State of Montana

ESInet Design and Implementation Plan

(Draft)

June 28th, 2019

Prepared by:

"Unleashing the Power of Technology"

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Table of Contents

1. Executive Summary

Federal Engineering, Inc. (***FE***) respectfully submits this Draft Emergency Services Internet (ESInet) Design and Implementation Plan to the State of Montana 9-1-1 Program Office.

Montana's current E9-1-1 network was developed and implemented around landline technology more than 40 years ago and was not designed to facilitate the transmission of text messages and data images such as pictures and video. Consumers are driving the telecommunications landscape, and Public Safety Answering Points (PSAPs) need to be able to meet expectations and accommodate a wider range of communication methods. In addition to receiving cellular and legacy 9-1-1 wireline calls, the public expects PSAPs to handle instant messaging, text messages, telematics (automatic crash notification) and live video feeds. Today, the PSAPs in Montana (State) are not able to support these applications; therefore, there is a need to transition Montana's current Enhanced 9-1-1 (E9-1-1) network to a Next Generation 9-1-1 (NG9-1-1) system.

A communications shift is also occurring among the hearing and speech impaired community. Because of the nearly obsolete Telecommunication Device for the Deaf/Teletype (TDD/TTY) equipment and lack of portability, these individuals have embraced new technologies in their everyday lives. Advances in wireless phone technologies now include smart devices that bring portability and ease of use to these individuals.

While the current 9-1-1 system has served the State well for decades, consumers and new technologies are driving Montana's communications industries to rapidly move to an infrastructure that offers enhanced capabilities and increased capacity. The new infrastructure is being referred to as NG9-1-1 that will utilize an Emergency Services Internet Protocol network (ESInet) to easily interface with the communication methods available today and those communications methods of the future. Next Generation 9-1-1 involves the evolution of E9-1-1 to an all Internet Protocol (IP)-based emergency communications system.

As Montana PSAPs consider transitioning to NG9-1-1 systems and the associated ESInet, it's critical that the system be developed using open standards that interface between the PSAP, ESInet and the callers' devices. Components of the National Emergency Number Association (NENA) NG9-1-1/ESInet standards [1] are frequently referred to as the i3 Architecture that defines the ESInet model, functions, interfaces and required services.

This new digital network will drive changes in the PSAP environment, and all stakeholders will need to address emerging technologies and public policy concerns. Changes in state and federal requirements, funding methods, diverse demographics and jurisdictions will present significant challenges and unique opportunities.

[1] https://www.nena.org/page/i3_Stage3

The 9-1-1 Program Office will promote collaboration between all PSAPs regarding network governance, procurement and implementation. Montana's PSAPs will need to consider and plan for training and retaining skilled employees in the 9-1-1 centers of the future.

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.

The current emergency communications 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 Customer Premise Equipment (CPE) support.

Consumers expect 9-1-1 centers to keep pace with new technologies and they expect the same level of service in rural Montana that they receive in urban parts of the State.

To assist the local and tribal government entities and telecommunications providers with developing and improving the PSAPs to meet the public expectations and to acquire IP-based/capable systems, the State implemented a grant program via legislation passed in 2017, effective July 2018. The legislation is a revision to Montana Code Annotated 2017, Title 10. Chapter 4. State Emergency Telephone System, Part 3. Emergency Telephone System Account – Usage, 9-1-1 Grants 10-4-306[2]. The grant program provides funding for the following:

"…emergency telecommunications systems plans; (b) project feasibility studies or project plans; (c) the implementation, operation, and maintenance of 9-1-1 systems, equipment, devices, and data; and (d) the purchase of services that support 9-1-1 systems."

This ESInet Design and Implementation Plan (Plan) identifies the overarching steps and tasks necessary to assess, plan, design, test, implement and maintain a complete NG9-1-1 System in Montana.

This Plan utilizes a comprehensive methodology for the implementation of NG9-1-1 in Montana. The following phases are outlined in this plan:

- Initiation
- Assessment and Analysis
- Requirements, Design and Planning
- Proof of Concept

[2] https://leg.mt.gov/bills/mca/title_0100/chapter_0040/part_0030/section_0060/0100-0040-0030-0060.html

- Implementation
- Maintenance and Management

In each phase there are studies, reports, requirements, designs and plans related to the following tasking areas:

- Regulatory, Legislative and Funding
- Governance
- Technology
- Operations
- Security

This document is designed to be an actionable, sustainable, tactically focused plan for a Statewide NG9-1-1 implementation.

Meeting the challenges and capitalizing on the opportunities will require thorough preparation. This Plan represents the first step towards the continued excellence in 9-1-1 services today and into the future. The 9-1-1 Program Office, along with the 9-1-1 Advisory Council, will strive to facilitate a cooperative means for the migration to NG9-1-1 services in the State. This Plan is intended to be a living document and will enable the State to qualify for future federal grant funds. To maintain its relevancy, the 9-1-1 Program Office, along with the 9-1-1 Advisory Council and various 9-1-1 stakeholders, will formally review and periodically update this Plan.

Every year, states pass legislation to improve the operations of emergency communications via access and funding of modern technologies. States that enacted legislation related to NG9-1-1 include Iowa, Montana and New Mexico. According to the 2017 National 911 Progress Report, 20 states have adopted a statewide NG9-1-1 plan and 22 reported being in the installation and testing phase of NG9-1-1 component implementation.

2. Current 9-1-1 Environment

2.1 9-1-1 Funding

The State of Montana 9-1-1 Program Office has the primary responsibility of managing the quarterly allocation and distribution of state 9-1-1 revenues and monitoring the use of said funds by local and tribal governments and wireless service providers.

