STATE OF VERMONT
ENHANCED 911 BOARD

General Meeting #2 – 13 April 2021
Location: Meeting held via Microsoft Teams due to the pandemic.

10:01 AM – Call to Order
Chair Marcoux brought the meeting to order. The following were in attendance via Microsoft Teams:

Board Members Present	*Staff Members Present*	*Others Present*
Sheriff Roger Marcoux, Chair	Barbara Neal, Executive Director	Stephen Whitaker
Chief Steven Locke, Vice-Chair	Soni Johnson, Board Clerk	Mel Myer
Jerome Pettinga	Jared Lamere, E911 IT Manager	Paul Fitzgerald
Kelly Kennedy		Adam Thiel
Brian Keefe		William Boynak
		Ryan Woodward

Approval of Minutes
General Meeting #1 – 1/19/21 – Motion: Chief Locke made a motion to accept the minutes as written; 2nd by Kelly Kennedy. There was no discussion and the motion passed unanimously by voice vote.

Change in Agenda – Chair Marcoux moved agenda item *LIFT America Act* to first on the agenda following *Approval of Minutes* (most guests at the meeting attended to comment on this item).

LIFT America Act – NG911 Grant Program
Executive Director Neal provided an overview of the LIFT America Act. A handout, *LIFT America Act – NG911 Background and Proposed Changes,* has been incorporated into these minutes.
Board Discussion
Is the Board going to take a position on this? What does it mean that the i3 standards are not incorporated in the Act? No NENA standards are listed in the Act. Why are some standards specifically listed in the Act and some aren't? Will funds be available to organizations that adhere to standards not listed in the Act? What is the role of the advisory board? Who will make up the advisory board?
Public Comment
Mel Myer: Draft bill was supported by Congress, NENA & NASNA were involved, i3 standards are not excluded and are protected, state and local governments will retain control over 911 services. The advisory board will provide guidance to the grant office and will be made up of public safety professionals and 911 system users.
Paul Fitzgerald: Standards should be open-source and non-proprietary.
Adam Thiel: Bill supports states and localities; need to make sure that the national architecture covers multiple standards & is not proprietary; the advisory board should make sure everyone is represented in making these decisions.
William Boynak: State and local control will be maintained; i3 standards are protected; security is a big issue; it's important that all concerns are addressed.
Stephen Whitaker: This Act should not follow the First Net process/model. Transparency is important. Independent, third party analysis is called for.

Legislative Updates – Budget, Governance, and Emergency Responder Wellness Commission
- Budget: Executive Director Neal provided an update on the ongoing USF revenue shortfall impacting E911's budget. House Appropriations recommended that America Rescue Plan Act funds be used to cover the current shortfall and that the Agency of Administration review the existing statutory funding streams for VT E911 and propose changes/additions to ensure program sustainability.
- Governance: The bill to create the Agency of Public Safety did not make crossover. Discussion continues on this issue.
- Emergency Responder Wellness: S.42 – an act related to establishing an emergency service provider wellness commission. The handout, *Mental and Physical Health in 911*, has been incorporated into this document.

Chair Marcoux commended Executive Director Neal on her hard work and legislative testimony in support of Vermont's 911 program.

School ECS Grant Program and Compliance Status
Executive Director Neal provided a status update; the *School ECS Compliance Status Report (April 5, 2021)* has been incorporated into this document.
Public Comment: Mr. Whitaker asked the Board to consider identifying further sources of funding for the compliance grant program.

Redundancy and Resiliency Report Discussion
The following documents have been incorporated into this document:
- *Redundancy and Resiliency in Vermont's 911 System (March 2021)*
- *Outage Report Summary and Detail 2019-2020 (a supplement to Redundancy & Resiliency in Vermont's 911 System (March 2021))*

Board Discussion – Should call volume statistics be added to the report? Adding geographic information about outages might be beneficial.
Public Comment
Mr. Whitaker: Recent Craftsbury outage was not reported to the Board. The Board should take the opportunity to release the report to the community. Broadband buildout is an issue; VoIP calling capability is more vulnerable and subject to interruptions in service. Loss of power on outside pole amplifiers can impact connection to 911.

Executive Director Neal noted that Board staff have reached out to the VoIP service provider concerning the Craftsbury outage to make sure they are aware of outage reporting requirements. Board staff will also work with the Public Service Department to make sure that all appropriate parties (providers of voice service) are aware of the reporting requirements.

FCC Updates
Executive Director Neal provided updates on the FCC Strike Force created to investigate 911 fee diversion, a request for comments on a proposed rule concerning outage notification for OSPs, and a request from NASNA that the FCC look into 911 cost recovery mechanisms in NG911 systems.

New Business
- Mapping Access for Dispatch – Board staff was approached by a dispatch agency about the 911 system being able to share the location (map) of any incidents in their coverage area. The current system does have this capability. Beta testing is possible (will need an MOU and user agreement). Board staff plans to move forward with this project per Board approval. Note: Board Chair Marcoux determined (and members agreed) that a vote on this was not necessary.

- Strategic Plan Development – Board staff are working on a strategic plan document for Vermont's 911 system & programs and plans to provide a draft to members by the next meeting.

Public Comment
Stephen Whitaker – The Board has continually failed to address issues (VoIP vulnerability, cell phone dead zones, broadband rollout) that have been brought before them multiple times.

Next Meeting Date & Adjournment
The next quarterly board meeting will take place on July 13, 2021.

Motion: There being no further business, Jerome Pettinga made a motion to adjourn; 2nd by Chief Locke. There was no discussion and the motion passed unanimously by voice vote. The meeting adjourned at 11:35 AM.

Respectfully submitted:

Soni Johnson   4/20/21
Soni Johnson, Board Clerk   Date

LIFT America Act

NG911 Background and Proposed Changes

Federal legislation is needed to facilitate nationwide deployment of Next Generation 9-1-1 services.

- **NG911 is critical to the safety and security of our communities.** It enables the nation's 911 systems to keep pace with advancing technology, and it provides improved communications resiliency during emergencies.

- **Federal funding is needed.** While many states have invested in NG911 technology, funding remains the biggest obstacle to full nationwide deployment. The National 911 Office estimates that $12-15B is needed to complete NG911 implementation nationwide.

Federal legislation should preserve State/Local control of NG911 while establishing a national framework that promotes national, state, and local coordination and ensures interoperability and cybersecurity of NG911.

- **Interoperability of NG911 is critical.** NG911 should be based on open standards that ensure interoperability, and the legislative framework should ensure interoperability of new and existing systems. With that in mind, two modest changes to the 2019 Act are recommended.

  - ➢ **Modify the definition of "Commonly Accepted Standards."** The definition included in the *LIFT America Act* is overly prescriptive and could create impediments to NG911 implementation as standards and technologies evolve. A more forward-looking definition that accommodates all relevant standards is recommended:

    - *COMMONLY ACCEPTED STANDARDS.—The term 'commonly accepted standards' means standards followed by the communications industry that enable interoperability, are consensus-based, and are developed by recognized standards development organizations.*

  - ➢ **Modify the definition of "Interoperable."** The definition included in the *LIFT America Act* restricts the use of proprietary interfaces but fails to recognize that such interfaces are sometimes necessary to interconnect new NG911 systems with legacy 911 systems. The definition of "interoperable" should ensure NG911 interoperability with existing systems.

    - *INTEROPERABLE.—The term 'Interoperable' or 'interoperability' means the capability of emergency communications centers to receive 9–1–1 requests for emergency assistance and related data such as location information and callback numbers from the public, then process and share the 9–1–1 requests for emergency assistance and related data with other emergency communications centers and emergency response providers, regardless of jurisdiction, equipment, device, software, service provider, or other relevant factors, and without the need for proprietary interfaces, <u>except for those which are required for the continued operation of legacy systems already in use</u>.*

- **NG911 cybersecurity is critical.** Considerable efforts are already being made to ensure implementation of effective cybersecurity protections, but NG911 legislation must provide some assurances that cybersecurity protections are addressed.

    - **Cybersecurity expenditures should be explicitly authorized.** The *LIFT America Act* does not explicitly identify cybersecurity as a permissible expenditure under the NG911 grant program. It should make that clear to help ensure States take appropriate steps to protect against cyber threats.

    - **Cybersecurity protections should be assured by grant applicants.** The *LIFT America Act* does not explicitly require grant applicants to address cybersecurity in their planned NG911 systems. It should be amended to require applicants include cybersecurity in their NG911 plan and certify that effective cybersecurity measures will be taken. **We have proposed cybersecurity language below.**

- **Grant Advice from Public Safety.** The National 911 Office might benefit from public safety advice as it develops the new NG911 grant program. The Board should be lean, however. It must avoid adding unnecessary bureaucracy, additional costs, or administrative burdens that might delay the award of grant funds. The Board's role should be limited to providing advice on grant guidelines, and Board members should be individuals with experience on matters of NG911 implementation. **We have proposed language creating such a board below.**

Congress should <u>avoid</u> unnecessary, costly legislative provisions that would undermine State and Local authority over 911. The establishment of a new federal entity to manage cybersecurity would undermine State/Local control of 911, inject significant and complex privacy, technical and legal challenges into the NG911 implementation process, and impose additional costs and administrative burdens on the National 911 Office. It is both unnecessary and potentially harmful to the future implementation of NG911.

NG911 network reliability requirements should be consistent with the rules established by the Federal Communications Commission. Robust reliability is an essential characteristic of NG911, but achieving reliability in an NG911 is an evolving challenge that requires evolving solutions. The FCC rules (which include physical path diversity) are more comprehensive, granular, and future-proof than the requirements proposed in the *LIFT America Act*.

Proposed Cybersecurity Provisions

(5) NEXT GENERATION 9–1–1 IMPLEMENTATION GRANTS.—

(1) GRANTS.—The Assistant Secretary and the Administrator, acting through the Office, shall provide grants to eligible entities for—

[…]

(C) systems, equipment, software, and services designed to provide cybersecurity protections for Next Generation 9-1-1;

[…]

(3) GRANT CERTIFICATIONS.—Each applicant for a grant under this section shall certify to the Assistant Secretary and the Administrator at the time of application, and each applicant that receives such a grant shall certify to the Assistant Secretary and the Administrator annually thereafter during any period of time the funds from the grant are available to the applicant, that—

(A) no portion of any designated 9–1–1 charges imposed by a state or other taxing jurisdiction within which the applicant is located are being obligated or expended for any purpose other than the purposes for which such charges are designated or presented during the period beginning 180 days immediately preceding the date on which the application was filed and continuing through the period of time during which the funds from the grant are available to the applicant;

(B) any funds received by the applicant will be used to support deployment of Next Generation 9–1–1 that ensures interoperability by requiring the use of commonly accepted standards;

(C) the applicant will ensure effective cybersecurity resources are employed to protect Next Generation 9-1-1 systems and services from cyber attacks including through the use of intrusion detection and protection services.

