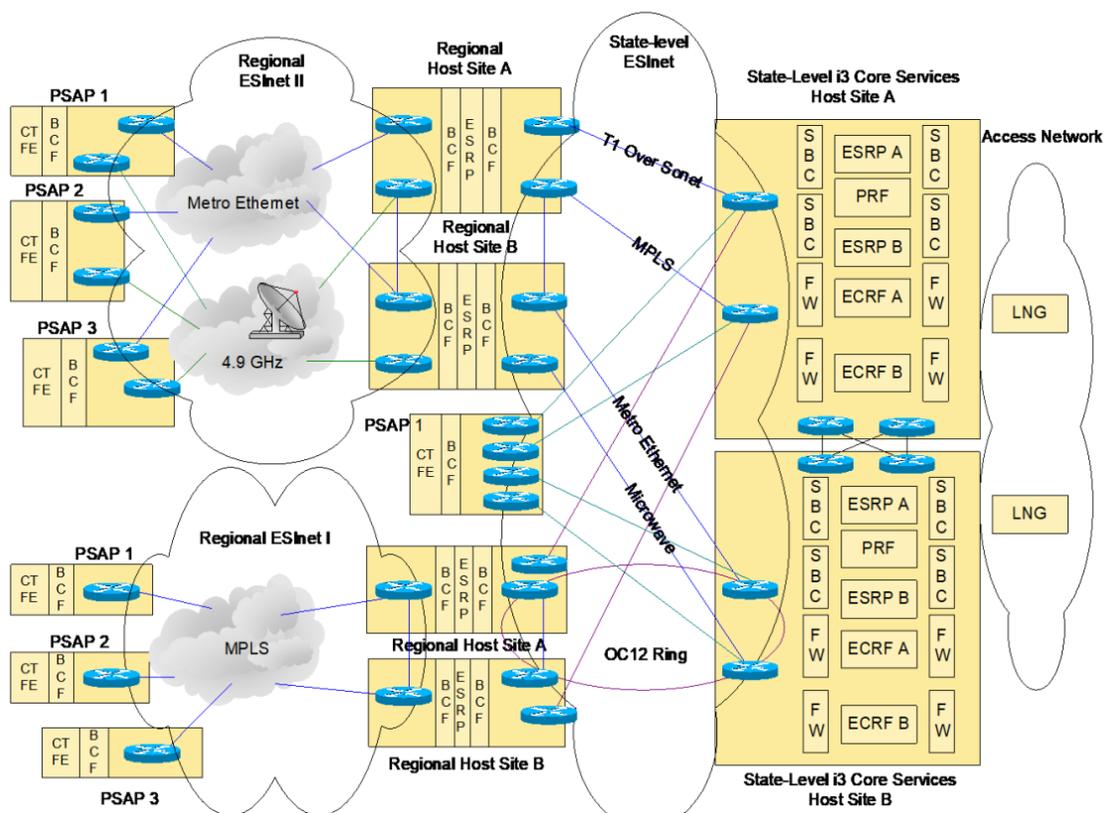


Figure 6 – Interconnecting Multiple ESInets Example¹¹

4.2.10 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. This includes collaboration with all NG9-1-1 stakeholders.

4.2.11 Quality of Service (QoS)

The NENA i3 specification defines the Quality of Service (QoS) mechanism 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 ESInet Provider.

¹¹ https://www.nena.org/page/i3_Stage3



4.2.12 Security

The network design should include network security in accordance with standards referenced under Section 5 and any security policy as approved by the State. The State may modify the security policy at any time at its sole discretion.



5. Relevant Uniform Standards

The purpose of the NG9-1-1 uniform standards is to establish a set of current Standards and Information documents to be used in design and transition to a state-wide NG9-1-1 system. Where applicable, all equipment and network components should comply with established national industry standards to allow for the implementation of technology components.