The 9-1-1 grant program was created via legislation in 2017, effective July 1018, for the purpose of supporting the implementation, operation, and maintenance of 9-1-1 systems, equipment, devices, and data. Funding of E9-1-1 and wireless E9-1-1 is provided through an assessment of a fee of $1.00 on subscribers of local landline and wireless access.

The 9-1-1 surcharge of $1.00 per month per subscriber is required to have $0.75 per subscriber fee deposited in an account for quarterly distribution to local and tribal government entities[3] in accordance with 10-4-305 and with rules adopted by the department in accordance with 10-4-108; and $0.25 per subscriber fee is deposited in an account for distribution in the form of grants to private telecommunications providers and/or local and tribal government entities that host public safety answering points, or both in accordance with 10-4-306.

Eligible uses of 9-1-1 fees that are quarterly distributed and expended by certified Montana PSAPs are costs associated with the following:

- personnel,
- computer aided dispatch (CAD) systems,
- 9-1-1 telephone equipment,
- radio systems/wireless commercial services,
- connectivity/infrastructure,
- voice logger/data recorder,
- geographic information systems (GIS)/master street address guide (MSAG),
- facilities,
- office operations,
- mass notification system,
- public education and proration of expenditures

**If item, service or personnel listed above will also be used or employed for a purpose other than the 9-1-1 system, the PSAP will allocate funds based on the cost attributable only to the 9-1-1 system.*

[3] Note that tribal government entities were added to legislation in 2019.

2.1.1 Funding the Montana State 9-1-1 Department

The State of Montana 9-1-1 Program Office is also funded through the collected 9-1-1 fees. Department duties and powers are provided in 10-4-107, MCA.

2.1.2 State of Montana, 9-1-1 Grant Program

In 2017 House Bill 61 was passed by the Montana Legislature and signed by Governor Steve Bullock on May 10, 2017. House Bill 61 provided for approximately $6.8 million in funding for the award of 9-1-1 grants by the Department of Administration in state fiscal year (SFY) 2019. The Department, in consultation with the 9-1-1 Advisory Council, awarded grants[4] in May 2019.

Eligible applicants and recipients of State of Montana 9-1-1 grants include: private telecommunications providers and local and tribal government entities that host certified public safety answering points (10-4-306(1) MCA).

Eligible uses of awarded grant funds include: project feasibility studies or project plans; the implementation, operation, and maintenance of 9-1-1 systems, equipment, devices, and data; and the purchase of services that support 9-1-1 systems (10-4-306(2) MCA).

10-4-101(1) MCA defines a 9-1-1 system as *"…telecommunications facilities, circuits, equipment, devices, software, and associated contracted services for the transmission of emergency communications. A 9-1-1 system includes the transmission of emergency communications: from persons requesting emergency services to a primary public safety answering point and communications systems for the direct dispatch, relay, and transfer of emergency communications; and to or from a public safety answering point to or from emergency service units."*

Eligible prospective applicants must submit a 9-1-1 Grant Application Form for individual projects for which the applicant is seeking financial assistance. Application submittal is an annual process.

2.1.3 Funding Model Needed

The 9-1-1 Surcharge Fee has greatly improved the 9-1-1 landscape in Montana. The 2017 legislation provided a framework to administer the 9-1-1 program. The funding component of the legislation provided a mechanism to fund the grant program and the administration of 9-1-1 programs. The legislation allows certified PSAPs in less populated areas to maintain their current systems with the ability to migrate to a Statewide NG9-1-1 network.

The public expects their local and tribal governments to keep pace with technology and be able to provide universal access to emergency services regardless of whether they are in an

[4] http://sitsd.mt.gov/Governance/Boards-Councils/9-1-1

urban or rural area. To meet that expectation, PSAPs will need to replace aging technologies and networks with a NG9-1-1 system. Successful models suggest this can be done with a Statewide or regional network. The current funding model will need to be clarified and expanded to assist PSAPs with their migration plans towards a Statewide NG9-1-1 network that can provide the best available Public Safety service available throughout Montana.

The current 9-1-1 surcharge fee along with the approximately $8M available in the 9-1-1 grant program account in SFY 2020 will help jump start this project. While this funding will move Montana forward the 9-1-1 Advisory Council should continue to explore changes to state laws that would account for ongoing NexGen future technologies, services and devices that are capable of accessing 9-1-1 and establish a new funding model for NG9-1-1 to help subsidize and assist certified PSAP's to timely move to the Statewide NG9-1-1 system. Further discussion of this is found later in this plan.

3. Network Overview

The existing Enhanced 9-1-1 (E9-1-1) network in the State of Montana is comprised of two sub-networks, both operated by CenturyLink with Vision Net being the designated subcontractor. Montana PSAPs handled approximately 500,000 9-1-1 calls for emergency services in the year 2018. This estimate is based on a combination of statistical data obtained from CenturyLink, Vision Net, and the six busiest Montana PSAPs as detailed in the following table.

Table 1 – Six Busiest PSAPs Approximate Annual Call Volume

PSAP	Approximate Annual 9-1-1 Calls
Cascade County	49,000
Flathead County	34,000
Gallatin County	174,000
Lewis & Clark County	27,000
Missoula County	67,000
Yellowstone County (City of Billings)	82,000

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.