(D) the state in which the applicant resides has established, or has committed to establish no later than 3 years following the date on which the funds are distributed to the applicant, a sustainable funding mechanism for Next Generation 9–1–1 and effective cybersecurity resources to be deployed pursuant to the grant;

(E) the applicant will promote interoperability between Next Generation 9–1–1 emergency communications centers and emergency response providers including users of the nationwide public safety broadband network implemented by the First Responder Network Authority;

(F) the applicant has or will take steps to coordinate with adjoining States to establish and maintain Next Generation 9–1–1; and

(G) the applicant has developed a plan for public outreach and education on how to best use Next Generation 9–1–1 and on its capabilities and usefulness.

Proposed Next Generation 9-1-1 Advisory Board

(6) Establishment of Next Generation 9-1-1 Advisory Board.—

(H) Establishment.—The Office shall establish a "Next Generation 9-1-1 Advisory Board" to advise the Office in carrying out its duties and responsibilities under this section.

(I) Membership.

(i) Voting members.—Not later than 30 days after the date of enactment of this title, the Assistant Secretary and Administrator shall appoint 14 public safety members to the board, of which

(I) 2 members shall be representative of local law enforcement officials;

(II) 2 members shall be representative of fire and rescue officials;

(III) 2 members shall be representative of emergency medical service officials;

(IV) 3 members shall be representative of state 9-1-1 authorities;

(V) 3 members shall be representative of 9-1-1 agencies that both receive 9-1-1 Requests for Emergency Assistance and dispatch for multiple public safety disciplines and jurisdictions; and

(VI) 2 members shall be other individuals representative of 9-1-1 professionals.

(ii) Diversity of Membership.—Members shall be representatives of state and local governments, chosen to reflect geographic and population density differences, as well as public safety organizations at the national level across the United States;

(iii) Expertise.—All members shall have specific expertise necessary for developing technical requirements under this section, such as expertise in designing, procuring, deploying, or operating Next Generation 9-1-1 networks and components.

(iv) Rank and File Members.—At least one of the representatives of each of the public safety disciplines listed in (B)(i)(I, II, and III) shall be currently employed as a rank and file member of that discipline.

(J) Period of Appointment –

(i) In General.—Except as provided in subparagraph (ii), members of the Board shall be appointed for the life of the Board.

(ii) Removal for Cause.—A member of the Board may be removed for cause upon the determination of the Assistant Secretary and Administrator.

(K) Vacancies.—Any vacancy in the Board shall be filled in the same manner as the original appointment.

(L) Quorum.—A majority of the members of the Board shall constitute a quorum.

(M) Chairperson and Vice Chairperson.—The Board shall select a Chairperson and Vice Chairperson from among the voting members of the Board.

(N) Duties of the Board.—Not later than 120 days after the date of enactment of this Act, the Board shall submit to the Office recommendations concerning:

> (i) The importance of deploying Next Generation 9-1-1 in both rural and urban areas;
>
> (ii) The importance of ensuring flexibility in guidance, rules and grant funding to allow for technology improvements;
>
> (iii) The importance of ensuring adequate cybersecurity protections for Next Generation 9-1-1 systems; and
>
> (iv) The value of enabling effective coordination among state, local, tribal, and territorial government entities to ensure that the needs of emergency communications centers in both rural and urban areas are taken into account in each plan for the coordination and implementation of Next Generation 9–1–1.

(O)   Duration of Authority.—The Board shall remain in place for 60 days beyond the date on which the Office releases its Notice of Funding Opportunity.

Mental and Physical Health in 9-1-1

Mental Health

- Research has shown that 9-1-1 telecommunicators are at heightened risk for conditions such as depression and PTSD.
- In a sample of over 800 telecommunicators from across the US, Lilly and Allen (2015) found that 17.6% to 24.6% of 9-1-1 telecommunicators met cut-off for probable PTSD. This number is:
  - Five to six times greater than in the general population
  - Two to four times greater than a recent sample of firefighters
  - An elevated but overlapping rate compared to a more recent sample of police officers (7% - 19%).
- Additionally, 23.9% of the same nationwide sample met cut-off for probable major depression compared to 7.1% in the general population.

Physical Health

- Research has shown that law enforcement and firefighters are at elevated risk for impairments in physical health.
- Research on physical health in 9-1-1 is limited. However, the large nationwide sample found that 53.4% reported a body mass index (BMI) in the obese range compared to 39.8% in the US general population (www.cdc.gov/obesity/data/adult.html).
- Telecommunicators in the sample also reported an average of 17 different physical health complaints in the month before data collection in the nationwide sample.

Why the Enhanced Risk for 9-1-1 Industry?

- The 9-1-1 work environment is marked by a high degree of novelty, lack of control, unpredictability, and social evaluation. These factors are some of the strongest predictors of stress. High levels of stress impact mental health over time, and are linked to greater risk for poor physical health and disease.
- 9-1-1 telecommunicators, like other public safety personnel, are recurrently exposed to duty-related distressing events. Research has shown that trauma exposure has cumulative effects over time; that is, individuals who have more exposure are at heightened risk for poor mental and physical health compared to individuals with limited trauma exposure.
- Work as a 9-1-1 telecommunicator is a sedentary job. Telecommunicators remain seated for the majority of their shifts, which provides limited opportunity for physical movement and enhances risk for poor physical health.
- Sleep-related issues are common in the industry, resulting from duty-related stress, shiftwork scheduling, and mandatory overtime. Research is expanding every day to demonstrate the profound negative impact of poor sleep on mental and physical health.

Future Impacts of NG911 Technology on 9-1-1 Industry Health

- As these data were collected prior to NG911-related technological shifts, future research will be able to investigate, at least on a broad scale, whether psychological and physical health is altered by adoption of NG911 technology.

School ECS Compliance Status Report
April 5, 2021

Barbara Neal
Executive Director
Vermont Enhanced 911 Board
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School ECS Compliance Status

Background: In the spring of 2016, the Enhanced 911 Board resumed its work of assessing the capabilities of telecommunications systems in Vermont's schools.   The assessment focused on whether existing multi-line telephone systems (MLTS), now referred to as Enterprise Communications Systems (ECS), could send accurate and specific location information to Vermont 911.

The phrase "accurate and specific location information" means that when a 911 call is placed from the school's phone system, the 911 call-taker can see not only the physical address of the school building, but also the unique phone number in use and the specific location (room number, floor number, etc.) of the caller within the school. This information is also referred to as the "dispatchable location". The ability of a 911 call-taker to see the dispatchable location information, and pass it on to emergency responders, is critical in events where a caller is unable to speak or does not know their specific location or phone number.

In the fall of 2016, only 60 of Vermont's 304 public schools (less than 20%) had demonstrated the ability to send all required location information to 911. By July 1, 2019, the number of schools capable of sending this information had increased to 178, or approximately 58% of public schools.   The increase was due in large part to heightened awareness of the requirements and the availability of funds through the 911 Compliance Grant Program (see page 3) to support technology upgrades in the schools.
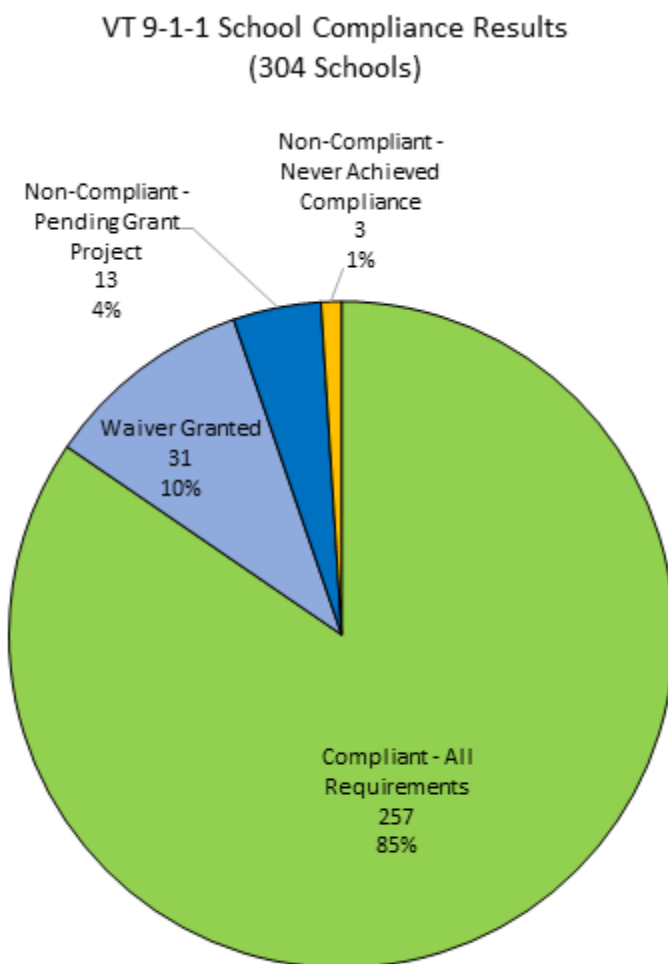
July 2019: New Rule Governing 911 Requirements for Enterprise Communications Systems: In July 2019, the Enhanced 911 Board adopted a new [rule](#) to codify the 911 location requirements for ECS systems.   In addition, a new requirement was incorporated to ensure that all users of an ECS system have the ability to directly initiate a call to 911 without having to dial any additional digit, code, prefix or post-fix. This requirement is commonly referred to as " [Kari's Law](#) ".

Current Status: (See Figure 1 on p. 2) As of 4/6/2021:

- 257 of Vermont's 304 public schools (84.5%) are compliant with all requirements of the rule - including dispatchable location and direct dial capability.
- 47 of Vermont's 304 public schools (15.5%) have not yet demonstrated compliance with the dispatchable location and/or direct dial requirements. Of these:
  - 13 schools have been awarded compliance grant funds and have work in progress to upgrade their ECS to meet the requirements.
  - 31 schools have an approved plan and waiver on file with the 911 Board, including appropriate interim steps to ensure end user awareness.
  - 3 schools have been asked to provide a written plan to achieve compliance along with a formal waiver request. The deadline for providing the written plan has been extended multiple times as a result of the COVID-19 pandemic.

Note: All Vermont public schools have demonstrated the ability to provide 911 with the correct street address and town name for their facilities.