A thorough comparison of the current NG9-1-1 standards germane to the implementation of NG9-1-1 was completed. The vast majority of these NG9-1-1 standards and information documents are being shepherded by the National Emergency Number Association (NENA) Working Groups¹² and in some cases in collaboration with the Association of Public-Safety Communications Officials (APCO) International Standards Development Committee (SDC).¹³ Hyperlinks to actual documents are shown below.

The world of NG9-1-1 is in a constant state of change. It must therefore be assumed that current standards pertaining to the new 9-1-1 technology will be evolving, and the requirement to publish updated standards will be ongoing.

Refer to *Appendix "A" – Referenced Documents* for a detailed listing of the *NG9-1-1 Uniform Standards*. The spreadsheet:

5.1 NG9-1-1 Transition

NENA 08-751 - NENA i3 Technical Requirements Document - This "NENA i3 Technical Requirements Document" is intended to specify the requirements the i3 (Long Term Definition) Standard should meet. This document is issued to guide the development of the i3 Standard.

https://www.nena.org/page/i3_Requirements_LTD

NENA-INF-006.1-2014 - NG9-1-1 Planning Guidelines Information Document - The purpose and scope of this document is to provide guidance to help 9-1-1 Authorities create a smooth, timely and efficient transition plan to accomplish implementation of NG9-1-1.

<https://www.nena.org/page/ng911planning>

¹² <https://www.nena.org/page/NDGCommitteeList>;

¹³ <https://www.apcointl.org/standards/>



NENA-INF-008.2-2013 (originally 77-501) - NG9-1-1 Transition Plan Considerations Information Document - The public safety community has recognized the need to evolve legacy emergency services networks to next generation concepts which may facilitate new capabilities and services. As such there are numerous industry associations and Standard Development Organizations (SDOs) that are defining architectures and protocols for these next generation networks. The public safety community desires to take advantage of this work and address the challenge it represents to emergency communications. To this end, work is progressing in other NENA committees to define the specific emergency services architectures and protocols involved. The transition of emergency services addressed by this document relies upon this collective work.

https://www.nena.org/page/NG911_TransitionPlan

5.2 NG9-1-1 Data Structures

NENA-STA-010.2-2016 (originally 08-003) - NENA Detailed Functional and Interface Standards for the NENA i3 Solution (update in progress) - This specification builds upon prior NENA publications including i3 requirements and architecture documents. Familiarity with the concepts, terminology and functional elements described in these documents is a prerequisite. While the requirements and architecture documents describe high level concepts, the present document describes only the detailed functional and external interfaces to those functional elements. If there are discrepancies between the requirements or architecture documents and this document, this document takes precedence. This document provides a baseline to other NG9-1-1 related specifications.

https://www.nena.org/page/i3_Stage3

NENA-STA-004.1.1-2014 - NENA Next Generation 9-1-1 (NG9-1-1) United States Civic Location Data Exchange Format (CLDXF) Standard - This document defines the civic location data elements that will be used to support the NENA compliant Next Generation systems, databases, call routing, call handling, and related processes. The CLDXF document was developed to:

1. Provide a definitive set of core civic location data elements that support emergency call routing and dispatch.
2. Map a profile between Presence Information Data Format-Location Object (PIDF-LO) and those same NENA core civic location data elements.



3. Map those civic location data elements to the corresponding Federal Geographic Data Committee, United States Thoroughfare, Landmark, and Postal Address Data Standard, Document Number FGDC-STD-016-2011 set of data elements, which was sponsored by the Urban and Regional Information Systems Association (URISA) and the National Emergency Number Association (NENA).
4. Provide illustrative examples of address parsing.

<https://www.nena.org/page/NG911CLDXF>

NENA-STA-015.10-2018 (originally 02-010) - NENA Standard Data Formats for E9-1-1 Data Exchange & GIS Mapping - This document sets forth NENA standard formats for Automatic Location Identification (ALI) data exchange between Service Providers and Data Base Management System Providers, a Geographic Information System (GIS) data model, and formats for data exchange between the ALI Database and ECC Controller equipment.