A detailed description of the existing E9-1-1 network and associated call volumes have been described in previous deliverables to the Montana 9-1-1 Program Office, namely:

1. *ESInet Maps and Inventory Summary Memorandum* (March 4, 2019)

2. *State of Montana NG9-1-1 Technology Requirements* (May 15, 2019)
3. *High-Level PSAP NG9-1-1 Needs Assessments* (May 31, 2019)

The following is the summary of the key elements and features of the existing E9-1-1 network germane to this document:

3.1 Originating Service Providers

Wireline Carriers: Each of the following 13 Wireline Host/End Offices is interconnected to a digital access and cross-connect system network (DACS) with T1 connectivity between all the DACS sites throughout the State:

1. CenturyLink Montana
2. 3 Rivers Telephone Cooperative
3. InterBel Telephone Cooperative
4. Blackfoot Telecommunications
5. Ronan Telephone Company
6. Northern Telephone Cooperative
7. Triangle Communications
8. Central Montana Communications (CMC)
9. Nemont Telephone Cooperative
10. Mid-Rivers Communications
11. Range Telephone Cooperative
12. Project Telephone Company
13. Citizens Telephone Company

The DACS locations are used as aggregation points creating a pseudo-ring with static routing. The entire DACS network is homed into Missoula and Billings DACS with connectivity provided over redundant T1's to the Selective Routers located at Missoula and Billings.

The following are the eight DACS locations and their respective operators:

1. Sunburst - Northern Telephone Cooperative (leased) – 1 Central Office
2. Fairfield - 3-Rivers Telephone Cooperative (leased) – 7 Central Offices
3. Havre - Triangle Communications (leased) – 10 Central Offices
4. Glasgow – Nemont Telephone Cooperative (leased) – 5 Central Offices
5. Missoula – Blackfoot Telecommunications (owned) – 7 Central Offices

6. Billings – CenturyLink Montana (owned) – 5 Central Offices
7. Glendive - Mid-Rivers Communications (leased) – 3 Central Offices
8. Forsyth – Range Telephone Cooperative (leased) – 3 Central Offices

3.2 Wireless Carriers

The four major Wireless Carriers in the State of Montana are:

1. AT&T
2. Sprint
3. T-Mobile
4. Verizon

All other Wireless Carriers and Mobile Virtual Network Operators (MVNOs) typically run their voice traffic over the networks of the carriers listed above, except for Sagebrush and Mid-Rivers that own their networks.

3.3 9-1-1 Service Provider

The current CenturyLink 9-1-1 network in the State of Montana consists of the following:

1. Legacy Qwest network – not supported by Vision Net
2. IP MPLS Network – supported by Vision Net
    a. A dedicated MPLS network is provisioned with one single Virtual Routing and Forwarding (VRF) channel dedicated for 9-1-1.
3. AudioCodes Media Gateway using G.711 codec to deliver VoIP all the way to the site.

A detailed inventory of the PSAP names, their associated 9-1-1 network (Legacy vs. MPLS), voice, ANI/ALI connectivity and existing bandwidth allocation are captured in the *ESInet Maps and Inventory Summary Memorandum* (see Appendix A).

All call routing is managed by CenturyLink based on Master Street Address Guide (MSAG) information (for landline calls), and Pseudo Automatic Number Identification (pANI) or cell-tower information for all other calls.

The wireline ALI services are provided by CenturyLink and their database group is responsible for updates on all landline Automatic Location Identification (ALI) information.

West provides ALI and Wireless Phase 2 location information for Wireless, VoIP and other mobile services such as OnStar.

An overview of existing assets has been captured in the submitted *ESInet Maps and Inventory Summary* (see Appendix A) document including diagrams of the existing 9-1-1 system elements.

3.4 Public Safety Answering Points

3.4.1 PSAP Connectivity

- There are total of 61 PSAP sites in the State of Montana. This count includes primary, secondary, back-up and tribal PSAP sites.
- There are 43 PSAPs sites on the CenturyLink/Vision Net MPLS network. For all these PSAPs, both voice and data are delivered over the same circuits. There is no indication of redundancy or diversity by the carrier.
- 18 PSAPs sites that are served by the Legacy Qwest network are routed to Selective Routers (SRs) located in Helena and Billings via dedicated CAMA trunks. CAMA trunk inventory is captured within the ESInet Maps and Inventory Summary document.

3.4.2 PSAP CPE (Equipment)

The PSAPs use a variety of Customer Premise Equipment (CPE) to perform the 9-1-1 call answer function. 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)

Thirteen (13) of the PSAPs (MPLS network) are IP enabled and possess NG9-1-1 ready equipment.

Currently 33 of Montana PSAPs are Text-to-9-1-1 enabled. A detailed inventory of Text-to-9-1-1 enabled PSAPs and the onsite equipment used to deliver these services are captured in the *MT PSAP Inventory Memorandum* (see Appendix A).