Figure 1: Current Status of School ECS Compliance

VT 9-1-1 School Compliance Results
(304 Schools)

Non-Compliant -
Never Achieved
Compliance
3
1%

Non-Compliant -
Pending Grant
Project
13
4%

Waiver Granted
31
10%

Compliant - All
Requirements
257
85%

Progress Over Time: Figure 2 shows the change in schools demonstrating compliance since the Fall of 2016:
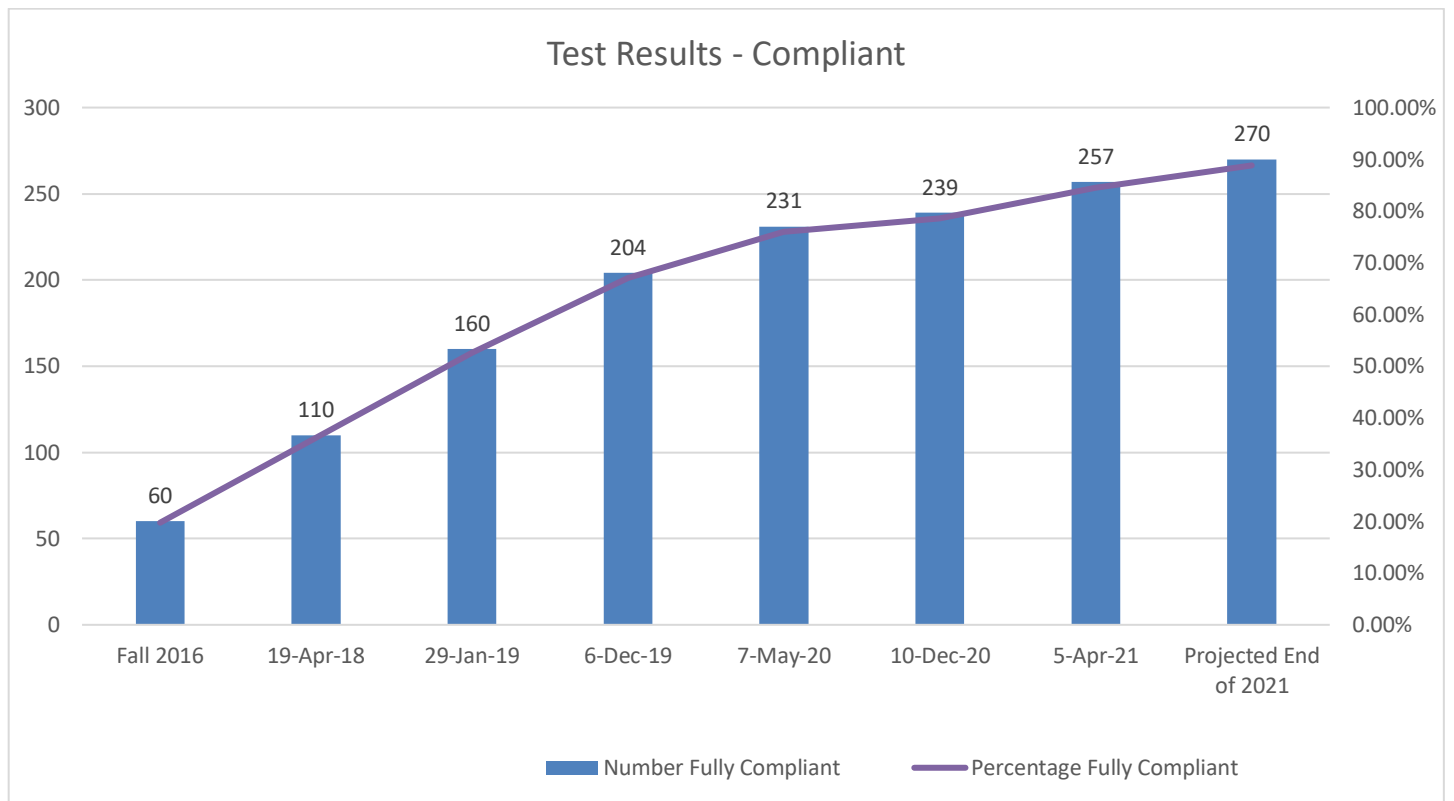
Figure 2: Progress Over Time

Moving Forward: Based on known "projects in progress" as a result of 911 Compliance Grant awards, the Enhanced 911 Board anticipates at least 13 additional schools will become compliant with both the dispatchable location and direct dial requirements by the end of 2021. When this work is completed, 89% of Vermont public schools will be compliant with the 911 requirements.

911 Compliance Grant Program: The final grant application period closed on April 2, 2021. The evaluation team is in the process of reviewing the grant applications and expects to identify awardees by the end of April 2021.

END OF REPORT

Redundancy and Resiliency in Vermont's 911 System

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March 2021

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Table of Contents

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Executive Summary

Introduction

Act 11 of the 2018 Special Session required the Vermont Enhanced 911 Board ("Board") to develop and present a report, *Redundancy and Resiliency in Vermont's 911 System,* to the Joint Fiscal Committee. The original report was submitted in August 2018 and an update was provided in May 2019. This March 2021 report is necessary because of the Board's recent implementation of a new Next Generation 911 (NG911) system provided by INdigital. This report replaces the previous reports and provides updated information regarding:

- the level of resiliency and redundancy within the 911 system;
- plans for ensuring operational integrity in the event of critical software or hardware failures;
- identification of the locations and services deemed most vulnerable to system outages or call failures, as determined by the Board;
- cost estimates for making any recommended system upgrades.

The information in this report is supported by detailed technical documentation. Every effort has been made to provide a sufficient level of detail to address the report requirements without compromising the security and integrity of the statewide 911 system.

Multiple Networks Involved in the 911 Call Delivery

A discussion of redundancy and resiliency within the 911 system must begin with an understanding of the networks involved in 911 call delivery. When a call is placed to 911 in Vermont, it will traverse many networks before being answered by a Vermont 911 call-taker. These networks can be grouped into three categories:

Originating Service Provider (OSP) Networks – The OSP networks are owned and operated by the service providers that offer calling services to customers such as cellular plans, Voice over Internet Protocol (VoIP) or traditional wireline service.

911 Tandem/Legacy Network Gateway (LNG) Environment/Border Control Function (BCF) – With the transition to INdigital as Vermont's 911 Service Provider (SP), the 911 tandems serve as the aggregation point for Vermont wireline 911 traffic only. The tandems connect to a Point of Interface (POI) provided by the 911 SP and the 911 traffic is then backhauled to the 911 SP's Border Control Function (BCF). Wireless and VoIP OSPs connect directly to the 911 SP Legacy Network Gateway (LNG) if the traffic is delivered via Time Division Multiplex (TDM) or alternatively to the 911 SP BCF if the OSP delivers their 911 traffic via Session Initiation Protocol (SIP). The LNG function is to convert signaling and media from TDM to Internet Protocol (IP) for delivery into the NG911 system.

Next Generation 911 (NG911) System – The NG911 system processes and selectively routes 911 calls to Vermont's six Public Safety Answering Points (PSAPs) and provides associated data to allow the call-taker to effectively assist an emergency caller.

Resiliency and Redundancy in Each Network

OSP Networks
VoIP and Cellular OSPs – Primary and secondary routes are available for the delivery of 911 calls from VoIP and cellular OSPs to the two geo-diverse LNGs or BCFs. Failure of both routes results in the calls being delivered directly into the NG911 system via a third route.

Wireline OSPs – Primary and secondary routes are available for the delivery of wireline 911 traffic to the geo-diverse 911 tandems and then backhauled to the two geo-diverse LNGs. In some cases, third and fourth routes also exist.

911 Tandem/LNG Environment – There are two geo-diverse 911 tandems in Vermont. Each tandem has two Time Division Multiplexing (TDM) routes for 911 call processing along with a third possible route. Two geographically diverse POIs provide backhaul connectivity to the geographically diverse BCFs. Each POI has two possible IP routes to a BCF for call delivery into the NG911 system.

NG911 System – Once a 911 call is received by the NG911 system from the BCF or LNG environment, it is routed to the primary PSAP based on the caller's location. If the primary PSAP is unavailable, the call is automatically rerouted to an available call-taker at one of the five remaining PSAPs. The NG911 system is supported by two redundant geo-diverse data centers. A failure of both data centers or a loss of connectivity to all PSAPs results in the delivery of the 911 call over a dedicated Direct Inbound Dial (DID) number that delivers the calls to a PSAP dispatch line(s).

Identified Vulnerabilities in Each Network, Existing Mitigation, Recommendations for Change and Associated Costs

The following table summarizes the Board's findings related to vulnerabilities in each network involved in 911 call delivery. With the implementation and transition to the new INdigital NG911 system in October 2020, two of the four vulnerabilities identified in 2018 have been resolved. These are the vulnerabilities in the LNG environment and physical diversity[1] to each PSAP. We have also included a new vulnerability in originating networks related to the dependency on electricity of non-line-powered telephone service.

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[1] Physical diversity is provided to the street level for all PSAPs. If a PSAP facility has diverse path entries into their facility, then it was utilized.

Identified Vulnerabilities in Originating Networks	Mitigation	Recommendation	Costs
Central Office Isolation	Emergency Stand Alone where available	Continued discussion and research of potential mitigation steps	None at this time
Backhaul connectivity for cellular base stations	Overlapping cellular and/or wi-fi signals where available	Encourage continued growth of cellular coverage in Vermont by commercial carriers	N/A
Non-Line-Powered Telephone Service – Electricity Dependency	Use of Back Up Power Equipment by Customers	Continued public education regarding electricity dependence of non-line-powered services	N/A
Identified Vulnerabilities in 911 Tandem/LNG Environment	**Mitigation**	**Recommendation**	**Costs**
LNG Environment – Factors contributing to January 5, 2016 event	Final Route to DID in previous system	None - Resolved October 2020	N/A
Identified Vulnerabilities in NG911	**Mitigation**	**Recommendation**	**Costs**
Physical diversity to each PSAP	Holistic system design delivers calls to alternate PSAPs when a primary PSAP is offline	None – Resolved October 2020	N/A

The Vermont 911 system, and the various networks involved in 911 call delivery, are resilient and have redundancy. Mitigation steps are in place to lessen the risks of known vulnerabilities.

The Enhanced 911 Board has established strong relationships with multiple partners who have the shared goal of ensuring the reliable delivery of Vermont 911 calls. These partnerships also allow the Board to identify the appropriate course of action in the event of any concerns about, or failures of, 911 call delivery. The Vermont Enhanced 911 Board is committed to working with these partners, the legislature, and all stakeholders, to ensure continued redundancy and resiliency in the statewide 911 system.

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Introduction

Overview

This updated report is provided as a replacement to an original report required by Act 11[2] of the 2018 Special Session of the Vermont General Assembly. Act 11 required that on or before September 1, 2018, the Executive Director of the Enhanced 911 Board provide a report to the Joint Fiscal Committee that:

- details the level of resiliency and redundancy within the 911 system;
- explains plans for ensuring operational integrity in the event of critical software or hardware failures;
- includes, with explanation, identification of the locations and services deemed most vulnerable to system outages or call failures, as determined by the Board;
- includes a cost estimate for making any recommended system upgrades.