<https://www.nena.org/general/custom.asp?page=DataFormats>

NENA-STA-006.1-2018 - NENA Standard for NG9-1-1 GIS Data Model - This document defines the Geographic Information Systems (GIS) Data Model, which supports the NENA Next Generation 9-1-1 (NG9-1-1) Core Services (NGCS) of location validation and routing, both geospatial call routing or to the appropriate agency for dispatch. This model also defines several GIS data layers used in local ECC and response agency mapping applications for handling and responding to 9-1-1 calls.

<https://www.nena.org/page/NG911GISDataModel>

APCO / NENA 2.105.1-2017 - NENA/APCO NG9-1-1 Emergency Incident Data Document (EIDD) - The Emergency Incident Data Document (EIDD) provides a standardized, industry-neutral National Information Exchange Model (NIEM) conformant (XML-based) specifications for exchanging emergency incident information to agencies and regions that implement NG9-1-1 and Internet Protocol (IP) based emergency communications systems. Emergency incident information exchanges supported by the EIDD include exchanges between disparate manufacturers' systems located within one or more public safety agencies and with other incident stakeholders.

<https://www.nena.org/page/EIDD>



5.3 Data Management

NENA-STA-003.1.1-2014 - NENA Standard for NG9-1-1 Policy Routing Rules - An important feature of NG9-1-1 is the ability of the system to adapt to outages, excessive call volumes, emergencies and normal scheduled ECC outages. The Policy Routing Function (PRF) described in 08-003 is the function that handles the diversion of calls. To support the PRF, Policy Routing Rules (PRRs) must be developed. These PRRs define to where calls are diverted if the target ECC is unreachable. This Working Group's charter was to define a template to guide the development of these PRRs. To that end, the committee developed templates to facilitate the PRRs that a 9-1-1 Authority must develop for any new NG9-1-1 System. The minimum set of rules developed must address all call diversion capabilities present in the current E9-1-1 system. A 9-1-1 Authority may choose to implement additional and/or enhanced PRRs to divert calls in a manner that takes advantage of capabilities available in a NG9-1-1 system that are not available in E9-1-1 systems.

<https://www.nena.org/page/NG911RoutingRules>

NENA-INF-011.1-2014 - NENA NG9-1-1 Policy Routing Rules Operations Guide - This document is provided to assist 9-1-1 Governing Authorities in using Policy Routing Rules (PRRs) during the full life cycle of a NG9-1-1 System. The document provides considerations and recommendations to 9-1-1 Governing Authorities implementing NG9-1-1 systems during the Request For Information (RFI) and Request For Proposals (RFP) used to select a vendor, through the implementation phase where PRRs are initially established, to the steady-state operations of a NG9-1-1 System where PRRs are refreshed and refined. Using the information in this document the reader will be able to take full advantage of the power of PRRs defined in the NG9-1-1 Standards referenced. This document is intended for staff of 9-1-1 Governing Authorities and ECCs with a baseline understanding of NG9-1-1. Reading the reference documents listed in Section 4 is helpful but is not a requirement to use this document.

https://www.nena.org/page/PRR_OptnsGuide

NENA 71-502 - An Overview of Policy Rules for Call Routing and Handling in NG9-1-1 Information Document - This document is an overview of what policy rules are, how policy is defined, and the ways that they may be used. Policy rules influence the delivery of calls to an ECC and, how these calls are handled based on call-taker skill sets and other criteria. Policy Rules are defined and implemented by the governing 9-1-1 Authority.



https://www.nena.org/page/NG911_Policy_Rules

NENA-REQ-002.1-2016 - NENA Next Generation 9-1-1 Data Management Requirements - This document defines discrepancy report and the performance reports associated with processes within the Next Generation 9-1-1 (NG9-1-1) system. The intent of the document is to provide 9-1-1 Authorities, vendors, Communication Service Providers (CSP), and other interested parties with guidelines for communicating issues or status of various elements within the system. The components of the document are Discrepancy Report Requirements and Performance Statistic Report Requirements.

