



Commonwealth of Virginia Internet Protocol (IP)-Based 9-1-1 Network Feasibility Study



Final Report



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MissionCriticalPartners



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EXECUTIVE SUMMARY

Mission Critical Partners, Inc. (MCP) respectfully submits the Commonwealth of Virginia Internet Protocol (IP)-based 9-1-1 Network Feasibility Study. This study focuses on the key aspects associated with planning, implementing, and operationalizing a network for Next Generation 9-1-1 (NG9-1-1) implementation in the Commonwealth from a technical, operational, economic, and policy perspective. To do this, MCP worked closely with the Virginia Information Technologies Agency (VITA) staff, in addition to stakeholders across the public safety answering point (PSAP) community within Virginia, to gather input and feedback during this study's development.

Planning within the Virginia 9-1-1 PSAP community has begun and this feasibility study is testament to the Commonwealth's vision to leverage the current wisdom in the industry, solid economic analysis, current trends assessment, and economic forecasting—as well as an examination of the effective practices and lessons learned from early adopters—in order to best position decision-makers for well-founded financial and policy decisions. There are numerous complex operational, technical, regulatory, and funding issues that must be addressed to successfully implement an NG9-1-1 system throughout the Commonwealth. Deployment will be a complicated and evolving process, requiring the willing cooperation of many stakeholders from all levels of government and the private sector.

In order to understand the 9-1-1 landscape in Virginia, MCP worked closely with VITA and the PSAPs to engage the community and gather information across three key efforts:

- 1. Existing data from VITA**

Utilizing data VITA previously gathered from the PSAPs, MCP was able to reduce duplication of effort and maximize the value of existing data. MCP then compared the existing data with the data requirements for the study to identify information gaps.

- 2. Online survey to primary PSAPs in Virginia**

Based on the identified data requirements, MCP worked with VITA and the Regional Coordinators to develop a 62-question online survey that was distributed to the 121 primary PSAPs in the Commonwealth. Participants were provided a 30-day response window; 119 PSAPs fully completed their survey within the allotted time.

- 3. Town Hall meetings in all seven regions in Virginia**

At the completion of the survey period, MCP, in coordination with VITA, traveled to each of the seven regions within Virginia to conduct a Town Hall meeting and provide an update on the effort, highlights of survey results, and most importantly, to gather additional input and feedback from stakeholders. These meetings provided valuable perspective and insight on the PSAP and 9-1-1 landscape in Virginia.

These key inputs, in addition to understanding and accounting for the policy and legislative landscape at both the state and national levels, provided the basis for formulating this study, and assured it is fully tailored to, and aligned with, the needs of Virginia. Based on our understanding of the PSAP and 9-1-1 landscape in Virginia, MCP conducted a thorough and comprehensive feasibility study from an



operational, technical, regulatory, and economic perspective. Highlighted recommendations are provided below.

Operational Feasibility

The operational feasibility of integrating disparate PSAPs across the Commonwealth through an Emergency Services IP network (ESInet) and NG9-1-1 solution requires extensive understanding of current PSAP operations, which must be considered in order to understand how to implement NG9-1-1 from an operational perspective. Highlighted recommendations include the following:

- No more than three qualified call handling vendors should be identified that would be supported as part of state purchasing contracts. PSAPs should be encouraged to purchase from/through the state contract.
- PSAPs should be incentivized to act regionally when procuring computer aided dispatch (CAD) solutions and NG9-1-1-capable customer premise equipment (CPE) solutions and a regional shared services approach encouraged.
- The obstacles to standardizing a CAD system in each region should be identified and prioritized. Specific focus should be placed on the impact to agency mobile data and records management systems (RMS).
- An assessment should be conducted to determine which PSAPs routinely interoperate today and which ones plan to potentially share calls and/or personnel in the future. Those agencies should be encouraged to standardize on map display options as much as possible so as to limit risk and unnecessary training issues.

Additional recommendations may be found in Section 3 of this study.

Technical Feasibility

The technical feasibility of deploying a statewide ESInet to implement an NG9-1-1 solution in Virginia requires an intricate understanding of the current environment in the Commonwealth as well as NG9-1-1-related technologies. MCP reviewed and studied the current technical capabilities and existing infrastructure to develop both an understanding of what is needed to implement NG9-1-1 and specific recommendations for how this can be achieved. Highlighted recommendations include the following:

- VITA should work in cooperation with the localities to assess the needs and requirements within the Commonwealth. Network requirements should be determined and a competitive Invitation to Bid (ITB) issued for network services. The solution that best meets the requirements of the Commonwealth, while achieving the greatest level of carrier, path, and network diversity, should be procured.
- Each region, as defined by VITA's Integrated Services Program (ISP), should determine the best solution design for itself and then procure and deploy that solution.
- The Commonwealth should deploy an ESInet that adheres to industry standards and utilizes transitional elements¹ such as legacy network gateways (LNGs), legacy PSAP gateways (LPGs), legacy selective router gateways (LSRGs), and location databases (LDBs) to facilitate a phased migration.

Additional recommendations may be found in Section 4 of this study.

¹ Additional information on NG9-1-1 components may be found in Section 4, Technical Feasibility.



Statutory, Regulatory, and Political Considerations

Ensuring that the statutory and regulatory requirements have been addressed is essential to a successful implementation of NG9-1-1. Existing laws, rules and regulations, and tariffs specifically reference older technologies or limit system capabilities. It is prudent to examine Virginia's current statutes as these laws also may inhibit the migration to IP-enabled 9-1-1 services. MCP developed a policy-change schedule for both statutory and regulatory activity; this is designed to assist VITA with the planning and development of processes that will be needed to migrate from the existing regulatory environment to one that supports the implementation of NG9-1-1. In support of this policy-change schedule, several recommendations are provided including the following:

- The E-911 Services Board should consider legislative changes that will move the program into closer compliance with national guidelines for statewide coordination of all 9-1-1 service types.
- The Commonwealth should designate a statewide 9-1-1 Coordinator who will be the recognized authority for all elements of the 9-1-1 program and all service types as defined by national guidelines.
- A review of the E-911 Services Board's composition is recommended as the Board takes on a stronger and more direct statewide coordination role for NG9-1-1; expanded membership should be representative of the electorate and general public.
- The E-911 Services Board should develop and adopt a comprehensive state NG9-1-1 Master Plan.
- Any expanded responsibility of the E-911 Services Board should be appropriately supported by a statewide 9-1-1 Coordinator (now the Public Safety Communications [PSC] Coordinator) and additional VITA support staff.
- Statutes should include language that assures that collected 9-1-1 funds, whether statewide or locally, are protected and dedicated to 9-1-1 purposes.

Additional recommendations may be found in Section 5 of this study.

Economic Feasibility

The economic feasibility of implementing NG9-1-1 in the Commonwealth requires an understanding of the financial and economic transition issues, discussing the on-going management and maintenance of an NG9-1-1 system, and offering recommendations for action or further consideration by the E-911 Services Board. Highlighted recommendations include the following:

- Sound fund management practices should be implemented and generally accepted accounting principles relied upon to ensure an effective and properly managed 9-1-1 fund.
- Appropriate auditing and accountability practices should be established for the collection and use of the 9-1-1 funds to strengthen public trust.
- The existing 9-1-1 fee structures should be examined and a funding model identified that will support NG9-1-1.

Additional recommendations may be found in Section 6 of this study.



Based on MCP's experience, and as demonstrated throughout this report, the establishment of a statewide ESInet and ultimate implementation of NG9-1-1 will enable the Commonwealth to meet the demands and expectations of today's public and the evolving technology landscape. This effort requires recognition that 9-1-1 service is no longer a local issue and requires a coordinated effort at all levels across Virginia. This study represents the first step in an extensive and important process to establish the next generation of 9-1-1 service in the Commonwealth of Virginia.



1. INTRODUCTION

The 9-1-1 system in the Commonwealth of Virginia has successfully provided access to quality emergency services for decades. However, the public's increasing use of advanced telecommunication technologies—i.e., wireless telephones, texting services such as short message service (SMS), Voice over Internet Protocol (VoIP) telephony, and broadband applications such as video—is contributing to ever increasing public expectations that the current 9-1-1 system cannot effectively address.

Recognizing the opportunity, and need, to improve 9-1-1 services, the Commonwealth of Virginia is considering the implementation of an Emergency Services Internet Protocol (IP) network (ESInet), essentially a network-of-networks, to advance toward Next Generation 9-1-1 (NG9-1-1).² Several external factors point to an urgent need for the Commonwealth to take action toward implementation of NG9-1-1, including vendors exiting the 9-1-1 service provider marketplace, carriers abandoning legacy circuit-switched technologies in lieu of making a transition to all IP-based transport, and most importantly, fundamental shifts in consumers' expectations and behaviors.

NG9-1-1 will fully replace the current 9-1-1 system and provide all of the capabilities and functions in place today, while adding operational, technical and backup flexibility for the public safety answering points (PSAPs) and 9-1-1 authorities. NG9-1-1 also will add capabilities to integrate and interoperate with emergency response and support entities beyond the PSAP.

With more than 120 primary PSAPs in Virginia today, some challenges persist with the sharing of information, as technical and operational limitations exist concerning the legacy analog communications systems. The Commonwealth is in the process of determining the steps necessary to achieve NG9-1-1, and the deployment of a statewide ESInet is an essential building block to fully functional NG9-1-1. A statewide ESInet will enable a new public safety operating environment in the Commonwealth and will enable ubiquitous support for the newest communication technologies.

ESInets offer several advantages while creating a flexible and seamless transition to NG9-1-1. A statewide ESInet will increase flexibility and staff resources to promote virtualization, interoperability, and convergence of applications, and public safety agencies will be able to access shared applications through a common ESInet. NG9-1-1 over an ESInet enables the use of broadband networking to improve the public's ability to provide text, video and enhanced voice information from any IP-capable device. Additional public safety and emergency management applications also can be integrated into an ESInet, which may result in greater expenditure reduction through the sharing of common tools across the Commonwealth.

² As noted in the *E-911 Services Board FY2014 Annual Report*, NG9-1-1 is an IP-based system comprised of managed IP-based networks (ESInets), functional elements (applications), and databases that replicate traditional E9-1-1 features and functions and provide additional capabilities. NG9-1-1 is designed to provide access to emergency services from all connected communications sources, and provide multimedia data capabilities for PSAPs and other emergency service organizations.



1.1. NG9-1-1 MOTIVATORS

An ESInet will enable a variety of new system architectures, enhance interoperability, allow for new operating models, enable competition between new service providers, and offer public safety new capabilities that today's legacy infrastructure will never have the ability to support.

1.1.1. *New Architecture*

An intrinsic characteristic of an IP network is its ability to connect an almost infinite number of sites without any distance limitations or arbitrary boundaries. IP technology provides for new network architectures beyond the legacy 9-1-1 system's typical hub-and-spoke, point-to-point network design. ESInets enable network architectures and solution models that previously could not be supported due to the limitations of legacy technology. These architectures include, but are not limited to, cloud services models, centralized hosted models, and multi-regional shared services models.

Table 1 – NG9-1-1 Architectures

Model	Description
Cloud Services	Solution where a majority, if not all, of the 9-1-1 systems within a respective state or region are hosted in redundant and geographically diverse data centers. This dispersed services model enables new operational capabilities as the 9-1-1 services can be deployed via secure remote log-in for access to the network. Several 9-1-1 solutions vendors have deployed varying types of cloud-based solutions with some focusing on core i3 functional elements, with others focusing more on cloud services for call handling systems.
Centralized Host	Provides similar capabilities as the cloud services model, but typically these systems are hosted in closer proximity to the jurisdictions that they serve. The industry has already experienced the benefits of centralized hosted solutions with the deployment of VoIP customer premises equipment (CPE) systems, such as those deployed in the Southwest and New River projects within the Commonwealth. These projects are the initial steps in taking advantage of IP technologies for enabling new operational capabilities. However, this model only scratches the surface of the possibilities in deploying shared systems.
Multi-regional Shared Services	Utilizes the centralized host model solution to provide services to a broader set of entities. This enables a region to maximize its technology investment by providing services to other regions within a state. For example, a region consisting of six counties sharing a call handling system could share that same hosted system with an eight-county region that is hundreds of miles away. Capacity limitations of these solutions exist; however, many of today's leading call handling systems can support two to three hundred workstations on a single pair of host nodes. Other limitations include available bandwidth at the host locations, simultaneous call capacity, and rack space availability for hosting the gateways, servers, switches, and routers.



1.1.2. *New Interoperability*

A statewide ESInet will enhance interoperability across the Commonwealth. Today's legacy 9-1-1 network provides limited interoperability between PSAPs, with boundaries set by the service area of each PSAP's selective router(s). These boundaries do not consider the needs of public safety communications and arbitrarily limit today's operations.

A statewide ESInet consisting of standards-based i3 systems will enable any PSAP to transfer calls to any other PSAP in the Commonwealth with voice and location information. This expanded interoperability will enable new continuity of operations (COOP) models within the Commonwealth. In a new ESInet model, calls could be handled by a PSAP that is hundreds of miles from a coastal PSAP that is ravaged by a hurricane. While this presents new challenges in communicating with the first responders in the devastated coastal area, complimenting technologies such as radio over IP, amongst others, will provide interoperability opportunities that currently cannot be supported by the legacy network.

Additionally, the Policy Routing Function (PRF) provided within the ESInet will enable new interoperability for addressing the peak call volume situations. The PSAP survey revealed that almost 25 percent of the PSAPs send their overflow calls to their own administrative lines, as seen in Figure 1 below. There are many factors driving this as the most popular choice. For instance, larger PSAPs cannot send their calls to a single neighboring jurisdiction, as their call volume likely would overwhelm the smaller neighboring PSAP's operations. While the same administrative line rollover functionality may be supported within an ESInet, new operational capabilities become available as well.

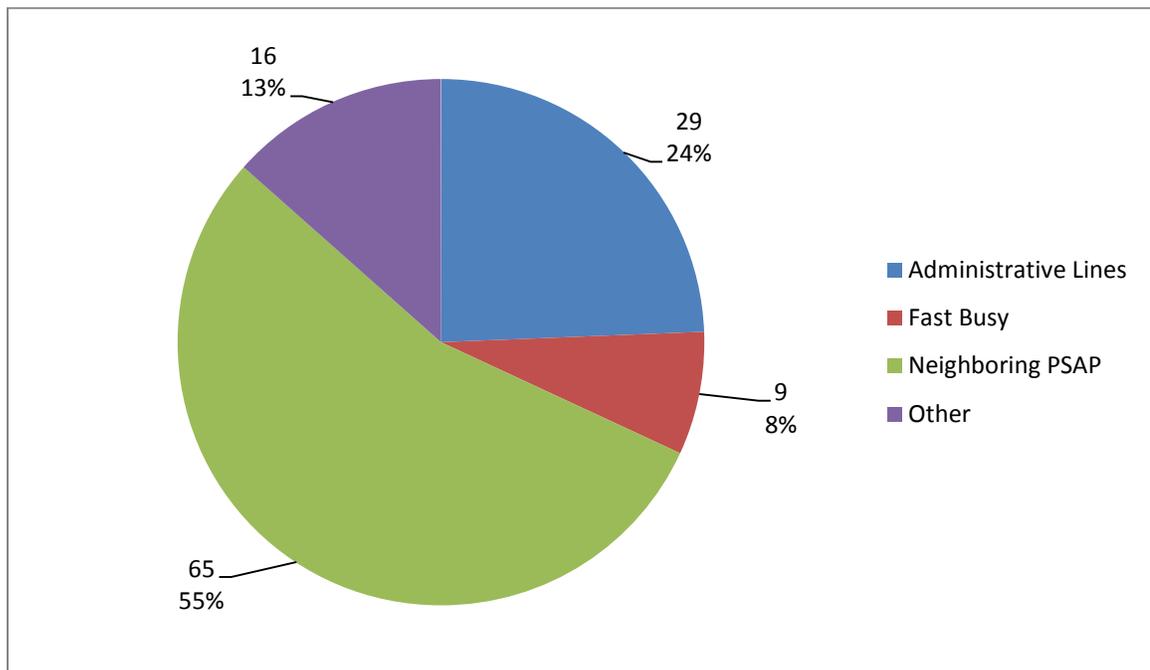


Figure 1 – PSAP Overflow Destinations



Calls may be distributed to neighboring jurisdictions using round-robin, hierarchical, geographical, load-balanced, and other potential models. These distribution models provide the ability to spread a large PSAP's call volume to its neighboring jurisdictions in a logical manner that is optimal for an efficient and effective response. Without a doubt, the potential distribution models will have a significant impact on operations that will require more in-depth collaboration between agencies, both technically and operationally, including new or revised mutual-aid agreements. The ESInet simply lays the foundation for the Commonwealth and its localities to view emergency response through a whole new lens.

1.1.3. New Operating Models

New operating models provide functionality and capabilities that PSAP operations have previously not been afforded. A statewide ESInet provides for new operating models such as software as a service (SaaS) call handling operations. These new operating models focus on taking what has historically been a one-to-one (1:1) relationship between PSAPs and their call handling system and expanding the economies of scale to take them to a 10:1, 25:1, or 50:1 scale.

While the economies of scale will not directly translate to financial gain (e.g., the \$100,000 system that is now shared with ten other PSAPs will not lower the cost to \$10,000 each), cost sharing will enable lower total costs of ownership while providing new operational capabilities. For example, an SaaS model provides software licenses on a subscription basis. The call handling interface is a thin client (i.e., web browser) that provides the ability for users to authenticate themselves on the cloud-hosted server, which enables the call taker to handle calls from almost any secured location on the ESInet. This could allow a call taker from Fluvanna County to handle their 9-1-1 calls from a workstation in Louisa County in the event of a PSAP evacuation.

1.1.4. New Service Providers

The 9-1-1 service provider ecosystem is changing in the Commonwealth. While NG9-1-1 is opening the marketplace to new service providers, at the same time the Commonwealth's largest 9-1-1 service provider is not planning to offer NG9-1-1 routing and data management services.³ Intrado was the first competitive service provider to deploy a NG9-1-1 system with the Pittsylvania County Pilot going live in September 2011.⁴ Now major systems integrators are entering the industry with partnerships, as

³ In MCP's due diligence meeting on November 17, 2014, Verizon stated that they will not be offering NG9-1-1 routing and data management services, but rather focusing on supporting NG9-1-1 through their core competencies of IP networks and cloud hosting services.

⁴

<http://www.vita.virginia.gov/communications/publications/publicSafetyCommunications/default.aspx?id=6442469895>



demonstrated by the awarding of the Commonwealth of Massachusetts' NG9-1-1 system contract to General Dynamics.⁵

The addition of these new service providers introduces a healthy economic environment with cost competition and faster evolution of innovation. When combined with the new operating environment, the Commonwealth and its localities have an opportunity to look at 9-1-1 call handling and emergency response in an entirely new manner.

1.1.5. New Capabilities

With the adoption of IP technologies, the 9-1-1 ecosystem will be afforded new capabilities that previously could not be supported by the legacy architecture. Improvements will be experienced with faster call setup times⁶. Calls will be delivered with location information and potentially supplemental information about the 9-1-1 caller, such as family medical history, photos of children that could be used in Amber Alert scenarios, and premise information such as the location of potentially hazardous materials at the home or business. That information may be made available at the time of the call, as well as to the receiving party of a call transfer.

New services such as text messaging may be supported by a statewide ESInet enabling ubiquitous emergency texting services across the Commonwealth. These services are destined to mature and expand to include multimedia services that provide still images, video, and audio clips. While these new services may not be of interest to all PSAPs, an ESInet will enable such services to be shared across the Commonwealth.

The deployment of a statewide ESInet will enable a migration from tabular emergency services number (ESN)-based call routing to geospatial call routing. Geospatial routing is a solution where the location of the caller is plotted on a map to determine the proper PSAP to receive the call. The same geospatial data is then used to determine the appropriate PSAP to receive a transferred call, based on the caller's current location. Additionally, the location of the caller, and subsequent location updates, will provide the call taker with the geospatially accurate responding agencies, which can enhance dispatching services.

Lastly, and possibly most importantly, the migration to NG9-1-1 and a statewide ESInet will enable ubiquitous support for the newest communication technologies. Fifteen years ago, the industry was on the cusp of deploying its first Phase I wireless services. These services were deployed in a means where the industry had to manipulate the system by integrating pseudo automatic number identification (p-ANI) numbers into the wireline selective routing systems, in order to properly route a wireless caller to a PSAP.

⁵ <http://www.prnewswire.com/news-releases/general-dynamics-awarded-contract-to-implement-massachusetts-statewide-next-generation-9-1-1-system-272563171.html>

⁶ NENA-08-501, Section 1.3, Issued June, 2004. https://www.nena.org/?page=NtwkInterface_IP_PSAP



Today, the PSAP to which the Phase I call is routed is pre-provisioned based on a rough estimate of the coverage of the cell site sector. The PSAP CPE has to bid (query) an ALI database, which in turn bids an auxiliary mobile positioning center (MPC) or gateway mobile location center (GMLC) to obtain the address information of the cell site, sector face information, call back number of the caller, and the serving carrier's name. The deployment of a statewide ESInet with i3-compliant systems will provide an environment that will natively support the public's future adoptions of communication technologies, allowing location to be delivered with the call and using the provided location for the determination of where to route the call in initial call delivery; a situation not enabled by today's legacy 9-1-1 system.

1.2. FEASIBILITY STUDY PURPOSE

In the Commonwealth, the current 9-1-1 system is based on legacy analog technologies that were established decades ago. The result is two widespread, significant limitations that impact the level of 9-1-1 service that Virginia citizens receive today. The limitations are as follows:

- Length of 9-1-1 call set up time
- Limited ability to transfer 9-1-1 calls statewide

While these are the overarching limitations, the Commonwealth is aware that there are other limitations, which are described within this document. Overcoming these limitations, and others, will vastly improve the service currently delivered to citizens and establish a new technological foundation from which to begin the migration to NG9-1-1.

To accomplish this, the Commonwealth of Virginia sought a feasibility study for the design of a single statewide IP-based 9-1-1 network. This study provides statewide IP-based 9-1-1 network design options for consideration by the E-911 Services Board and is a critical first step to statewide deployment of NG9-1-1.

The results of the feasibility study will contribute to the blueprint for the Commonwealth's related long-term planning efforts and will provide insight to local jurisdictions on the statewide NG9-1-1 efforts.

1.3. GOALS AND OBJECTIVES

The goal is to complete a feasibility study for Virginia's E-911 Services Board that provides multiple solutions for the design of a single statewide IP-based 9-1-1 network. The study will address system design, procurement, implementation, operation, and any necessary modifications to the existing governance structure inherent to the E-911 Services Board. This study is the first step in a long-term strategic approach to improve 9-1-1 service in the Commonwealth.

In order to meet the goal of this feasibility study, several objectives were identified as part of the effort and include:

- Present a technical statewide design that will support the creation of a single statewide IP-based 9-1-1 network, which can be achieved from the solutions provided.



- Address local management of PSAP data, allowing call routing to be done by policy that reflects the current call delivery process within the 9-1-1 network.
- Provide a migration plan to the statewide IP network for existing NG9-1-1 pilots and PSAPs that are currently transitioning to an IP-based solution.
- Evaluate the practicability of regional IP-based 9-1-1 networks as identified in previous E-911 Services Board planning documents.
- Recommend how secondary PSAPs should interconnect with the statewide IP network to maintain current network relationships with primary PSAPs.

1.4. DOCUMENT OVERVIEW

The Commonwealth's 9-1-1 system fundamentally needs improvements in technology, operations, funding, and governance to support the new service level required to make NG9-1-1 a reality. To fully understand what is needed to migrate toward NG9-1-1 in the Commonwealth, this feasibility study explores technical, operational, economic, and policy feasibility.

1.4.1. Operational Feasibility

Understanding the operational feasibility of implementing NG9-1-1 in the Commonwealth requires a review of current PSAP operations in order to focus on specific recommendations for statewide ESInet operations, along with advice for governance and policy. As a result, this section focuses on the following key areas:

- Review of existing capabilities and options for problem reporting (i.e., trouble-ticket management), training, configuration management, security, and other operational functions.
- Review of continuity of operations best practices with recommendations for operational changes to mitigate potential service disruptions.
- Provisioning of examples of existing best practices for operation of a statewide ESInet.
- Recommendations associated with operational feasibility associated with NG9-1-1 implementation.

1.4.2. Technical Feasibility

As the Commonwealth looks to the future, migration from legacy 9-1-1 technologies is critical. This Technical Feasibility section focuses on the key aspects associated with migrating from legacy 9-1-1 technologies to the technologies required to implement an ESInet to support NG9-1-1. To understand what is possible and what is required to design and implement an ESInet and NG9-1-1 in the Commonwealth, key focus areas are as follows:

- Current aspects of 9-1-1 service in the Commonwealth today
- Motivators for NG9-1-1 in the Commonwealth
- Key system components for a single statewide IP-based 9-1-1 network
- Conceptual network designs
- Network design considerations



- Public safety-grade considerations
- Master Street Address Guide (MSAG) database maintenance
- Communication service providers

1.4.3. Statutory, Regulatory and Political Considerations

Ensuring that the statutory and regulatory environments have been addressed is essential to a successful implementation of NG9-1-1. Existing laws, rules and regulations, and tariffs specifically reference older technologies or limit system capabilities. It is prudent to examine current statutes as these laws also may inhibit the migration to IP-enabled 9-1-1 services.

Statewide 9-1-1 system assessments also provide a method for state coordinating agencies, such as the E-911 Services Board and VITA, to gauge the status of state and local programs, and to identify areas within the current system that may require modification in order to remain effective and true to respective missions. Suggested assessments are as follows:

- Current national legislative landscape and trends, early adopter approaches, and regulatory standards development
- National guidelines for state NG9-1-1 legislative language
- Current regulatory framework in Virginia
- Comparison of current Virginia 9-1-1 statutes with other states
- Comparison of National 9-1-1 Program guidelines with current Virginia statutes
- Comparison of current Commonwealth policy with other areas in the U.S. and identification of enabling legislation
- Comparison of current Commonwealth regulatory environment with other areas in the U.S.
- Recommendations for higher levels of compliance with national guidelines
- Summary of all policy, statutory, and regulatory considerations
- Milestones and policy-change schedule

1.4.4. Economic Feasibility

The economic benefits of establishing a statewide ESInet can be realized through the sharing of network capacity, routing, security, and monitoring. While fiscal savings are achieved, there are also operational and functional benefits, including enhanced situational awareness, emergency response, disaster recovery, and interoperability.

Once deployed, the network will offer PSAPs within the Commonwealth an IP-enabled network with broadband capability upon which NG9-1-1 functions and various emergency call-management applications can be built. The risks identified as a result of choosing to not take any action are significant and present major challenges to the Commonwealth's current 9-1-1 system, most notably to its users and the stakeholder community it serves on a daily basis.



In order to fully understand the economic benefits and requirements associated with NG91-1, this section focuses on the following areas:

- Cost projections
- Cost comparison of current and projected costs
- Funding recommendations for ESInet/NG9-1-1 implementation
- Cost of implementing NG9-1-1
- Cost benefits of ESInet/NG9-1-1 implementation
- Cost of doing nothing
- Cost of legacy 9-1-1 conversion for NG9-1-1 implementation

The intent of this section of the document is to focus on the economic feasibility of NG9-1-1 and to frame the financial and economic transition issues, discuss the on-going management and maintenance of an NG9-1-1 system, and offer recommendations for action or further consideration by the E-911 Services Board.

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2. METHODOLOGY

The feasibility study required a comprehensive process and key assumptions in order to fully address the requirements of this study. As a result, this section covers the process and assumptions applied during the study's development.

2.1. PROCESSES

In order to develop the feasibility study, Mission Critical Partners (MCP) applied a collaborative approach with the Virginia Information Technologies Agency (VITA) and the PSAP community to understand the current 9-1-1 landscape in the Commonwealth. MCP used common data-gathering procedures, as well as guidelines from nationally known organizations, to maintain objectivity throughout the assessment process.

2.1.1. Survey

MCP conducted a survey distributed to 121 PSAPs within the Commonwealth; 119 surveys were returned, which represents a completion rate of more than 98 percent. The survey results provide a high-level perspective of the Commonwealth's current 9-1-1 operations. The full survey results may be found in Appendix A – PSAP Survey Results. MCP also worked with the Integrated Services Program (ISP) Regional Coordinators to identify three PSAPs in each region to conduct a sample survey regarding geographic information system (GIS) capabilities. This survey resulted in the collection of additional data from ten PSAPs that responded to the survey request.

2.1.2. Regional Coordinator Input

In addition to the MCP survey, additional data was collected through close coordination with VITA and the ISP Regional Coordinators, who served as resources in providing relevant information associated with their respective regions, while also supporting efforts to interface with individual PSAPs. Data collected from the Regional Coordinators include the annual PSAP True-Up process in addition to region-specific information as needed during study development.

2.1.3. Town Hall Meetings

To ensure that MCP understood the position and perspective of the local PSAP authorities, information was gathered in Town Hall meetings conducted throughout the Commonwealth. Between October 27 and November 12, 2014, MCP conducted such meetings in each of the seven regions.

These meetings allowed the opportunity to update the stakeholder community on the study and to engage in a discussion on current needs, challenges, and associated efforts to further inform the study. In addition, MCP conducted personal follow up with key stakeholders, which was invaluable in



establishing the outlook and view of the service delivery practitioners. Their input was essential for this study, and will be to the success of any transition to NG9-1-1.