The original report was submitted in August 2018 and an update was provided in May 2019. This March 2021 replacement report is necessary because of the Board's recent implementation of a new NG911 system provided by INdigital. This report provides updated information regarding the resiliency and redundancy of the networks involved in the delivery of 911 calls from a service provider's originating network, through the 911 tandems, LNG, BCF environment, and into Vermont's NG911 system.

The information presented in this report is supported by detailed technical documentation where available. In many cases, the supporting documentation contains proprietary information and/or technical details related to system security. Every effort has been made to provide a sufficient level of detail to address the report requirements without compromising the security and integrity of the statewide 911 system.

Background and Current Environment

30 V.S.A Chapter 87[3] established the Vermont Enhanced 911 Board as the single governmental agency responsible for the statewide 911 system. The Board consists of nine members, appointed by the Governor, representing state, local and county law enforcement, emergency medical and fire service, municipalities, and the public. Ten Board staff members are responsible for day-to-day oversight and management of the system and system provider, GIS and database management, training, quality control, public education, and administrative functions.

The Board has developed, and relies upon, effective partnerships with multiple stakeholders to fulfill its responsibility for management and oversight of the statewide 911 system. The Board

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[2] Act 11 - An act relating to making appropriations for the support of government, financing education and vital records, Sec. E.235, (2018 Spec. Sess.), https://legislature.vermont.gov/Documents/2018/Docs/ACTS/ACT011/ACT011%20As%20Enacted.pdf
[3] 30 V.S.A §7051-7061, (1993 Adj. Sess.), https://legislature.vermont.gov/statutes/chapter/30/087

works closely with many agencies and organizations – both public and private – to ensure the reliable and effective operation of the 911 system. Stakeholders include, but are not limited to, Vermont's Agency of Digital Services, Public Service Department, Department of Public Safety, Department of Health, regional dispatch centers serving as Public Safety Answering Points (PSAPs), emergency response agencies and their dispatch centers, wireline, cellular and VoIP telephone service providers, and municipal 911 coordinators in every Vermont town.

Currently, the Board contracts with INdigital for a fully-hosted NG911 system.   In 2020, 209,990 911 calls[4] were processed by the system and routed to fully trained and certified 911 call-takers in six geo-diverse PSAPs[5] in the state. The answering PSAP may provide dispatch services for any given emergency or may transfer the call to one of nearly fifty dispatch centers serving Vermont.

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[4] Enhanced 911 Board, *2020 System Statistics*, January 2021, https://e911.vermont.gov/forms-and-publications/2019-system-statistics

[5] Enhanced 911 Board, *PSAP Configuration Map*, updated September 16, 2019, https://e911.vermont.gov/forms-and-publications/system-information

Redundancy and Resiliency in 911 Call Delivery

Networks Involved in Delivery of 911 Calls

When a call is placed to 911 in Vermont, it will traverse many networks before being answered by a Vermont 911 call-taker. These networks can be grouped into three categories:

<u>Originating Service Provider (OSP) Networks</u> – OSP networks are owned and operated by the service providers that offer calling services to customers such as cellular plans, VoIP or traditional wireline service.

<u>911 Tandem/Legacy Network Gateway (LNG) Environment/Border Control Function</u> – The 911 tandems, once the selective routers of the original 911 network in the State of Vermont, now serve only as the aggregation point for all Vermont wireline 911 traffic. Wireless and VoIP 911 traffic is delivered directly to the LNGs and/or BCFs provided by the INdigital solution. The LNGs convert Time Division Multiplex (TDM) to Internet Protocol (IP) for delivery into the state's NG911 system. The BCF provides a secure endpoint into the Emergency Services IP Network (ESINet) for emergency calls presented to the network via Session Initiation Protocol (SIP).

<u>Next Generation 911 (NG911) System</u> – The NG911 system processes and selectively routes 911 calls to the PSAPs, queries and delivers Automatic Location Identification (ALI) with the call, provides geo-spatial mapping to the call-taker, identifies the correct emergency response agencies based on caller location, provides text to 911 capability, stores historical 911 call data and recordings, allows for ALI and Geographic Information System (GIS) discrepancy processing, and provides access to municipal coordinators for addressing database additions and maintenance.

Figure 1, on the following page, provides a high-level illustration of these networks in Vermont.
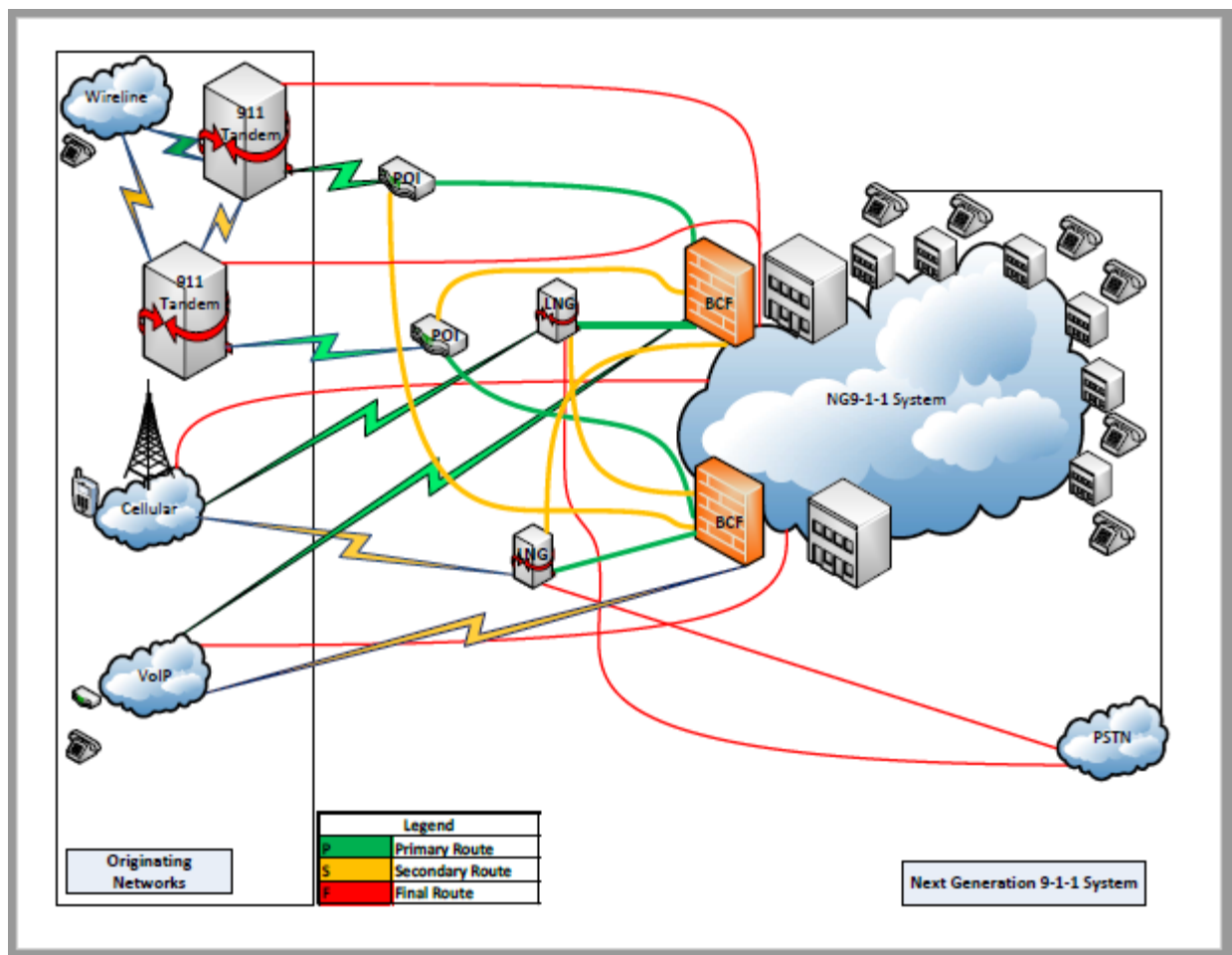
Figure 1 – High Level 911 System Diagram from Caller to Call-taker

Differences exist in the OSP network architectures, however all 911 calls in Vermont will traverse either a 911 tandem, LNG and/or the BCF before being delivered into the NG911 system where the calls are answered by a certified Vermont 911 call-taker.

The following sections of this report will discuss resiliency and redundancy within each of the three network categories and identify locations and services within each category that the 911 Board has determined are most vulnerable to system outages or call failures.

Originating Service Provider (OSP) Networks

Call Flow

Each 911 call starts within the originating service provider's network. When the digits 911 are dialed from the user equipment, the call traverses the OSP network and is delivered to one of the two geo-diverse 911 tandems, LNG or BCF.

A high-level illustrative overview of call flow from each type of OSP is discussed on the following pages and shown in Figures 2 - 4.

<u>VoIP OSP Call Flow</u>

Call flow begins when a 911 call is placed on user equipment connected to VoIP service. The 911 call travels to the VoIP Service Provider (VSP) call server. The VSP call server interacts with the VoIP Positioning Center (VPC) which checks the caller's telephone number for the registered address. The 911 call is then routed to an Emergency Service Gateway (ESGW) which sends the call over one of the connections to a geo-diverse LNG or BCF depending on the OSPs connection type. The call is then delivered into the Vermont NG911 system. In 2020, VoIP calls accounted for approximately 10% of 911 call volume.