3.5 Montana's E9-1-1 Network

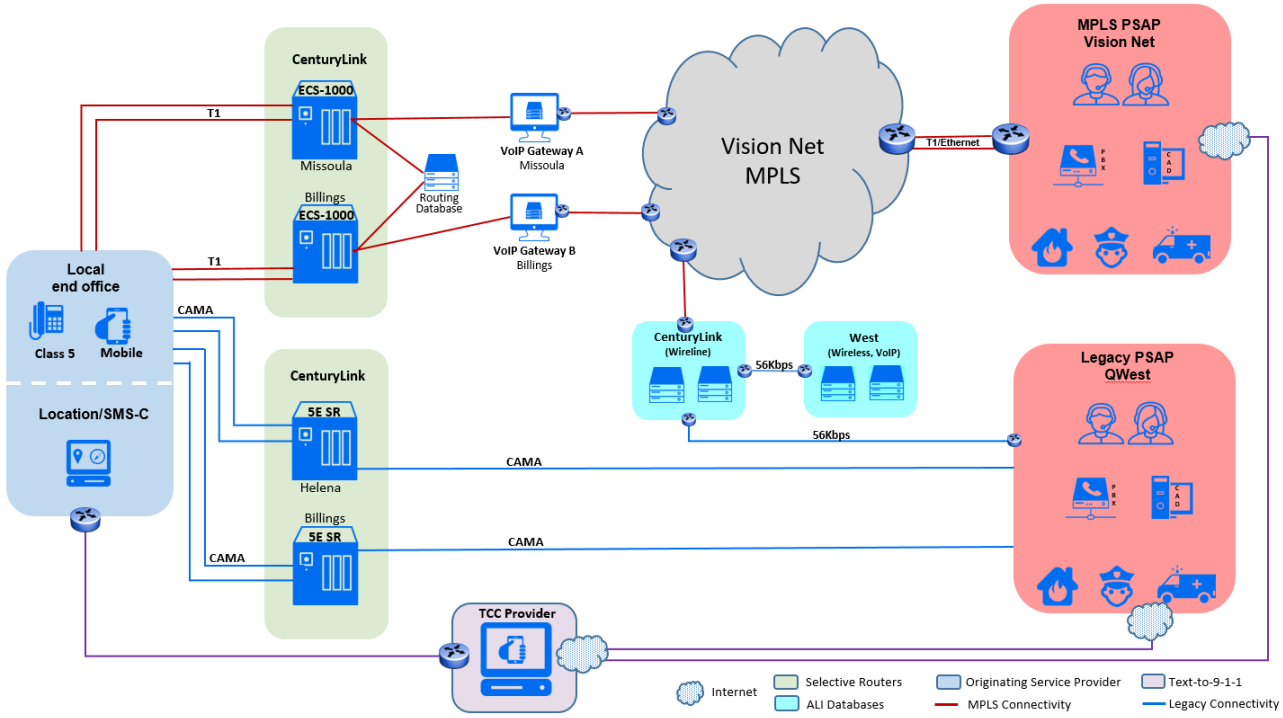

Figure 1 – Conceptual Design: Montana NG9-1-1

3.5.1 Next Generation 9-1-1 Services in Montana

3.5.1.1 NG9-1-1 Overview

Montana's current 9-1-1 system, although extremely reliable, has reached end of life and cannot keep up with evolving technologies OR public expectations. It was not designed to facilitate the transmission of the requests for service from the public using new types of technology that allow for exchange of text, video and images.

Today, when a caller located in the State of Montana places a 9-1-1 call, the call travels from the Originating Network to a specialized Enhanced (E9-1-1) Network. For the majority of calls, the E9-1-1 networks determine which PSAP serves the area from which the 9-1-1 call was placed and routes the call, along with ancillary information (e.g., subscriber's name, location information, call back number, service provider name and contact number, etc.) to that PSAP.

When NG9-1-1 is fully implemented in the State of Montana, a request for emergency assistance (9-1-1 call) will transit from the originating network to the NG9-1-1 network referred to as Emergency Services IP Network (ESInet) and the associated NG9-1-1 Core Services (NGCS). These networks will be capable of conveying additional data about the

call, caller and caller's location when requested by the PSAP (if available). These functions will be performed based on Internet Protocol (IP) network technology and will be based on Session Initiation Protocol (SIP) signaling. In short, an end-to-end IP call; from Originating Services Provider (OSP), through NGCS to an IP enabled PSAP.

To accommodate the technology changes, OSPs, NG9-1-1 Service Providers and the PSAPs will need to migrate to a NG9-1-1 system that can easily interface with the many different types of communication methods available today and the near future. This system should be based on internationally recognized standards that interface between the PSAP, ESInet and the caller's device.

The NENA developed i3 solution meets the set-out requirements as it supports end-to-end IP connectivity and it describes transition from existing legacy networks to NG9-1-1, including ongoing interworking requirements for IP-based and TDM-based PSAPs and origination networks.

Ensuring that the State of Montana NG9-1-1 System is as resilient as the existing legacy E9-1-1 network, will require a balance of forward thinking as well as sound and proven standards-based design fundamentals.

The Engineering Principles and Best Practices used to address reliability, resiliency and security of the NG9-1-1 networks are also captured within the current NENA i3 Standard. In order to maintain and improve 9-1-1 system reliability, these standards, design principles and best practices must be adhered to by all NG9-1-1 stakeholders.

3.5.2 NG9-1-1 System Design

This section describes the main factors that influence the technical design of the state-wide NG9-1-1 System.

3.5.2.1 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.[5]

- The network between the PSAP 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 PSAP should use redundant local area networks for reliability;
- PSAP Local Area Network (LAN) to an ESInet must be resilient, secure, physically

[5] https://www.nena.org/page/i3_Stage3

diverse, and logically separate;
- ESInet shall be engineered to sustain real time traffic, including data, audio, and video;
- Connections between the PSAP 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.

These are the core requirements that should be at minimum met by the ESInet provider.

3.5.2.2 Service Availability and Reliability

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.

Table 2 – Service Availability and Downtime

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

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).

3.5.2.3 Industry Standards and 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 Montana.

"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 PSAPs 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 PSAP. Each PSAP 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%). PSAPs utilizing this solution must therefore rely on traditional methods (i.e., back-up PSAPs 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. "