2.1.4. Policy Review

MCP reviewed existing laws, rules and regulations, and tariffs related to 9-1-1 services in the Commonwealth, as well other supporting statutes such as purchasing laws, data practices standards, the Communications Sales and Use Tax act, Information Technology (IT) risk management standards, and the IT Information Security Standards, as well as policies related to liability protections for service providers and records retention.

Internal reports such as the Virginia Comprehensive 9-1-1 Plan, Next Gen and Beyond, March, 2011; E-911 Services Board meeting minutes and budget; Virginia's Next Generation Implementation Plan presented to the E-911 Services Board on March 8, 2012; and the 2014 Annual Report of the Board to the legislature as prescribed by statute also were consulted. This was done to gain a deeper understanding of 9-1-1 services in Virginia, the E-911 Services Board's vision and policy as it relates to 9-1-1, and the local public safety communications community.

2.1.5. External Reference Review

In addition to statute review, MCP used two nationally prepared reference documents: the National Highway Traffic Safety Administration (NHTSA) [Guidelines for State NG9-1-1 Legislative Language](#) and the U.S. Department of Transportation (USDOT) NHTSA [Model State 911 Plan](#), version 1.0, February, 2013. These documents provided the basis for the analysis of how Virginia compared with national guidelines and best practices, including recommendations for how the Commonwealth can achieve a higher degree of compliance with those guidelines and best practices.

Specific to funding and the economic issues surrounding the migration from legacy 9-1-1 systems to NG9-1-1, MCP consulted previous studies such as the Blue Ribbon Panel on 911 Funding [Report to the National 911 Program](#), December 2013, and the Federal Communications Commission (FCC or the Commission)-commissioned Communications Security, Reliability and Interoperability Council (CSRIC) Working Group 4B's [Transition to Next Generation 9-1-1 Final Report](#), March 2011.

2.2. KEY ASSUMPTIONS

Pricing documentation is presented as a rough order of magnitude (ROM). Assumptions and known variables that can significantly impact pricing are clearly stated.

Once the process to identify potential public sector-owned infrastructure and other prospective partner resource availability was completed, locations that cannot be serviced by these resources will need to be supplemented by newly constructed network infrastructure in order to obtain service. Additional partnerships, agencies, and/or providers could be included in future discovery for the procurement process.



The following assumptions relative to the program objectives were made during the feasibility study:

- Provide NG9-1-1 call handling pricing that reflects both capital expenditure (CAPEX) and operational expenditure (OPEX) options
- Maximize efficiency of costs and resources across multiple mission-critical applications
- Share existing broadband networks to build the connectivity and/or provide redundancy and resiliency
- Increase situational awareness and disaster recovery
- Advance interoperability
- Promote coordination and information sharing
- Provide dual paths for primary and secondary PSAPs
- Local control of data and call routing rules

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3. OPERATIONAL FEASIBILITY

Understanding the operational feasibility of implementing NG9-1-1 technology in the Commonwealth, and ultimately a statewide ESInet, requires a thorough review of current PSAP operations and interactions.

3.1. BACKGROUND

Deployment of IP-based networks for the delivery of 9-1-1 calls for service represents a fundamental and progressive step forward for any state, regional, or local agency. From an operational perspective, this migration will require significant changes at all levels. The increased quantity of multimedia content will expand the role of telecommunicators (call takers and dispatchers), allowing for dynamic and truly scalable options in the role of public safety. This evolution aligns with the vision outlined by national organizations such as the National Emergency Number Association (NENA), the Association of Public-Safety Communications Officials – International (APCO), and the USDOT National 911 Program Office.

While this shift in technology allows organizations flexibility and scalability in their service to the public, it also presents new and unique operational situations that must be considered on a much higher level. Through this study, analysis of provided survey data from participating PSAPs allows for a macro view of operations within the Commonwealth as well as broad operational conclusions at the regional and PSAP level.

In their final report released in March 2011, *Transition to Next Generation 9-1-1*, the FCC's CSRIC Working Group 4B outlined a definition of operations that will be applied to this study. It states, “[s]ystem operational issues are defined as issues related to the roles and responsibilities of 9-1-1 Authorities in the operation of the NG9-1-1 system.”⁷

Transitioning to NG9-1-1 and the rollout of ESInets presents considerations for the roles and responsibilities at the state, regional, and local levels. Operations and technology are interdependent and a balanced approach to overall system capabilities is required to assure successful transition. Management, monitoring, and configuration of technical systems must align with operational goals of improving performance metrics and the quality of service that stakeholders expect from the Commonwealth and its emergency responders. Leveraging current networks and deploying future ESInets will enhance connectivity among PSAPs and regions within the Commonwealth. Connectivity, however, is only part of the solution. Operational compatibility among the many functional elements involved in managing and disseminating emergency calls is a critical component that must be addressed in an NG9-1-1 migration plan.

⁷ <http://transition.fcc.gov/pshs/docs/csric/CSRIC-WG4B-Final-Report.pdf>, page 3.



3.2. TECHNOLOGICAL CAPABILITIES

Assessing PSAP technical capabilities is an important first step in determining how the Commonwealth should proceed in deploying NG9-1-1 functionality. The level to which technical systems are able to exchange critical data is key to expanding interoperability among PSAPs and regions within the Commonwealth. Historically, diverse enhanced 9-1-1 (E9-1-1) call handling and dispatch systems do not interoperate without implementation of proprietary interfaces that are costly and limited in functionality. Technical standards such as the APCO/NENA [Emergency Incident Data Document \(EIDD\)](#), currently in development, will eventually provide a National Information Exchange Model (NIEM) conformant Information Exchange Packet Document (IEPD) and an Extensible Markup Language (XML) schema to address incident information sharing between disparate PSAPs and systems. Until such time as these and other standards are finalized and widely deployed, it will be necessary to carefully assess the impact of diverse technologies and consider plans to allow for improved interoperations during transition.

An inventory of existing PSAP systems, gained through the PSAP survey, identifies a significant diversity of deployed systems throughout the Commonwealth. The disparity in systems presents potential challenges to interoperability.

3.2.1. *Call Handling Equipment*

Call handling equipment (also referred to as CPE) is used to handle communications between a caller and a PSAP telecommunicator. It includes numerous interfaces and applications and provides the PSAP with the automatic number identification (ANI) and automatic location identification (ALI) associated with each 9-1-1 call. When assessing the potential for interoperable communications, the primary focus is on the ability to seamlessly transfer a 9-1-1 call with location information from an originating PSAP to another PSAP or public safety agency. This capability is often limited to PSAPs within a specific region using technology supplied by the same vendor. Based on survey responses, the following vendors currently have call handling equipment deployed in the Commonwealth:

- 911 Inc./TriTech
- Emergency CallWorks
- Microdata/TeleCommunication Systems, Inc.(TCS)
- Motorola
- PlantCML/Cassidian/Airbus DS
- Positron/Intrado
- Zetron

The deployed call handling systems have an extensive range of hardware components and software versions associated with each vendor product. Nearly 75 percent of systems in use are manufactured by Airbus DS Communications (formerly Cassidian/PlantCML). Table 2 depicts the number of PSAPs within the Commonwealth that have deployed each manufacturer's systems.



Table 2 – Call Handling Solutions

Manufacturer	# of PSAPs
911 Inc./TriTech	3
Emergency CallWorks	1
Microdata/TCS	2
Motorola	1
PlantCML/Cassidian/Airbus	89
Positron/Intrado	21
Zetron	2

Appendix B, Map 1, is a graphical representation of the call handling solutions by county.

Diversity of CPE manufacturers is expected in a state with 121 primary PSAPs and would not otherwise be a particular problem, especially when three-quarters of the PSAPs have independently selected the same manufacturer. However, the diversity of systems within each manufacturer is a cause for concern; based on survey data, there are 29 different CPE versions in operation across 119 of the primary PSAPs.

Of particular note, combining the two largest CPE vendors (Airbus DS and Intrado have the largest number of PSAPs in Virginia and the largest market share within the industry), there are five different product families (Pallas, VESTA, Sentinel/Patriot, Viper, and Power 911), at 22 different revision/version levels. This quantity of different systems and different versions make it impossible to share systems or coordinate support regionally.

In conducting its evaluation, MCP assessed whether the deployed call handling solution was capable of receiving Session Initiation Protocol (SIP) communications natively at the individual workstation, without the need for conversion to or from circuit-switched technology (i.e., centralized automatic message accounting [CAMA] or digital lines), either at the call taker stations or in the backroom equipment.

Based on PSAP survey results, 70 percent of the systems in use today would require replacement or upgrade to qualify as NG9-1-1-capable⁸. This is problematic, because while the vendors may provide upgrade paths in the future, it is unknown today what those upgrade paths will be or a possible timeline. Further, it is unknown whether those upgrades will require a hardware replacement. There are numerous vendor paths to upgrade, with varying degrees of project complexities, costs, and time required. As the Commonwealth continues its progress toward implementing a statewide ESInet, additional assessment of PSAP readiness, in particular for CPE equipment, will be required to ensure

⁸ NG9-1-1-capable equipment, as defined in Section 4.3, is essentially a call taking solution capable of receiving SIP communications natively at the individual workstation without the need for conversion to or from circuit-switched technology.



that the solutions (or system replacements) meet the required specifications to support NG9-1-1 call handling.

The PSAPs surveyed provided projected dates for the replacement of their current call handling systems. Table 3 provides a high-level snapshot of the planned upgrade cycles throughout the Commonwealth sectioned into 6-month periods for calendar years 2014–2018. The survey responses appear typical of replacement cycles in other states, i.e., a rolling cycle with PSAPs deploying as equipment is eligible for replacement, tied either to funding cycles or end of life.

Table 3 – Planned CPE Upgrade Cycles

Upgrade Timeframe	# of PSAPs
7/1/14 – 12/31/14	8
1/1/15 – 06/30/15	15
7/1/15 – 12/31/15	9
1/1/16 – 06/30/16	11
7/1/16 – 12/31/16	16
1/1/17 – 06/30/17	7
7/1/17 – 12/31/17	9
1/1/18 – 06/30/18	6
7/1/18 – 12/31/18	3
After 1/1/2019	32
Total	116

A significant opportunity exists to leverage the replacement cycles and encourage procurement of systems that meet NENA i3 standards and improve/enable the ability to transfer calls between regions. Procurement of systems on a local basis leads to technology silos that inhibit interoperability. The investment of funds and resources in a statewide ESInet infrastructure must be accompanied by improvements in the operational quality of service provided to stakeholders. More importantly, a significant degree of coordination needs to take place so that both the Commonwealth and the local jurisdictions are planning and implementing a standards-based solution, on an agreed upon schedule, based upon funding availability.

Nearly 50 percent of PSAPs report a plan to replace or upgrade their call handling systems by the end of 2016. The Commonwealth should take direct action to engage with the involved PSAPs and Regional Coordinators to take advantage of this timing to encourage and incentivize a regional approach to procurement that will allow for improved sharing of 9-1-1 calls across jurisdictional boundaries. While it may not be possible to standardize all agencies on a single call handling solution, the disparity must be addressed and reasonable constraints on procurement imposed. Reducing the disparity of call handling systems is achievable if financial incentives are offered, such as through a state purchasing contract. Limiting the vendors who will qualify for purchase off the state contract can



be challenging especially when it forces a PSAP to consider implementation of a new and unfamiliar system.

If the Commonwealth decides to standardize on a few (i.e., no more than three) different vendors and a limited number of approved versions, any perceived limitation would be offset by numerous benefits, including the following:

- Improvements in sharing and transfer of calls and associated call data across jurisdictional boundaries
- Potential to alternate route calls to other regions during adverse events or periods of peak demand
- Increased PSAP backup/continuity of operations flexibility when neighboring jurisdictions are using common or shared systems
- Reduced maintenance and support costs
- Financial incentives via state purchasing vehicle
- Leveraging training for multiple jurisdictions

3.2.2. Computer Aided Dispatch

Computer aided dispatch (CAD) systems provide software to manage multiple mission critical functions in the PSAP. The most common and often used functions are incident creation and dissemination of incidents (dispatch). After an emergency call is received, the telecommunicator must create an incident classifying the reason that the caller requires assistance. The incident is assigned a priority and further details are added to the incident record as they are received. The incident is dispatched via the CAD system to emergency responders in the field.

As discussed earlier, disparity among the CAD system solutions and their implementations can hamper the PSAPs' abilities to efficiently interoperate. Emergency incidents often require the involvement of more than one PSAP or responding agency. The location and circumstances of an incident often dictate the number and type of agencies that need to be involved. Law enforcement, fire and emergency medical services (EMS) are not always dispatched by the same PSAP. The ability to electronically share incident data is especially critical in cases where multiple PSAPs must coordinate resources to respond to an emergency. In an ideal scenario, a single telecommunicator is able to interface with a caller and manage the entry of CAD system incident information. The telecommunicator and any additional dispatchers receive incident updates electronically and relay the details to responding units per standard operating procedures (SOPs). In situations where multiple disparate CAD systems are in use, incident details must be relayed verbally by the original telecommunicator or a dispatcher. Downstream telecommunicators must create and manage separate CAD system incidents that are compatible with their in-house systems. Information exchange is inefficient, requires duplicative call entry, and results in longer call processing times and delays in the dispatch of resources.

Disparate CAD systems are typically unable to exchange data without use of a custom or proprietary interface such as is deployed in the National Capital Region (NCR) between TriTech, Tiburon and



Intergraph. Development, approval, and widespread deployment of NG9-1-1 information sharing standards will take several more years and it is likely that states and regions will proceed with ESInet deployments ahead of their adoption by CAD system vendors. The APCO/Central Station Alarm Association (CSAA) standard [Alarm Monitoring Company to Public Safety Answering Point \(PSAP\) Computer-Aided Dispatch \(CAD\) Automated Secure Alarm Protocol \(ASAP\)](#) is an exception to this trend. The ASAP interface provides a standardized data exchange for electronically transmitted alarm information between alarm monitoring companies and PSAPs. Use of this method of alarm transmission negates the need for lengthy phone calls between the PSAP and the alarm company. The standard was piloted by the Richmond PSAP and is now in use by several major city PSAPs across the nation including Washington D.C and Houston, Texas.

The PSAP survey results show the disparity of CAD systems deployed throughout the Commonwealth is greater than that found with call handling equipment, as 17 vendors currently have systems in place, each with differing software versions and hardware components.

Table 4 – CAD System Solutions

Manufacturer	# of PSAPs
Archonix Systems	1
DaPro Systems	41
EnRoute Emergency Systems	2
HTE/SunGard / OSSI/SunGard	19
IBM	1
Information Technologies Inc.	1
Interact Public Safety Systems	4
Intergraph	4
Motorola	4
New World Systems	5
Northrop Grumman	1
Shield Technology Corp	5
Southern Software	17
Spillman Technologies	4
Tiburon	3
VisionAIR/TriTech	1
Other	6

Appendix B, Map 2, is a graphical representation of the CAD system solutions by county.

While the overarching intent of NG9-1-1 is to increase functionality and interoperability, deployment of regional or statewide ESInets is only half the battle. Networks will provide much needed connectivity between Virginia’s PSAPs. Interoperability constraints caused by a wide variance in call handling and



CAD systems, however, will leave the operational landscape largely unchanged. Standardizing the CAD system environment is likely to be more challenging than standardizing call handling solutions. CAD systems are significantly more complex and require more training for PSAP personnel. While external law enforcement, fire and EMS stakeholders do not typically interface to or make use of software modules within the call handling systems, that is not the case with CAD systems. External agencies frequently use CAD system modules to enhance their operations and often play a role in the configuration options for a respective system. CAD systems are also the primary source of data for most public safety mobile computing solutions and agency records management systems (RMS). The downstream impact of a change to a CAD system requires long-term planning, agreed upon standards, and strategy discussions with all affected agencies.

A different approach on the Commonwealth's part is warranted when encouraging PSAPs and regions to adopt interoperable CAD systems. Incentives could be made available to PSAPs willing to host CAD systems for multiple PSAPs or counties. The Southwest NG9-1-1 pilot project is a good example of where to begin. With VITA's support, the geodiverse VIPER call handling system was implemented for Dickenson, Lee, and Wise counties and the City of Norton. While connectivity and configuration issues continue to be addressed, call handling interoperability has been achieved. The four agencies all use a Spillman CAD system, but interoperability among their CAD systems is still challenging. Additional financial assistance and technical and project management support could help to further develop the ESInet and interfaces for the CAD systems, with the ultimate goal of seamlessly sharing both calls and data during emergency incidents.

Although beyond the scope of this study, there is an opportunity to study how the PSAPs use RMS and mobile data software to determine the extent to which they would be affected by changes to CAD systems.

3.2.3. Logging Recorders

Every PSAP must have access to a logging recorder or logging service to maintain a legal record of incident communications and associated data. The choice of where PSAP information is logged is at the discretion of local authorities. It is common in today's environment for each PSAP to house and maintain its own logging recorder. Logged information may be used for internal and external incident review, quality assurance (QA), personnel evaluations, or in response to judicial subpoena. Logging recorders also support instant recall recording (IRR) capabilities used by telecommunicators to ascertain critical information that was missed or difficult to discern. NENA [08-003](#), *Detailed Functional and Interface Standards for the NENA i3 Solution*, describes standard interfaces by which PSAP functional elements access logged data. NG9-1-1 loggers must be capable of logging all communications sessions that originate or terminate in a PSAP, including associated metadata and multimedia as denoted by local or state law. Many of the logging recorder vendors have modified their current system versions to support the interfaces defined in the current NENA i3 standard or plan to do so in the near future when i3 version 2 is finalized.



Based on the survey results, 13 vendors currently have logging systems in place in the Commonwealth's primary PSAPs.

Table 5 – Logging Recorder Solutions

Manufacturer	# of PSAPs
Applied Digital Solutions/Dictaphone/NICE	56
Audiolog/Verint	7
Carolina Recording Systems	5
DSS	4
Eventide	13
EXACOM	3
Higherground	4
RedBox Recorders	1
Revcord	9
Ten 4/Stancil Corporation	4
Voice Print International (VPI)	5
VS Logger/Versadial Solutions	3
Other	5

Appendix B, Map 3, is a graphical representation of the logging recorder solutions by county.

The deployment of multiple logging recorders does not present significant challenges today, but does necessitate a broader long-term strategy. A key question that ultimately will need to be answered concerns whether logging and recording will continue to be a local function, or if it should transition to a regional approach once ESInets are deployed in the Commonwealth. The current approach of each PSAP maintaining its own logging recorder is not cost effective or efficient in an NG9-1-1 environment. This is even more critical when CAD systems are shared in an NG9-1-1 environment, to ensure that all associated call/event data is captured in an integrated manner.

Logging recorders will be integral to tracking more than analog audio as is seen in the current E9-1-1 environment. Network transactions must be logged to assure integrity of an IP-based 9-1-1 call delivery architecture. Emergency calls, radio transmissions, and incident records with supporting additional data and multimedia will require significant storage and channel capacity and thus will be more costly. In an interoperable environment, multiple PSAPs and agencies may require dynamic access to logged data that will not be possible if there are a multitude of individual loggers storing the relevant information. The most feasible method going forward is to consider housing data in centralized shared logging recorder systems where external interfaces allow secure access.

PSAPs should be encouraged to move toward centralized logging recorder solutions, either at the regional level or through a state-level system, perhaps provided as a hosted solution. One distinct



benefit to having logging occur at the state-level is the ability to collect accurate statistical data automatically, versus relying on self-reporting as is done today.

As stated, financial incentives can be leveraged by pre-qualifying vendors for purchase off the state contract. Assistance could be offered in providing training or the technical support that will be required to configure, maintain, and assign access rights to an NG9-1-1-shared logging recorder service. The Commonwealth can also take the lead in educating regions and public safety agencies who perceive that they will lose control of their confidential data if it is moved to a shared platform.

3.2.4. Management Information Systems

Each PSAP has some application or function within another system to gather statistics and data on incoming 9-1-1 calls. Some of these management information systems (MIS) are part of the CPE, while others exist within a CAD system or RMS. There is not, however, a centralized MIS repository for all PSAPs, resulting in manual or semi-manual processes to provide data for various purposes, including the annual “true-up” process.

Implementation of a statewide MIS application would generate significant benefits to the Commonwealth and PSAPs themselves, including:

- Improved situational awareness and early identification of serious incidents
- Automated, accurate process to provide data for annual true-up efforts
- Ability to identify trends in call volume and activities, to aid in planning, in particular for the transition to NG9-1-1
- Ability to monitor performance to identify and recommend improvements

There are a few vendors in the marketplace (e.g., ECaTS, FirstWatch, Synergem) that offer MIS that would be beneficial for this data gathering process. These products will provide business intelligence and analytics and real-time displays of information to enable better decision-making.

The Commonwealth is urged to evaluate the available product offering and determine which option best meets their MIS requirements and engage other states that are using a statewide MIS to gather information and best practices for implementation.

3.2.5. Mapping

Mapping software is used by PSAP systems to visually represent a region’s underlying GIS⁹ data. Mapping is a critical functional element associated with both call handling and CAD system solutions. PSAP personnel rely on map data for functions such as locating wireless callers, tracking locations of incidents and responding units, and for situational awareness when multiple incidents are in progress.

⁹ GIS and its role in NG9-1-1 are discussed at length in Section 4.



The PSAP survey results showed 18 vendors have deployed mapping solutions within the Commonwealth.

Table 6 – Mapping Solutions

Manufacturer	# of PSAPs
911 Mapping Systems Inc.	2
Digital Graphics	1
EnRoute Emergency Systems	3
GeoComm	39
Geographic Technologies Group	1
InterAct Public Safety Systems	3
Intergraph	4
Microdata/TCS	4
Motorola	3
MSAG Data Consultants, Inc.	13
New World Systems	4
Northrop Grumman	1
Orion/PlantCML/Airbus	3
Shield Technology Corp.	3
Southern Software	10
SunGard OSSI	20
Tiburon	1
Other	4

Appendix B, Map 4, is a graphical representation of the mapping solutions by county.

The variety of mapping systems is not a significant barrier to operations or interoperability. As long as the underlying GIS data adheres to national standards and best practices, plotting the locations on a map is relatively straightforward. The greatest challenge to interoperability occurs when personnel from one PSAP are asked to staff positions at another PSAP as personnel may be unfamiliar with the other system's display characteristics. There are many options for PSAPs to choose when configuring their map display such as specialized icons, colors and boundary designators. The method for displaying specific layers of data (i.e., rail, utilities, postal boundaries, etc.) can also vary. National standards and best practices do not heavily address standardization of map display and configuration. PSAPs that frequently work together (or provide backup capabilities to each other) should be encouraged to standardize mapping software and display options as much as possible so as to limit risk and unnecessary training issues.



In addition, if the Virginia Geographic Information Network (VGIN) Coordinator is formally added as a technical advisor to the E-911 Services Board as proposed¹⁰, their role will help the Board identify and adopt GIS standards for NG9-1-1 and could help coordinate GIS and mapping efforts. Given the critical dependency of NG9-1-1 and GIS, the PSC Coordinator should be tasked with providing regular updates to the VGIN Board to increase the interaction of the E-911 Services and VGIN Boards.

3.2.6. System Management

NG9-1-1 uses software applications and data content to manage and control IP-based processes, enabling exponential increases in available data and information. An NG9-1-1 system involves a multitude of IT processes and operational procedures for controlling and monitoring system functionality. Examples include database updating and maintenance, troubleshooting, network operations, security processes, database and system auditing, data quality and integrity procedures, and many others.

Ownership and overall management of PSAP systems is predominately a local activity with the majority of support coming from local government IT divisions. Figure 2, based on data gathered from the PSAP surveys, depicts how PSAPs in the Commonwealth approach IT support and system maintenance.

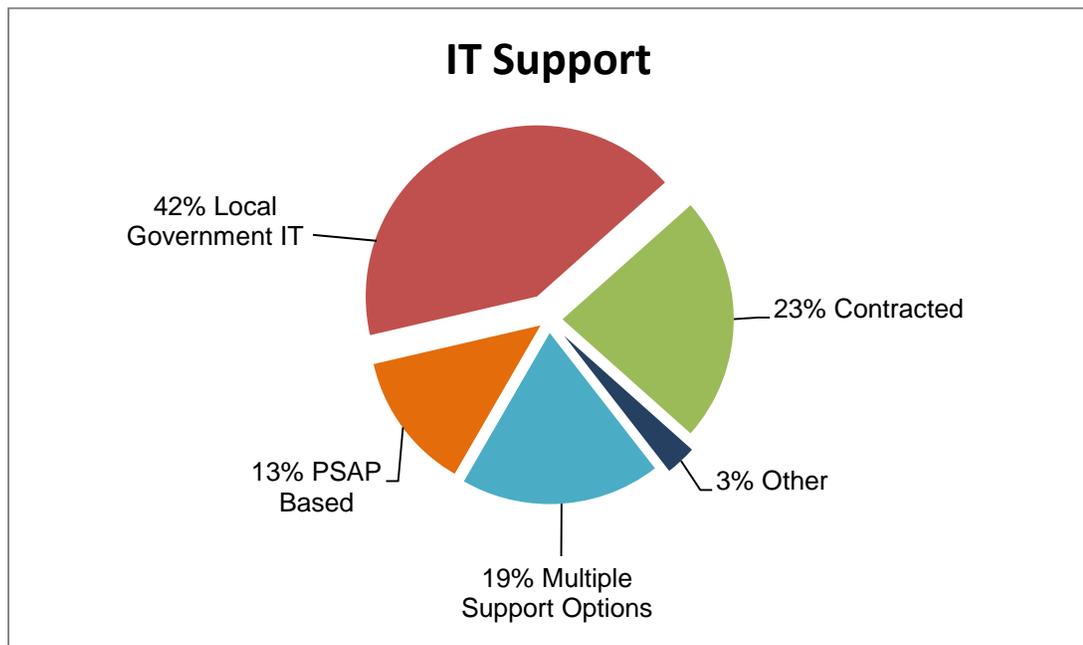


Figure 2 – IT Support for PSAPs

¹⁰ Please refer to Section 5.6.11, E-911 Services Board Support (Non-voting), for further information.



Additional work is required to identify how each mission critical technology is being managed and whether adequate staff and appropriate system management expertise is available. With implementation of an ESInet backbone and interconnection of regional ESInets, it will be necessary to develop an IT staffing strategy to support the deployment and management of the network infrastructure. Depending on the technical solution selected, it will be necessary to determine if ESInet management will be handled internally (e.g., by state government employees) or if outside support will be provided through a third-party. The required skill sets and expertise of individuals may vary depending on their defined roles and responsibilities. Roles may include software developers, network engineers, information security officers, system administrators, and help desk staff.

Examples of certifications that are applicable for individuals involved in the operation of an ESInet are provided below. Specific certifications would depend on the solutions and manufacturers selected.

- ACME Certified Engineer or equivalent for deployed session border controllers (SBCs)
- Linux Professional Institute Certification 3 (LPIC-3)
- Cisco Certified Network Professional (CCNP)
- Cisco Certified Internetwork Expert (CCIE)
- Juniper Networks Certified Professional Enterprise Routing and Switching (JNCIP-ENT)
- Hewlett-Packard (HP) Advanced System Administrator HP-UX
- F5 Certified Technology Specialist
- Certified Information Systems Security Professional (CISSP)
- Institute of Electrical and Electronics Engineers (IEEE) Computer Society Certified Software Development Professional (CSDP)
- Information Technology Infrastructure Library (ITIL)

A staffing review/study is needed to develop and plan how ESInet support will be provided and to outline the roles and responsibilities of requisite staff. It is strongly discouraged that this role simply be assigned as an additional responsibility to current staff. It would be advantageous to assign staff that can engage state-level executives as well as Chief Information Officers (CIOs) at multiple levels of government to assist in facilitating the necessary multi-jurisdictional coordination and cooperation.

3.2.7. Risk Management and System Reporting

Major 9-1-1 service outages on both coasts of the U.S. have elevated the need for stronger risk management efforts by all parties involved in the 9-1-1 process. Just before midnight on Wednesday, April 9, 2014, Pacific Daylight Time (PDT) a 9-1-1 call-routing facility in Englewood, Colorado, stopped directing emergency calls to 81 PSAPs in seven states (California, Florida, Minnesota, North Carolina, Pennsylvania, South Carolina, and Washington). "The outage was caused by a software coding error in



the Colorado facility, and resulted in the loss of 911 service for more than 11 million people for up to six hours. Over 6,600 calls to 9-1-1 never reached a PSAP...”¹¹

Prior to this event, on December 12, 2013, the FCC adopted a [911 Reliability Report and Order](#) requiring covered 9-1-1 service providers to take reasonable measures to provide reliable service with respect to 9-1-1 circuit diversity, central office backup power, and diverse network monitoring, as evidenced by an annual certification of compliance with specified best practices or reasonable alternative measures.¹² The Commission also adopted changes to its outage notification requirements, specifically the requirement to notify 9-1-1 authorities of outages that might impact 9-1-1.