<https://www.nena.org/page/NGDataMgmt>

NENA 02-014 - NENA GIS Data Collection and Maintenance Standards - This document is the NENA recommended standard for GIS data collection and GIS data maintenance. This document is meant to provide ECC management, vendors, and other interested parties necessary guidelines for collecting and maintaining GIS data. Collection and maintenance of GIS data is most reliably accomplished by qualified, trained individuals or vendors that have received formal GIS training and instruction. This standard also provides information on data collection to meet accuracy requirements for wireless and Voice over Internet Protocol (VoIP) 9-1-1 technologies that use x, y, z coordinates to provide location of the 9-1-1 caller.

<https://www.nena.org/page/gisdatacollection>

NENA-INF-014.1-2015 - NENA Information Document for Development of Site/Structure Address Point GIS Data for 9-1-1 - This document is an informational tool chest, not a listing of instructions and requirements. The reader will find a great deal of practical information on address point placement methodologies, based on real world experience. Reading the entire document will provide the greatest understanding of address point placement options and be the most beneficial to the reader.

<https://www.nena.org/page/SSAP>

NENA-STA-005.1.1-2017 - NENA Standards for the Provisioning and Maintenance of GIS data to ECRF and LVFs - This document defines operational processes and procedures necessary to support the i3 Emergency Call Routing Function (ECRF) and Location Validation Function (LVF). Additionally, this document identifies ECRF/LVF performance and implementation considerations for 9-1-1 Authorities' consideration.

<https://www.nena.org/page/ProvGISECRFLVF>



NENA-INF-71-501 – NENA Information Document for Synchronizing GIS with MSAG & ALI - This document is meant to provide ECC management, vendors, and other interested parties necessary guidelines for synchronizing GIS data with existing 9-1-1 databases. The synchronization process of the GIS data is most reliably accomplished by qualified, trained individuals or vendors that have received formal GIS training and instruction.

https://www.nena.org/page/synch_gis_msag_ali

NENA-INF-028.1-2020 - NENA Information Document for GIS Data Stewardship for Next Generation 9-1-1 - The purpose of this document is to support the development of complete, accurate and current GIS datasets to be used within NG9 1 1 systems. These datasets will be used to validate call location information, to route calls to the correct responding agency, and to display locations in context for call handling purposes. Following the recommendations presented will result in more accurate, efficient and reliable operation of GIS data dependent services within NG9 1 1 Systems.

<https://www.nena.org/page/GISDataStewardship>

5.4 Agency Systems

NENA-STA-026.5-2016 (originally NENA 04-002) - NENA PSAP Master Clock Standard - This Standard is a guide for designers and manufacturers of ECC equipment. It identifies engineering and technical requirements to be met before the NENA membership shall consider purchase of such equipment; it may also be of value to purchasers, maintainers and users of such equipment.

https://www.nena.org/page/PSAP_Master_Clock

NENA/APCO-REQ-001.1.2-2018 - NENA/APCO Next Generation 9-1-1 Public Safety Answering Point Requirements - This technical requirements document introduces requirements for a NG9-1-1 ECC that is capable of receiving IP-based signaling and media for delivery of emergency calls conformant to the latest version of the NENA i3 Architecture document. An emergency call enters the i3 ECC using Session Initiation Protocol signaling. NG9-1-1 encourages the creation of many new coordination and information access services to enrich collaborative interactions between all agencies involved in processing emergency service requests. This document is issued as NENA/APCO recommended requirements for functions and interfaces between an i3 ECC and NG9-1-1 Core Services, and among Functional Elements associated with the



i3 ECC. This document is primarily intended to drive the development of more standards that meet the technical requirements specified herein. Unless otherwise indicated, the requirements in this document do not apply to products and services unless and until matching specifications are published in applicable standards.