Primary and secondary connections provide redundancy from the ESGW to the LNGs or BCFs. If there is a failure of both connections, the call is routed to the VSP's 24 x 7 call center which then manually transfers the call into the Vermont NG911 system. Failures of the VPC route information or the existence of an invalid registered address will also result in the call being routed to the VSP provided call center for manual delivery into the NG911 system.
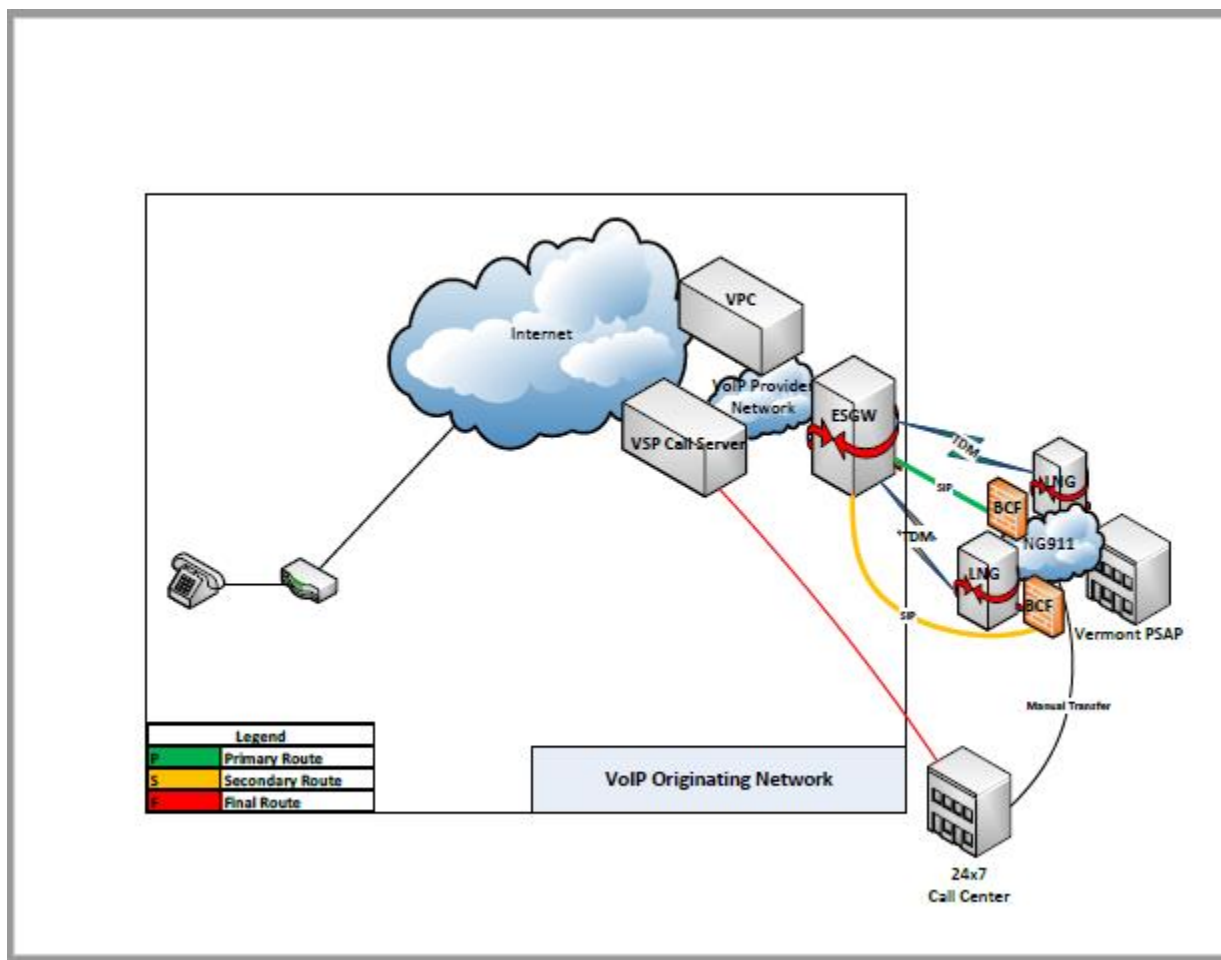

Figure 2 – VoIP Call Flow Illustration

Cellular OSP Call Flow

When a 911 call is placed by user equipment connected to a cellular network, the call travels over the cellular OSP's network to the Mobile Switching Center (MSC). The call is then delivered over dedicated and redundant 911 trunk groups to one of the two geo-diverse LNGs before being delivered to a call-taker in the NG911 system. Cellular calls make up approximately 70% of Vermont's annual 911 call volume.

As with VoIP calls, primary and secondary connections provide redundancy from the cellular OSP networks to the Vermont 911 LNGs. Failure of both trunk groups will result in the MSC attempting to deliver the call to Vermont's NG911 system using a pre-programmed direct inbound dial (DID) number that is part of the NG911 system.
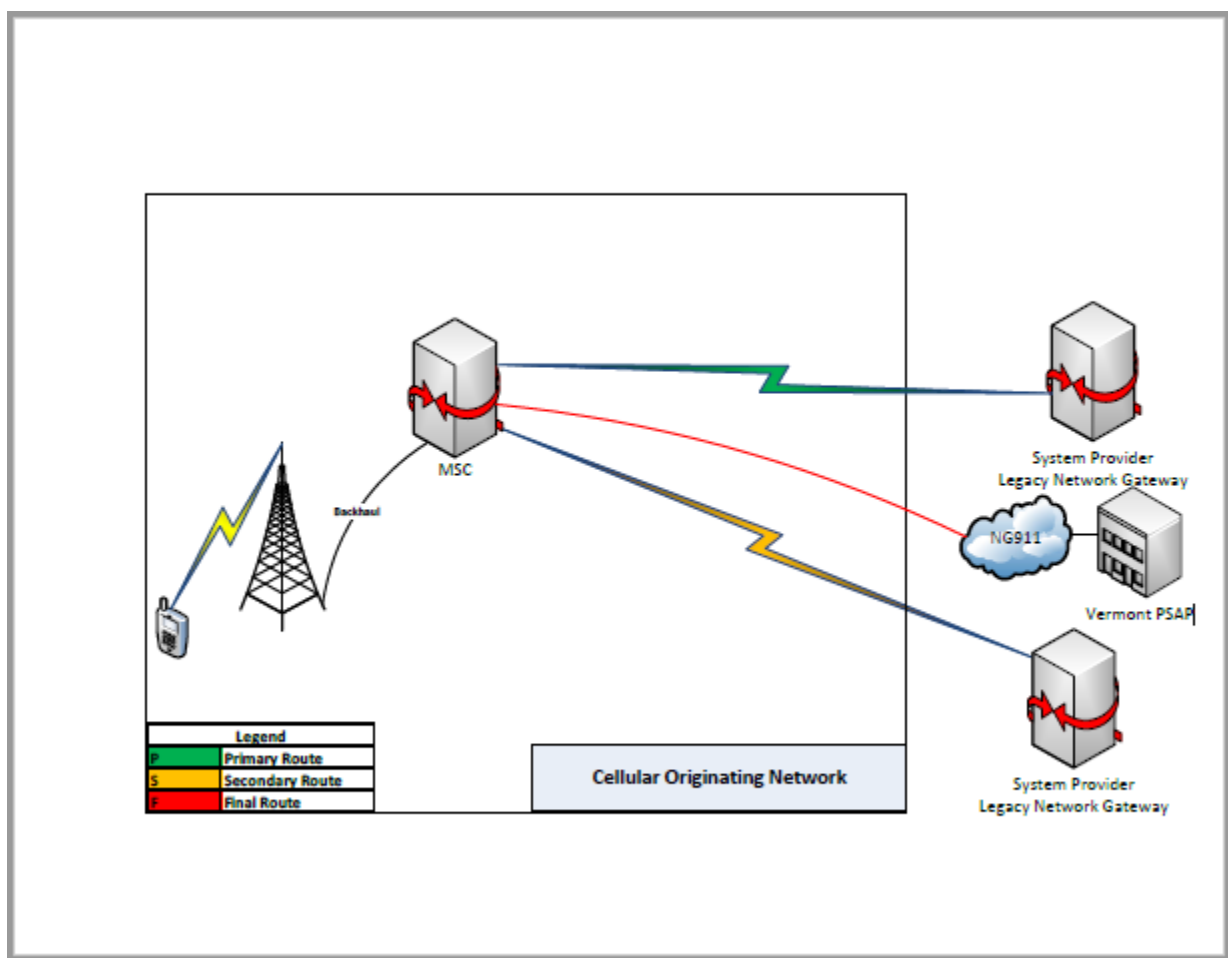

Figure 3 – Cellular OSP Call Flow Illustration

Wireline OSP Call Flow

When a 911 call is placed on user equipment connected to wireline service, the call travels through the central office serving that customer and is delivered over dedicated and redundant 911 trunk groups to one of the two geo-diverse 911 tandems in Vermont before being delivered into the NG911 system. Approximately 15% of Vermont's 2020 call volume was from wireline callers.

If the delivery of the call from the dedicated 911 trunk groups to the 911 tandems fails, the serving central office has a tertiary route to the Traffic Operator Position System (TOPS)[6]. TOPS uses analog switching to send the call to a TOPS site. In some cases, this may involve a human operator manually routing the call to the appropriate 911 tandem.

If the TOPS route is unavailable, a local final route may exist to send the call to a local 24 x 7 public safety agency, but only if the agency is served by the same central office. Due to consolidation of dispatch centers and dispatch centers migrating to other dial tone providers, there are very few instances where the local final route is a viable option.
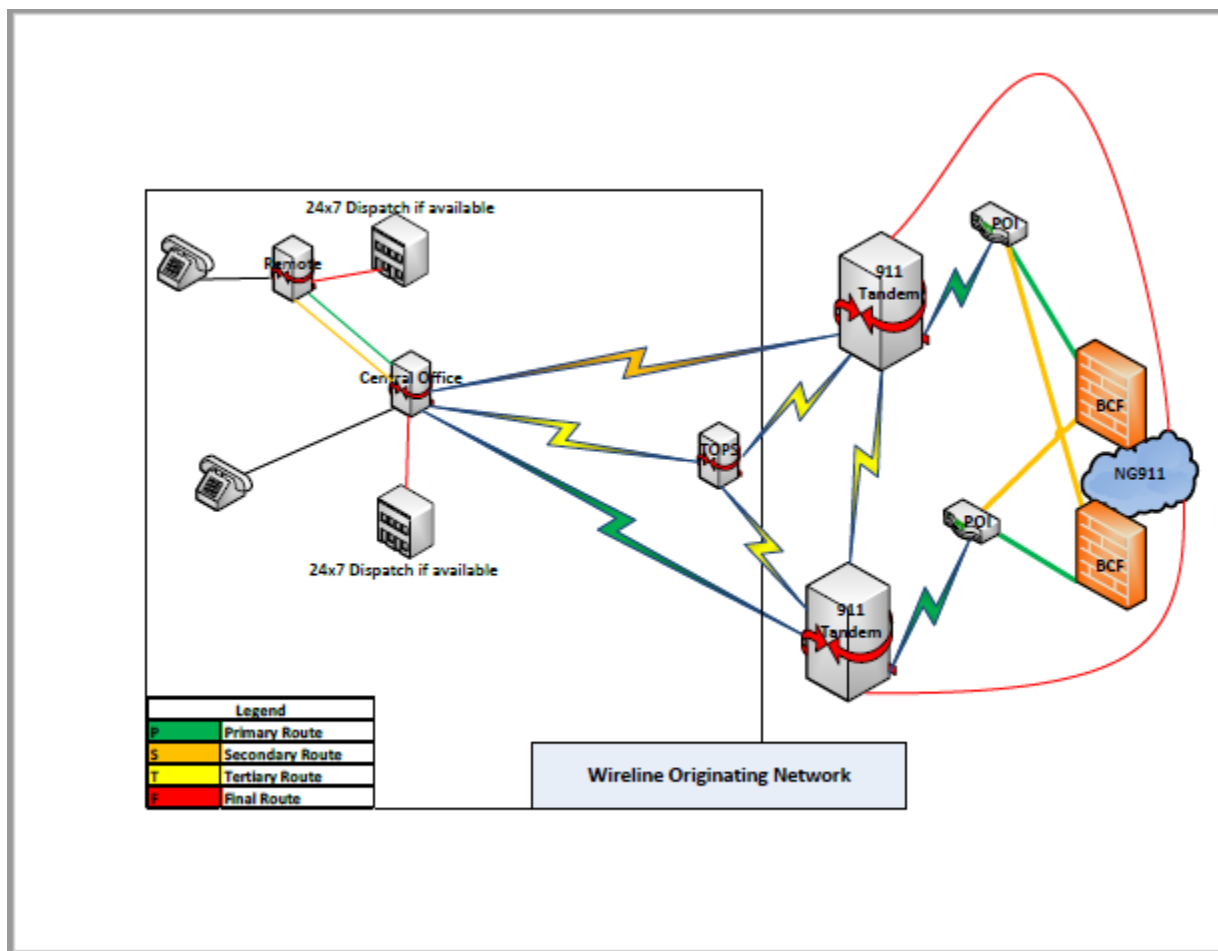

Figure 4: Wireline Call Flow Illustration

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[6] The Tertiary TOPs route only exists in the incumbent local exchange carrier's network. All other LECs serving Vermont have just a primary and secondary route to the two geo-diverse 911 tandems.