Clearly, no one wants to have to face failures in the 9-1-1 system. This type of occurrence is not an isolated incident or an act of nature. “So-called ‘sunny day’ outages are on the rise. That’s because, as 911 has evolved into a system that is more technologically advanced, the interaction of new and old systems is introducing fragility into the communications system that is more important in times of dire need.”¹³

The causes of the April 2014 outage “highlight vulnerabilities of networks as they transition from the long-familiar methods of reaching 911 to IP-supported technologies. In particular, the technical and operational failures that caused and prolonged the outage suggest the need for a close examination of the transition to IP-supported 9-1-1 services,”¹⁴ and this has significant implications for the roll-out of NG9-1-1.

*NG911 networks, which rely on IP-supported architecture rather than traditional circuit-switched architecture, introduce promising new capabilities, such as more flexible call routing and the ability to provide PSAPs with a greater range of information (such as video). At the same time, however, they can also introduce new vulnerabilities and challenges.*¹⁵

Sound risk management practices become increasingly important, even essential, as the service and infrastructure become more complex, particularly in an NG9-1-1 environment. NG9-1-1 will promote a more complex service delivery environment, with more types of services able to connect to NG9-1-1 systems, more external data sources available to PSAPs, and increased information sharing options among emergency response agencies. These technological possibilities will potentially complicate how risk management is conducted and liability protection is appropriately provided for new and future services. 9-1-1 service providers, emergency response agencies, and originating service providers that

¹¹ A Report of the Public Safety and Homeland Security Bureau. *April 2014 Multistate 911 Outage: Cause and Impact*. Report and Recommendations. October 2014. page 1.

http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1017/DOC-330012A1.pdf

¹² http://transition.fcc.gov/pshs/911/911%20Cert/Overview_911_Reliability_Order.pdf

¹³ Ibid.

¹⁴ Ibid.

¹⁵ Ibid.



are prepared to transition to NG9-1-1 systems will likely more rapidly do so with the legal certainty that their good faith efforts to improve 9-1-1 and emergency communications services will not expose them to further liability.

The introduction of NG9-1-1 and IP-based technologies will require state and local governments “to move aggressively to ensure that technology enabled optimization does not introduce unacceptable risks that threaten imperiling 9-1-1 reliability and resiliency. Everyone has a role in ensuring that 911 works as it should, when it is most needed.”¹⁶

It is worth noting that a national survey conducted by Stratus Technologies determined that 70 percent of public safety agencies had experienced system downtime within the previous 12 months.¹⁷

All parties involved in 9-1-1 end-to-end call completion, as well as appropriate public safety authorities, need to take steps to improve situational awareness during an outage. Approaches must be identified and implemented for enhanced situational awareness of current and future systems to understand how and when system outages occur. As best practices and standards are developed and as the development of the Commonwealth’s NG9-1-1 Master Plan goes forward, the goal of higher levels of situational awareness and how to manage those opportunities will become important to a successful outcome. The Commonwealth currently does not collect or publish reports related to system downtime or service outages, so additional insight to the extent or frequency of system failures is hard to characterize within the Commonwealth.

3.2.8. Service Levels

Level of service is a qualitative measurement used within the 9-1-1 community to describe the type and quality of service or capability being provided to a customer. Level of service is often tied to performance metrics and in the case of emergency communications involves many different measureable components. In Virginia, current 9-1-1 call handling systems are based on legacy technologies that limit the quality of service that is provided to citizens. The Commonwealth has focused on two key technical limitations of legacy 9-1-1 that impact PSAP service levels, and were the two initial reasons for conducting the feasibility study:

- Length of 9-1-1 call setup time
- Limited ability to transfer 9-1-1 calls statewide

The Technical Feasibility section addresses issues regarding call setup and how migration to NG9-1-1 can improve current statistics. It also addresses Virginia’s current 9-1-1 trunk and CPE capacity as well as a detail of call taking positions obtained via the PSAP survey.

¹⁶ Ibid., page 2.

¹⁷ <http://www.9-1-1magazine.com/Q&A-Stratus-2013-PSAP-Survey>



As discussed previously, the ability to transfer calls and associated call data between disparate PSAPs is limited. As ESInets are implemented and NG9-1-1 systems deployed, this limitation can be gradually overcome. An essential first step in improving service levels is acknowledging the need for standardized operational practices and training. Without consistent standards across regions, unequal and non-uniform levels of service will continue to exist.

3.3. OPERATIONAL CAPABILITIES

3.3.1. PSAPs

NENA classifies PSAPs as either primary or secondary. NENA defines a primary PSAP¹⁸ as “[a] PSAP to which 9-1-1 calls are routed directly from the 9-1-1 Control Office,”¹⁹ and a secondary PSAP as “[a] PSAP to which 9-1-1 calls are transferred from a Primary PSAP.”²⁰ In Virginia, only primary wireless PSAPs are eligible to receive wireless 9-1-1 funding.

The roles of secondary PSAPs were discussed with VITA staff, Regional Coordinators, and during multiple Town Hall meetings. Each Town Hall meeting included several discussion topics, including how a respective PSAP worked with secondary PSAPs. Stakeholder responses indicated that there are varying viewpoints regarding the role of secondary PSAPs within the Commonwealth. Attendees agreed that call transfers between primary and secondary PSAPs are time-consuming and resource-intensive.

Working in coordination with VITA staff, a PSAP survey was developed and distributed to 121 primary PSAPs within the Commonwealth. While the [FCC Master PSAP Registry](#) lists 177 PSAPs associated with the Commonwealth (some listings are noted as orphaned, added, or modified, and some as secondary), the list does not appear to include all potential secondary PSAPs in the Commonwealth. Secondary PSAPs may include the following:

- Local jurisdiction (town or city) PSAPs that are primary for some types of 9-1-1 calls (e.g., wireline calls), but classified as secondary for other types of calls (e.g., wireless)
- Colleges and universities that receive internal 9-1-1 calls and dispatch for campus police
- Law enforcement, fire and EMS dispatch agencies that receive direct-dial 10-digit emergency calls in addition to transferred 9-1-1 calls (Virginia State Police [VSP] falls into this category as they answer #77 calls)
- Federal agencies and Department of Defense installations that receive internal 9-1-1 and/or 10-digit emergency calls and dispatch emergency resources

Further work is necessary to develop an accurate and comprehensive list of all secondary PSAPs to determine the extent to which they are able to participate in ESInet implementations. It will also be

¹⁸ NENA defines a PSAP as “[a]n entity responsible for receiving 9-1-1 calls and processing those calls according to a specific operational policy.” <http://www.nena.org/glossary>, page 120 of 172.

¹⁹ Ibid., page 118 of 172.

²⁰ Ibid., page 126 of 172.



necessary to identify which of secondary PSAPs are dependent on selective routers as a move to an ESInet could “orphan” these entities or require the selective routers to remain operational. Consideration must also be given to secondary communications centers or private institutions that are not associated with, or supported by, municipal funds. The most common example is a commercial ambulance agency that provides dispatch for EMS units across one or multiple jurisdictional boundaries. As NG9-1-1 systems are deployed, policies must be established to determine the best methods by which to integrate these dispatch agencies into an ESInet.

A comprehensive view of the PSAPs will also improve understanding of the complex array of mutual aid agreements that are in place or that need to be established to assure effective and efficient interoperability. The Commonwealth should take a leading role in establishing an environment that fosters mutual aid and support. NENA is expected to finalize the *NENA Mutual Aid Standard/Model Recommendation* (NENA-STA-009.2-2015) currently in draft by early 2015.²¹ The document will provide operational guidance and recommendations for the development of mutual aid agreements or memoranda of understanding (MOUs) between public safety communications agencies. When released, this standard can be used in conjunction with other established agreements to enact standard processes for local and regional agencies to follow in the creation of mutual aid agreements. While the Commonwealth should create a framework, it will still be necessary for participating agencies to have latitude in finalization of the agreements based on local policies and legislation.

3.3.2. PSAP Backups

PSAP backup capabilities within the Commonwealth are localized and are likely to be insufficient should a disaster or significant event affect multiple agencies within a region. A number of PSAPs have backup agreements with neighboring jurisdictions in the event of evacuation or system failure, but the ability of the neighboring PSAPs to dispatch calls for another PSAP is inconsistent. In many cases the originating PSAP must take manual action to assure that calls are alternately routed to a viable destination. Some of the larger PSAPs have backup sites available within their jurisdiction. Geodiversity is a concern, however, in that a natural disaster or sizeable system failure may affect both the primary and backup locations.

While deployment of ESInets and NG9-1-1 will improve scalability and call handling backup capacity for PSAPs in the Commonwealth, it is important to note that alternate routing of emergency calls is only a part of the solution. The PSAP receiving the call must have the ability to relay the incident to appropriate emergency responders in a timely manner. The issue of dispatch capability must be forefront when regions are planning their backup strategy and drafting mutual aid agreements.

Implementation of ESInets and NG9-1-1 will offer the Commonwealth additional flexibility with regard to backup plans. In the current E9-1-1 environment, it is unrealistic for large, busy PSAPs with high call

²¹ The comment period for this draft ended on December 12, 2014; as such the document is no longer available for public review. This standard will replace document 53-002 of the same name.



volumes to “offload” calls to smaller PSAPs with limited staff. NG9-1-1 will allow calls in these cases to be dynamically distributed across multiple jurisdictions according to technical capabilities and available resources.

3.3.3. Continuity Planning

The Department of Homeland Security (DHS) has designated the nation’s 9-1-1 systems as critical infrastructure. Critical infrastructure is defined as:

*...systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters.*²²

Resilience is defined as:

*...the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions...[it] includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents.*²³

External and internal emergency incidents that are capable of affecting the operational capacity of the 9-1-1 system can occur at any time with little or no warning. Virginia is susceptible to a wide-range of natural, technological, and human-induced (both intentional and unintentional) hazards. The Commonwealth must assure there is appropriate resilience and operational capacity of its regions and 9-1-1 systems regardless of emergency or disaster circumstances. PSAPs are an integral component of Virginia’s public safety infrastructure that also includes telecommunication service providers, network operating centers, voice and data networks, aerial and underground cables, and microwave transmission equipment.

Code of Virginia §[44-146.18](#) places the Virginia Department of Emergency Management (VDEM) “in charge of providing guidance and assistance to state agencies and local governments in developing and maintaining COOP programs, plans and systems. Executive Order 41 (2011) requires that each executive branch agency including institutions of higher education with guidance from their Emergency Coordination Officer:

1. Create or update Continuity of Operation Plans to conform to the template produced by the Virginia Department of Emergency Management, and
2. Utilize the resources available from the Virginia Department of Emergency Management for creating or updating Continuity of Operations Plans.”²⁴

²² USA Patriot Act of 2001 P,L 107-56. <http://www.gpo.gov/fdsys/pkg/PLAW-107publ56/pdf/PLAW-107publ56.pdf>

²³ Presidential Policy Directive (PPD)-21 – Critical Infrastructure Security and Resilience. February 12, 2013, <http://www.whitehouse.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil>



VITA participated in the VDEM's 2014 State Continuity Planning Work Group and assisted in revising the Commonwealth's Continuity Plan Template. It is acknowledged that implementation of a statewide ESInet and NG9-1-1 has the potential to improve resiliency of the Commonwealth PSAPs. The immediate need, however, is to assure that each PSAP has a formal COOP in place and the Regional Coordinators would be beneficial in this coordination effort. The plans should encompass all phases of mission continuity management including prevention, preparedness, response, and recovery. They must outline the steps necessary for the PSAP and 9-1-1 system to maintain operational capacity during a localized or region-wide disruption of normal operations. Additional work should be undertaken to identify primary PSAPs that do not have viable and documented continuity plans on record and provide assistance as necessary or through VDEM to assure that plans are drafted.

3.3.4. *Interim Text-to-9-1-1*

Currently the ability to send text messages to 9-1-1 is an industry focus, and part of the PSAP survey was to assess the current state of text-to-9-1-1 deployment within the Commonwealth. Figure 3 below summarizes the survey results.

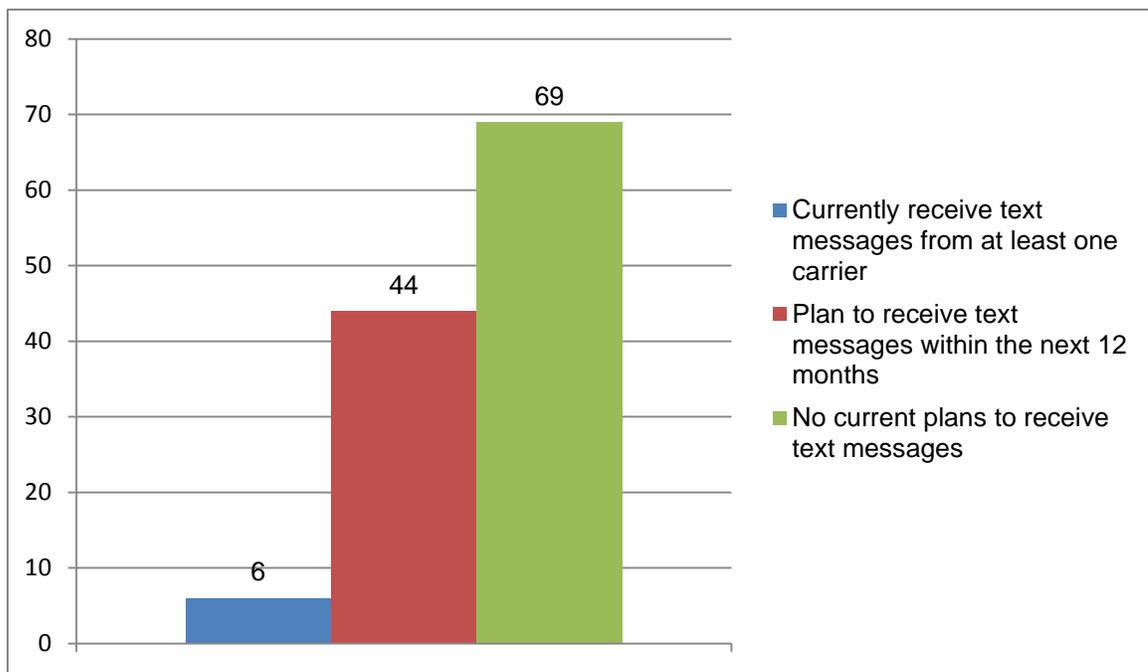


Figure 3 – Text-to-9-1-1 Deployment Status

²⁴ <http://www.vaemergency.gov/em-community/plans/coop>



The ability to send texts to 9-1-1 has become an expectation of the general public, including hearing- and speech-impaired citizens who desire parity of access to 9-1-1 services. More than half of the primary PSAPs in the Commonwealth do not plan to incorporate interim text-to-9-1-1 into their operations in the foreseeable future. However, as a large number of PSAPs begin to receive text messages, public expectation may drive the need for additional PSAPs to incorporate this technology into their service offering over the next 12–18 months. NENA has drafted a [planning guide and other text-to-9-1-1 resources](#) that may be beneficial.

3.3.5. Training and Performance

PSAP interoperability is essential to providing a high level of service to the citizens and public safety agencies in the Commonwealth. Technical aspects of interoperability such as deployment of ESInets, standardized software, and shared services are key components for PSAP information sharing. Training and performance metrics are often overshadowed by technology requirements, but are just as critical to success. As PSAPs look to share calls more frequently, it is especially important that basic telecommunicator training programs, such as those provided by the Virginia Department of Criminal Justice Services (DCJS)²⁵, align with national standards and best practices. Standardized training helps to assure that uniform levels of service are provided to callers. Consistency in training also improves the ability of personnel from disparate PSAPs to interact with each other as everyone possesses the same baseline expectation of how to manage an incident.

A list of [APCO American National Standards Institute \(ANSI\) standards](#) that address PSAP training is provided below.

- Minimum Training Standards for Public Safety Telecommunicators
- Core Competencies and Minimum Training Standards for Public Safety Communications Training Officer (CTO)
- Core Competencies and Minimum Training Standards for Public Safety Communications Instructor
- Core Competencies and Minimum Training Standards for Public Safety Communications Quality Assurance Evaluators (QAE)
- Core Competencies and Minimum Training Standards for Public Safety Communications Supervisor
- Core Competencies and Minimum Training Standards for Public Safety Communications Manager/Director
- Core Competencies and Minimum Training Standards for Public Safety Communications Training Coordinator
- Public Safety Answering Point (PSAP) Service Capability Criteria Rating Scale

²⁵ DCJS provides compulsory minimum training criteria for dispatchers within the Commonwealth. <http://www.dcjs.virginia.gov/standardsTraining/compulsoryMinimumTraining/cjsmanual-LAWCH5PerformanceDP.pdf>



VITA, in coordination and cooperation with DCJS, should work towards implementing basic training mandates²⁶ for all primary PSAP telecommunicators that align with national standards and best practices. Training gaps are so vast within the Commonwealth that they need to be looked at foundationally. Input should be gathered by organizing a working group comprised of stakeholders from PSAP management and operations; if a Regional Advisory Council²⁷ were established, for example, this task could fall to that group to provide input on current training programs and how best to move forward. The Commonwealth should evaluate the following options in order to ensure accessibility to training curricula once developed:

- Web-based training classes that can be attended from the PSAP workstation
- On-demand training programs where PSAP personnel log into a website and complete the training at their own pace

The [APCO Project 33 Agency Training Program Certification](#) is a “formal mechanism for public safety agencies to certify their training programs as meeting APCO American National Standards (ANS).”²⁸ Once an established curriculum is agreed upon by the Commonwealth, consideration should be given to a certification process for PSAP training.

In addition to establishing minimum training standards, the Commonwealth should implement basic performance metrics to measure the operational efficiency of a PSAP against targeted goals and established standards. Performance metrics provide agencies with the ability to evaluate the operational level of service they are providing to the public. The most common metric involves the average time it takes a PSAP to answer its incoming emergency calls. PSAPs typically try to align their call answering goals to either NENA or National Fire Protection Association (NFPA) standards.

NENA [56-005](#), *NENA Call Answering Standard/Model Recommendation*, recommends that “[n]inety percent (90%) of all 9-1-1 calls arriving at the Public Safety Answering Point (PSAP) shall be answered within ten (10) seconds during the busy hour (the hour each day with the greatest call volume, as defined in the NENA Master Glossary 00-001). Ninety-five (95%) of all 9-1-1 calls should be answered within twenty (20) seconds.”²⁹

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, focuses on emergency communications systems and PSAP operational best practices. The latest edition (2013) of NFPA 1221, section 7.4.1, states that “Ninety-five percent of

²⁶ Please refer to Section 5.3.2, National Guidelines for State NG9-1-1 Legislative Language, for further information.

²⁷ Please refer to Section 5.6.4, Regional Advisory Council, for information on this recommendation.

²⁸ <https://www.apcointl.org/training-and-certification/project-33-training-program-certification.html>

²⁹ NENA Call Answering Standard/Model Recommendation, Document 56-005 Section 3.1 June 10, 2006. <https://www.nena.org/?page=911CallAnswerStnd>



alarms received on emergency lines shall be answered within 15 seconds, and 99 percent of alarms shall be answered within 40 seconds.”³⁰

The Commonwealth should consider adopting a national standard as their performance benchmark for all primary PSAPs.

3.3.6. Security

The PSAP survey asked respondents what type of security measures were in place today within their PSAP. A majority of PSAPs have both physical and IT security measures. Figure 4 depicts the current security measures in place at PSAPs that responded to the survey.

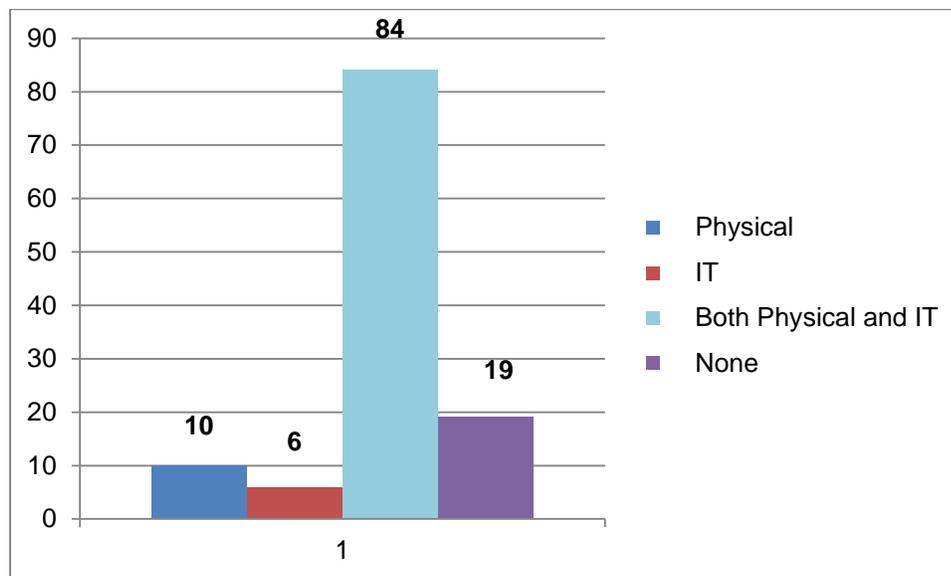


Figure 4 – PSAP Security Measures

It is a troubling statistic that PSAP survey results indicate that 16 percent of the primary PSAPs have neither a physical nor IT security policy in place. With the movement to an NG9-1-1 system, this aspect becomes critical. Connecting PSAPs to an IP-based solution provides greater potential for information sharing, but also increases the risk of targeted attacks to PSAP operations. As the Commonwealth prepares for its migration to NG9-1-1, the Commonwealth must assure that each PSAPs implements

³⁰ NFPA 1221 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems (Edition 2013), Section 7.4.1. <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=1221>



and adheres to best practices for physical and IT security³¹ as a breach or lapse in security will have serious ramifications for all users.

3.3.7. Education and Outreach

3.3.7.1. Public Education

As changes to 9-1-1 capabilities are implemented, VITA's Division of Public Safety Communications (PSC) may be best positioned to coordinate, encourage and support 9-1-1 public education efforts. The E-911 Services Board should take an active role in establishing a public information and outreach effort related to 9-1-1 service that will be experienced with the migration to NG9-1-1. It is just as important to explain to the public what the new NG9-1-1 technology will do or provide, as it is to discuss the limitations of the new services and what it will not do. Managing the expectations of the public will be critically important to the success of the public's understanding and use of the system.

Consideration should be given to developing, conducting, and promoting public education regarding the appropriate use of 9-1-1. In the NG9-1-1 environment, such a program might include:

- Information related to text-to-911
- Public service announcements (PSAs) on texting with 9-1-1 PSAPs
- Pre-prepared slide presentations or programs highlighting what NG9-1-1 is and the advantages and challenges of the new technology that local jurisdictions or regions might use as part of their public information campaign or outreach at a local level
- Using the Regional Advisory Council and local jurisdictions to push a consistent message to the public on the proper use of 9-1-1

In addition to public outreach, the development of materials would help to educate State legislators, state and local agencies, and regulatory bodies, as well as municipal government bodies, to ensure that they understand how current regulations and laws facilitate or inhibit NG9-1-1.

An expanded outreach effort should be considered to enhance discussions with the 9-1-1 stakeholder community on how NG9-1-1 will impact their operations, or how the proposed Regional Advisory Council is envisioned to be a forum for deliberation on issues and development of consensus-based standards and rules. As NG9-1-1 will increase the local jurisdictions' interactions and relationships with other partners such as neighboring communities or even neighboring states along Virginia borders, discussion on the benefits and challenges of NG9-1-1 that will affect their operations should be held.

³¹ Section 4.6.1. Security, of this study describes security requirements in more detail and the Commonwealth will need to take steps to ensure that all organizations that connect to the ESnet have sufficient security policies in place.



3.3.7.2. Stakeholder Community

Stakeholder community outreach should include the E-911 Services Board members' associations and organizations and the Virginia-based first responder agencies that support law enforcement, fire, and EMS. Similarly, the outreach effort should extend beyond the local PSAPs and include city or county officials such as city managers or county administrators and elected officials such as city council or county commissioners, local GIS directors, local emergency management agency (EMA) directors, and local technology directors. PSAP representatives should be engaged in assisting with the local outreach efforts as their local perspective and network contacts will be invaluable in developing a tailored message and successful stakeholder program. Frequent communications, tailored to the audience, will be beneficial in ensuring a successful project.

3.3.7.3. Legislators

As legislative changes are being considered, it will be important to identify a legislative sponsor as early as possible in the process. This sponsor will be the focal point of legislative outreach efforts, although support from across the stakeholder community at local and state levels will also be important. Periodic briefings, such as one-page fact sheets and brief power point presentations that can easily be digested by legislative staff will help them update their legislator. The goal is to quickly educate and inform the legislators without being overburdening them with details of extraneous information.

These legislative briefings will begin to build a foundational understanding among many legislators so that when bills are introduced, heard in committee, or discussed in the General Assembly, the Board has a cadre of informed legislators who understand why the action is being required in legislation.

3.3.7.4. Special Interest Communities

Representatives of the deaf and hard of hearing community and the Virginia Relay Service will be able to provide direction on how this community can be engaged in special outreach efforts. Each will have a unique perspective, a clear understanding of the needs, and past experience working with the community. They will also have a network already in place to assist with the message delivery to ensure its success.

Other special interest groups such as domestic violence groups, teen groups, and other public associations could be engaged to assist in public education and outreach efforts. Teen groups may be especially helpful with messages regarding texting and 9-1-1 protocols for handling non-verbal calls.

There are numerous organizations and associations, but a few that might initially be considered as affected by NG9-1-1 services and, therefore, be part of the early outreach program include the following:

- Virginia Department of Social Services information and referral services ([Virginia 2-1-1](#))
- [Partnership for People with Disabilities \(PPD\)](#)



- [Parent Education Advocacy Training Center \(PEATC\)](#),
- [Virginia Association of Area Agencies on Aging \(VAAAA\)](#)
- [Virginia Department of Education \(VDOE\)](#)
- [Virginia Board for People with Disabilities](#).

Virginia's disability information services and advocacy programs are diverse and multilayered, and may operate independently or as a part of a larger agency or organization. More in-depth research into this special interest community might be necessary as a program is more fully developed.

3.3.7.5. State of Virginia Outreach

The Virginia Attorney General has recently launched two statewide efforts that can be looked to as examples of outreach programs to model. One, the "[Virginia Rules](#)" program, Virginia's state specific law-related education program to help middle and high school students make good decisions, avoid breaking laws, and become responsible, active citizens within their schools and communities. The program's 22 modules cover topics ranging from alcohol and tobacco to drug prevention, bullying, relationship violence, gangs, and traffic laws. This type of outreach can be leveraged and used as an example of how a similar program related to NG9-1-1 might be beneficial.

In addition, in March 2014, the Attorney General also launched a 2-week public safety tour of Virginia during which he held 22 regional meetings to hear from local public safety and law enforcement leaders and local elected officials about challenges in their area and ways that he can help protect the communities.³² A similar outreach effort might be designed specifically for NG9-1-1.

The Commonwealth is encouraged to consider discussions with the public information officer or the Attorney General's office to learn more about how the outreach was conceived, what the challenges were to its roll out, and to gain insight into how such a program might be replicated.

3.3.7.6. Other Potential Partners or Considerations

[DCJS](#) provides a link to the Commonwealth's preparedness strategy chain focusing on the law enforcement community. Key office responsibilities include developing a conduit for law enforcement leaders to express needs and concerns as they relate to homeland security and emergency management, National Incident Management System (NIMS) implementation, preparedness planning, and liaison to federal and state agencies working to ensure our nation and the Commonwealth are prepared and secure. Because of their close link with the activities related to 9-1-1 both locally and statewide, they should be considered as a potential partner in an outreach effort.

³² <http://oag.state.va.us/index.php/media-center/news-releases/112-attorney-general-herring-launches-statewide-public-safety-tour-march-17-2014>



The [Law Enforcement Command Advisory Group \(LCAG\)](#) was formed to meet a need identified by police chiefs and sheriffs in the Commonwealth for a law enforcement leadership group to convene regularly, focusing on four primary objectives:

- Promote and sustain intra- and inter-regional communication and collaboration
- Develop a coordinated security and preparedness strategy
- Provide a forum for law enforcement needs and concerns to be heard across a broad spectrum
- Define regional and statewide objectives that require federal or state funds

The LCAG is not intended to replace or duplicate any current organization, but rather to enhance the capability of the law enforcement community to speak the same message with its many voices. Because the group focuses on inter-regional communications and collaboration, and the development of a coordinated security and preparedness strategy, they are prime candidates for a 9-1-1 outreach partnership effort.

VITA has its own cybersecurity unit that provides guidance and information related to cybersecurity best practices. VITA partners with the [Multi-State Information Sharing and Analysis Center](#) to provide a number of informational briefings including a monthly newsletter focusing on raising information security awareness. The newsletter provides security awareness information for people to use at work and at home to protect information. Leveraging VITA's knowledge of cybersecurity is recommended to further protect 9-1-1 critical infrastructure.

3.3.7.7. Website

Public information about 9-1-1 efforts within the Commonwealth are not easily found within VITA's website and web search results are particularly inconsistent, depending on search criteria. For example, "Virginia 911" and "Virginia 9-1-1" generate completely different results. The general public would be better served if a more readily accessible website were available to access information. Keeping with other n-1-1 organizations in Virginia (e.g., [211virginia.org](#) and [511virginia.org](#)), [911virginia.org](#) is an available domain that could be registered for the Commonwealth's 9-1-1 program.

This website might contain general information on 9-1-1, plus information for Virginia's 9-1-1 professionals, such as updates on the progress toward NG9-1-1.