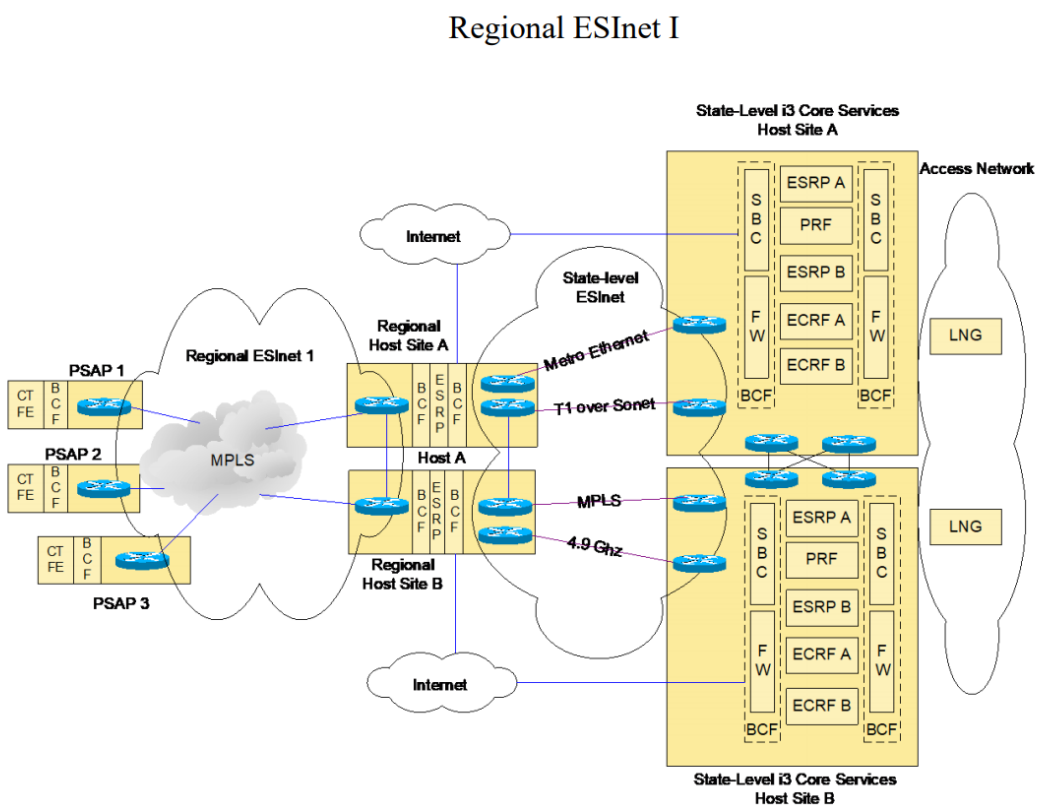

Figure 2 – Regional ESInet I Example

3.5.2.4 ESInet-to-ESInet Interconnection

It is anticipated that in the future, Montana's NG9-1-1 network will interconnect to 5 neighboring state ESInets as well as three Canadian Province Wide ESInets listed within the *State of Montana NG9-1-1 Technology Requirements* document (Section 3.3.8).

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

An example of how these ESInets might be interconnected is provided in NENA-INF-016.2-2018 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.

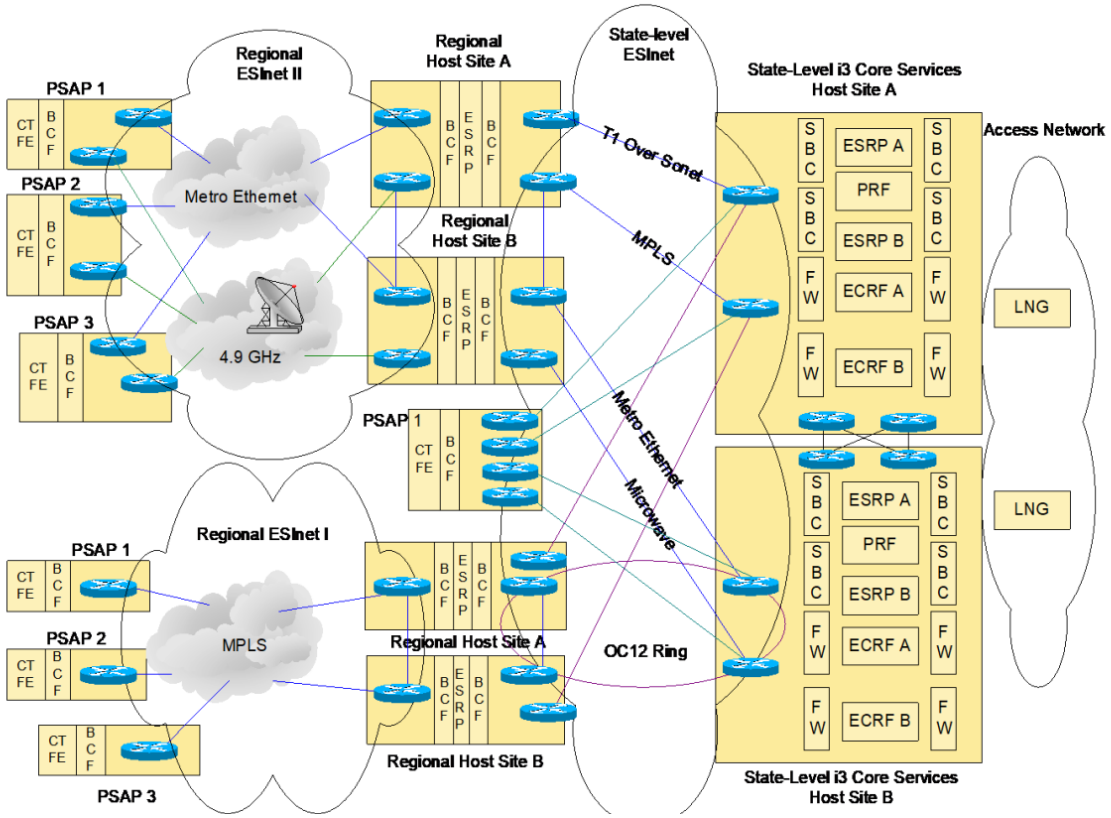

Figure 3 – Interconnecting Multiple ESInets Example[6]

3.5.2.5 Bandwidth Calculation

Appendix B contains the Bandwidth Requirements spreadsheet that provides the minimum bandwidth requirements for each of Montana's PSAPs. The calculation is made using G.711 codec[7], currently used by the existing provider, this codec uses 64Kbps for voice. The minimum recommended bandwidth for each single workstation site is 1.544 Mbps[8].