Vulnerabilities in OSPs

VoIP and Cellular OSP Networks

The Federal Communications Commission (FCC) requires interconnected VoIP and cellular service providers to transmit their customers' 911 calls to Public Safety Answering Points[7]. Many of these providers voluntarily adhere to the Communications Security, Reliability and Interoperability Council's (CSRIC) network reliability best practices. CSRIC's 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"[8]. The FCC requires all originating service providers to report system outages meeting certain conditions.

Interconnected VoIP and cellular OSPs are not currently subject to the same state regulatory authority as traditional wireline service providers. This regulatory environment, along with the proprietary nature of OSP network information, prevents the Enhanced 911 Board from determining with certainty whether specific single points of failure exist within the VoIP and cellular originating networks. In general terms, however, single points of failure may exist due to failures at a cellular base station when there is not overlapping signal, failures of backhaul connections and/or loss of internet/transport for VoIP customers. Non-line-powered telephone service is dependent upon electricity and can therefore be impacted by electric power outages.

The Vermont Enhanced 911 Board adopted a rule, effective February 4th, 2021, governing outage reporting requirements for originating carriers and electric power companies[9]. This rule incorporates outage reporting thresholds that are much more granular than previously required in Vermont for VoIP and cellular OSPs. As these providers begin to report outages under the new rule, the 911 Board may have more insight into vulnerabilities that may exist in their networks.

Additional information regarding the FCC requirements for interconnected VoIP service providers can be found on the FCC website[10].

Wireline OSP Networks

The Vermont Public Utility Commission supervises the quality of service of Vermont's public utilities, including wireline service providers, as defined in 30 V.S.A[11]. These providers are also

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[7] 47 C.F.R §9.5(b)(2), (2005), https://www.law.cornell.edu/cfr/text/47/9.5 and 47 C.F.R. §20.18(b), (1998), https://www.law.cornell.edu/cfr/text/47/20.18

[8] "CSRIC III", Federal Communications Commission, accessed August 17, 2018, https://www.fcc.gov/about-fcc/advisory-committees/communications-security-reliability-and-interoperability-1

[9] Vermont Enhanced 911 Board Rule Governing Outage Reporting Requirements for Originating Carriers and Electric Power Companies, https://e911.vermont.gov/sites/nineoneone/files/doc_library/E911-AdoptedRule_January2021_1.pdf

[10] "VoIP and 911 Service", Federal Communications Commission, last updated/reviewed September 8, 2017, https://www.fcc.gov/consumers/guides/voip-and-911-service

[11] 30 V.S.A., https://legislature.vermont.gov/statutes/title/30

subject to requirements related to 911 call delivery outlined in the 911 Board's Technical and Operational Standards[12].

Known single points of failure have existed in the wireline network since the inception of 911 in Vermont. These vulnerabilities are due to the host-remote architecture which, in some cases, allows for the possibility of the isolation of a central office. A central office isolation limits calling only to numbers within the affected exchange. Calls to numbers outside the local exchange, including calls to 911, are not possible during isolation events.

In the summer of 2019, the 911 Board received updated information about host-remote vulnerabilities from all wireline providers in Vermont. At that time there were twenty-six host-remote vulnerabilities remaining in Vermont. This equates to a reduction of approximately 57% from the previously reported sixty host-remote vulnerabilities in 2009[13]. There is an ongoing workshop at the Public Utilities Commission that is seeking additional details on steps being taken to further reduce the number of host-remote isolation vulnerabilities. The PUC workshop is currently "stayed" due to COVID-19 impacts on the stakeholders.

Recommendations and Cost Estimates for OSPs

VoIP and Cellular OSP Networks

There are no specific recommendations related to VoIP and cellular network changes at this time. Senior staff at the Enhanced 911 Board meet regularly to review FCC actions and inquiries related to VoIP and cellular network requirements and will continue to monitor the reliability of the delivery of 911 calls from these OSPs. The Board will engage with the FCC to address any reliability concerns that are identified.

Wireline Networks

Additional information is needed to fully understand the feasibility and costs associated with design changes in the wireline networks to remove or reduce host-remote isolation vulnerabilities. Potential next steps could include conducting cost studies[14] to determine the amount required to build in redundancy in these vulnerable host-remote locations and/or continued discussions with each service provider to determine an alternate solution to mitigate an isolation event.

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[12] Technical & Operational Standards for Enhanced 911
[13] Enhanced 911 Board, *C.O. Isolation Solution*, September 2009
[14] Estimates for cost studies from one service provider range from $55,000 - $75,000.

911 Tandems, LNG, and BCF Environment

The 911 tandems, once the selective routers of the original 911 network in Vermont[15], now serve only as the aggregation point for Vermont 911 wireline traffic.

All 911 calls from wireline OSPs that serve Vermont customers are delivered to one of the two geo-diverse 911 tandems. The tandems have multiple routes to deliver the call to the NG911 system. The LNG environment consists of two geographically diverse switches that convert 911 calls from TDM to IP and deliver the calls to the NG911 system. The BCF environment consists of two geographically diverse points where 911 calls are delivered via SIP from OSPs that switched to this delivery mechanism once Vermont transitioned to their new NG911 System Provider.

As shown in Figure 6, each Tandem, LNG and BCF have multiple routes to deliver the 911 call to the NG911 system.

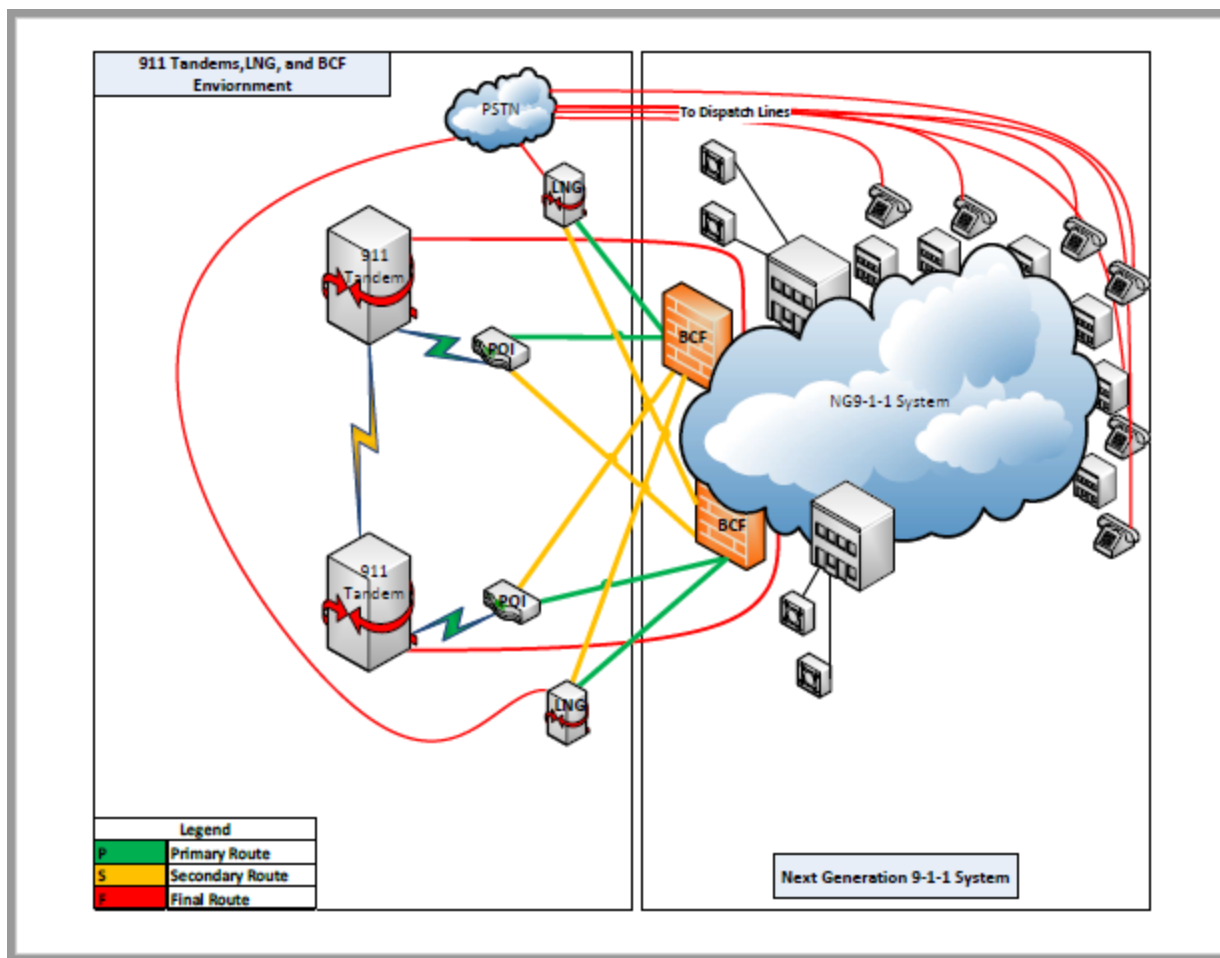[15] The selective routing of Vermont 911 calls is now handled by the NG911 system.

Figure 6:   911 Tandem, LNG, and BCF Environment

Vulnerabilities in the 911 Tandem/LNG/BCF Environment

There are no single points of failure in the 911 tandem, LNG, or BCF environment. Operational integrity is upheld in these environments through redundancy and diversity.