3.4. FINDINGS AND RECOMMENDATIONS

As presented throughout this section, there are multiple opportunities for improving operations in an NG9-1-1 environment. Table 7 summarizes the operational feasibility findings and recommendations.



Table 7 – Operational Feasibility Findings and Recommendations

Operational Findings and Recommendations	
Findings	Recommendations
1. System management of an ESInet will require some level of dedicated staff at the statewide 9-1-1 authority level, or within VITA.	A staffing review/study should be performed to develop and plan how the Commonwealth will model ESInet support and outline roles and responsibilities of requisite staff.
2. Sound risk management practices are essential as services become more complex.	It is recommended that 9-1-1 service providers demonstrate adherence to the reliability measures outlined in the FCC's 911 Reliability Report and Order adopted on December 12, 2013.
3. Procurement of mission critical systems on a local basis leads to technology silos that inhibit interoperability.	PSAP systems that could be pre-qualified and purchased via state contracts should be identified and prioritized.
4. There is significant diversity in call handling software (seven vendors/numerous software versions) deployed across the Commonwealth. The disparity prevents effective sharing of calls and location information.	No more than three qualified call handling vendors should be identified that would be supported as part of state purchasing contracts. PSAPs should be encouraged to purchase from/through the state contract.
5. Seventy percent of the deployed call handling solutions in the Commonwealth are not NG9-1-1-capable.	Qualified call handling systems should support the NENA i3 critical interfaces and protocols defined in Table 10 before they are considered for inclusion on a state contract. Vendors must demonstrate the ability to support these interfaces and protocols. Grant guidance should be updated so that non-compliant systems are ineligible for grant funding.
6. Fifty percent of PSAPs plan to replace or upgrade their call handling systems by the end of 2016.	PSAPs should be incentivized to act regionally when procuring NG9-1-1-capable CPE solutions and a regional shared services approach encouraged.
7. The disparity in CAD systems across the Commonwealth (17 vendors/multiple platforms and software versions) is much greater than the disparity in call handling solutions. The wide variance in CAD systems will leave the PSAP operational landscape largely unchanged even if regional ESInets are deployed.	PSAPs should be incentivized to act regionally when procuring CAD systems and a regional shared services approach encouraged. Technical and project management support should also be offered to assist regions that do not have the internal expertise or personnel to bring complex CAD system projects to fruition.
8. Changes to CAD systems will have an impact on multiple agency systems, which can cause resistance and unwillingness to move forward.	The obstacles to standardizing a CAD system in each region should be identified and prioritized. Specific focus should be placed on the impact to agency mobile data and RMS.
9. The current approach of each PSAP	PSAPs should be encouraged to move toward centralized logging



Operational Findings and Recommendations	
Findings	Recommendations
maintaining its own logging recorder is not cost effective or efficient in an NG9-1-1 environment. Multiple PSAPs and agencies may require dynamic access to logged data that will not be possible if there are a multitude of individual logging recorders storing the relevant information.	recorder solutions. Vendors should be pre-qualified for purchase off the state contract. Training or technical support that will be required to configure, maintain and assign access rights to an NG9-1-1-shared logging recorder service should be provided.
10. Agencies are reluctant to store confidential data in a centralized logger.	An education effort to dispel myths and provide information as to how data integrity is maintained via secure access rights and appropriate policy should be developed.
11. The variety of mapping systems is not a significant barrier to operations. The greatest challenge to interoperability is the many options available for configuring map displays, such as specialized icons, colors and boundary designators.	An assessment should be conducted to determine which PSAPs routinely interoperate today and which ones plan to potentially share calls and/or personnel in the future. Those agencies should be encouraged to standardize on map display options as much as possible so as to limit risk and unnecessary training issues.
12. A comprehensive inventory of secondary PSAPs does not currently exist.	An accurate list of Commonwealth secondary PSAPs should be developed.
13. VITA should take a leading role in establishing an environment that fosters mutual aid and support.	Mutual aid agreements and MOUs between PSAPs and regions throughout the Commonwealth should be encouraged.
14. The issue of dispatch capabilities must be forefront when regions are planning their backup strategy and drafting mutual aid agreements.	Mutual aid agreements and backup plans should be reviewed to assure that PSAPs receiving another agency's calls have the capability to notify the appropriate emergency responders in a timely manner.
15. PSAP training that aligns with national standards and best practices is key to effective interoperability and providing uniform levels of service.	The Commonwealth should work towards implementing basic training mandates that align with APCO national training standards for all primary PSAP telecommunicators. Once an established curriculum is agreed upon, consideration should be given to a certification process for PSAP training.
16. Performance metrics provide agencies with the ability to evaluate the operational level of service they are providing to the public.	A 9-1-1 performance metric that aligns with either NENA or NFPA call answering standards should be adopted.
17. NG9-1-1 transition best practices are essential to implementing NG9-1-1 statewide.	Standards and best practices for the transition to NG9-1-1 should be developed and implemented.
18. Intergovernmental and stakeholder information sharing is essential.	Intergovernmental and stakeholder information sharing is needed. This increased communication and information sharing as well as shared input for planning what will work best for the Commonwealth



Operational Findings and Recommendations	
Findings	Recommendations
	is supported by the recommendation for the establishment of a Regional Advisory Council ³³ .
19. Situational awareness of system outages is critical for managing the network.	Approaches for enhanced situational awareness of current and future systems should be identified to understand how and when system outages occur. As best practices and standards are developed and as the development of the Commonwealth's NG9-1-1 Master Plan progresses, the goal of higher levels of situational awareness and how to manage those opportunities will become important to a successful outcome.
20. Each PSAP requires a formal mission continuity plan, which encompasses all phases of mission continuity management including prevention, preparedness, response, and recovery.	Primary PSAPs that do not have viable documented continuity plans on record should be identified and assistance provided as necessary or through VDEM to ensure that plans are drafted.
21. As changes to 9-1-1 capabilities are implemented, PSC may be best positioned to coordinate, encourage and support 9-1-1 public education efforts.	Public education regarding the appropriate use of 9-1-1 should be developed, conducted, and promoted. Materials to educate state legislators, state and local agencies and regulatory bodies, as well as municipal government bodies, should also be developed to ensure that they understand how current regulations and laws facilitate or inhibit NG9-1-1.

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³³ Please refer to Section 5.6.4, Regional Advisory Council, for further information.



4. TECHNICAL FEASIBILITY

As the Commonwealth looks to the future, migration from legacy 9-1-1 technologies is critical. This Technical Feasibility section focuses on the key aspects associated with migrating from legacy 9-1-1 technologies to the technologies required to implement an ESInet to support NG9-1-1.

4.1. BACKGROUND

The migration to NG9-1-1 is a multi-faceted, complex journey that encompasses all stakeholders in the 9-1-1 call path. This includes stakeholders from the legacy network as well as NG9-1-1 solution providers in the NG9-1-1 solution. To fully appreciate the needs for the NG9-1-1 components and services, one must first understand the existing legacy 9-1-1 environment.

A vast majority of legacy 9-1-1 systems can be broken down into three main stakeholder groups: originating communication services providers (CSPs), 9-1-1 service providers, and PSAPs. For simplicity, it is generalized that the CSPs include all providers of dial tone, such as wireline, wireless, VoIP and telematics service providers. The 9-1-1 service providers are those who provide selective routing, 9-1-1 trunks, and ALI services. The term “call” refers to any request for emergency service regardless of the originating device (wireline, VoIP, wireless, text device, or telematics), the content (voice or non-voice), or the method of delivery (legacy or NG9-1-1). Lastly, the PSAPs are the agencies answering the 9-1-1 calls.

4.1.1. *Current 9-1-1 Service Providers*

The Commonwealth of Virginia currently has three primary 9-1-1 service providers, CenturyLink, Intrado, and Verizon, who provide selective routing and/or ALI services to the PSAPs.³⁴ The legacy selective routing services are performed by legacy telephone switches with specialized 9-1-1 software and are hosted in the 9-1-1 service provider’s central offices. Historically, legacy 9-1-1 systems and services are generally provided by the predominant incumbent local exchange carrier (ILEC) serving the PSAP’s jurisdiction. 9-1-1 services are regulated by the Virginia State Corporation Commission (SCC) with services defined in each of the carriers’ respective tariff filings with the SCC.

Typically, a state will find that each 9-1-1 service provider will have a single selective router or a mated pair of selective routers per local access and transport area (LATA). With 12 defined LATAs and two

³⁴ Per Verizon, the former operator of the Frontier rate center in Alleghany County, “The Frontier rate center that has subscribers in Alleghany VA is Crows-Hematite which is a remote off the White Sulphur Springs 5ESS Host. (Under 200 subscribers). The Frontier Crows-Hematite area does not pass thru the Frontier Selective Routers. There was direct trunking from Lewisburg WV to the Covington Wire Center.” It is believed that the Covington wire center, CLLI code CVTNVAXARS1, then sends 9-1-1 calls to the Alleghany County PSAP, or possibly the Covington 9-1-1 Center. Secondly, Heather Miller, E9-1-1 Administrator for Frontier in West Virginia, stated that Frontier does not provide 9-1-1 service in Virginia. Based on this information, MCP removed Frontier from being considered a 9-1-1 service provider in Virginia.



dominant legacy 9-1-1 service providers, Virginia has a total of 18 selective routers serving the Commonwealth, with one of these located outside the state. Except for cases of mated pair selective routers, there is typically no interoperability between selective routers, which results in multiple islands of interoperability across the state. This means that PSAPs that reside near or on top of a LATA boundary will not be able to transfer calls with ANI and ALI to its neighboring PSAP in a neighboring LATA. These boundaries and routing infrastructure were developed in a time that rarely required the ability to transfer calls across jurisdictions, and prior to wireless phone service. The advent of mobile phones and their intrinsic nomadic nature combined with legacy infrastructure results in an operational issue with limited ability to transfer calls on emergency trunks and share ALI data between PSAPs.

Further complicating interoperability and sharing information among PSAPs occurs when databases are owned, operated, and maintained in a single PSAP. For example, Floyd County maintains their own ALI database, also known as a standalone ALI or SALI. SALIs are typically owned, operated, and maintained by a single jurisdiction and provide limited to no access for other PSAPs to query the system for location information. This also results in an operational challenge for sharing location information in call transfer scenarios, regardless of LATA boundaries and serving selective routers. Figure 5 depicts the isolated nature of the legacy 9-1-1 systems and contrasting Figure 6 depicts the borderless environment enabled by an ESInet.

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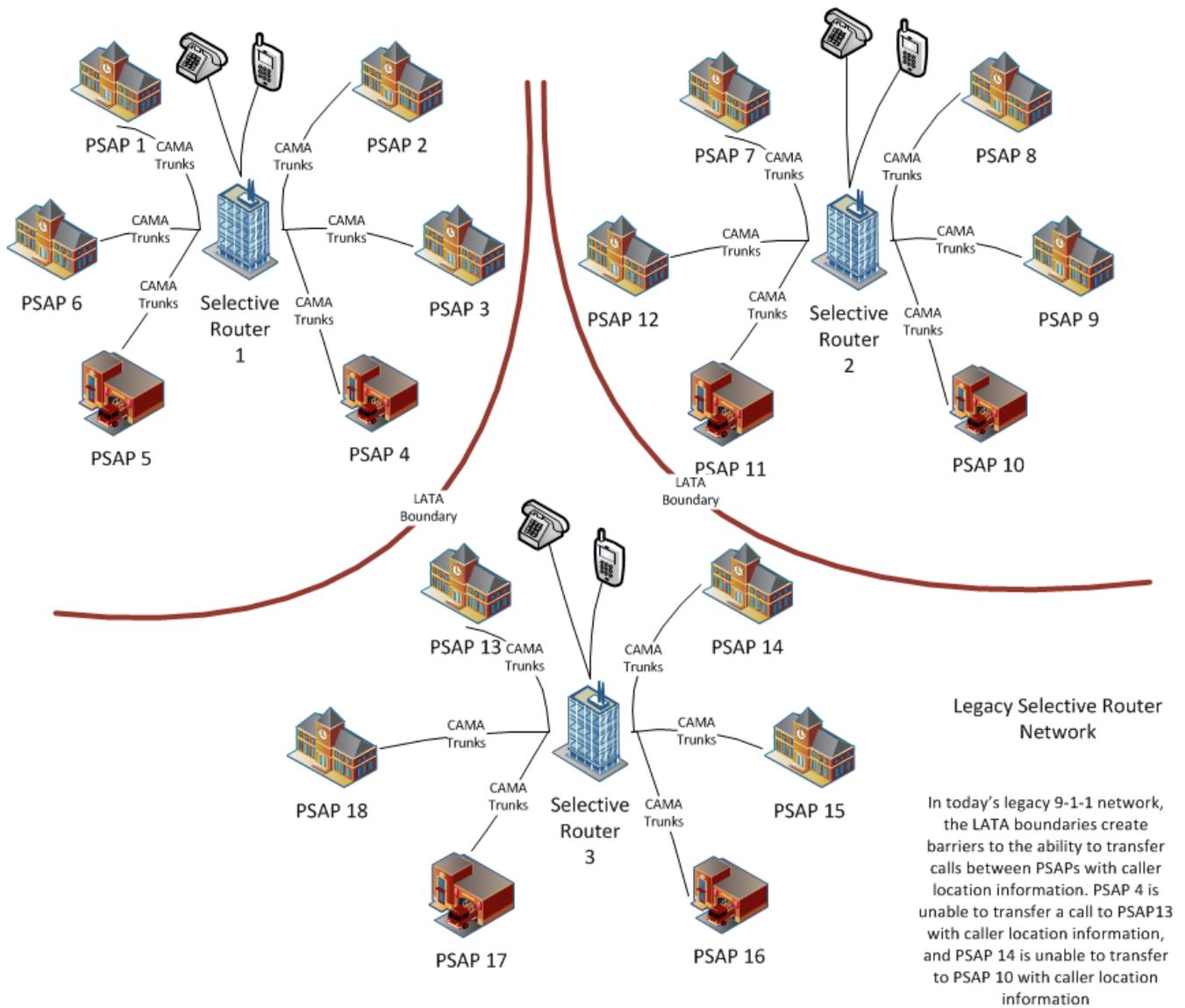


Figure 5 – Legacy Selective Router Network

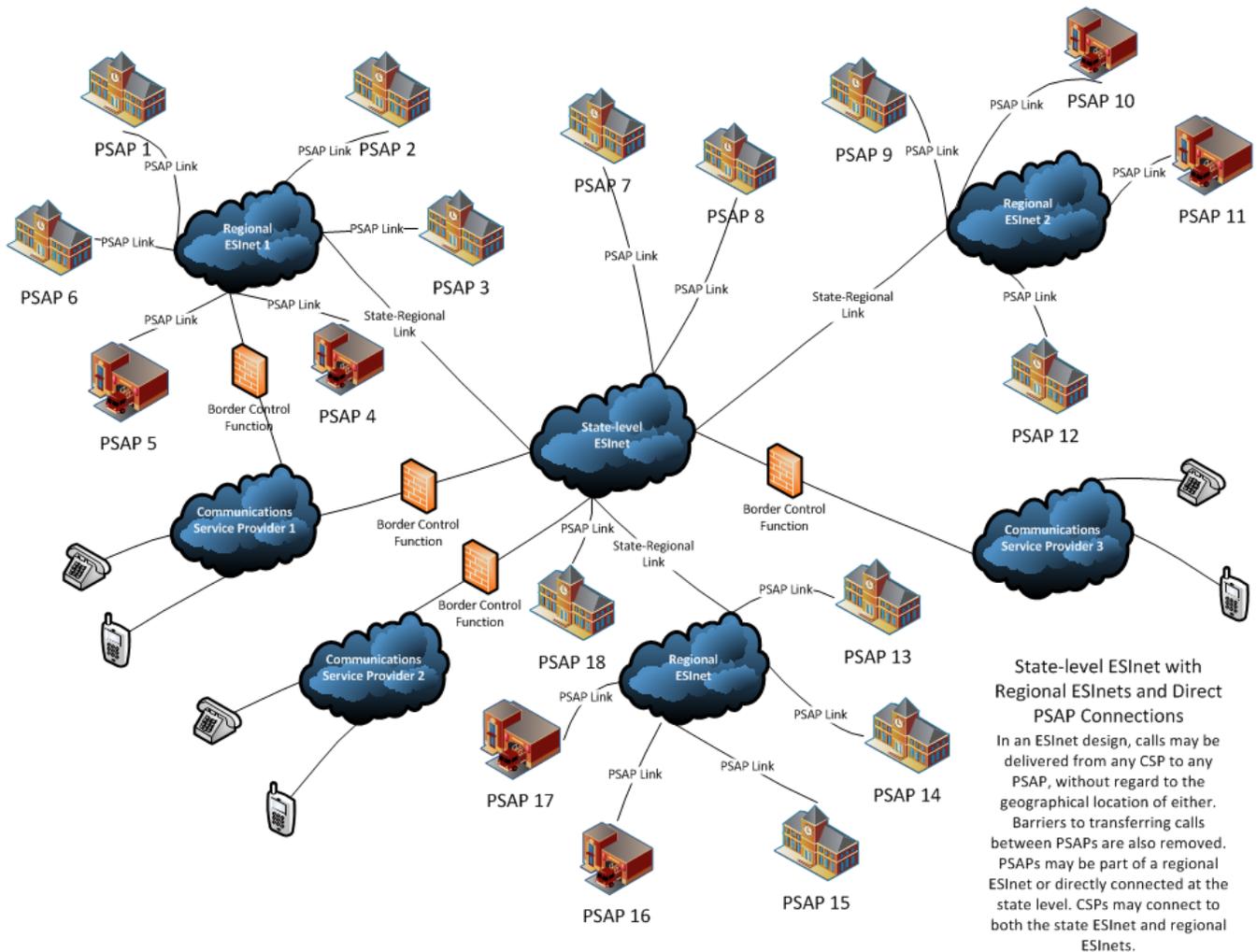


Figure 6 – Borderless ESInet

4.1.2. Originating Networks

The 9-1-1 call starts at the originating network that provides communications services for its subscribers. For wireline CSPs, the call starts at the phone switch located at the serving end office or central office. The wireless calls are served by cell tower antennas that are served by a mobile switching center (MSC), which can serve geographic boundaries from a city, region or multiple states. VoIP calls are served by software- or hardware-based switching infrastructure that can potentially provide global service. Telematics calls typically look like a VoIP call to the 9-1-1 network. The originating CSPs have interconnection agreements (ICAs) in place with each 9-1-1 service provider defining how the originating CSP's 9-1-1 traffic will be delivered to the 9-1-1 service provider's network. These agreements define each party's responsibilities for call delivery and point(s) of demarcation.



Wireline CSPs may aggregate their end office traffic at a central office before delivering its traffic to the selective router(s), whereas in other scenarios, they may have end offices directly trunked to the selective router. In some cases, one may find that some smaller ILECs and telephone cooperatives have special arrangements with the 9-1-1 service provider where the 9-1-1 service provider is picking up the small CSP's traffic at the CSP's local end office. With 14 ILECs and 6 telephone cooperatives³⁵, depicted in Table 8, served by three 9-1-1 service providers in the Commonwealth, it is highly likely that unique trunking arrangements will be unveiled with the migration to NG9-1-1. This discovery process will occur as the NG9-1-1 service provider works with each CSP in laying out the ingress network design. The NG9-1-1 service provider can only perform this process as an agent of the locality with proper ICAs in place with each CSP.

With 14 ILECs and six telephone cooperatives served by three 9-1-1 service providers in the state, it is highly likely that unique trunking arrangements will be unveiled with the migration to NG9-1-1.

Table 8 – ILECs Serving Virginia

Investor-Owned ILECs	Telephone Cooperative ILECs
Amelia Telephone Corporation (TDS Telecom)	Buggs Island Telephone Cooperative
Burke's Garden Telephone Exchange	Citizens Telephone Cooperative
Central Telephone Company of Virginia (CenturyLink)	Highland Telephone Cooperative
Frontier Communications of Virginia	New Hope Telephone Cooperative
Lumos Telephone Inc. (Lumos Networks)	Pembroke Telephone Cooperative
Lumos Telephone of Botetourt County (Lumos Networks)	Scott County Telephone Cooperative
MGW Telephone Company, Inc.	
New Castle Telephone Company (TDS Telecom)	
Peoples Mutual Telephone Company, Inc.	
Shenandoah Telephone Company	
United Telephone Southeast LLC (CenturyLink)	
Verizon South Inc. (Verizon)	
Verizon Virginia LLC (Verizon)	
Virginia Telephone Company (TDS Telecom)	

Wireless CSPs tend to directly connect their MSCs to selective routers. VoIP CSPs use a variety of means to deliver their calls to 9-1-1; either a network access provider (NAP), a VoIP Positioning Center (VPC) provider, or direct connect. Altogether, a typical selective router will have dozens of originating switches and hundreds of trunks delivering 9-1-1 calls to the central office in which it resides.

³⁵ Source: VITA 911 Baseline Configuration Notes, Appendix 2a – Listing of Virginia Incumbent Local Exchange Carriers



These connections are typically made via Signaling System 7 (SS7), which is a time division multiplex (TDM) technology originating in the 1970s.

Trunk groups from the originating CSPs are built with a minimum of one trunk per 10,000 subscribers, with no fewer than two trunks from any location. Each trunk group has a default route PSAP assigned. It is typically the originating CSP's responsibility to assign the default PSAP for each emergency services trunk group. These assignments should be mutually agreed upon with the respective default PSAPs. In most cases, the default route PSAP is assigned based on the PSAP that receives the majority of the selectively routed calls from the 9-1-1 trunk group in question. Default route PSAP assignments can become much more complicated as more traffic is aggregated and the geographic service area broadens. An example of this may be seen in some wireless carrier MSCs that support multiple states. The intricacies of the ingress trunking to the selective router can be very complex when considering the possible aggregation scenarios, ownership of trunks, and default route provisioning. This is then compounded when viewed at the state-level where multiple 9-1-1 service providers operate multiple selective routers.

4.1.3. Customer Premise Equipment

As the 9-1-1 call progresses through the call path and arrives at its termination point, the PSAP's CPE presents the call taker with the caller's information. The primary purpose of CPE, also known as 9-1-1 telephony or 9-1-1 call handling equipment, is to receive the variety of 9-1-1 and administrative calls, both emergency and non-emergency. Among other things, these systems include graphical user interfaces (GUI) for viewing, answering, and transferring calls. CPE has historically been procured on an individual PSAP basis with individual systems serving a single PSAP location. While there are great success stories of localities coming together to share systems in the Commonwealth, such as the Southwest Pilot, the point is exemplified with the fact that 121 primary PSAPs utilize 117 CPE systems. While there are legitimate reasons for the ways in which CPE systems have been historically deployed, this situation further demonstrates the silos of the stakeholder systems in the legacy 9-1-1 call path.

4.2. NG9-1-1 SYSTEM COMPONENTS

MCP recommends that an ESInet adheres to industry standards; most notably for technical standards is NENA [08-003](#), *Detailed Functional and Interface Standards for Next Generation 9-1-1, Version 1.0 (i3)*, and [NENA INF-008.2-2013](#), *NENA NG9-1-1 Transition Plan Considerations Information Document*. Although NENA 08-003 Version 2.0 development is underway, the revised standard is not yet complete. As soon as the revision becomes available, an analysis of the impact and effects on any ESInet development should be made.

MCP's recommendation includes the recommended transitional elements such as legacy network gateways (LNGs), legacy PSAP gateways (LPGs), legacy selective router gateways (LSRGs), and location databases (LDBs). The NENA i3 standard and the transitional elements provide a foundation that will enable next generation capabilities within the realities of today's operational environment. The following sections detail the components required within the statewide IP network and should be



considered mandatory elements for entities procuring NG9-1-1 services and systems. Figure 7 provides a high-level drawing of NG9-1-1 system components.

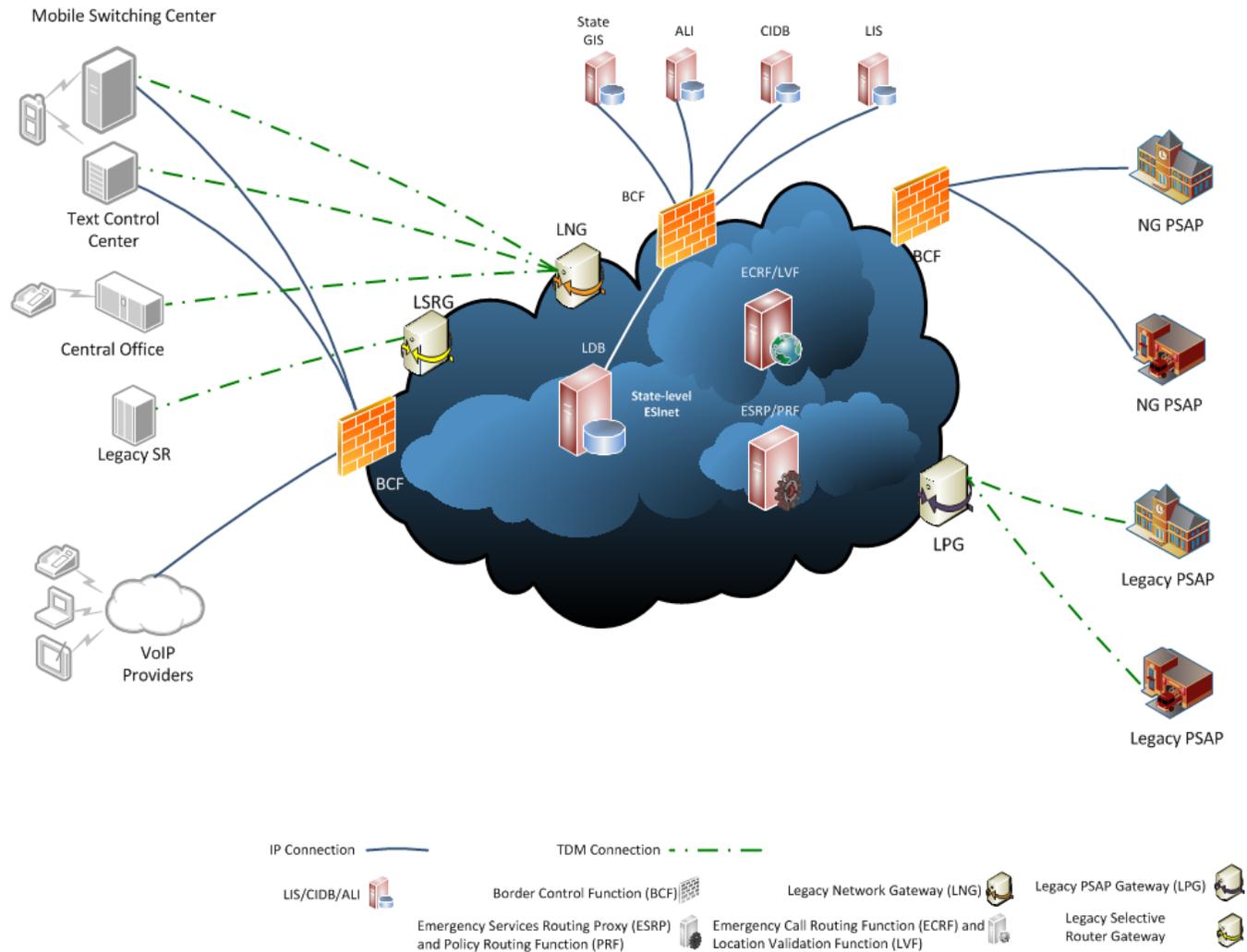


Figure 7 – NG9-1-1 System Components

4.2.1. Legacy Selective Router Gateway

In general, PSAPs tend to be served by the same selective router(s) as their neighboring PSAPs. Exceptions exist for PSAPs which sit on selective router service borders, which typically align with LATA boundaries. As PSAPs migrate to an NG9-1-1 solution, interoperability with the legacy selective router that they just migrated from is required to maintain call transfer and bridging capabilities between the NG9-1-1 PSAP and its neighboring legacy PSAPs. The legacy selective router gateway is a



component within the NG9-1-1 system that will provide for the interworking between the legacy system and the NG9-1-1 ESInet.

The LSRG must be able to interwork calls that originate in a legacy environment that need to be transferred or bridged to an NG9-1-1 environment, requiring the ability to interwork TDM to IP. Conversely, the system must also be able to perform the reverse where a call that originates in the NG9-1-1 environment must be able to be transferred or bridged to a TDM legacy 9-1-1 environment. To the legacy selective router, the LSRG looks like another legacy selective router and uses the tandem-to-tandem routing processes as defined in [NENA 03-003](#), *NENA Recommendation for the Implementation of Inter-Networking, E9-1-1 Tandem to Tandem*.

Additionally, the LSRG must be able to assign call transfer pseudo ANIs (p-ANIs) for the delivery of calls between networks and cache location information for retrieval after a call has reached its legacy PSAP destination. These call transfer p-ANIs are different than the wireless and VoIP pANIs used in legacy networks and are introduced in NG9-1-1 for the transfer of calls between legacy and NG9-1-1 networks.