FE's analysis of the existing bandwidth assignment for PSAPs on the MPLS network found only six PSAPs will require bandwidth augmentation to support NG9-1-1. As part of the analysis, ***FE*** notes that the minimum bandwidth requirements support E9-1-1 equivalency,

[6] https://www.nena.org/page/i3_Stage3

[7] https://www.sip.us/blog/latest-news/whats-a-g-711-voice-codec-and-why-should-you-care/

[8] https://www.cisco.com/c/en/us/td/docs/voice_ip_comm/cust_contact/contact_center/icm_enterprise/icm_enterprise_11_6_1/Design/Guide/ucce_b_soldg-for-unified-cce-116/ucce_b_soldg-for-unified-cce-116_chapter_0110.html

i.e. voice and data delivery for the 9-1-1 call. As new features become available for NG9-1-1 services, the bandwidth requirement for each PSAP must be reviewed and adjusted.

3.5.2.6 Next Generation Core Services

The term NG9-1-1 Core Services (NGCS) is defined by the NENA i3 standard to describe those functions within an ESInet that are necessary to process a 9-1-1 call. The NENA i3 standard addresses only the functionality of these services, not the organizational responsibility for providing them. NGCS includes the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services, and typical IP services such as DNS and DHCP.

3.5.2.7 Cybersecurity

The system should include cyber security as an essential feature of the proposed solution. It is expected that the future NG9-1-1 platform provider will ensure the highest level of cyber security possible by adhering to all current applicable security standards. It should provide the necessary security requirements across all elements of the system:

- Emergency Services IP network (ESInet)
- Next Generation Core Services (NGCS)
- Call Handling Functional Element - Customer Premise Equipment (CPE)
- Geographic Information System (GIS) Services

3.5.2.8 Customer Premise Equipment – i3 CHFE Consideration

The Call Handling Functional Element (CHFE) is responsible for management of 9-1-1 calls as it handles all communication from the 9-1-1 caller. It is comprised of all interfaces, devices and applications used by the 9-1-1 communicator to process the call. It receives associated location data and may display the content of multimedia calls such as text and video to the call taker. It can be deployed in local, host and remote configurations. Although CHFE is typically outside of the ESInet, the availability of different deployment options makes it relevant to the design document. The CHFE requirements are outlined within the NENA/APCO Next Generation 9-1-1 Public Safety Answering Point Requirements document (NENA/APCO-REQ-001.1.2-2018)[9].

[9] https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/NENA-APCO-REQ-001.1.2-2018_N.pdf

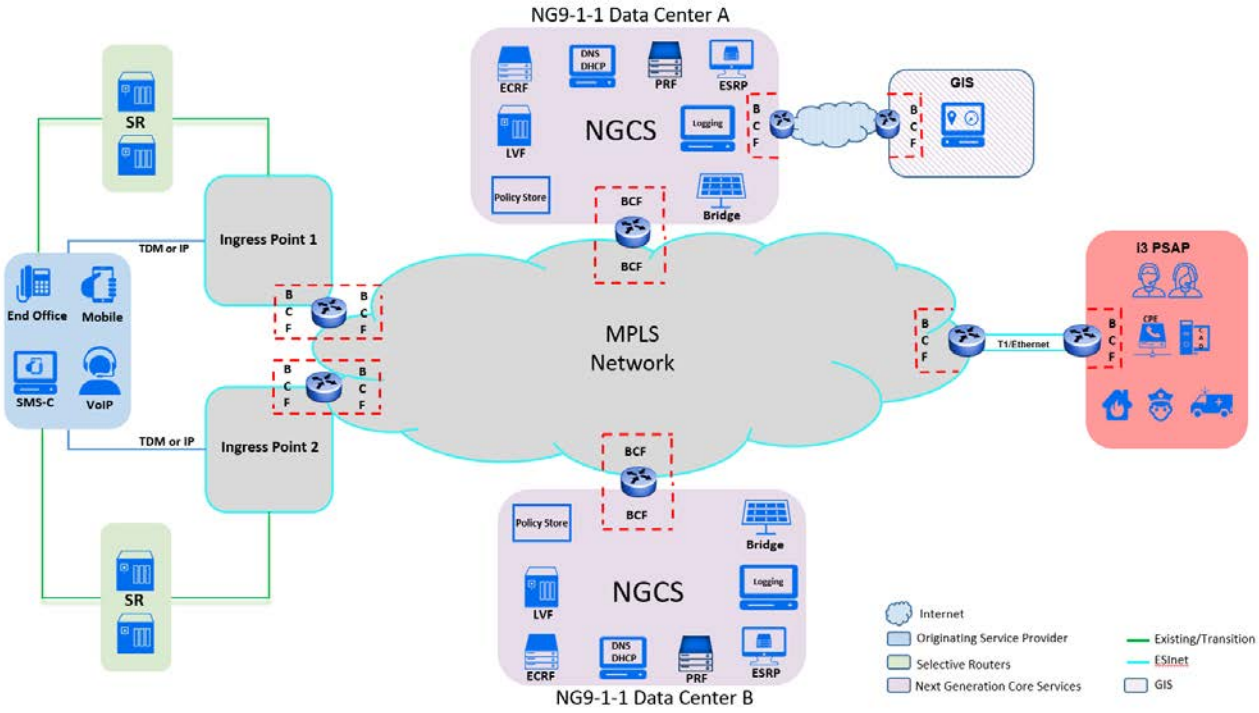

FIGURE 4 – Montana NG91-1 Conceptual Design

4. Implementation Plan Recommendations

Using the criteria identified within this document and analysis of the data collected and submitted in previous tasks, ***FE*** presents the following vision of the NG9-1-1 system in the State of Montana. The findings and recommendations describe the broad goals, advantages, risks and procurement strategies for a statewide implementation of NG9-1-1 platform.