https://www.nena.org/page/NG911_PSAP_REQ

NENA-STA-019.1-2018 - NG9-1-1 Call Processing Metrics Standard - Call processing metrics are measurements between events in the call processing chain used to drive reporting, analysis, and real-time monitoring. The intent of this document is to define normalized NG9-1-1 call processing metrics for computing useful statistics so that independent implementations can derive the same comparable measurements. This is ANSI Accredited NENA Standard.

https://www.nena.org/page/NG_CallProcMetrics

5.5 Interconnection & Security

NENA-INF-016.2-2018 (originally NENA 08-506) - NENA Emergency Services IP Network Design for NG9-1-1 Information Document - This document is intended to provide information that will assist in the development of requirements necessary to design ESInets that meet industry standards and best practices related to the NG9-1-1 systems that will depend on them for services. Readers are encouraged to review and refer to this document during preparations for procuring, building and implementing an ESInet and to use it as an informative resource.

https://www.nena.org/page/IP_Network_NG911

NENA 75-502 - Next Generation 9-1-1 Security (NG-SEC) Audit Checklist Information Document - This Information Document is a companion to NENA 75-001 - NENA Security for Next-Generation 9-1-1 Standard (NG-SEC) Standard. To effectively use this document the user should have a clear understanding of the concepts and procedures described therein. This checklist provides a summary of the requirements and recommendations detailed in the NG-SEC standard and provide the educated user a method to document a NG-SEC Audit.

<https://www.nena.org/page/NGSecurityChecklist>



NENA 75-001 - Security for Next-Generation 9-1-1 (NG-SEC) - The purpose of this document is to establish the minimal guidelines and requirements for the protection of NG9-1-1 assets or elements within a changing business environment. This document:

- Identifies the basic requirements, standards, procedures, or practices to provide the minimum levels of security applicable to NG9-1-1 Entities.
- Provides a basis for auditing and assessing levels of security and risk to NG9-1-1 Entities, assets or elements, and exception approval / risk acceptance process in the case of non-compliance to these guidelines.

https://www.nena.org/page/NG911_Security

NENA-INF-015.1-2016 – NENA NG9-1-1 Security (NG-SEC) Information Document - This information document is a companion to NENA STA-010. This document provides detail of the mechanisms and best practices relative to security of the i3 system. This document describes procedures and best practices on how to deploy security for the system.

https://www.nena.org/page/NG911_Security_INF

5.6 Miscellaneous

CSRIC Best Practices - The Communications Security, Reliability and Interoperability Council's (CSRIC) mission is to provide recommendations to the FCC to ensure, among other things, optimal security and reliability of communications systems, including telecommunications, media, and public safety.¹⁴ CSRIC's members focus on a range of public safety and homeland security-related communications matters, including: (1) the reliability and security of communications systems and infrastructure, particularly mobile systems; (2) 9-1-1, Enhanced 9-1-1 (E9-1-1), and Next Generation 9-1-1 (NG9-1-1); and (3) emergency alerting.

<http://transition.fcc.gov/pshs/advisory/csrlic>

¹⁴ <https://www.fcc.gov/about-fcc/advisory-committees/communications-security-reliability-and-interoperability-1>;