The LSRG must be able to support the following interfaces and protocols:

- Signaling interworking of SS7-to- SIP and SIP-to-SS7
- SIP for interworking with NG9-1-1 ESInets and NG9-1-1 PSAPs
- TDM for interworking with legacy selective routers and legacy PSAPs
- Emergency Services Protocol (ESP) for E2 and/or PSAP to ALI message (PAM) location queries to and from ALI systems and the LSRG's cached location information response
- Location to Service Translation (LoST) for querying the Emergency Call Routing Function (ECRF) in routing initial calls via the location and for routing a bridged call based on using the p-ANI for determining the destination PSAP
- Hypertext Transfer Protocol (HTTP) GET for retrieving Additional Data associated with a call, a caller, or a location

Additional information on these interfaces and protocols may be found in NENA [08-003](#), *Detailed Functional and Interface Standards for the NENA i3 Solution*.

MCP has seen LSRG implementations in other ESInet deployments in the United States. These LSRG implementations focus on the tandem-to-tandem transfer capabilities between legacy PSAPs and ESInet PSAPs enabling ANI and ALI delivery for wireless and VoIP calls. MCP has not seen the implementation of LSRG p-ANI assignment in a production environment, leaving MCP to believe that additional work is to be done by the vendor community to completely fulfill the i3 standard for the LSRG. Provided that a typical ESInet migration may take anywhere from 12–24 months to complete, MCP believes that complete LSRG functionality with p-ANI implementation will be supported during the Commonwealth's migration to an i3 ESInet.



4.2.2. Legacy Network Gateway

As the Commonwealth migrates to NG9-1-1, the ESInet will need to interface with systems and networks that are not yet capable of utilizing i3 interfaces and protocols. This may be due to financial, technical, operational, or political reasons. Regardless of the reasoning, NENA i3 provides for a system component that resolves the requirement for interfacing with legacy systems. The LNG, which is technologically possible today, interworks legacy and NG9-1-1 systems, which enables a phased transition to the NENA i3 end state architecture.

The LNG has three primary functions: the Protocol Interwork Function (PIF), the NG9-1-1 Interwork Function (NIF), and the Location Interwork Function (LIF). Each functional component serves its own purpose within the ESInet and the physical proximity to one another is irrelevant as long as the systems are able to interoperate via ESInet connectivity. In some cases, the NG9-1-1 service provider may have several PIF instances across a state, perhaps up to two PIFs per LATA, which communicate with only a pair of NIFs and LIFs that are co-located with the other core functional elements, such as the Emergency Services Routing Proxy (ESRP) and ECRF. This architecture aligns with NENA i3 and provides for a resilient solution design.

As the name suggests, the PIF's role is to convert the legacy TDM voice traffic to the i3 SIP communications required of the ESInet's ESRP. Specifically, the PIF sits at the ingress edge of the ESInet and converts the incoming multi-frequency (MF) or SS7 protocol from the CSP's originating networks to SIP. The PIF also provides the conversion of teletypewriter (TTY) to real-time text (RTT), which is the IP equivalent within the ESInet. NENA i3 defines the mappings of the specific fields between the TDM protocols and the SIP INVITE message with references to other telecommunication standards, as appropriate. The PIF will continue to serve its role within the ESInet until all ingress traffic is delivered via SIP to the Border Control Function (BCF).

The next step in the delivery of the call to the ESRP is the NIF. The NIF is the intelligence center of the LNG, being able to recognize the call type that it receives from the PIF, processing location queries, interfacing with the ECRF, coordinating Additional Data, and delivering the call and location information (or location reference) to the ESRP. The NIF is the functional element that assimilates all the information that the LNG has aggregated, develops the appropriate SIP INVITE, and establishes the SIP session with the ESRP. Simply, it is the heart of the LNG operation.

Until all carriers deliver location with the call, the LNG LIF will be required for obtaining the best available location at the time of call delivery. The LIF is responsible for obtaining the routing key (e.g., p-ANI) from the NIF and retrieving location information from the appropriate LDB. The location information may be geodetic or civic and may include the callback number of the caller. This location information will be used by the NIF for determining the target PSAP in which to route the call. For wireless calls, the LIF will immediately respond to the NIF with the wireless Phase I destination PSAP with an indication that it is a wireless call along with the emergency services routing key (ESRK) and uniform resource identifier (URI) of the LNG so that the PSAP has the appropriate information on where it needs to query for obtaining a dispatch address. While the call is being routed by the NIF to the



ESRP, the LIF will make a query to the appropriate MPC/GMLC and store the dispatch location for later retrieval by the PSAP.

4.2.3. Border Control Function

As the Commonwealth explores the migration from TDM to a statewide IP network, it is important to account for network security. The migration from TDM to a statewide IP network provides many new capabilities and is poised to enhance emergency response and public safety operations; however, IP networks are much more vulnerable to malicious attacks than the TDM, point-to-point networks. IP network security is best approached in a multi-tiered manner that addresses the physical, policy, procedural, data, and systems aspects of the network design and operations. NENA i3 defines the BCF as the functional element for ensuring that the network edge is protected.

The BCF is a combination of firewalls and SBCs, and is technologically possible today. All data and voice traffic must pass through these two components to reach the core elements and PSAP end points within the ESInet. The firewalls provide security for the application layer by examining data packets and eradicating malware as it is discovered. These systems also provide protection to the network layer through port management in limiting access to certain ports with specific traffic types such as Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and others. Firewalls will provide for limiting traffic through the management of access control lists (ACLs). These are the rules that the system administrator sets up for analyzing packets for the protocol, port numbers, source, and destination addresses for allowing or denying access past the firewall interface. Firewalls monitor for unusual ingress packets for detecting denial of service (DoS) and distributed DoS (DDoS) attacks and shutting down their distribution to the network or destination device. The firewall may be appliance- or software-based.

SBCs are the backbone of VoIP networks and serve many functions in the handling of VoIP calls. From a security perspective, the SBC's most important roles are for quality of service (QoS) priority marking, DDoS protection, and encryption/decryption of VoIP traffic. A more comprehensive list and description of the functions of SBCs and firewalls may be viewed in [NENA 08-003](#), *Detailed Functional and Interface Standards for the NENA i3 Solution*.

4.2.4. Location Database

The location data model changes significantly in the NENA i3 model with two primary sources and sets of data. Today's location information and caller information are provided by the ALI database with the exception being where the ALI database steers a bid to an auxiliary system such as the MPC/GMLC for wireless calls or the VPC for VoIP calls. Ultimately, the ALI database is the system that determines what data may be presented and the formatting of that information based on its limited data fields. In NENA i3, the location information server (LIS) will provide the location information for the user and the call information database (CIDB) will provide information about the call, the caller, and/or the location of the incident. Whereas the E9-1-1 service provider is responsible for the storage and maintenance of ALI records today, the responsibility moves to the CSPs for LIS and CIDB management with other



sources also coming into the fray with the expanded NG9-1-1 datasets that may be available about a location. While not the original vision of NENA i3, it is completely possible that the CSPs may outsource the data management of LIS and CIDB functions to third-party providers, potentially even a 9-1-1 authority.

Recognizing that it will take time, system changes, and significant effort by the carriers to move to a LIS/CIDB model, [NENA-INF-008.2-2013](#), *NG9-1-1 Transition Planning Considerations*, provides for an LDB for enabling a transitional model to the i3 end-state. The LDB, which is technologically possible today, provides an environment where the carriers may continue to operate as they do today while work is performed to deploy LIS and CIDB functional elements. Data management processes may continue to validate against the tabular MSAG while the geospatial equivalent with the i3 Location Validation Function (LVF) is developed and put into operation. The LDB may be provisioned as an ALI with the ability to steer bids to other existing ALI databases, MPCs/GMLCs, and VPCs. The LDB provides all the current ALI data, system functionality, protocols, and interfaces while adding new NG9-1-1 protocols and interfaces. Specifically, the LDB may use the following interfaces depending on the specific implementation of location data systems:

- Legacy ALI query for traditional ALI bids from the PSAP
- ALI Query Service (AQS) for ALI bids from the PSAP
- HTTP-Enabled Location Delivery (HELD) for location de-reference requests from the LNG
- ESP for E2 bids to MPC/GMLC or VPC
- Mobile Location Protocol (MLP) for location requests to wireless carrier networks
- Service Order Input (SOI) for legacy ALI provisioning
- LoST for validating location using LVF
- Proprietary protocols for internally facing systems

The LDB will exist until all provisioned location and caller data resides in the LIS and CIDB.

4.2.5. Location Information Server

The LIS provides location in one of two means: location by value or location by reference. In location by value, the location of the call is provided with a civic address or latitude and longitude in the Presence Information Data Format – Location Object (PIDF-LO). Wireline and fixed VoIP solutions are examples of call types that are most likely to use location by value. Location by reference solutions provide a location URI in the geolocation header of the initial SIP message, which can then be de-referenced with a query back to the LIS. Mobile VoIP and wireless calls are the most likely to supply location by reference.

A good analogy to today's legacy environment is that the wireline location is provided immediately upon ALI bid (location by value), whereas the wireless calls send a pANI to the ALI system, which has to reference the MPC/GMLC to obtain the caller's location (location by reference). The location by reference may be made via either HELD and/or the SIP Subscribe/Notify process. HELD would provide for individual queries for location information while the SIP Subscribe/Notify process provides for repeat



location updates to be provided to the subscribed end points or PSAP(s). The latter methodology is useful in scenarios where a telecommunicator is tracking a caller, similar to how some of today's CPE may have an automatic, timed re-bid functionality for obtaining updated Phase II location from ALI. Similar to today's ALI and MSAG validation process, a LIS must validate locations prior to entering them in to the LIS. This is done via the LVF.

LISs are technologically possible today, although MCP has yet to see a carrier-provided LIS in production.

4.2.6. Call Information Database

NENA i3 has defined Additional Data as information about the call, the caller, and/or the location of the call. This Additional Data is either stored or temporarily staged in the CIDB. 9-1-1 calls may be handled by the PSAP with data from a single CIDB, or potentially several CIDBs, and the Additional Data may be sent by value in the call delivery or by reference with a database address (URI) for the CIDB that has the additional information. A device, service, or any service provider handling the call may add Additional Data or a URI in the call delivery to indicate that there is Additional Data available. The CIDB may be queried by multiple ESRPs since multiple agencies may handle the call.

In order to provide the functional equivalent of ALI information in an i3 environment, a minimum set of information must be sent by the CSP as Additional Data. When combined with the location information, the PSAP will receive an equivalent of today's ALI information. However, as NG9-1-1 promises much more information about the call, the CIDB is the answer to providing that additional information. The potential providers of CIDBs will include for-profit companies, such as Rave Mobile Safety with their Smart911™ service, and non-profit government organizations, such as the Virginia Department of Transportation (VDOT) with traffic camera information. Table 9 contains examples of Additional Data.

Table 9 – Additional Data Examples

Data Associated with a Call	Data Associated with a Caller	Data Associated with a Location
Service provider contact information	Medical information	Floor plans or building evacuation plans
Service Type of the call (wireless, VoIP, etc.)	Disability information	Heating, ventilation and air conditioning (HVAC) status
Device type	Emergency contact information	Bank or transportation cameras in the proximity
Multimedia capabilities of device	Photo of caller	Hydrants
Sensor data from telematics or medical monitoring device		Hazardous materials

CIDBs are technologically possible today, although MCP has yet to see a CIDB in production in an ESInet.



4.2.7. Emergency Services Routing Proxy

The ESRP is at the center of the i3 routing model. It is the central system that coordinates the processes for getting the call to the right location, whether it is a PSAP or another network. NENA i3 has three locations of ESRPs in the i3 architecture:

- *The "Originating ESRP" is the first routing element inside the ESInet. It receives calls from the BCF at the edge of the ESInet*
- *One or more "Intermediate ESRPs" which exist at various hierarchical levels in the ESInet. For example, the Originating ESRP may be a state-level function, and an intermediate ESRP may be operated by a county agency.*
- *The "Terminating ESRP"^{36]} is typically at the edge of a PSAP, just past the PSAP BCF.³⁷*

The ESRP receives a SIP INVITE, obtains the location of the call either through the value provided or by de-referencing the URI, and queries the ECRF for the destination of the next ESRP to which it needs to be routed. That next ESRP, or hop, may be an Intermediate ESRP in a regional ESInet or the Terminating ESRP at the PSAP. However, before the ESRP sends the call to the next hop, it first queries the PRF to check the status of the next hop to determine if a unique routing rule, or policy, is in place that would direct the call to another location. If the queue state of the next hop is in normal, then it sends the call to that originally planned next hop; otherwise, it sends the call to the destination as defined in the policy. The downstream ESRP, which will typically be the Terminating ESRP, manages the queues and provides state status to ESRPs earlier in the call flow so that the PRF is able to distribute calls appropriately.

ESRPs are technologically possible today. While MCP is unaware of any implementations to date, it is also feasible that an ESRP may manage 10-digit administrative lines, especially in cases where the PSAP moves its public switched telephone network (PSTN) administrative line services to a VoIP service provider. This would provide for the same policy routing that is applied to the 9-1-1 calls and texts to be applied to administrative lines. This would enable greater flexibility in relocation of PSAP call takers when the Terminating ESRP is located in a data center in the network as opposed to the traditional location of the PSAP's backroom. The administrative lines from the VoIP service provider would route through the BCF providing security and anchoring of the media.

³⁶ The Terminating ESRP can be viewed as the traditional CPE at the PSAP. Its role is to send the call to the individual workstation or group of workstations for call handling.

³⁷ [NENA 08-003 v1](#), *Detailed Functional and Interface Standards for the NENA i3 Solution*.



4.2.8. Policy Routing Function

The PRF, which is technologically possible today, monitors the queues of downstream ESRPs for active understanding of the entity's queue status. With real-time information of destination URI's dynamic queue status, the PRF applies routing rules to provide for efficient distribution of calls in a prescribed manner. These routing rules are called policies and are held in a repository referred to as a policy store. A simple example of a policy is alternate routing in a legacy call routing environment. Today, when all 9-1-1 trunks to a PSAP are busy, the legacy selective router has logic to send the next call to the PSAP's alternate route. This is typically another 9-1-1 trunk group to an adjacent or backup PSAP, an administrative line hunt group, or to fast-busy. The same policies may be set up in the PRF in an ESInet using i3 call routing. When policies are developed and managed in a highly customizable, software-driven IP environment, the industry is afforded with greater capabilities as far as routing logic, breadth of destinations, and flexibility in managing the policies. Policy rules are given a priority to manage call delivery based on preset levels of importance to the PSAP's operations. The i3 solution provider's PRF interface should enable the PSAPs to have local control and management of the development and implementation of their individual call routing rules.

Terminating ESRPs manage the distribution of calls to workstations through queue management. The destination PSAP may pull calls from one of two queues: their normal call queue or their diversion queue. The normal queue contains calls from within the PSAP's jurisdiction while the diversion queue contains calls that originate in other PSAP jurisdictions that are diverted due to the implementation of the PRF's policy rules. The priority that is assigned to the various call queues to which the PSAP subscribes will determine the order in which calls are answered across the various queues.

The priority of call queues will be determined by the PSAP during the i3 routing deployment process. Due to the potential severity of an incident, a county with a nuclear power plant may designate a diversion queue from the power plant's PSAP as the highest priority; taking all calls from that queue before calls from its normal queue. While at the same time, the PSAP may have a diversion queue for a neighboring PSAP that will have a lower priority than its normal queue.

Policy rules may be applied to Additional Data as well. The ESRP that routes the call to the diversion queue of the county PSAP may send a notification to the county emergency management office to alarm that there is a potential event at the nuclear power plant. That notification may provide a URI for the emergency management office to de-reference for obtaining information about the call, caller, or location. Another example of a data driven policy is the situation where a call for assistance may be made by a telematics device where a vehicle accident exceeds a predetermined severity threshold. Upon receipt of the call from the vehicle that was southbound Highway 301, for example, the PRF may be provisioned to send the Additional Data to both the Chesterfield County Emergency Communications Center, as well as the Virginia Commonwealth University LifeEvac dispatch center.



4.2.9. Emergency Call Routing Function, Location Validation Function and Spatial Information Function

In the E9-1-1 system used today, the location information of the device capable of calling 9-1-1 is validated when an originating network provider submits a new or changed customer order through the SOI. The SOI interfaces with the database management system (DBMS), which in turn compares the SOI data with the MSAG. This tabular data comparison determines if the SOI record will be provisioned in the ALI database or if the MSAG needs to be altered for the location to validate. Once the record is validated and provisioned in ALI, it is then used to develop the selective router database (SRDB), which is another tabular dataset that correlates the ANI, the equivalent of the 10-digit telephone number (TN), of the record to the ESN of the PSAP. When a call is then placed, the ANI is looked up in the SRDB to determine the ESN and the trunk group associated with the PSAP. The selective router uses the ESN to determine the correct trunk group in which to send the 9-1-1 call. In NG9-1-1, the processes used today will shift from the tabular MSAG and SRDB to spatial databases named for the function they perform—the ECRF and the LVF. These systems are available and in use today.

The comparison of the SOI record to the MSAG will transition into the equivalent of the SOI record being validated to the spatial data within the LVF. Today the originating network providers utilize the SOI process to validate their customer locations; in NG9-1-1 the providers can still use the SOI process, but the tabular DBMS used today for validation will be replaced by the LIS and LVF. The routing of a 9-1-1 call through the location associated with the ANI record based on the ESN will transition into the actual location of the calling device being spatially routed to the correct PSAP or Emergency Services entity based on the location of the calling device. The location of the calling device is contained in the PIDF-LO, which will replace today's ALI and ANI records. The location information in the PIDF-LO is validated to the spatial data contained in the LVF. Once the PIDF-LO location is validated, the validated location information is stored in a LIS or a transitional element, an LDB. Validated locations are periodically re-validated, as information with the LVF may change over time. When a call is placed to 9-1-1, the PIDF-LO, the location of the calling device, is sent to the ECRF. The ECRF determines which emergency services boundary the location is within and sends the call to the appropriate PSAP.

The ECRF and LVF require highly standardized, normalized and current GIS data to properly function. NENA recommends a 98 percent level of synchronization between the MSAG, ALI and GIS data before moving into an NG9-1-1 system.³⁸ This synchronization will require coordination and cooperation between the current MSAG coordinator and GIS staff. Just as today's MSAG and ALI database maintenance is typically handled by an MSAG coordinator (and/or respective staff), the spatial data used in the LVF and ECRF will be maintained by GIS staff. There will be a significant transition period where the MSAG coordinator team and the GIS team will need to work closely together.

³⁸ NENA Information Document for Synchronizing Geographic Information System databases with MSAG & ALI [NENA 71-501](#), Page 8, Version 1.1, September 8, 2009



In NG9-1-1 systems, the spatial data used by the ECRF and LVF is converted from the GIS database format into the LoST database format. Both the ECRF and LVF utilize LoST databases to perform their functions. The NG9-1-1 functional element responsible for converting the GIS data into the LoST format is the Spatial Information Function (SIF). The SIF takes any changes, moves, additions, deletions or other modifications made in the GIS data and immediately updates that information to the ECRF and LVF databases. The MSAG conversion service is also provisioned by the same SIF mechanism. The MSAG conversion service provides a convenient way to convert data from PIDF-LO to ALI and vice versa by converting the PIDF-LO to or from an [XML ALI](#) format for data exchange³⁹.

The SIF, ECRF and LVF allow for near real-time data updates to be made. For example, when a new road is added or a boundary is changed, the information is updated from the SIF to the ECRF and LVF almost instantly. This near real-time data updating to the validation and routing functions of a live system is not without some concerns over the viability and correctness of the data being updated. There should be levels of data quality, data integrity, and other quality control and quality assurance processes taking place prior to the SIF updating the ECRF and LVF with new spatial data.

4.2.10. Spatial Database Management System

One of the most time-consuming efforts of moving to an NG9-1-1 system will be the preparation of GIS data. Certain GIS data layers will become the core databases within NG9-1-1. These core GIS data layers will be provisioned into the NG9-1-1 system functional elements to provide location validation and routing of 9-1-1 calls to the appropriate PSAP. This same data is also used to determine the emergency services entities for a given location. The NENA-designated core GIS data layers required for the NG9-1-1 system to perform these functions are road centerlines, emergency services boundaries, PSAP boundaries, and authoritative boundaries. Existing ESN layers may be utilized to develop the PSAP boundary and the emergency services boundaries. Recommended GIS data layers for the ECRF and LVF include site structure/address points, cell site and sector locations, and boundary layers for counties and municipalities. Being able to aggregate all these data layers from local 9-1-1 authorities into a seamless Commonwealth or statewide database will require high levels of coordination and cooperation from all levels of 9-1-1 stakeholders. Ensuring the highest levels of data quality and data integrity are met could be accomplished through a statewide Spatial Database Management System (SDBMS). Other non-NG9-1-1 core GIS data layers, such as hydrology, railroads, and mileposts, could be included in the statewide public safety SDBMS. Combined, these data layers can be provisioned not only to the ECRF and LVF, but also to tactical map displays and other applications used by PSAPs, public safety dispatch centers and first responders.

The concept of a public safety SDBMS is to store, standardize, validate, and help authorized system users prepare their GIS data to meet and mitigate the rigid requirements of spatial data in NG9-1-1.

³⁹ NENA Standard Data Formats for 9-1-1 Data Exchange & GIS Mapping, [NENA 02-010](#), Version 9, March 28, 2011



Ideally the SDBMS would provide the tools and processes to meet the data integrity and data quality needs of the core GIS data layers for NG9-1-1, as well as being able to meet current E9-1-1 GIS data needs. The SDBMS would allow authorized entities to upload their GIS data into the system. The system would generate data quality and data integrity checks on the uploaded core GIS data layers and provide discrepancy, metrics, data integrity and data quality reports back to the entities submitting the GIS data. These reports could be aggregated and also provided to state-level entities. The SDBMS would also be capable of validating the GIS data with the forthcoming NENA standard, *GIS Data Model for Next Generation 9-1-1*, as well as meeting the functionality of the NENA i3 SIF as described in [NENA 08-003](#), *Detailed Functional and Interface Standards for the NENA i3 Solution*.

The system would be sized to meet current and future needs, and would be highly secure, redundant, and meet high levels of uptime.

4.2.11. Geospatial Data Exchange

4.2.11.1. NG9-1-1 Data Collection Challenge

Compiling the data necessary to support an NG9-1-1 implementation can become unwieldy to virtually impossible, unless the proper pre-planning and related steps have been executed. Collecting, analyzing, integrating, and maintaining multiple datasets from numerous entities can be a daunting task. The task becomes even more complex if multiple entities maintain different sets of data for a given area.

Another problem impeding the collection and maintenance of the data may be the unwillingness of some data stewards (one who creates or maintains a dataset) to relinquish control over their datasets. While data stewards may be convinced to do so in the early phases of the project, they may later suspend or even refuse to provide updates, which places data accuracy in jeopardy. NG9-1-1 systems cannot function properly without current and accurate data.

4.2.11.2. Data Storage Challenge

To aggregate the collected data for use in an NG9-1-1 system, the architect will need to build out a storage area network (SAN), which will consist of the systems needed to support the collection, storage, and redistribution of the data. Additionally, the process may require the enterprise to maintain a fully redundant secondary SAN system in another location, and perhaps even a tertiary SAN system in a third location for COOP purposes. The associated level of service and availability requirements for such a system would require staff augmentations at each site, or the procurement of a service contract with a data center able to provide 24 hours a day, 365 days a year (24x365) support for a large hardware implementation.



4.2.11.3. Data Maintenance Challenge

Compiled data becomes outdated the instant that it is replicated to another database. Some datasets, such as street centerlines, may change infrequently based on development in a jurisdiction, while other datasets could change daily. It is difficult to construct a statewide plan to establish GIS data currency across many datasets from many different jurisdictional areas.

4.2.11.4. Data Management Solution

Data for the NG9-1-1 system in the Commonwealth will likely be provided from many sources and across potentially different networks. The first step to defining the integration of GIS is to isolate the piece of system architecture that is GIS driven.

Local GIS data may come from different data stewards within each given locality. In some instances the number of data stewards could become quite large. The missing piece has been defined to this point in NG9-1-1 implementations as a SDBMS. Compiling data from multiple sources into a central data store adds a level of risk, cost, and management overhead to the system.

However, recent developments in geospatial technology have made another option available to NG9-1-1 system architects. It is crucial to overcome the conventional idea that data only can be shared by replicating the data into multiple databases, thereby creating stovepipe data stores. Generally, most GIS managers understand, consume, and even produce real-time, live-data feeds in the form of Web Feature Services (WFS) and Web Map Services (WMS). Using the Geospatial Data Exchange (GDX), shown in Figure 8, ensures the NG9-1-1 system will always have up-to-date data that is currently available from every jurisdiction. Additionally, all participating jurisdictions reap the added benefits of sharing additional data with other programs and governmental functions outside of the 9-1-1 world. Placing the GDX, which is technologically possible today, ahead of the SDBMS yields the solution shown in Figure 8.

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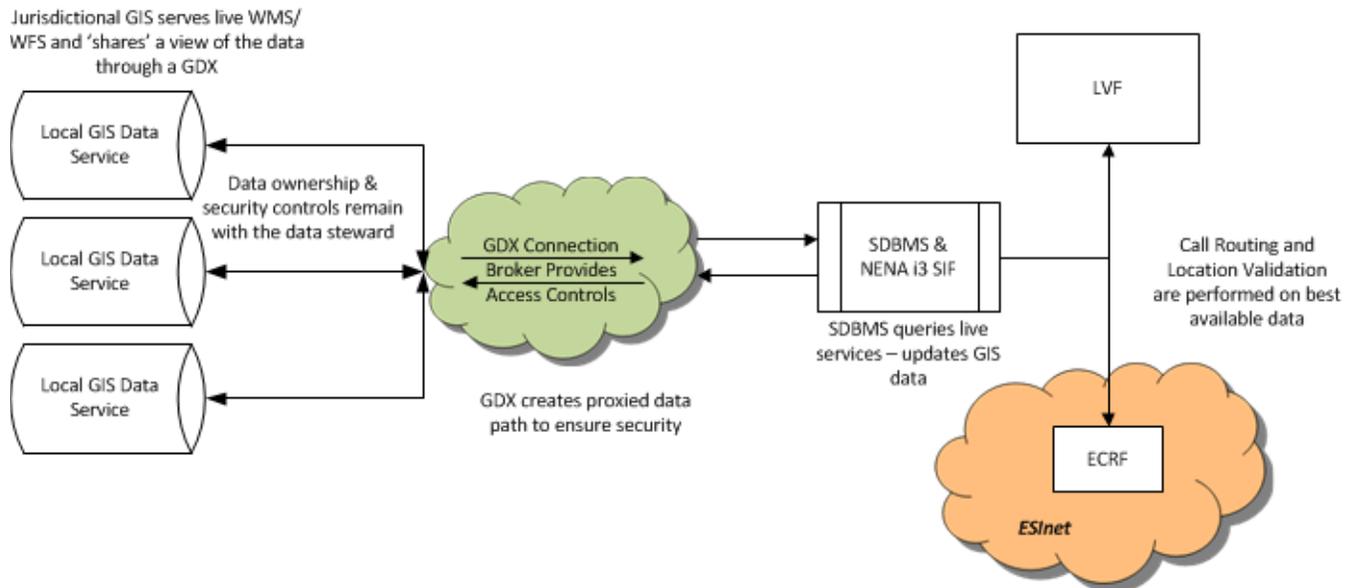


Figure 8 – Live Data from a Geospatial Data Exchange

Figure 9, on the following page, incorporates the addition of a GDX brokerage, which serves as the gatekeeper for the individual data stewards, protecting the source from unauthorized access while allowing connections from the SIF to fulfill the requirements of both the ECRF and LVF. The SDBMS performs quality control (QC), QA and data integrity checks on the updated information from the GDX. When the updated GIS data meets the data integrity requirements, the data is updated to the ECRF and LVF by the SIF interface in the SDBMS. This process is all transactional, which allows for near real-time updates to the ECRF and LVF. Additionally, the GDX allows for the sharing of other datasets among the participating jurisdictions with the same inherent access security.

The responsibility for collecting, maintaining or storing the data driving the system remains with the data stewards, who already maintain the data for their own use. The local authority is still responsible for verifying the accuracy and currency of the data, but will work with the data stewards to address any issues discovered through the QA/QC process. This approach eliminates the burden of hardware and software costs associated with the storage and dissemination of large spatial datasets.

4.2.11.5. GDX Defined

A data steward is anyone who creates or maintains a dataset, both spatial and non-spatial. Each dataset has some value to the data steward, as it addresses a specific need that warranted its creation and further maintenance. The true value in this data, however, is revealed by the number of other missions outside of the data steward's scope that benefit from the data. To fully discover the data's true value, a method must exist for the data steward to share the data with the widest possible audience, without compromising the security requirements of the data steward. A GDX allows for the sharing of a dataset with a prescreened audience of users and systems; each assigned a set of access rights and



privileges that allow the data steward to readily share the data. These same controls offer the data consumers a plethora of additional information made available by other data stewards.