Next Generation 911 System

The NG911 system consists of a managed and secure IP network with six geo-diverse PSAPs and two geo-diverse data centers.   Prior to the Enhanced 911 Board transitioning to the fully-hosted NG911 system provided by INdigital, the Board sought an Independent Verification and Validation (IV&V) to ensure the system meets the Enhanced 911 Board goal of 99.999% system reliability. The IV&V conducted by 911Authority in September 2020 reported that the system indeed meets the requirement of 99.999% system availability[16]. The data centers are equipped with fully redundant equipment and each PSAP has two physically diverse primary and secondary

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[16] 911Authority., *A Report on the Independent Verification and Validation (IV&V) of the Vermont Next Generation 911 System 9/21/2020*

connections. In addition, the PSAPs have a tertiary connection provided by a different carrier creating diversity of the primary and secondary connections.

Once a 911 call is received by the NG911 system from the 911 tandem/LNG/BCF environment, it is routed to the primary PSAP based on the caller's location. If the primary PSAP is unavailable due to a failure or because no call-taker is available, the call is automatically rerouted to an available call-taker at one of the five remaining PSAPs within the NG911 system.

Automatic failover to the redundant PSAP connections is handled by the redundant equipment at the data centers. If neither data center is able to route the call to any PSAP due to failure or because no call-takers are available anywhere in the statewide system, the call will be delivered over a DID number that is delivered to PSAP dispatch lines.

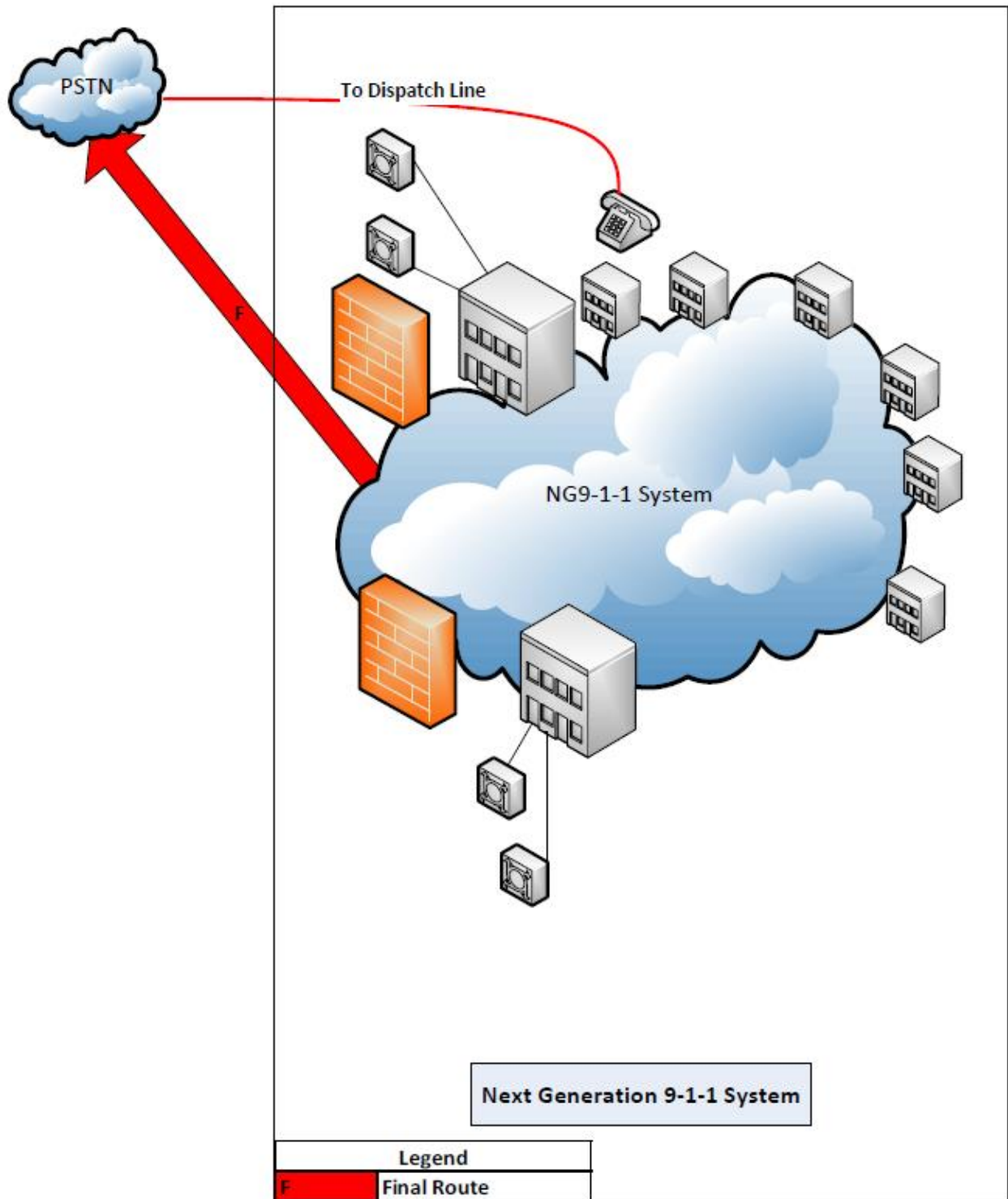Figure 7, on the following page, illustrates the NG911 system design.

Figure 7: NG911 System Design

Vulnerabilities in the NG911 System

There are no single points of failure in the NG911 system. Operational integrity is upheld in these environments through redundancy, diversity, and automatic failover.

Ensuring Operational Integrity in the Event of Critical Software/Hardware Failures in the NG911 System

The NG911 system is designed to automatically failover to the alternate component in the data center or to the alternate data center if there is a critical software or hardware failure.

The NG911 system has comprehensive host, network, and application monitoring. This monitoring provides operational integrity in that it alerts the system provider that a redundant component has failed. In addition, an internal testing process has been implemented to regularly confirm that critical call processing is stable and capable of processing calls. If the check does not come back correctly after two attempts, a critical alarm is raised to the system provider for an immediate response. Lastly, if there is a catastrophic failure in the redundant customer premise equipment (CPE) call handling applications, there is tertiary answering equipment at the PSAPs to ensure the call is delivered and answered by a certified Vermont call-taker.

Recommendations and Cost Estimates for the NG911 System

There is robust redundancy and resiliency within the NG911 system. There are no recommendations for changes to the NG911 system at this time.

The Enhanced 911 Board will ensure that any future procurements of NG911 systems continue to comply with industry standards and best practices related to redundancy and resiliency.

Conclusion

Summary Table of Vulnerabilities and Recommendations

The table below summarizes the identified vulnerabilities in each of the three networks involved in the delivery of a 911 call to a Vermont 911 call-taker, including vulnerabilities identified in the 2018 report which have been resolved by the implementation of the INdigital NG911 system. Also provided is the existing mitigation for each vulnerability, the Enhanced 911 Board's recommendations for changes and associated costs of those changes.

Identified Vulnerabilities in Originating Networks	Mitigation	Recommendation	Costs
Central Office Isolation	Emergency Stand Alone where available	Continued discussion and research of potential mitigation steps	None at this time
Backhaul connectivity for cellular base stations	Overlapping cellular and/or wi-fi signals where available	Encourage continued growth of cellular coverage in Vermont by commercial carriers	N/A
Non-Line-Powered Telephone Service – Electricity Dependency	Use of Back Up Power Equipment by Customers	Continued public education regarding electricity dependence of non-line-powered services.	N/A
Identified Vulnerabilities in 911 Tandem/LNG Environment	**Mitigation**	**Recommendation**	**Costs**
LNG Environment – Factors contributing to January 5, 2016 event	Final Route to DID in previous system	None - Resolved October 2020	N/A
Identified Vulnerabilities in NG911	**Mitigation**	**Recommendation**	**Costs**
Physical diversity to each PSAP	Holistic system design delivers calls to alternate PSAPs when a primary PSAP is offline	None – Resolved October 2020	N/A

The Vermont 911 system, and the various networks involved in 911 call delivery, are resilient and have redundancy throughout. Mitigation steps are in place to lessen the risks of known vulnerabilities.

The Enhanced 911 Board has established strong relationships with multiple partners who have the shared goal of ensuring the reliable delivery of Vermont 911 calls. These partnerships also allow the Board to identify the appropriate course of action in the event of any concerns about, or failures of, 911 call delivery. The Vermont Enhanced 911 Board is committed to working with these partners, the legislature, and all stakeholders, to ensure continued redundancy and resiliency in the statewide 911 system.

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Glossary

911 Tandem – The Central Office that provides the tandem switching of 911 calls. It controls delivery of the voice call with ANI to the PSAP.

Automatic Location Identification (ALI) – The automatic display at the PSAP of the caller's telephone number, the address/location of the telephone and supplementary emergency services information of the location from which a call originates.

Automatic Number Identification (ANI) – Telephone number associated with the access line from which a call originates.

Border Control Function (BCF) – Provides a secure entry into the ESINet for emergency calls presented to the network. The BCF incorporates firewall, admission control, and may include anchoring of session and media as well as other security mechanisms to prevent deliberate or malicious attacks on PSAPs or other entities connected to the ESINet.

Central Office – The Local Exchange Carrier facility where access lines are connected to switching equipment for connection to the Public Switched Telephone Network.

Communications Security, Reliability and Interoperability Council (CSRIC) – An advisory body of the FCC which provides recommendations to the FCC to ensure, among other things, optimal security and reliability of communications systems, including telecommunications, media, and public safety.

Direct Inbound Dialing (DID) – Telephone company facility that allows an outside caller to connect directly to an inside extension of an office without the help of an attendant or operator.

Emergency Service Gateway (ESGW) – The Emergency Services Gateway (ESGW) is the signaling and media interworking point between the IP domain and conventional trunks to the E911 SR that use either Multi Frequency (MF) or Signaling System #7 (SS7) signaling. The ESGW uses the routing information provided in the received call setup signaling to select the appropriate trunk (group) and proceeds to signal call setup toward the SR using the ESQK to represent the Calling Party Number/Automatic Number Identification information.

Emergency Services IP Network (ESINet) – A managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core services can be deployed, including, but not restricted to, those necessary for providing NG911 services. ESINets may be constructed from a mix of dedicated and shared facilities. ESINets may be interconnected at local, regional, state, federal, national and international levels to form an IP-based internetwork (network of networks). The term ESINet designates the network, not the services that ride on the network. See NG911 Core Services.

Federal Communications Commission (FCC) – An independent U.S. government agency overseen by Congress, the Federal Communications Commission regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia and U.S. territories.

Geographic Information System (GIS) – A system for capturing, storing, displaying, analyzing and managing data and associated attributes which are spatially referenced.

Host Switch – An end office with an internal controller or intelligent process used to complete calls. A host switch controls the function of one or more remote switch units (RSU) via a central "control" or "processor" resident within the host switch.