4.1 PSAP Connectivity: IP Enablement

A majority of Montana's PSAP sites (43) are already on a MPLS network. There are currently only 18 PSAP sites operating on the LQ Network that will need to be transitioned to IP connectivity. These PSAPs process a very low amount of 9-1-1 calls with average of 2 CAMA trunks and 2 call taker positions/seats per site, thus requiring minimum bandwidth when transitioned to NG9-1-1.

An analysis of the existing network assets collected from the E9-1-1 facility provider (Vision Net) and inquires to the current 9-1-1 Service Provider (CenturyLink) regarding the IP enablement, indicates that this would be the most appropriate approach to begin preparing for NG9-1-1. Further assessments of the current CenturyLink/Vision Net network

infrastructure will need to be performed and technical and operational requirements defined when creating a detailed network design.

4.1.2 Redundancy, Resiliency and Diversity

FE is recommending a thorough review of the existing network connectivity of the 48 IP enabled PSAPs, for any further expansion requirements (scalability), redundancy and diversity implementation opportunities. This review should be performed by the facilities provider who is the only entity that has intimate knowledge of the assets under their control.

4.1.3 PSAP CPE NG9-1-1 Readiness

An analysis of the existing PSAP CPE assets collected during PSAP visits indicates that 13 of the PSAPs (MPLS network) are IP enabled and possess NG9-1-1 ready Call Handling Functional Element. In order to avoid implementation of Legacy PSAP Gateways (stranded investment), ***FE*** recommends that PSAPs upgrade their CPE at the time of being on-boarded to the NG9-1-1 platform.

The minimum required version for each of the vendors to upgrade the equipment to NG9-1-1 capable is captured within each of the individual *High-Level PSAP Needs Assessment* documents.

An implementation of a HOSTED CPE for all Montana PSAPs should also be explored.

4.1.4 Legacy PSAP Network Connectivity Costs

The actual costs of the Legacy PSAP network connectivity will need to be determined later in this effort, as connectivity costs will be dependent upon the direction chosen by the Advisory Council. In short, the actual connectivity costs will be determined once the network provider has been chosen by each of the Legacy PSAPs.

4.2 NG9-1-1 Platform Procurement

Prior to moving forward with implementation of NG9-1-1, the 9-1-1 Advisory Council must recommend a procurement strategy.

The following NG9-1-1 platform elements must be included in determination of appropriate NG9-1-1 platform procurement strategy:

- Emergency Services IP network (ESInet)
- Next Gen Core Services (NGCS)
- Geographic Information System (GIS) Services
- *Optional* - Call Handling Functional Element (CHFE) - Customer Premise Equipment (CPE)

Based on the required NG9-1-1 platform elements, the state of the current E9-1-1 network and evaluation of procurement strategies employed by other states, ***FE*** submits the following options:

Option 1

One Vendor: Acquisition and full implementation of statewide ESInet, NGCS, GIS Services and Hosted CPE.

Advantages:

- Time saved during procurement process.
- A single vendor should be easier to manage.
- A single vendor should deploy faster with a streamlined implementation.
- There should be an assurance of interoperability among all components.
- A single vendor to answer all needs and address all issues.

Disadvantages:

- Selecting a single vendor could be problematic when NG9-1-1 stakeholders are at different stages of deployment, i.e. PSAP CPE NG9-1-1 readiness.
- Pursuing singular/streamlined solutions may result in stranded investments in equipment, system and network components.
- Cost of solution(s) may be high due to a limited number of vendors capable of providing all components and services.

Risks:

- If a selected vendor uses subcontractors, there may be no/or little input on individual components of solution.
- Service disruption may occur for all NG9-1-1 stakeholders should a primary or sub-contracted vendor change, or the relationship changes due to solvency or other contractual/business-related issues.

Option 2

Two Vendors: Separate procurement from one vendor for ESInet and NGCS and another vendor for Hosted CPE.

Advantages:

- Separating the ESInet and NGCS vendor selection from the CPE vendor selection process provides for flexibility in choosing a vendor that is the best fit to deliver each of the services.

- Two vendors are not difficult to manage.

Disadvantages:

- Detailed functional requirements must be developed and cross-referenced to reduce risk of gap in service and system functionality.
- Clear service level objections (SLOs) and/or service level agreements (SLAs) supporting the requirements and gap areas.
- Adaptability may be an issue for PSAP sites that have already began the transition to NG9-1-1.

Risks:

- Any change of the vendor(s) that provides the ESInet and NGCS may be complex and disruptive to NG9-1-1 stakeholders on both Ingress and Egress side of the service.

Option 3

Three Vendors: Separate procurement of CPE, ESInet and NGCS, and GIS services.

Advantages:

- Will allow increased flexibility in choosing the best vendor for each service.
- There will be an advantage to the consumer in negotiating costs and services among multiple vendors.

Disadvantages:

- Interoperability issues may increase when dealing with multiple vendors.
- Managing multiple vendors will be more difficult and require expanded expertise and oversight.

Risks:

- Any change of the vendor(s) that provides the ESInet and NGCS may be complex and disruptive to NG9-1-1 stakeholders on both Ingress and Egress side of the service.

Option 4

Four Vendors: Separate procurement of ESInet, NCGS, GIS services, and Hosted CPE.

Advantages:

- The most flexibility for PSAP sites who are at different stages of NG9-1-1 deployment.

Disadvantages:

- With multiple systems and expansive components, there will be few vendors able to integrate said systems and components into a single cohesive solution.

Risks:

- Long term management of four independent vendors will be difficult, requiring expanded expertise and oversight.

Option 5

Existing Provider and Network: Leverage the existing 9-1-1 Service Provider and network.

Advantages:

- The intimate knowledge of the existing network, equipment and locations will allow an expedited implementation.
- Utilizing local resources allows for scheduling flexibility and not competing with deployment schedules of other 9-1-1 Service Providers.

Disadvantages:

- A sole source acquisition will require detailed requirements to be defined just as a competitive procurement process, which may be resisted by the existing vendor and stakeholders.