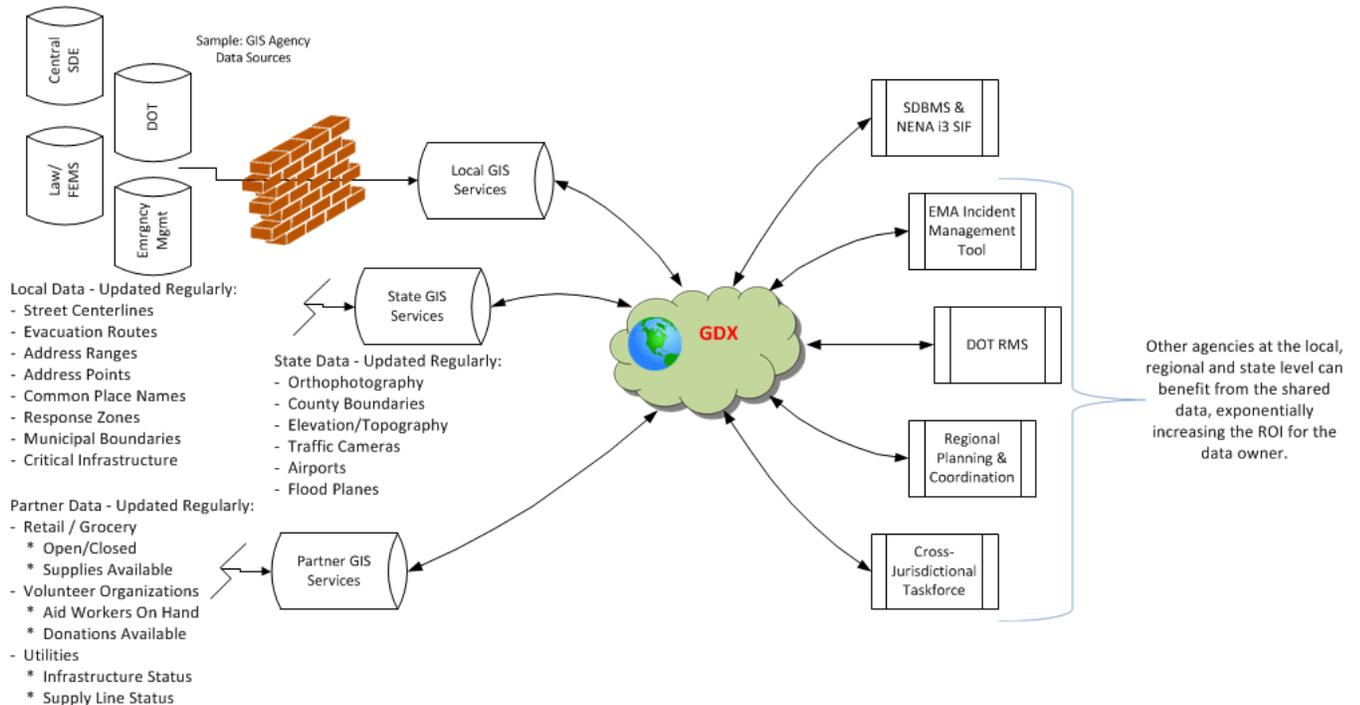


Figure 9 – GDX Implementation

Figure 9 shows a standard GDX implementation and the associated data flow necessary to support emergency services and associated common operating picture applications. The data services brokered by a GDX feeding the SDBMS/SIF provide the NG9-1-1 implementation with the level of real-time robust data necessary to realize a complete architecture capable of fulfilling the NG9-1-1 mission.

The benefits of a GDX connection to jurisdictional data are not limited to NG9-1-1. The mapping components of incident management systems are greatly enhanced through real-time connections to regional data. Additionally, a GDX is not limited to sharing only spatially enabled data, but can also share tabular data from databases or even spreadsheet information. This data can be added to the incident management systems to heighten situational awareness and improve the decision-making process. Figure 9 above also depicts just a small selection of the tools that would benefit from a GDX connection to jurisdictional data.

Within this solution, the SDBMS performs the aggregation of the NG9-1-1 data as well as performing the QA/QC, data integrity checks, and reporting of discrepancies and errors back to the data stewards.



4.2.11.6. GDX Implementation

A GDX is a relatively new concept in the geospatial community. The concept was first developed within the DHS Science and Technology Directorate (S&T). DHS S&T launched the Virtual USA pilot program in 2002 with eventual implementations in Alabama, Louisiana, and New England. In 2008, the NCR partnered with DHS S&T to further develop the Virtual USA program from a top-down model under federal control to a flattened model of equal ownership, participation, and control across all levels of government. This approach, coupled with dramatically increased security and data control features, resulted in a wide adoption in the 22 member jurisdictions, and also marked the first time federal and military partners both shared and consumed data in such a method. The success of the NCR GDX was proven through unprecedented spatial data sharing in preparation for the 2009 Presidential Inauguration. The next logical evolution for the GDX model is to support the demanding standards of NG9-1-1. If adopted, Virginia will join Maryland and the District of Columbia (D.C.) in implementing the GDX model to support NG9-1-1 data availability, providing current, accurate, robust data for public safety.

4.2.12. *Terminating ESRP*

Within the NENA i3 architecture, the PSAPs have a Terminating ESRP, which in today's terms is the CPE. Its role is to route the call to the appropriate call taker or group of call takers based on a PSAP's provisioned policies, which may include automatic call distribution (ACD). Today's operational environment consists of a mixture of legacy and NG9-1-1 "ready" CPE. While many CPE vendors have advertised their latest products as being NG9-1-1-capable or NG9-1-1-ready, the reality in the marketplace is that the systems may support some of the NENA i3 interfaces and protocols, but they will require a software upgrade in order to support the full suite of protocols and interfaces defined by NENA i3.

This is due to the fact that the initial release of the industry's primary NG9-1-1 standard, NENA i3, was initially released in June 2011 with a defined structure to the systems, but it left many gaps and critical details open to interpretation or simply undefined. Over the last three years, NENA and its key contributors have continued to work on the standard to fill in the missing pieces and refine the details necessary to implement an i3 solution. The next update to the standard is being reviewed for final comment and is anticipated to be formally released in the coming months. The release of the next version of the i3 standard document will enable the vendor community to refine their respective software code so that they may enable a vendor-agnostic i3 solution.

With the advancement of VoIP-based CPE systems and their use of modular, component-based systems, the industry is afforded solutions that may more easily evolve with the changing standards. Software upgrades may be able to support all future updates with an occasional hardware upgrade as operating systems require greater processing power and memory capacity. Table 10 lists the critical interfaces and protocols for Terminating ESRPs.



Table 10 – Critical Interfaces and Protocols for Terminating ESRPs

Critical Interfaces and Protocols
SIP
PIDF-LO <ul style="list-style-type: none">• Location by Reference• Location by Value
LoST
HTTP
HELD
HTTP GET
SIF (for mapping platform)
SIP Session Recording Protocol (SIPREC) (for media recording)

As new CPE platforms are deployed, legacy functionalities must be taken into consideration. For example, the “instaphones” deployed from the North Anna and Surry nuclear power plants, and potentially other locations, provide party line and private ring-down line service to the PSAPs surrounding their plants. These functions are provided by legacy telephone switches and are supported by the legacy CPE. Their functional equivalent will need to be considered as PSAPs migrate to an all-IP world. Fortunately, these types of services may be replicated in VoIP soft switches and deployed over an ESInet. This highlights the need for requirements to be gathered by each locality and accommodated by the regional or state-level ESInet provider.

Terminating ESRPs are technologically possible today. However, vendor implementations and protocol support vary, requiring PSAPs to ensure all i3 protocols are supported or have a definitive timeline for such support.

4.2.13. Legacy PSAP Gateway

A variety of CPE with varying levels of support for NG9-1-1 interfaces are employed within the Commonwealth. Even the most advanced CPE platforms will likely require some level of software updates in the next few years to fully support an i3 end state solution. For example, the VIPER 4.2 with Power 911 v5.5 is one of the most advanced CPE platforms in the industry; yet, it does not have support for text with Message Service Relay Protocol (MSRP). However, this platform does support ingress SIP call delivery with PIDF-LO. By far a more common issue in the Commonwealth is the broad lack of support by the majority of the CPE in the Commonwealth for this baseline requirement to support NENA i3. Understanding that not all PSAPs will be able to coordinate a CPE upgrade with a migration to an ESInet, NENA has designed an LPG, which is technologically possible today, to address this issue.

Logically, the LPG resides between the ESInet and a PSAP equipped with legacy CPE. The LPG’s role is to interwork next generation and legacy protocols and interfaces to enable a legacy PSAP to be part



of an NG9-1-1 ESInet. The LPG provides a SIP interface on the ESInet side and a legacy MF or Enhanced MF signaling on the PSAP side of the gateway. Additionally, it provides support for traditional ALI queries and responses for the PSAP CPE.

Similar to the LNG, the LPG has three primary functions: PIF, NIF, and LIF.

- The PIF provides the interworking of the SIP signaling with legacy signaling for interfacing natively with the legacy CPE. Additionally, the PIF is responsible for interworking a SIP message with MSRP to TTY for interfacing with the CPE's TTY module.
- The NIF provides the primary logic in the LPG for determining how the call and data must flow. For example, when it receives a wireless call that is destined for a PSAP that is designated as a Legacy PSAP, it will interrogate the SIP INVITE, take the appropriate information that it needs to develop the legacy signaling and send the call to the PIF for interfacing with the CPE. In this example, while the SIP INVITE has much more information such as location, call back number and p-ANI, the NIF will package the p-ANI and stage the call back number and location information for later retrieval when the LPG receives the ALI query from the PSAP. Additionally, the NIF provides the support for transfer requests by recognizing hook flash and capturing the signaling for setting up the call transfer. It also enables abandonment route capabilities by providing an interface for the PSAP to initiate an "all circuits busy" state (similar to how legacy PSAPs utilize a network control modem in a legacy selective routing environment).
- The LIF provides the interworking of the NG9-1-1 location delivery mechanisms with the legacy ALI retrieval process. The LIF provides an MSAG Conversion Service (MCS) for converting information received in a Location by Value scenario to develop an appropriate ALI response format. Similarly, if the call is providing Location by Reference, the LIF supports the NG9-1-1 de-reference interfaces for retrieving location information from the LDB, CIDB, and/or LIS. It then uses the MCS to package the information in the appropriate ALI format for responding to the legacy PSAP's ALI bid.

These three functions may be deployed in a single platform or distributed across the ESInet as long as the functionality is provided to PSAPs requiring LPG support. The LPG logs all events for system reporting performed by an Event Logger.

4.2.14. Event Logger

One of the benefits of moving to an ESInet is the implementation of shared systems and services. Event logging is an example of such a shared platform in an NG9-1-1 environment. One of the requirements of NENA i3 is that all elements in the call path must log all significant events, events related at the PSAP, events within the system itself, and for the duration of the call. This requirement takes functionality that, in the legacy environment, lives at the PSAP or at the 9-1-1 systems and brings them together for a unified logging service. Similar to today's best practices in voice recording at the PSAP, the recording should start as early in the call flow as possible, ideally at the point that the call enters the ESInet. This would be the closest equivalent of "trunk-side" recording in legacy terminology.



With interoperability being paramount in an ESN, each logging service should provide access to other authorized logging services for the purposes of compiling a complete event log in scenarios where a call may traverse multiple ESNs in its path to the serving PSAP. For example, if a call is delivered to the Region 5 ESN and needs to be transferred to a PSAP in Region 1, the event logging from Region 5 will need to be provided through a standards-based web services interface for correlating the call and developing an event for the entire call flow.

The logging service will provide a SIPREC interface for recording media and related call information, as well as the Real-time Streaming Protocol (RTSP) interface for users to play back the media through a client access portal, similar to instant recall recorder functionality in most existing CPE. Effectively, the event logging service is client/server architecture with the logging service being the core server having multiple end clients that deploy the SIPREC protocol for interfacing between each other. For example, the SBC component of the BCF and the terminating PSAP CPE will provide feeds to the logging services. Other i3 functional elements that contribute to the routing and management of the call are required to log significant events and provide their event log data to the logging service. These components will provide their respective incident tracking identifiers so the logging service can correlate the incident at the central server. Just as all other ESN components are redundant, the logging service should be architected with redundant servers located in geographically diverse locations. As such, the client components are required to support sending media and data streams to multiple servers.

To record the voice, the event logger is effectively bridged to the call at the time of call set up with the PSAP. As additional parties are added to the call, their audio streams are added to the recording session. The recording session will terminate after all parties have hung up.

As with logging systems today, there are operational considerations that must be made when deploying a logging service such as controlling access, recording retaining requirements, and specific media recording requirements. These issues are exacerbated in a shared services environment and will require development of regional policies for data management and access of the logging service including legal and privacy restrictions.

Event loggers are technologically possible today. The NENA Industry Collaboration Event (ICE) 8 provided many lessons learned to the CPE and logging vendor community. Several updates have been made to the event logging specifications within i3, which will be seen in the upcoming second version of the standards document. With that in mind, it is possible that full support for i3 event logging may require a phased implementation.

4.2.15. Text Control Center

Text-to-9-1-1 services is arguably the most discussed NG9-1-1 application in the industry. The industry's standard for emergency text messaging is ATIS/Telecommunications Industry Association (ATIS/TIA) [J-STD-110](#), *Joint ATIS/TIA Native SMS to 9-1-1 Requirements and Architecture Specification*. J-STD-110 defines the standards for data flow, messaging, interface, and system



requirements for the delivery of SMS texts to 9-1-1. The standard defines the reference architecture for three types of delivery mechanisms: a legacy system using TTY, transitional PSAP using a web services application, and delivery to a NENA i3 ESInet.

It is important to understand that the Text Control Center (TCC), which is technologically possible today, is a responsibility of the wireless carriers and not a critical element of the Commonwealth's ESInet. The TCC is a functional element responsible for acting as a gateway between the wireless carriers' networks, determining the routing of the text, and initiating the dialogue with the appropriate PSAP through the appropriate interworking function of the TCC. Corollary, the Commonwealth's ESInet will simply need to provide NENA i3 interfaces to the TCC for the delivery and handling of text messages to PSAPs connected to the ESInet. For PSAPs that have legacy CPE and require an LPG, it is recommended that they deploy a web services solution until such time that their CPE can support i3 call flows. A text-to-TTY solution could be deployed through the use of the LPG; however, there are limitations of the solution that should be explored with the text solution provider.

4.2.16. *Automatic Location Identification Database*

The migration to a comprehensive statewide ESInet will be a lengthy process and due to the complexity of the migration, a transitional LDB is recommended for providing location information with standards-based interfaces to i3 functional elements, such as LIS, CIDB, and LVF. During the transition to an i3 end state, the LDB will contain the ALI database functionality currently provided by Verizon and CenturyLink ALI services. This includes: a SOI process for provisioning CSP records; MSAG validation process; ALI data storage; legacy ALI query and ESP interface support; and a DBMS function for managing additions, changes, and deletions to the ALI database. As discussed earlier, the implementation of an LDB with ALI services provides for a phased transition that is transparent to CSPs in the management of their subscriber records. It also enables the localities to focus on GIS data preparation activities for a smooth transition to the LVF when the data and operations are ready.

4.3. INVENTORY OF CAPABILITIES

4.3.1. *Existing PSAP Capability and CPE Capacity (Including Current NG9-1-1 PSAP Pilots and Secondary PSAPs)*

NENA i3 architectural design provides for LPGs to accommodate legacy PSAPs with CPE that does not support i3 interfaces and protocols. The LPG masks the ESInet providing an appearance of a legacy selective router and ALI system to the PSAP CPE. From this perspective, 100 percent of the PSAPs in the Commonwealth have the capability to support the migration to a statewide ESInet. The implementation of gateways provides greater flexibility in the migration to an ESInet as regions do not have to wait for all PSAPs in a region to upgrade to NG9-1-1-capable CPE before moving away from the legacy call routing infrastructure. This would allow legacy PSAPs to utilize network-based benefits of an ESInet, such as geospatial call routing, use of policy-based routing, and solution diversity and resiliency. However, the use of LPGs does not enable the legacy PSAP to appreciate the benefits from additional information potentially provided by an ESInet; the CPE call taking user interface is still limited



to legacy ALI information and TTY delivery of text messaging, unless a separate web browser-based text solution is deployed. Additionally, the use of LPGs does not support the Commonwealth's goal of shortening call delivery times, as the conversion of SIP to MF signaling adds 2–4 seconds of call setup time, whereas straight SIP call delivery from the entry point of the ESInet to the call taker's headset provides the opportunity for sub-second call delivery times. While LPGs enable a more expeditious migration to an ESInet, the upgrade of PSAP CPE will enable an elimination of LPGs providing a more ubiquitous NG9-1-1 service environment across the Commonwealth.

Starting with a base definition from the National 911 Program document *Guidelines for State NG9-1-1 Legislative Language*,

*NG9-1-1 is an IP-based system comprised of managed IP-based networks (ESInets), functional elements (applications), and databases that replicate traditional E9-1-1 features and functions and provide additional capabilities. NG9-1-1 is designed to provide access to emergency services from all connected communications sources, and provide multimedia data capabilities for PSAPs and other emergency service organization.*⁴⁰

Expanding on this base definition for this evaluation, NG9-1-1-capable equipment shall further be defined as a call taking solution capable of receiving SIP communications natively at the individual workstation without the need for conversion to or from circuit-switched technology (i.e., CAMA or digital lines), either at a call taker station or in the backroom equipment.

MCP's assessment of current CPE capabilities resulted in only 30 percent of PSAPs being capable of supporting receipt of 9-1-1 calls via direct SIP.⁴¹ Currently, MCP understands that there is no CPE vendor or system that supports all pertinent i3 interfaces and protocols. Specifically, to be considered completely i3-capable, MCP established the baseline that the CPE had to support ingress SIP with PIDF-LO; LoST query for obtaining dynamic agency information; HELD support for location update retrieval; and HTTP Secure (HTTPS) GET for Additional Data retrieval from a CIDB.

Many of Intrado's and Airbus's CPE systems in Virginia are capable of i3 functionality with a software upgrade. For example, in the Commonwealth, Intrado's VIPER platforms VIPER 4.2 and Power 911 5.5 may be able to be upgraded to 5.1 with Power 911 v6.1 in the second or third quarter of 2015. However, due to the unique upgrade requirements for each system that may impact hardware requirements, MCP is unable to accurately estimate what percentage of platforms may fall into this category. Table 11 depicts the PSAP NG9-1-1 capabilities and CPE capacities for the current NG9-1-1 pilots. The NG9-1-1 pilots are described as follows:

⁴⁰ www.nhtsa.gov/staticfiles/nti/pdf/811688.pdf, page vi.

⁴¹ This is based on the CPE version platform information provided in the PSAP survey responses. Some PSAPs did not provide version numbers and therefore their CPE were unable to be counted as being NG9-1-1-capable.



... the first realistic applications of NG9-1-1 technologies in the commonwealth and will provide the necessary real-world experiences to enable the E-911 Services Board to transition the current planning efforts into a sustained deployment strategy. The overall goal of the trials was to evaluate different technical and operational solutions for NG9-1-1 and to utilize the knowledge gained from this process when determining next steps in strategic NG9-1-1 planning activities.⁴²

Table 11 – NG9-1-1 Pilot Capabilities and CPE Capacities

Pilot Name	NG9-1-1 Capability	Existing CPE Capacity
New River Valley Project	IP-capable on current software revisions	Blacksburg Police Communications – 3 positions, 12 trunks Christiansburg Police Communications – 4 positions, 8 trunks Montgomery County – 4 positions, 8 trunks
Pittsylvania County Pilot	IP-capable on current software revision	5 positions ⁴³ , 20 trunks
Southside Pilot Project	IP selective routing with ALL services may be upgraded to i3 services with contract amendment Patrick CPE – IP-capable on current software revisions Franklin CPE – Software upgrade for IP support with potential requirement for hardware upgrade	Franklin – 6 positions, unknown Patrick – 4 positions, 8 trunks
Southwest Pilot	IP-capable on current software revisions	Dickenson – 3 positions, 8 trunks Lee – 3 positions, 8 trunks Norton – 2 positions, 6 trunks Wise – 4 positions, 8 trunks
Bland/Twin/Wythe Pilot	IP-capable on current software revisions	Bland – 3 positions, 6 trunks Twin – 4 positions, 8 trunks Wythe – 5 positions, 8 trunks
York County	IP-capable on current software revisions	16 positions, 14 trunks

MCP’s analysis of existing CPE capacity looked at both the number of 9-1-1 trunks and the number of potential positions for answering 9-1-1 calls across the Commonwealth. Figures 10 and 11 depict the survey results.

⁴² VITA’s [NG9-1-1 Lessons Learned](#) from analysis of the NG9-1-1 Pilots, presented at the Virginia E-911 Services Board December 9, 2013 Legislative Agenda Subcommittee

⁴³ Although Pittsylvania County reported 21 positions in their PSAP survey response, this is believed to be the number of authorized staff. Based on independent knowledge of the PSAP’s capabilities, Pittsylvania County has five call taker positions.

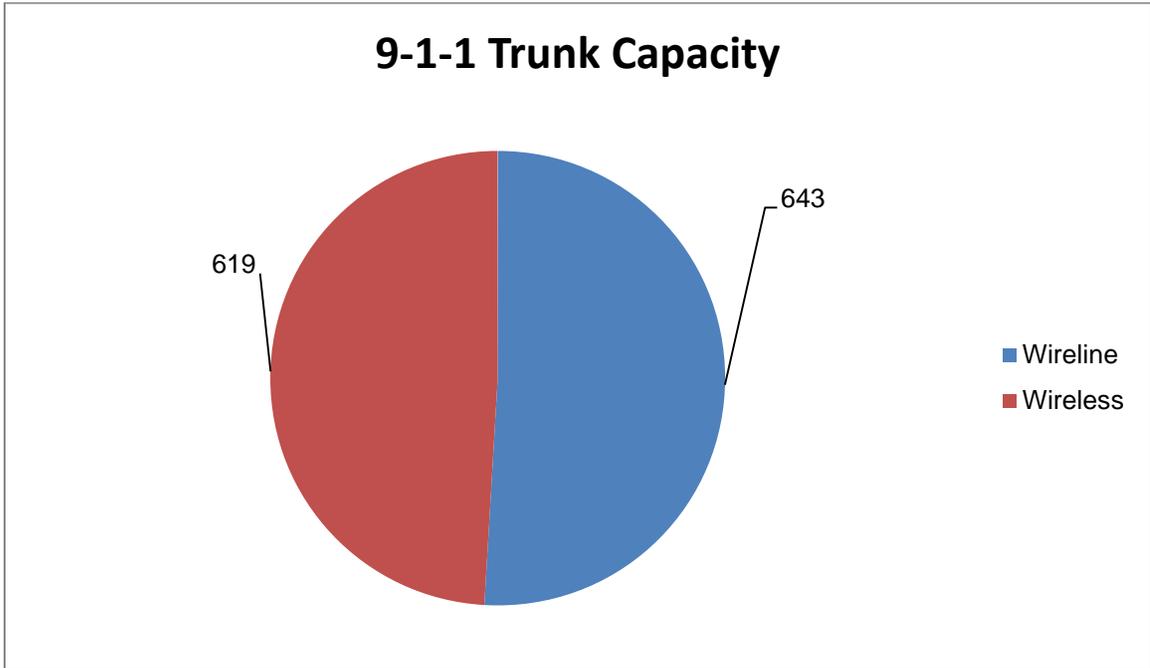


Figure 10 – 9-1-1 Trunk Capacity for the Commonwealth

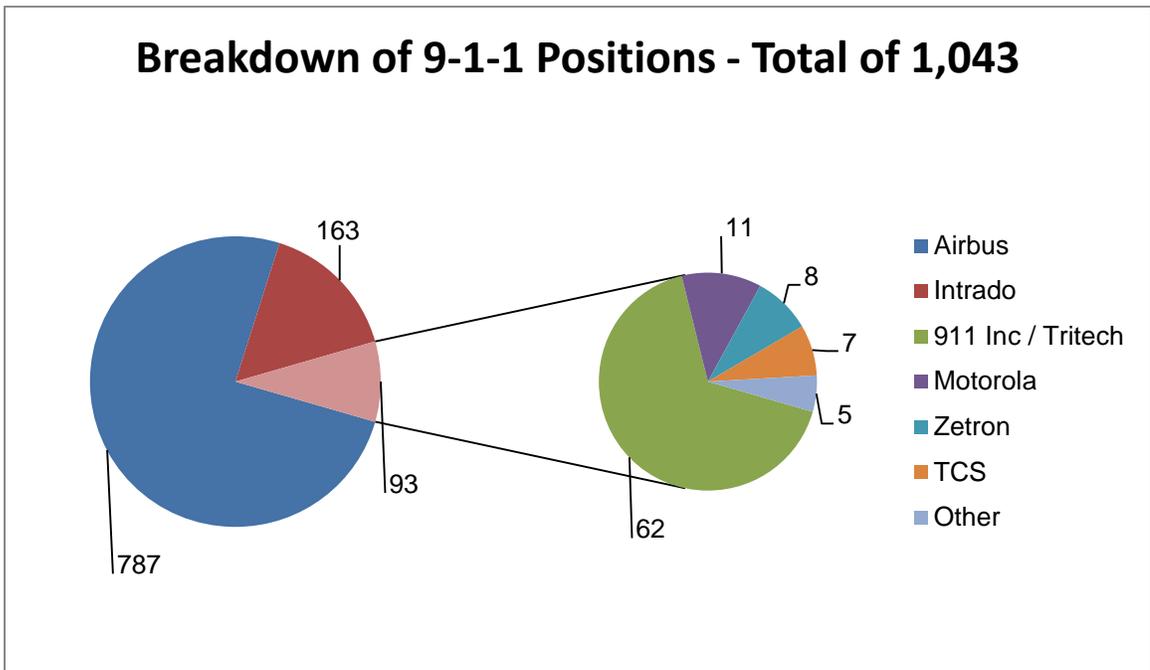


Figure 11 – 9-1-1 Position Count for the Commonwealth



Much of the CPE in the Commonwealth is capable of expanding support to upwards of 300 call taking positions. This would require significant redesign of the equipment, procurement of additional hardware and software licenses, but when deployed in an ESInet, it provides for the ability to share a redundant CPE system across dozens of PSAPs. MCP has supported counties in another Commonwealth in deploying such a shared CPE services model that enabled significant cost savings for the 13 participating counties.

4.3.2. Communications Services Accessing 9-1-1

A majority of the calls delivered to 9-1-1 today originate in wireless carrier, VoIP, multi-mode, and telematics switches and/or carrier networks that are capable of SIP call delivery to an ESInet. At the same time, while representing a lower number of calls but a greater number of switches connecting to the selective routers, many wireline switches also have the ability to deliver calls via SIP to an ESInet. The number of originating switches and networks supporting SIP call delivery will only continue to grow as carriers decommission legacy TDM technologies due to the cost to maintain such transport. This is starting to be seen with the announcements by several carriers that they are decommissioning frame relay and asynchronous transfer mode (ATM) network offerings in favor of multi-protocol label switching (MPLS) networks.⁴⁴ While these technologies are not used in the delivery of calls to 9-1-1 networks in the Commonwealth, frame relay is a transport method for ALI data in CenturyLink-served PSAPs. It is also indicative of the general movement by the ILECs to transition from legacy services to more modern and efficient transport. However, the adoption of SIP transport to an ESInet will only be realized after the standards are developed and ratified by a carrier-recognized standards development organization (SDO).

A network-to-network interface (NNI) for SIP call delivery to an ESInet has been developed by the Alliance for Telecommunications Industry Solutions (ATIS) Wireless Technologies and Systems Committee, a well-recognized SDO in the carrier community. While this standard has been ratified, it continues to be refined with recent action being taken to adopt a trunk identifier for default routing purposes. A fair estimate is that it may take 6–18 months from the ratification of the updated standard for CSPs to begin migrating to SIP call delivery to an ESInet.

The migration to SIP call delivery will benefit carriers and PSAPs alike. SIP call delivery to a statewide ESInet will reduce the number of interconnection points that a carrier has to provision and maintain, resulting in reduced cost. Additionally, redundant SIP call delivery provides greater resiliency than legacy TDM, point-to-point circuits, providing improved abilities for calls to be delivered to the ESInet in the event of a network path failure. (In today's network, a failure in the call path to the selective router is likely a fatal failure requiring the caller to redial 9-1-1 and use of a redundant trunk group to the selective router.) Another benefit will be the reduced call delivery time to the ESInet where sub-second call delivery time will become a regular occurrence.

⁴⁴ See CenturyLink announcement: http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1031/DA-14-1590A1.pdf



This capability has the greatest opportunity to be realized when the interconnection points are reduced from 18 selective routers to 6 or less. This is due to the significant labor effort that will be required for each CSP to design and provision new ingress connectivity to the ESInet. This is discussed in greater detail in Section 4.8.2, ESInet Ingress.

4.3.3. 9-1-1 Service and Database Provider Capability

Currently, three service providers supply selective routing and ALI database services in the Commonwealth: CenturyLink, Intrado and Verizon. CenturyLink and Verizon are the long-standing local exchange carriers) in the Commonwealth, with Intrado a new competitive 9-1-1 service provider. Additionally, TCS provides text-to-9-1-1 services for James City County, Martinsville-Henry County 911, Southampton County Sheriff's Office, and York-Poquoson-Williamsburg 911 Center.

4.3.3.1. CenturyLink Capabilities

In the Commonwealth today, CenturyLink provides legacy selective routing and ALI database management services through two pairs of selective routers and a pair of ALI databases. In other markets in the United States, CenturyLink has migrated individual PSAPs and entire states to an ESInet with IP selective routing (IPSR) and ALI services. In these other markets, CenturyLink's MPLS and TDM networks provide transport, with core application functionality provided by their solution partner, Intrado.