Internet Protocol (IP) – The method by which data is sent from one computer to another on the Internet or other networks.

Legacy Network Gateway (LNG) – An NG911 Functional Element that provides an interface between a non-IP originating network and a Next Generation Core Services (NGCS) enabled network.

Mobile Switching Center (MSC) – The wireless equivalent of a Central Office, which provides switching functions from wireless calls.

Municipal Coordinators – A contact determined by each municipality participating in the enhanced 911 system to serve as the liaison to the Board and the system provider on all issues regarding 911 service.

Next Generation 911 (NG911) – A system comprised of Emergency Services IP networks (ESINets), IP-based Software Services and Applications, Databases and Data Management processes that are interconnected to Public Safety Answering Point premise equipment. The system provides location-based routing to the appropriate emergency entity. NG911 provides standardized interfaces for call and message services, processes all types of emergency calls including non-voice (multi-media) messages, and acquires and integrates additional data useful to call routing and handling for appropriate emergency entities. NG911 supports all E911 features and functions and meets current and emerging needs for emergency communication from caller to Public Safety entities.

Originating Service Provider (OSP) – An entity that provides telecommunications services to an end user placing a call.

Public Safety Answering Point (PSAP) – An entity responsible for receiving 911 calls and processing those calls according to a specific operational policy.

Public Switch Telephone Network (PSTN) – The network of equipment, lines, and controls assembled to establish communication paths between calling and called parties in North America.

Remote Switch – A small switching system that is located at a remote point from a host switch. All or most of its call processing capability is obtained from an electronic type host office. The remote is connected to the host by umbilical circuits providing message and signal handling capabilities.

Selective Router – The Central Office that provides the tandem switching of 911 calls. It controls delivery of the voice call with ANI to the PSAP and provides Selective Routing, Speed Calling, Selective Transfer, Fixed Transfer, and certain maintenance functions for each PSAP.

Time Division Multiplexing (TDM) – A digital multiplexing technique for combining a number of signals into a single transmission facility by interweaving pieces from each source into separate time slots.

Traffic Operator Position System (TOPS) – A computerized operator telephone switchboard.

VoIP – Technology that permits delivery of voice calls and other real-time multimedia sessions over IP networks.

VoIP Positioning Center (VPC) – The VoIP Positioning Center (VPC) is the element that provides routing information to support the routing of VoIP emergency calls and cooperates in delivering location information to the PSAP over the existing ALI DB infrastructure. The VPC supports access to the routing data in the ERDB.

[END OF REPORT]

Outage Report Summary and Detail

2019 – 2020

Supplement to the Report:

Redundancy and Resiliency

in

Vermont's 911 System

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March 2021

<u>Vermont 911 System Outages – Summary</u>

2019 – None

2020 – None

<u>Telephone Service Provider Outages – Summary</u>

Reports of outages occurring within a telephone service provider's network that impact the ability of the subscriber to make calls, including calls to 911. In 2019 and 2020, wireless and VoIP providers were required to report only outages meeting certain FCC thresholds for outage reporting. Beginning in August of 2021, these providers will report in accordance with the 911 Board's <u>Rule Governing Outage Reporting Requirements for Originating Carriers and Electric Power Companies</u>.

2019			
Number of Reported Outages - 28	Wireline - 26	Non-Wireline - 2	
Cause Summary	Equipment Failure	8	
	Fiber Cut - 7	7	
	Fiber Relocation/Roll/Throw	5	
	Link Congestion	1	
	Power Loss	5	
	Unknown	2	
Duration Summary	Less than 10 minutes	5	
	10 minutes - 1 hour	1	
	1 hour - 4 - hours	15	
	4 hours - 8 hours	4	
	> 8 hours	3	
2020			
Number of Reported Outages - 24	Wireline - 22	Non-Wireline - 2	
Cause Summary	Equipment Failure	7	
	Fiber Cut	14	
	Unknown	3	
Duration Summary	Less than 10 minutes	0	
	10 minutes - 1 hour	3	
	1 hour - 4 - hours	3	
	4 hours - 8 hours	5	
	> 8 hours	13	

Telephone Service Provider Outages – Detail

Class of Service	Number of subscribers	Date and Time Outage Began	Actual Restoration Time	Duration of Outage (hr:min:ss)	Cause
Wireline	56	1/24/19 9:10	2019-01-24 11:13:00.000	2:30:00	Equipment Failure
Wireline	280	2/25/19 16:10	2019-02-26 11:45:00.000	19:35:00	Fiber Cut - Burnt Fiber
Wireline	124	3/19/19 13:00	2019-03-20 03:55:00.000	14:55:00	Fiber Cut
Wireline	240	3/22/19 12:30	2019-03-22 14:10:00.000	1:40:00	Switching Issue
Wireline	50	3/23/19 8:30	2019-03-23 10:30:00.000	2:00:00	Power Loss
Wireline	200	5/21/19 10:16	2019-05-21 10:19:00.000	0:03:00	Equipment Failure
Wireline	565	5/21/19 13:29	2019-05-21 18:59:00.000	5:30:00	Fiber Cut
Non-Wireline	Unknown	5/24/19 15:49	2019-05-26 18:52:00.000	51:03:00	Unknown
Wireline	Unknown	6/18/19 7:15	2019-06-18 07:55:00.000	0:40:00	Equipment Failure
Wireline	Unknown	6/19/19 13:31	2019-06-19 17:22:00.000	3:51:00	Fiber Cut
Wireline	1259	7/13/19 0:38	2019-07-13 03:26:00.000	2:48:00	Fiber Throw - Planned
Wireline	1815	7/19/19 1:10	2019-07-19 01:17:00.000	0:07:00	Fiber Throw - Planned
Wireline	99	7/23/19 1:16	2019-07-23 03:51:00.000	2:35:00	Equipment Failure

Class of Service	Number of subscribers	Date and Time Outage Began	Actual Restoration Time	Duration of Outage	Class of Service
Wireline	262	8/21/19 8:30	2019-08-21 10:43:00.000	2:13:00	Power Loss - Commercial Outage
Wireline	Unknown	8/26/19 16:00	2019-08-27 00:00:00.000	8:00:00	Fiber Cut
Wireline	1131	8/28/19 0:10	2019-08-28 01:19:00.000	1:09:00	Fiber Roll
Wireline	2013	8/28/19 0:10	2019-08-28 01:19:00.000	1:09:00	Fiber Roll
Wireline	53	9/4/19 1:23	2019-09-04 08:39:00.000	7:16:00	Power Loss - Tripped Breaker
Wireline	Unknown	9/18/19 18:13	2019-09-18 18:15:57.000	0:02:00	Link Congestion
Wireline	Unknown	9/24/19 23:28	2019-09-25 00:36:00.000	1:08:00	Equipment Failure
Wireline	Unknown	10/14/19 22:50	2019-10-15 00:51:00.000	2:01:00	Equipment Failure
Non-Wireline	Unknown	11/1/19 15:00	2019-11-01 18:10:00.000	3:10:00	Fiber Cut
Wireline	930	11/10/19 4:22	2019-11-10 04:27:00.000	0:05:00	Equipment Failure
Wireline	28	11/21/19 14:30	2019-11-21 17:30:00.000	3:00:00	Fiber Relocation
Wireline	3130	12/3/19 10:06	2019-12-03 10:09:00.000	0:03:00	Equipment Failure
Wireline	922	12/10/19 7:15	2019-12-10 11:15:00.000	4:00:00	Unknown
Wireline	197	12/24/19 2:01	2019-12-24 03:12:00.000	1:11:00	Power Loss
Wireline	56	12/31/19 16:49	2019-12-31 22:55:00.000	6:06:00	Power Loss

Class of Service	Number of subscribers	Date and Time Outage Began	Actual Restoration Time	Duration of Outage (hr:min:ss)	Cause
Wireline	96	1/22/20 1:40	2020-01-22 03:22:00.000	1:42:00	Equipment Failure
Wireline	25	2/5/20 9:15	2020-02-05 10:45:00.000	1:30:00	Fiber Cut
Wireline	1900	2/7/20 17:51	2020-02-08 04:44:00.000	10:53:00	Equipment Failure
Wireline	84	2/7/20 17:57	2020-02-08 05:57:00.000	12:00:00	Fiber Cut
Wireline	96	3/1/20 17:40	2020-03-02 18:30:00.000	24:50:00	Unknown
Wireline	1070	3/27/20 8:14	2020-03-27 10:48:00.000	2:34:00	Unknown
Wireline	80	4/14/20 13:01	2020-04-14 20:00:00.000	6:59:00	Fiber Cut - Tree Down
Wireline	55	4/14/20 15:06	2020-04-14 20:00:00.000	4:54:00	Fiber Cut - Burnt Fiber
Non-Wireline	Unknown	5/15/20 11:31	2020-05-16 03:14:00.000	15:43:00	Fiber Cut - Backhaul Carrier
Wireline		5/15/20 11:31	2020-05-16 03:14:00.000	15:43:00	Fiber Cut - Motor Vehicle Accident
Wireline	319	6/12/20 9:56	2020-06-13 05:30:00.000	19:34:00	Fiber Cut
Wireline	230	6/18/20 14:53	2020-06-18 15:35:00.000	0:42:00	Equipment Failure
Wireline	65	6/25/20 8:48	2020-06-25 19:00:00.000	10:12:00	Fiber Cut
Wireline	6450	7/17/20 13:30	2020-07-17 14:30:00.000	1:00:00	Equipment Failure
Wireline	2138	7/23/20 16:58	2020-07-24 16:42:00.000	23:44:00	Fiber Cut
Wireline	71	7/23/20 17:07	2020-07-24 16:06:00.000	22:59:00	Fiber Cut
Non-Wireline	Unknown	8/19/20 17:28	2020-08-19 18:05:00.000	0:37:00	Unknown

Class of Service	Number of subscribers	Date and Time Outage Began	Actual Restoration Time	Duration of Outage (hr:min:ss)	Cause
Wireline	1200	8/30/20 3:42	2020-08-30 18:44:00.000	15:02:00	Fiber Cut - Burnt Fiber
Wireline	2080	9/17/20 12:55	2020-09-17 17:15:00.000	4:20:00	Equipment Failure
Wireline	Unknown	9/18/20 5:00	2020-09-18 22:17:00.000	17:17:00	Equipment Failure
Wireline	3000	9/19/20 7:00	2020-09-19 12:00:00.000	5:00:00	Equipment Failure
Wireline	Unknown	10/8/20 20:00	2020-10-09 15:28:00.000	19:28:00	Fiber Cut
Wireline	400	10/25/20 14:00	2020-10-27 13:59:00.000	47:59:00	Fiber Cut - Tree Down
Wireline	175	10/30/20 6:00	2020-10-30 13:00:00.000	7:00:00	Fiber Cut - Motor Vehicle Accident

End of Supplement