6. ESInet Conceptual Design and Recommendations

6.1 ESInet Conceptual Design

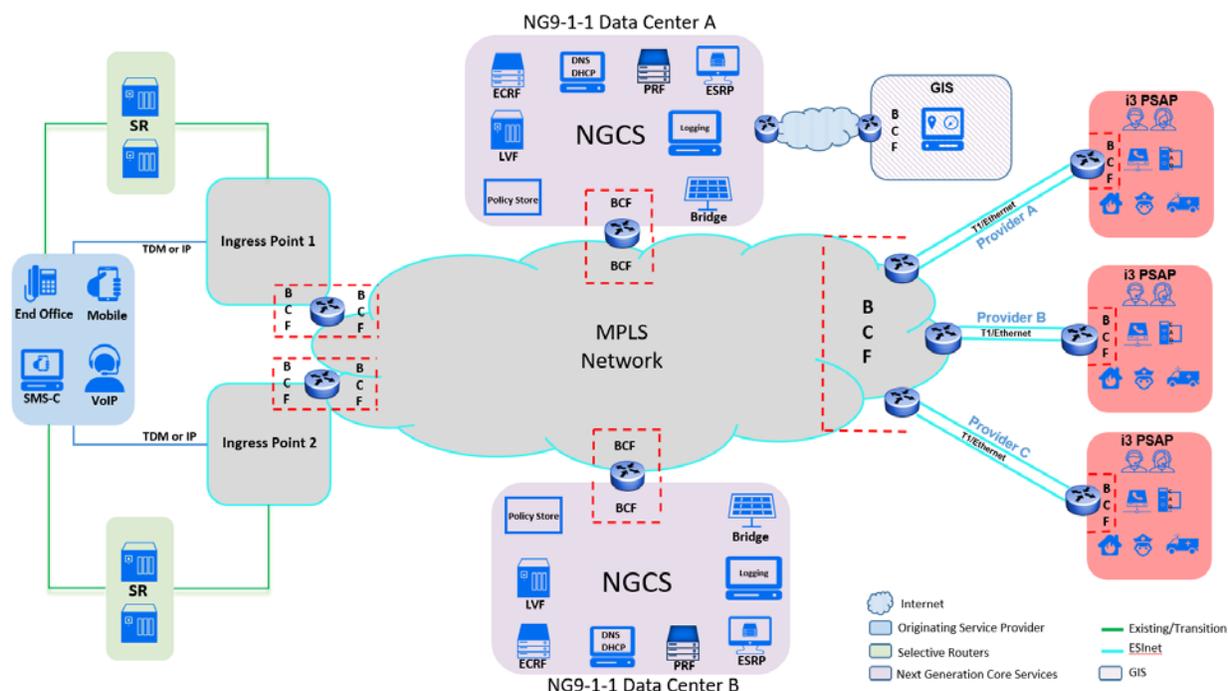


Figure 7 – ESInet Conceptual Design

6.2 ESInet Recommendations

Creating a statewide ESInet is expected to be a significant undertaking. The State’s challenging terrain and sparse population has resulted in the commercial carriers reluctant to invest in statewide network infrastructure.

As depicted in Figure 7 (above), it is **FE’s** opinion that the ESInet buildout for the State will need to be done by establishing partnerships with network providers that meet the NENA i3 standards in every respect.

There are three generic network providers depicted in this example (above). The actual suppliers of the network connectivity will ultimately be determined by any number of successful proposers as vetted through an RFP process. In addition, it should be reiterated that in **FE’s** opinion, the NGCS should be provided by a single vendor. **FE**

recommends that the NGCS provider owns and manages the relationships between ECC connectivity providers (ESInet).

Based on stakeholder interviews, the analysis of the obtained/provided information, as well as standards required for ESInet buildout, **FE** recommends the following:

Recommend the IPSCC prepare and issue a NG9-1-1 Request for Information (RFI) for a statewide NG9-1-1 ESInet and Next Generation Core Services system.

Recommend the IPSCC develop detailed requirement specifications for a statewide ESInet considering all relevant NENA standards and information acquired through the RFI process.

Recommend the IPSCC prepare, issue, and evaluate vendor responses to a Request for Proposal (RFP) for the procurement of a statewide NG9-1-1 ESInet and Next Generation Core Services system.

Recommend the IPSCC pursue the selection of a NG9-1-1 Service Provider Partner, through a procurement process, that is capable of the coordination of all activities relative to NG9-1-1 services including ESInet build out and Next Generation Core Services operation. The selection criteria for the NG9-1-1 Service Provider Partner must be clearly captured within the scope of work. This should preferably be done through a well-defined RFP.



Appendix A - Referenced Documents

Document Name
<i>NG9-1-1 Uniform Standards.pdf</i>