On December 4, 2014, MCP conducted a due diligence meeting with CenturyLink via teleconference. CenturyLink shared their NG9-1-1 plans for the Commonwealth. CenturyLink plans to initially offer IPSR/ALI services from two vendors, Intrado and TCS. The routing solution from both vendors will eventually support i3 routing and data services with no defined timeline at this point. These services include project management, network management services, system maintenance, and managed MPLS networks. CenturyLink has successful deployments with Intrado in Washington State and Minnesota, and in counties in Utah and North Carolina. Additionally, CenturyLink has begun the deployment process in North Dakota with Intrado's solution. The TCS IPSR solution will be paired with CenturyLink's ALI solution in North Carolina; it is being beta tested in the state with anticipated completion in the first or second quarter of 2015.

CenturyLink emphasized that the two-vendor approach provides the Commonwealth with options for potentially deploying TCS, Intrado or both solutions under the management and support of CenturyLink. CenturyLink could deploy a TCS solution in one region with an Intrado solution in a neighboring region with interoperability between the two. CenturyLink stated that this approach would provide greater diversity to the Commonwealth in that it further diversifies the routing platforms with a very low chance that all four core systems would be impacted at the same time. CenturyLink states that this would almost eliminate the chance that the Commonwealth would ever be completely out of service. MCP



believes that there is validity to this claim; if the state of Washington had a two-vendor solution, it would not have experienced a complete statewide outage in April 2014⁴⁵.

CenturyLink infrastructure provides 55 data centers across the United States with six in, or within close proximity to, the Commonwealth. CenturyLink was unable to provide additional details regarding the data centers prior to publication of this report. Additional information may be obtained directly from the CenturyLink Virginia account executive.

4.3.3.2. Intrado Capabilities

On December 8, 2014, MCP conducted a due diligence meeting with Intrado via teleconference to discuss their current services and other NG9-1-1 services offerings. Presently, Intrado provides IPSR and ALI services for Franklin County, Pittsylvania County, and Patrick County. Intrado advised that they are deploying IPSR and ALI services for the City of Roanoke, Loudoun County, and Pulaski County, as well as A9-1-1 VIPER[®] services for the City of Roanoke. Additionally, Intrado has deployed, or is in the process of deploying, A9-1-1 TXT29-1-1[®] services for Botetourt County, the City of Norton, the City of Roanoke, Dickenson County, Dinwiddie County, Franklin County, Lee County, Patrick County, Pittsylvania County, Pulaski County, Roanoke County, and Wise County.

Intrado offers a suite of NG9-1-1 services, including a bundled offering named Great Migration. While Intrado's IPSR and i3 routing services include managed IP networks, Intrado advised that they lease carrier-diverse MPLS circuits from major network providers.

Intrado's NG9-1-1 services are branded as Advanced 9-1-1 or A9-1-1. This suite of services includes the following:

- A9-1-1 Routing – IPSR and i3 routing
- A9-1-1 Location Data Management – ALI services including Location Database (LDB), LIS, and CIDB
- A9-1-1 TXT29-1-1 – Text-to-9-1-1 services
- A9-1-1 Data – Supplemental location and caller data services
- A9-1-1 VIPER – Cloud-hosted call handling services
- A9-1-1 GIS data management –GIS public safety data management tool
- Support Services –CAD system integration, performance and metrics call detail, solution delivery management, and single point of contact service
- Great Migration – Bundle of all the above services including Intrado's i3 Guarantee[™]

⁴⁵ <http://www.fcc.gov/document/april-2014-multistate-911-outage-report>



Intrado stated that their LSRG is connected to or in the process of being connected to eight legacy selective routers:

- CenturyLink: Johnson City and Wytheville
- Verizon: Danville and Lynchburg, Fredericksburg and Winchester, Fairfax and Alexandria

Intrado currently operates 22 legacy network gateways (LNG) across the United States. CSPs may choose to interconnect to any LNG on Intrado's network. Intrado stated that they are required to have a point of interconnect (POI) at the ILEC to pick up originating 9-1-1 traffic and for selective router call handoff and transfers. They utilize these POIs for delivering the ILEC's 9-1-1 traffic to the Intrado LNGs in Greensboro and Durham, North Carolina. Additionally, Intrado introduced the concept of a public safety gateway, which is discussed at length in Section 4.8.2.1, Concept of a Public Safety Gateway.

4.3.3.3. Verizon Capabilities

On November 17, 2014, MCP conducted a due diligence meeting with Verizon via teleconference to discuss their NG9-1-1 offerings. Verizon confirmed that they will continue to serve their existing client base with legacy selective router and ALI services until such time as their PSAPs migrate to an ESInet. In terms of NG9-1-1 service offerings, Verizon is focused on offering their core competencies of IP networks, network management services, network security services and data center cloud-hosting services. Verizon may sell these services to NG9-1-1 service providers and systems integrators, but will not provide NG9-1-1 routing and data management services as a prime vendor. Verizon specifically stated that they are focusing on their core competencies and would not resell or sell NG9-1-1 applications or services other than transport and hosting services as a foundation of potential ESInets.

4.3.4. Existing Networks

MCP's research of existing networks in the Commonwealth resulted in a substantial list of potential opportunities for the development of the statewide ESInet. The Commonwealth has many fiber and MPLS network providers to develop a cohesive network connecting regions from the western mountains to Hamptons Roads to northern Virginia and points in between. While some existing local and regional networks may be approached for partnerships in the build out of the ESInet, MCP believes that traditional fiber and network services providers will be required to tie each region together and for providing last mile access to the PSAPs.

Local fiber networks, such as the Rockbridge Area Network Authority (RANA), which operates a fiber network within Rockbridge County, may provide local access to the Rockbridge Regional Public Safety Communications Center (PSCC) and the local first responder agencies. RANA may then be connected to Lumos Networks' statewide fiber network for connecting to regional and state-level networks and data centers. An advantage of using local and regional fiber network providers is the elimination of the costs of reseller agreements that are typically in place when using a single statewide network provider, such as CenturyLink or Verizon. Conversely, while cost savings may be experienced in this specific example, the county then has to work with multiple network providers for managing its transport to access regional and state ESInets, which may be difficult when troubleshooting transport issues; an



advantage to using the major network providers is that they provide a single interface when troubleshooting network issues.

In other state ESInets, such as Alabama's Next Generation Emergency Network (ANGEN)⁴⁶, the transport provider may be a public corporation or alliance of public entities. For ANGEN, their IP network is provided by the Alabama Supercomputer Authority⁴⁷ whose mission is to "provide a professional portfolio of information technology resources and services for the advancement of education, research, and economic development in Alabama."⁴⁸ MCP has seen where other states are also looking at their higher education fiber networks as potential transport for their ESInet. In Virginia, the Mid-Atlantic Research Infrastructure Alliance (MARIA) is an alliance of institutions that is "dedicated to facilitating access to advanced information, instruction, and research infrastructure technology and advancing research and education in the United States."⁴⁹ While MARIA is focused on supporting research and education, they may have excess fibers available for local access to the campus-based PSAPs (e.g., Old Dominion, Virginia Tech, and the University of Virginia). The primary advantage of these public partnerships is that the transport may be offered at a fraction of the cost of regional and state network providers.

MCP's research unveiled several regional fiber network providers who have fiber available in a small regional or multi-regional footprint. In many cases, these regional fiber providers are part of a larger telecommunications cooperative to expand the capabilities and network reach, which enables them to compete with the larger providers like Verizon. For example, LIT Networks is a partnership of four regional Virginia fiber providers, as well as three regional fiber providers serving North Carolina and Georgia. Their networks extend to major peering points, which effectively extends their network nationwide. Figure 12 depicts the LIT Networks partnership.

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⁴⁶ http://al911board.com/sites/default/files/ANGEN10713_FINAL.pdf

⁴⁷ Ibid.

⁴⁸ <http://www.asc.edu/aboutasa/index.shtml>

⁴⁹ <http://www.marialliance.net/our-agencies>

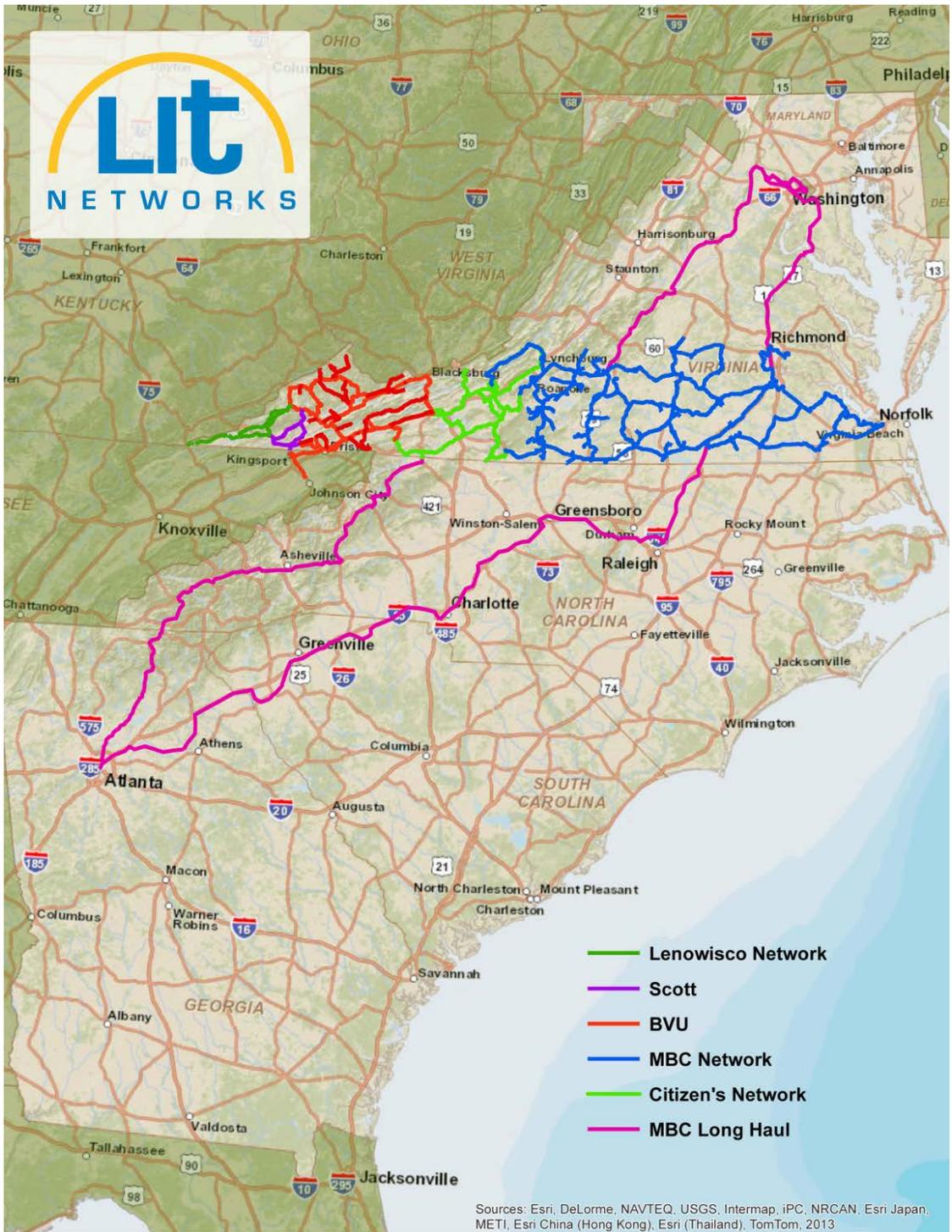


Figure 12 – LIT Networks Partnerships⁵⁰

⁵⁰ Source: http://www.mbc-va.com/content/File/Website_LIT_Static_Map_9-6-2013.pdf



Not only is this map a good example of how Bristol Virginia Utilities (BVU), Citizens Telephone Cooperative, Mid-Atlantic Broadband Communities Corporation (MBC), and Scott County Telephone Cooperative (SCTC) connect within the Commonwealth to extend fiber across all regions, it provides a visual for the type of internetworking that is likely to be required in order to deploy a statewide ESInet.

The existing fiber networks across the Commonwealth provide the potential fabric for a statewide ESInet. Conceptually, an integration of LIT Networks, Shentel, and Lumos Networks with local networks such as the NCR network (NCRnet), New River Valley, and York-Poquoson could capitalize on the support of local network providers, financial viability of using existing regional investments, and the lower costs provided by competitive telecommunications cooperatives. The interconnection of fiber networks and the build out of network routes to each PSAP enables the Commonwealth to have an exact understanding for each mile of its ESInet. This enables the Commonwealth to understand single points of failure, lack of route diversity, and all other network vulnerabilities. When piecing together a network of networks, it is critical that the Commonwealth consider managed network services, as discussed in greater detail in Section 4.5.2.9, Network and Application Management and Monitoring. Table 12 provides a sample of the various network providers in the Commonwealth and the VITA ISP regions that they serve.

Table 12 – Local, Regional, and State Networks⁵¹

Network Provider	Local, Regional, or Statewide ⁵²	Region						
		1	2	3	4	5	6	7
CenturyLink Business	Regional Fiber	x						x
	Statewide MPLS	x	x	x	x	x	x	x
Charter Business	Regional	x				x		
Citizens Telephone Cooperative	Regional				x		x	
LENOWISCO ⁵³	Regional				x			
LIT Networks	Statewide	x	x	x	x	x	x	x
Lumos Networks	Statewide	x	x	x	x		x	x
Mid-Atlantic Crossroads (MAX)	Local							x
MARIA	Statewide	x	x	x		x	x	x
Mid-Atlantic Broadband	Regional	x		x		x	x	

⁵¹ Network provider list is representative of fiber and network service providers in the Commonwealth and should not be construed as a definitive list. A more comprehensive list of providers may be obtained via an invitation to bid (ITB) for network services based on the Commonwealth's requirements, service provider requirements, and data center locations.

⁵² Statewide designation given to providers who serve five or more VITA ISP regions.

⁵³ LENOWISCO serves Lee, Scott, and Wise counties and the City of Norton.



Network Provider	Local, Regional, or Statewide ⁵²	Region						
		1	2	3	4	5	6	7
NCRnet	Local							x
New River Valley Project	Local						x	
RANA	Local						x	
Scott County Telephone Cooperative	Local				x			
Shentel Business	Statewide	x	x	x	x	x	x	x
Summit IG	Regional							x
ValleyNet	Statewide		x	x	x		x	x
Verizon Business	Statewide Fiber ⁵⁴	Unknown						
	Statewide MPLS	x	x	x	x	x	x	x
York-Poquoson Regional Microwave ESInet	Local					x		
Zayo	Statewide	x	x	x	x		x	x

Each network provider will offer varying levels of service with varying levels of capabilities. These nuances will need to be explored with each network provider as the Commonwealth and/or each region conducts due diligence in comparing its specific needs with the network providers' offerings. MCP recommends that in these discussions, the Commonwealth and/or region discuss the minimum recommended network requirements, listed in Table 13, for the development of regional and state-level ESInets. Some requirements may not be applicable depending on whether the solution is dark fiber or a managed network.

Table 13 – Network Provider Requirements

Recommended Minimum Network Provider Requirements
Support for virtual private networks (VPNs), such as IP Security (IPSEC) to all end points
Public IP addresses provided to customer firewalls/edge security devices
Maximum 150 millisecond (ms) round trip time through network with 50ms monthly average measurements taken every 5 minutes, assuming 500 bytes sustained for one minute without packet loss
Support for quality of service (QoS) honoring the bytes provided and not simply passing the QoS markings through unchanged
Virtual local area network (VLAN) support
One-way jitter guarantee of 20ms

⁵⁴ Verizon fiber route maps were unavailable. Statewide fiber is assumed to be available in all regions due to Verizon's extensive LEC footprint and their claim of almost 20,000 fiber route miles in the Commonwealth. Source: http://www.verizon.com/about/community/va_technology.html



Recommended Minimum Network Provider Requirements
Packet loss of less than one-half of 1 percent (<0.5%)
99.999 percent network availability; defined as having cumulative service downtime not to exceed 5.26 minutes per year
Security provisioned at physical and application layers
24/7 single point of contact to troubleshoot and resolve network issues
Trouble ticketing system
In case of network issue, response time of 15 minutes or less for notification of issue ⁵⁵
Provide the client, or its designee, with the ability to monitor last mile IP network via Simple Network Management Protocol (SNMP) alarms
Detailed change management process, including alerting the customer of upcoming maintenance windows
If the network provider is going to provide the entire network infrastructure including edge security, those devices need to be able to support SIP and Real-time Transport Protocol (RTP) across a Network Address Translation (NAT) boundary

When working with the various network providers, the Commonwealth and/or regions need to review the potential overlay of all network providers to enable the maximum level of network route path diversity. Core systems that are located in data centers and host sites must have the appropriate bandwidth capabilities for serving its determined footprint of PSAPs and to allow for the additional traffic generated by the failure of another data center. Ultimately, the network engineers from the solution provider and the network provider will have to collaborate to confirm needs, bandwidth requirements, network access, and overall system design.

Alternatively, an end-to-end network may be procured from a single provider, such as Verizon, CenturyLink, or others. The procurement of the ESInet transport from a single provider simplifies the responsibilities of the Commonwealth and its ISP regions. The network provider will be responsible for connectivity to each defined end point at the prescribed bandwidth per location. The network provider will be responsible for all maintenance and monitoring of the network including dispatch of resources to fix issues. The challenge that is often experienced with these network solutions is that the Commonwealth may have limited insight to the route paths, potential route diversity issues, and potentially an incomplete understanding of their network vulnerabilities. This is a key requirement that should be written into invitation to bid (ITB) requirements and contracts, and carried through in network implementation. (Appendix C contains an ITB template.) The Commonwealth's understanding of its operational needs, with input from each region, will guide the decision on what network solution will be best for providing transport for the ESInet.

Due to the recent "sunny day" outages within the 9-1-1 industry over the last few years, the FCC has issued a Policy Statement and Notice of Proposed Rule Making (NPRM) regarding 9-1-1 governance

⁵⁵ This enables the Commonwealth or its managed services provider to determine if the issue is an FCC reportable issue and submit an initial notification to the FCC.



and accountability.⁵⁶ In paragraph 67 of the NPRM, the FCC seeks comment regarding the roles and responsibilities of the 9-1-1 transport provider, with the 9-1-1 transport provider defined as the entity responsible for the delivery of calls to the PSAP. MCP recommends that the Commonwealth review the NPRM, make comment as appropriate, and follow the proceedings resulting from this NPRM, as it has the potential to have major ramifications on the Commonwealth's requirements for ESInet networks and 9-1-1 transport.

4.4. CONCEPTUAL SOLUTIONS

As the Commonwealth considers the deployment of a statewide ESInet, there are multiple conceptual solution designs that may be implemented, including staying as the Commonwealth operates today in a mixed legacy environment with pockets of NG9-1-1 deployments. Each solution design presents its own set of benefits and challenges and the weighted value of those must be considered and balanced by the localities, the regions, and the Commonwealth. Table 14 provides a description of the conceptual solution designs available to the Commonwealth and their corresponding benefits and challenges.

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⁵⁶ FCC 14-186, http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1121/FCC-14-186A1.pdf#page=27



Table 14 – Benefits and Challenges of Conceptual Design Solutions

Conceptual Design	Description	Benefits	Challenges
Status Quo	<p>Status quo is a model where CenturyLink and Verizon continue to provide legacy selective routing and ALI services. Competitive 9-1-1 service providers, such as Intrado, will provide pockets of NG9-1-1 solutions.</p> <p>Use of existing networks by competitive 9-1-1 service providers is possible.</p>	<ul style="list-style-type: none"> • Easy • Established cost model • No change to operations 	<ul style="list-style-type: none"> • Inability to integrate new services • Limited data sets • Limited interoperability • Slow call set-up time • Inability to share systems
Buy/Own/Operate	<p>The buy, own and operate model is one where a region or the Commonwealth will procure the transport, network equipment, and all the i3 functional elements. The respective entity will host those systems in their own facilities or lease space from data center providers. The region or Commonwealth is responsible for 24/7 operation of the system or it may outsource these services to a third-party.</p> <p>Use of existing networks is probable.</p>	<ul style="list-style-type: none"> • Complete control of system • Challenge to budget due to new features that often require new hardware and software licenses • Must understand high availability design 	<ul style="list-style-type: none"> • High up-front costs • High support personnel costs • Staffing requirements <ul style="list-style-type: none"> ○ Initial training ○ On-going training ○ Cost of support staff turnover • System maintenance • Unknown system maintenance costs • Availability of public safety-grade host sites • Typically, the highest total cost of ownership
Locally-hosted Service	<p>A locally-hosted service model would align very closely with traditional selective routing and ALI services models where an NG9-1-1 service provider would host their core components within the Commonwealth and potentially within the region they serve. The solution would be provided in a service-based model</p>	<ul style="list-style-type: none"> • Similar comfort level as legacy systems with local or regionally hosted systems • Predictable, level costs for duration of contract • Majority of NG9-1-1 vendors offer this solution • Low impact to PSAP and VITA staff 	<ul style="list-style-type: none"> • 100% dependency on vendor transparency • Availability of public safety-grade host sites • Typically, a higher total cost of ownership



Conceptual Design	Description	Benefits	Challenges
	<p>where all the system would be owned by the service provider.</p> <p>Use of existing networks is possible.</p>	<ul style="list-style-type: none"> • Moderate scalability • No additional costs for software and hardware upgrades 	
<p>Cloud-based Service</p>	<p>A cloud-based service model may host very few elements within the Commonwealth. LNGs, LSRGs, and LPGs are possibly the only elements that might be physically located within the Commonwealth, with the possibility of none being hosted in state.</p> <p>The solution would be provided in a service-based model where all the system would be owned by the service provider.</p> <p>Use of existing networks is possible.</p>	<ul style="list-style-type: none"> • Rapid deployment • Predictable, level costs for duration of contract • Majority of NG9-1-1 vendors offer this solution • Low impact to PSAP and VITA staff • Greatest chance of providing the PSAPs, regions or Commonwealth the power to enforce service level agreements (SLAs) or any other contractual agreement, especially after the service provider has been paid for initial implementation • Greatest scalability • No additional costs for software and hardware upgrades 	<ul style="list-style-type: none"> • 100% dependency on vendor transparency • For best pricing, a commitment to PSAPs in each region or state-level is required • Interfacing with administrative lines, CAD, logging, and other systems must be addressed in the solution design • May require a single vendor solution for best price, which could be a political challenge • Stringent SLAs required • Well written contract must include feature updates for new standards • Monthly pricing varies significantly; challenge to estimate without design • Sufficient services in all rural areas would need to be determined • Typically, the lowest total cost of ownership



Figure 13 depicts the conceptual design of a “network-of-networks” solution within the Commonwealth, which includes a state-level ESInet, regional ESInets, direct connect PSAPs, and a public safety gateway.

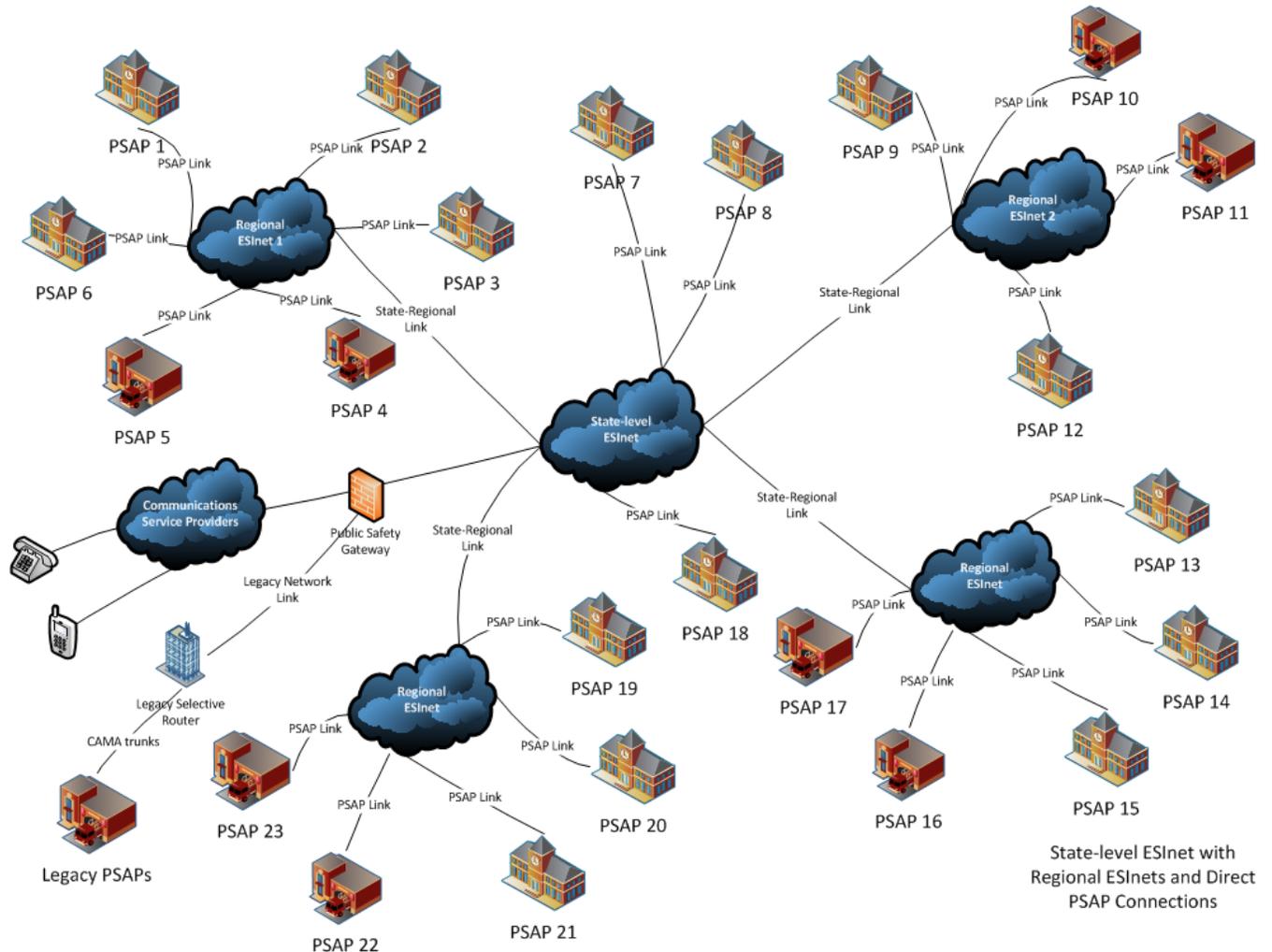


Figure 13 – Network-of-networks

MCP recommends that each region determine the best solution design for itself and then procure and deploy that solution. For example, a hosted SaaS model may be very appealing to the rural western portion of the Commonwealth due to the lack of public safety-grade host facilities in the region. Additionally, the ability to support a “Buy/Own/Operate” model in a rural region would be difficult due to a more limited pool of highly technical network engineers to staff as compared to a high tech region such as the NCR.



4.5. NETWORK DESIGN CONSIDERATIONS

It is generally accepted that, regardless of network topology, fiber optics is the preferred method for connectivity due to available capacity (bandwidth) and increased reliability. Given the amount of fiber optic facilities and interconnections between those fiber optic networks in the Commonwealth, the statewide ESInet design should include as much fiber as possible, not only on the transport side, but on the access side as well. A number of providers have Fiber to the Premise (FTTP) deployments. A short list includes: Verizon, Lumos Networks, Bristol Virginia Utilities, and Scott County Telephone Cooperative. Some providers may offer both the Active Ethernet for business-class service and passive optical network (PON) for residential. Depending on how one traces out the routes, there are several possible transport rings overlaying the Commonwealth. There is currently access to long-haul interstate transport to Maryland, Pennsylvania, Kentucky, Tennessee, and North Carolina. This becomes important when considering future interconnections to other states' ESInets, and also offers options for geographically diverse data center locations.

The only bandwidth limitation with a fiber network is the equipment used to terminate the fiber and the distance between equipment. Long-haul transport fiber networks typically have a regeneration (regen) site every 80 kilometers (km). There is no speed degradation associated with the regen site. In the access portions of the network (from the central office to the PSAP), optics are available for distances up to 80km. Typical breakpoints are 10km, 20km, 40km, and 80km, but individual equipment manufacturers may offer different distances. Depending on the equipment initially selected, upgrading the link from 1 gigabyte (GB) to 10GB may be a change of optic modules, an additional card and optics, or simply a few configuration changes. Incremental changes (100 megabyte [MB] to 300MB, for instance) are typically a simple matter of provisioning and are not usually service affecting. In most cases, provisioning the capacity changes can be accomplished with little to no downtime. Given the resiliency of a ring design, downtime on a given segment of the ring should be transparent to callers and PSAPs.

Redundancy and resiliency are two key characteristics of a public safety-grade network. Redundancy is the concept of having no single point of failure in the network, be it a link, a router, a switch, a firewall, or any other component that is critical to maintaining the flow of traffic across the network. Resiliency refers to the speed with which the redundant component becomes active after a failure of the primary component.

Redundancy is achieved at the physical network layer through ensuring route diversity on all circuits, including the entrance points to any given facility. This is commonly referred to as an "east-west entrance." This is mandatory for any data center or POI location, and optional for most PSAPs. Large PSAPs, based on either the number of positions or the call volume, should have east-west entrances and physical diversity to upstream facilities where technically feasible. In some cases, this may require circuits from two different service providers. It will be important in any case to specify that the two routes not have any poles or trenches in common.