Risks:

- May be limitations in the knowledge-base and experience of existing vendor deployment and support staff.
- The cost and time to bring these resources up to date may impact anticipated expedited deployment.

Option 6

Regional Procurement of Variant Solutions: PSAP sites could be divided into distinct regions. This consideration allows for an introduction of procurement variant to all the options listed in relation to CPE vendor selection. This option lends itself to selecting a vendor(s) that offer a Hosted CPE deployment.

This PSAP Regionalization concept should be explored prior to making procurement strategy and deployment decisions.

Advantages:

- A regional approach should create cost efficiencies.
- Improved scalability.

- Enhanced security.
- Provide for easier maintenance that is administered on a regional level.
- Provide for additional disaster recovery options and capabilities.
- Standardized policies and procedures for call taking that are relevant to the region.

Disadvantages:

- May be difficult to gain consensus from all the PSAPs within the region due to perceived loss of control.

Risks:

- Loss of a Host site may result in a region's isolation if not configured, maintained and diligent focus on adherence to policy and procedures.

4.3 Next Steps

Once the 9-1-1 Advisory Council determines whether a competitive procurement process or adapting the current network is in the best interest of the PSAPs, then complete and detailed requirements should be developed based on the deliverables' content to-date. The next step in the roadmap to NG9-1-1 for the State of Montana includes the development of detailed specifications and requirements for the acquisition of the ESInet, NGCS, CPE and GIS services as deemed appropriate by the 9-1-1 Advisory Council and certified PSAPs.

The path to NG9-1-1 for the State of Montana must also include the following critical steps:

1. Policy and regulatory adaptation
2. Consideration, guidance and training toward the operational impact of NG9-1-1
3. Planning for the fiscal impact of emerging technologies
4. Development of the RFP(s) to fulfill the NG migration Plan as outlined in this document
5. Identifying and engaging resources for providing the necessary oversight to the technical acquisitions, contract negotiations, and implementations

Appendix A - Referenced Documents

Document Name
ESInet Maps and Inventory Summary Memorandum 20190627 Revised Final.pdf
MT NG911 Technology Requirements 20190627 Revised Final.pdf
MT PSAP Inventory Memorandum 20190627 Revised Final.pdf
NENA Master Glossary of 9-1-1 Terminology (NENA-ADM-000.22-2018)[10]

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

Appendix B – Bandwidth Calculation Requirements

KEY

	No Changes to Existing Bandwidth
	Bandwidth Augmentation Required
	Required to Transition to IP Network

PSAP NAME	# of 9-1-1 Call Taking Positions	# of 9-1-1 Lines/ Bandwidth	NG9-1-1 Required Bandwidth
Anaconda-Deer Lodge County	2	3	1.544 Mbps
Beaverhead County	2	2	1.544 Mbps
Big Horn County	2	T1	1.544 Mbps
Blaine County	2	T1	1.544 Mbps
Broadwater County	2	2	1.544 Mbps
Butte-Sliver Bow County	3	4	3 Mbps
Carbon County	1	T1	1.544 Mbps
Cascade County	8	9	10 Mbps
Central Montana	3	T1	3 Mbps
Chouteau County	3	4	5 Mbps
Custer-Garfield Counties	2	T1	1.544 Mbps
Daniels County	1	T1	1.544 Mbps
Dawson County	2	T1	1.544 Mbps
Fallon-Carter-Wibaux-Prairie Counties	2	T1	1.544 Mbps
Flathead County	8	T1	10 Mbps
Gallatin County	4	6	5 Mbps
Glacier County	2	T1	1.544 Mbps
Granite County	2	T1	1.544 Mbps
Havre (City of)	2	T1	1.544 Mbps
Jefferson County	2	4	5 Mbps
Lake County	4	T1	5 Mbps
Laurel (City of)	1	2	1.544 Mbps
Lewis & Clark County	6	6	5 Mbps
Liberty County	2	T1	1.544 Mbps
Lincoln County	2	T1	1.544 Mbps
Madison County	2	10Mb ETH	10 Mbps
McCone County	2	T1	1.544 Mbps

Meagher County	2	T1	1.544 Mbps
Mineral County	1	T1	1.544 Mbps
Missoula County	6	T1	5 Mbps
Musselshell County	2	T1	1.544 Mbps
Park County	4	4	5 Mbps
Phillips County	2	T1	1.544 Mbps
Pondera County	1	4X4Mb ETH	1.544 Mbps
Powder River County	1	T1	1.544 Mbps
Powell County	2	3	3 Mbps
Ravalli County	4	T1	5 Mbps
Richland County	2	T1	1.544 Mbps
Roosevelt County	2	T1	1.544 Mbps
Rosebud-Treasure Counties	2	T1	1.544 Mbps
Sanders County	2	T1	1.544 Mbps
Sheridan County	2	T1	1.544 Mbps
Stillwater County	2	2	1.544 Mbps
Sweet Grass County	2	T1	1.544 Mbps
Teton County	2	T1	1.544 Mbps
Toole County	2	10Mb ETH	10 Mbps
Valley County	2	T1	1.544 Mbps
West Yellowstone (Town of West Yellowstone)	2	2	1.544 Mbps
Wheatland County	2	T1	1.544 Mbps
Yellowstone County (City of Billings)	12	8	10 Mbps
Yellowstone ICC	6	8	10 Mbps
Eureka PSAP		T1	1.544 Mbps
Flathead County (Whitefish)		T1	1.544 Mbps
Hill County	4	T1	5 Mbps
Troy PSAP		T1	1.544 Mbps
Blackfeet Nation		T1	1.544 Mbps
N. Cheyenne Nation		T1	1.544 Mbps
Rock Boy Detention Center		T1	1.544 Mbps