At the equipment level, there are two approaches to redundancy, one for the data centers and one for the PSAPs. In the data centers, the routers and switches should be chassis-based, service provider-grade devices with hot-swappable, redundant power supplies, processor cards, and interface cards. The chassis are typically designed for a 15-year or more service life, allowing the service provider to upgrade individual components as needed; typically every three to five years or as new features are required. At the PSAP level, installing dual routers and LAN switches will provide the necessary redundancy levels. The smaller access switches and routers used in the PSAPs should be replaced roughly every five years.

While there are many excellent network equipment vendors that each conform to recognized standards, there can sometimes be a slight difference in the implementation of those standards. For this reason, mixing of vendors should be avoided, especially within and between data centers. While equipment inconsistencies can be worked around, they will add unnecessary complexity and cost to a statewide IP network.

Resiliency is achieved through the use of routing protocols that allow for fast packet rerouting. This also requires the use of another protocol that monitors the link status on a given device. Two routing protocols commonly used in provider networks are Open Shortest Path First (OSPF) and Border Gateway Protocol (BGP). Proper tuning of both protocols, in conjunction with the use of Bidirectional Forwarding Detection (BFD), will provide failover times in the sub-50 ms range, which will be transparent to callers and call takers.

It is recommended that Virginia's statewide ESInet have three to five Tier 3 or better data centers located strategically around the Commonwealth, with a minimum distance of 100 miles between the centers. Tier 3 data centers are recommended as they provide for IT equipment to have dual power sources, individual distribution paths, and concurrent maintenance, meaning that the power, circuits, HVAC, and other redundant systems may undergo planned maintenance without an impact to the IT equipment. Tier 3 data centers are designed for providing 99.982 percent expected availability.⁵⁷ When meshed across multiple instances with 100 miles or greater distance in between to provide geographic diversity, 99.999 percent availability may be achieved. Three to five centers will allow for N+1, N+2, or greater solution architecture, where N equals the minimum set of equipment required to provide for 100 percent capacity. Most NG9-1-1 systems provide for N+1 architecture. N+2 or greater architecture capabilities will have to be explored with potential solution providers.

The data centers will house the i3 services, and also may be used to house a hosted call handling solution if acquired separately from the i3 systems. To provide for geographic diversity, possible locations include Fairfax, Herndon, Richmond, Norfolk, Charlottesville, Lynchburg, Danville, Roanoke, and Bristol, depending on facility availability. Consideration should also be given to locating one or more data centers in adjoining states. While gaining improved geographic diversity of the solution, data centers located out of state will require interstate ingress trunking to LNGs hosted in those facilities. For

⁵⁷ TIA-942-A Telecommunications Infrastructure Standard For Data Centers



the foreseeable future, many CSPs will continue to require distance-sensitive TDM connectivity to LNs. This issue will gradually diminish as standards are developed and CSPs upgrade to IP-based call delivery to the ESnet.

4.5.1. *Physical Network Designs*

The network drawings in the sections that follow show backbone connections as 1GB to 100GB. The standard optical interface speeds are 1GB, 10GB, 40GB, and 100GB. Service providers' network backbones are typically 40GB, and many service providers are upgrading to 100GB as it becomes feasible for them to do so. This is merely an indication of the physical connectivity, not the proposed or purchased bandwidth on those links. One of the underlying design principles of an NG9-1-1 network is the ability to easily and rapidly adjust bandwidth to changing needs. For example, the 9-1-1 authority may contract for 100MB to start, ramping up the bandwidth as traffic increases.

4.5.1.1. State Ring Design

The state-level ring should be a fiber optic data network with a capacity of 1GB–10GB initially, expandable as required. Figure 14 shows a high-level view of the state ring. The backup network is depicted as a wireless network, but in fact it may be any IP-capable network. At this level of the network, the backup network would typically be fiber or microwave.

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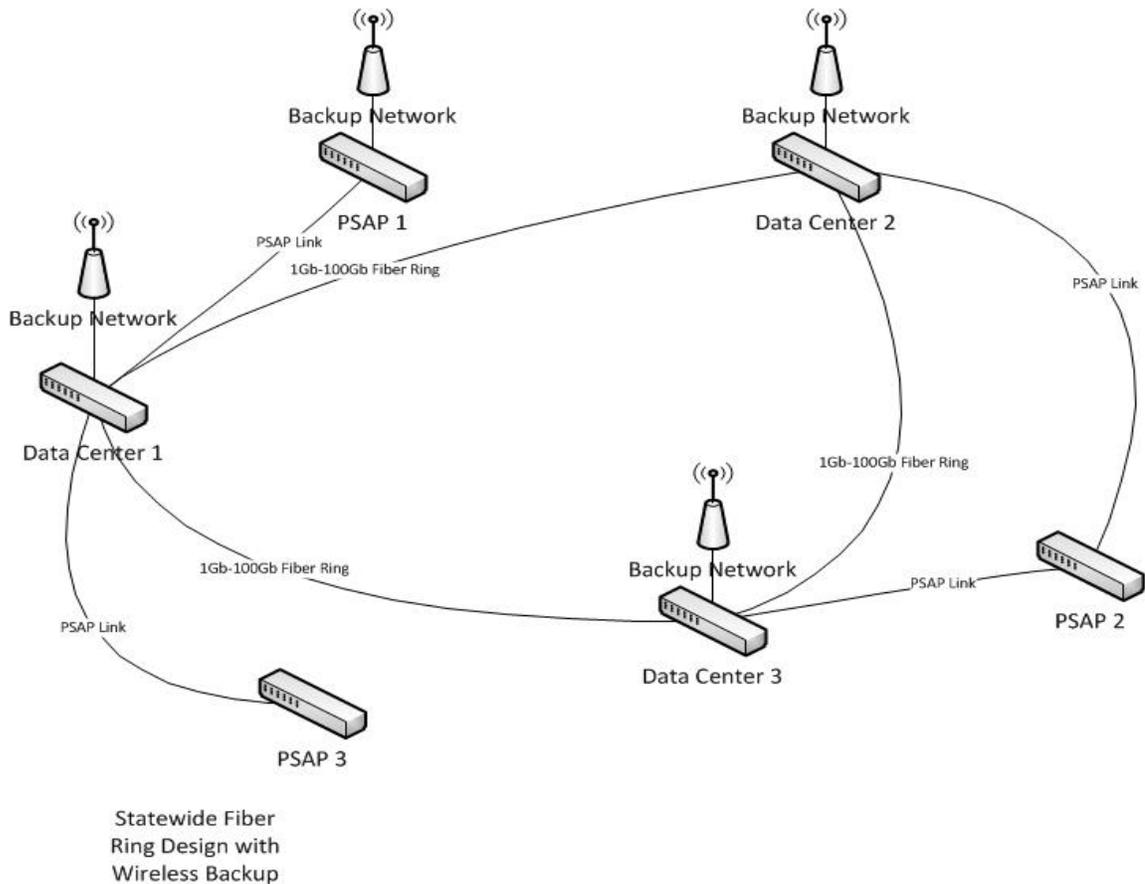


Figure 14 – Statewide IP Network Ring

Cable TV providers typically have extensive hybrid fiber coaxial (HFC) networks, with a fiber backbone feeding distribution cabinets from which the coax connects to the premises. These providers may have fiber plants in areas of the Commonwealth not otherwise covered by another service provider’s fiber network. Many cable providers offer an assortment of high capacity business services over the spare fibers in their backbone, often building fiber from the nearest node to the customer’s facilities. As a general rule, subscribed services below 10MB are delivered over copper, and those 10MB or greater are delivered over fiber for the last mile. These networks could serve as either primary or backup links in some areas.

Figure 14 above illustrates the ring design with PSAPs directly attached to it. The drawing also illustrates three possible backup scenarios: wireless backup (PSAP 1), a primary connection via fiber or T1 backed up by a physically diverse fiber or T1 link (PSAP 2), and no redundant circuit or service (PSAP 3). To the maximum extent economically and technically feasible, fiber optic connectivity should extend all the way to the PSAP, and each PSAP should have a physically diverse backup link.



In Figure 14, PSAP 3 does not have a redundant circuit. This is illustrated simply to make the point that the backup for some PSAPs may be through the PRF in the i3 services, the ESInet equivalent of a make-busy switch or a phone call to the selective router operator to reroute calls. Some PSAPs, rather than incur the cost of a redundant circuit, may choose to simply have their traffic rerouted to a neighboring PSAP.

4.5.1.2. Hub and Spoke Design

In its most basic form, the hub and spoke design is simply a single connection from the core network location to the PSAP. There is no inherent redundancy or resiliency in the design. Figure 15 illustrates the basic hub and spoke concept, with the addition of backup network links at selected PSAPs.

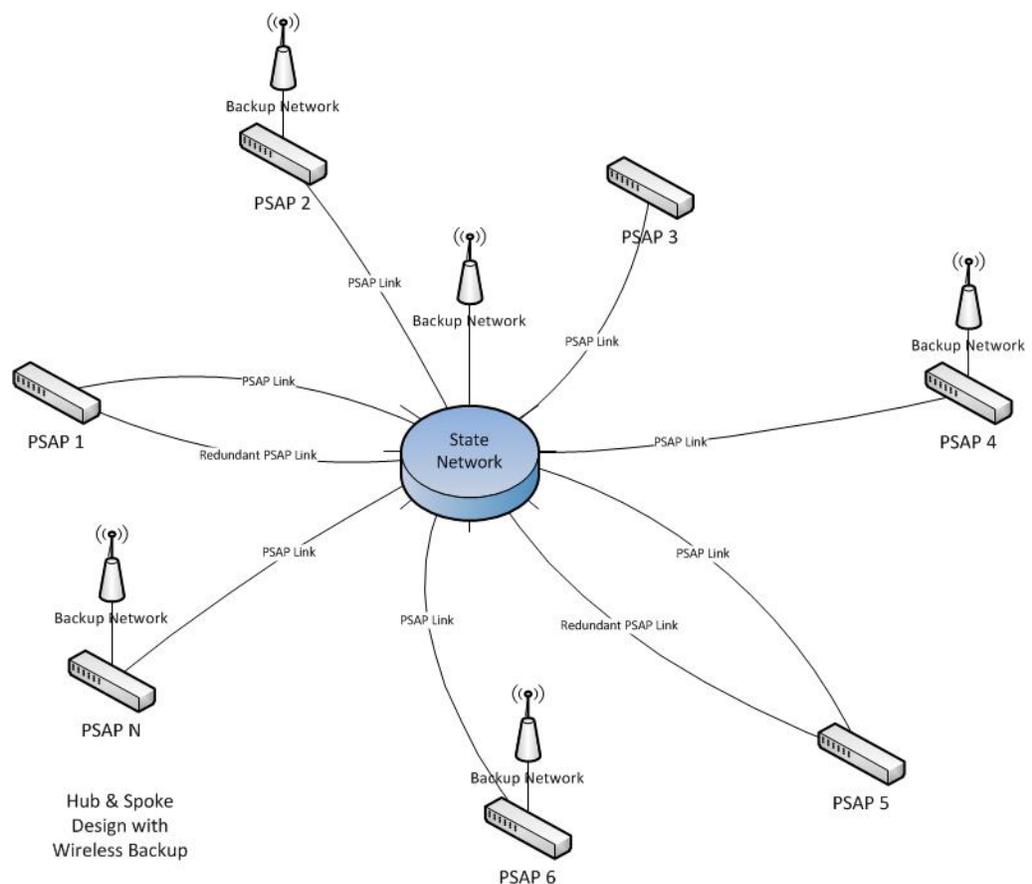


Figure 15 – Hub and Spoke

The complete failure or isolation of the hub location can and likely will bring down the entire network. Hub and spoke is not an optimal design to meet the stringent public safety-grade network requirements. Without some guarantee that the primary and redundant links are physically diverse, the only real



protection afforded by a backup link in this design is against failure of a physical port. To further improve redundancy and resiliency, a second core network location would have to be added to the design. Doing so takes the network from a hub and spoke design to a hybrid ring design.

4.5.1.3. Multiple Ring Design

The multiple ring design is an expansion and enhancement of the state ring design. The state ring forms the heart of the network, and becomes the “network of networks.” Figure 16 illustrates the hierarchy of networks from PSAP to regional to state-level ESInets. It also shows that individual PSAPs may connect directly to the state network in the event it is not economically feasible or technically possible for them to connect to a regional network. The drawing also illustrates three possible backup scenarios. Wireless, which may be in the form of point-to-point, microwave, or 4G LTE, is a viable backup solution, as shown for PSAP A. PSAP B has no redundant circuit or service. The regional rings are shown with a primary connection via fiber backed up by a physically diverse fiber link. To the maximum extent economically and technically feasible, fiber optic connectivity should extend all the way to the PSAP. The backup network may be any IP-capable media.

The scenario for PSAP B, no redundant circuit, is illustrated simply to reinforce the point that the backup for some PSAPs may be through the PRF in the i3 services, the ESInet equivalent of a make-busy switch or a phone call to the selective router operator to reroute calls. Some PSAPs, rather than incur the cost of a redundant circuit, may choose to simply have their traffic rerouted to a neighboring PSAP.

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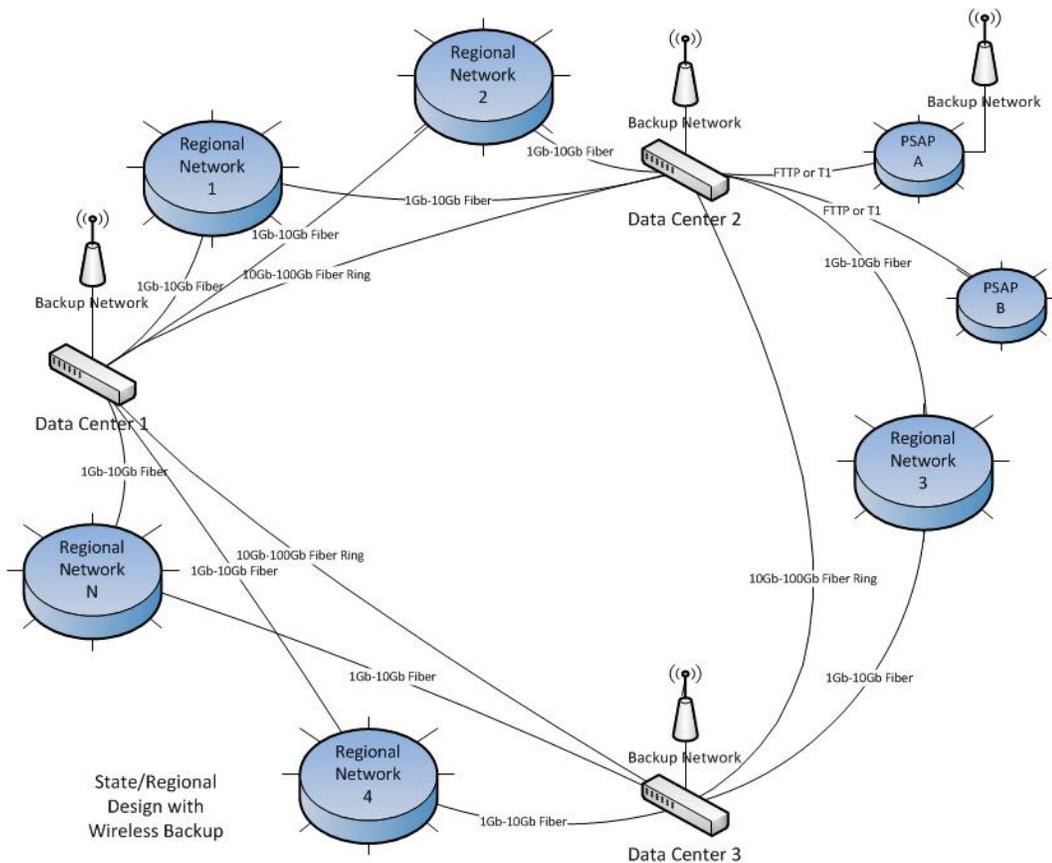


Figure 16 – Multiple Rings

The regional rings will be small-scale versions of the statewide ring. While a complete ring through all participating PSAPs in a given region is preferred, the reality is that there will be PSAPs where this is not feasible for either technical or financial reasons. This concept is similar to the illustration in Figure 16, where these outlying PSAPs connect to one or more state-level data centers. These PSAPs may only be able to have a single connection to the regional ring, or may be better served by connecting directly to the state-level ring. The idea behind showing both options is simply to demonstrate the flexibility of the ESInet, and to reinforce the idea that, within governance and security best practices, one of the primary underlying design principles is to get the PSAPs the best connectivity value for the best cost.

Network-of-networks

In a statewide “network-of-networks” deployment, many different providers will be involved in the installation and interconnection of circuits. The hierarchical design depicted in Figure 17 shows the various levels of the network, but it is a simplified view. Consider that there will likely be seven regional rings, each with two connections up to the state-level ring, and each with connections to 6–24 PSAPs.

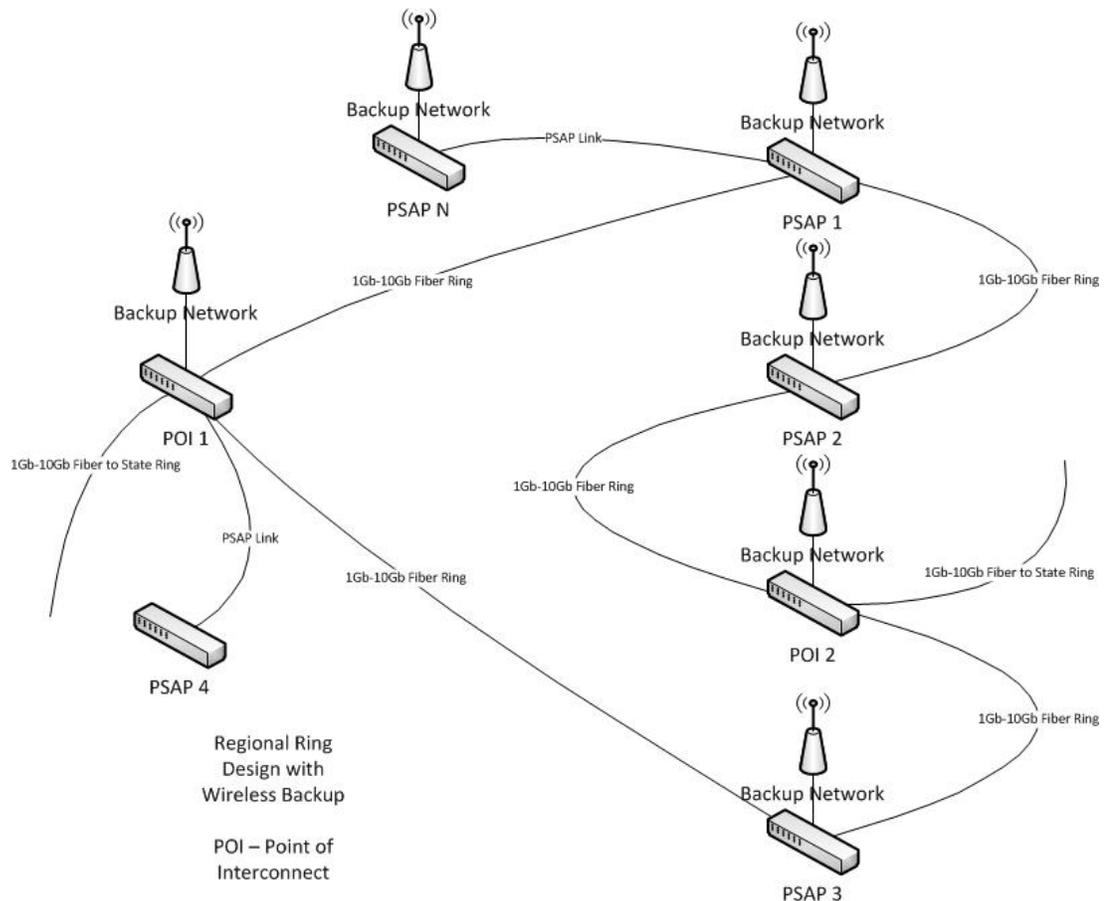


Figure 17 – Regional Ring Detail

Redundancy and resiliency are important characteristics of an ESInet. Redundancy is achieved through geographically diverse routes for network links, and dual routers or switches in the PSAPs, POIs, and data centers. Resiliency is achieved through the use of fast packet reroute protocols such as BFD and fine-tuning of the underlying routing protocols such as BGP and OSPF. Given the nature and typical Layer 3 design of an ESInet, control of these routing protocols will be of paramount importance to preventing routing loops and still providing the shortest path between any two nodes and the desired resiliency.

System integration and project management will be critical aspects of the implementation phase of the ESInet. Even though there will be many service providers involved, there must be one entity that oversees the entire project. This entity may be one of the responding service providers or a third-party. Whether it is a service provider or third-party, a key element of their response should be their adherence to the ITIL service delivery management model. Change management is discussed in greater detail in Section 4.5.2.9, Network and Application Management and Monitoring.



4.5.1.4. Meshed MPLS Design

Meshed MPLS networks are widely implemented by service providers, particularly those with mixed copper and fiber networks. This network type allows service providers to deliver connectivity using the best circuit at a given location, and link all circuits together in a method that is transparent to the customer's network. Figure 18 illustrates such a network. The service provider has a core network of Provider Edge (PE) routers, usually interconnected in a mesh or ring topology. The Customer Edge (CE) routers connect via a variety of circuits to the PE routers. Unless the customer specifies that no two CE routers in a given area may be connected to the same PE router, it is very likely that this will happen. Also, in the case of T1s connecting the CE and PE routers, the circuits to neighboring PSAPs may actually be multiplexed together to the same physical DS3 or OC3 port on the PE router. To meet the redundancy and resiliency requirements of a public safety-grade network, the 9-1-1 authority must specify that adjacent PSAPs or those that back each other up may be served by the same card or port on a given PE device. It is preferable that they not be served by the same PE device, but that may not be practical in some cases.

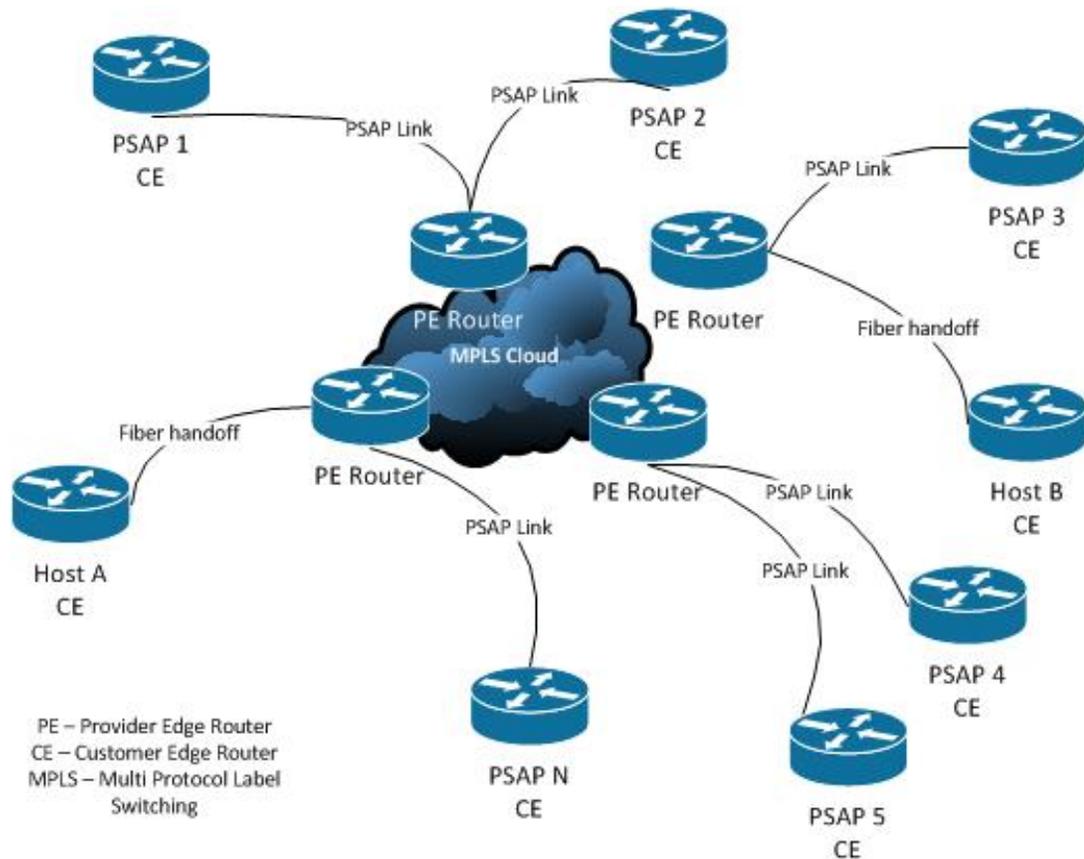


Figure 18 – Meshed MPLS



The PE routers undergo configuration changes every time a customer circuit is added. Although the major service providers have change management policies and procedures in place to minimize errors, mistakes happen. A single mistyped character can bring down the wrong circuit, Virtual Routing and Forwarding (VRF) group, or interface card. The VRF groups are the private network groups that isolate customer traffic from other customers. Also, software updates are more frequent on routers than on other service provider network equipment. Although manufacturers are improving the upgrade process, there is typically downtime associated with an upgrade, as well as the possibility of the upgrade failing for reasons unknown and bringing down the router.

There is a direct connection between the provisioned design of the network and maintenance issues. For mission-critical networks, it is important that the service providers involved understand that to the extent possible, they must provision in such a manner to avoid provisioning neighboring or related sites to a single PE router. In a statewide network, it is very likely there will be some meshed MPLS elements due to technical limitations in some geographical areas. As-built drawings provided by vendors should include the device name and port information of each PE router in the ESInet MPLS cloud, and the PSAP served.

Leased MPLS Circuits

Regardless of the ultimate network design, there will likely be some MPLS circuits required to reach certain PSAPs, either as a primary or backup link. These circuits will be leased from the provider having overall responsibility for the network, but they may traverse several providers between their origin and destination. A key part of as-built documentation should be full disclosure of all service providers traversed by a given circuit, be it one or many providers. This should be recorded for each circuit in the network.

4.5.2. Network Operations

4.5.2.1. Virtual Local Area Networks

A VLAN allows network administrators to isolate traffic at Layer 2 (data) of the Open Systems Interconnection (OSI) model. Since the overall network view from the Commonwealth will be at Layer 3 (network), this section primarily applies to the data centers, and should be included in the requirements for the regional data centers.

MCP recommends the implementation of multiple VLANs at each data center partition the network by functionality: Active Directory (AD) and Domain Name Service (DNS), CAD, automatic vehicle location (AVL), automatic vehicle route recommendation (AVRR), radio/voice recording, 9-1-1 call taking CPE, and network services (e.g., antivirus, monitoring, trouble ticketing, etc.). VLAN design may be influenced by future security policies and procedures, especially when considering compliance with the Criminal Justice Information Services Division (CJIS) Security Policy.



VLAN Design

Industry standards provide for up to 4,094 VLANs in a domain. Some equipment vendors have limits on how many of those can be trunked on one interface. How an organization chooses to manage their VLAN structure is less important than the task of implementing and maintaining the VLAN information in a sensible, logical manner. Once implemented, VLANs tend not to change drastically. One common method is to block off the VLANs, reserving blocks for backbone traffic (10 percent), network services (10 percent), applications (10 percent), facilities (10 percent), customers (30 percent), partners (15 percent), and providers (15 percent). The percentages are estimates and are presented as a starting point. Usual practice is to number from the core of the network out; beginning with low numbers on the backbone and moving to the highest numbers for customers, partners, and providers. Table 15 depicts an example of VLAN reservations.

Table 15 – VLAN Reservations

VLAN	Purpose
2–400	Network core and backbone traffic
401–800	Network service and applications
801–1200	Facilities
1201–2400	Other agencies
2401–3000	Partners
3001–3600	Service providers
3601–4094	Reserved

The VLANs could also be broken out by region, and within the regions, by functions as described above. For example, VLAN 1000–1399 to Region 1, 1400–1799 to Region 2, and 1800–2199 to Region 3, etc. Within each region, the VLANs would then be divided in a manner similar to Table 15, with a certain percentage assigned to each function or facility.

As an example, Table 16 depicts what VLAN assignments might be made in the network; this list is not exhaustive.

Table 16 – VLAN Assignments

VLAN	Assignment
3	FiberRing1
4	FiberRing2
99	Management (device management IP addressing)
401	AD/DNS/Dynamic Host Configuration Protocol (DHCP)
402	IP Recording
403	CAD
404	AVL/AVRR



VLAN	Assignment
405	CPE Servers
451	Network Services (antivirus, monitoring, trouble ticketing, etc.)

The internal VLANs will have associated router interfaces to allow traffic to move between them as required. Access lists should be implemented to regulate the internal traffic, allowing only the traffic pertinent to a given VLAN into or out of that VLAN. Since ACLs depend on IP addresses and are assigned to VLAN interfaces, the actual ACL configuration will occur after the VLANs are set up and the interfaces configured.

The use of multiple VLANs also limits the impact of problems by allowing portions of the network to be isolated without taking down the whole network. Additional VLANs should be used outside the firewalls for interconnection to partner agencies and service providers. These would not have routing interfaces associated with them on the switches as that would be handled by the firewalls and SBCs controlling access to those demilitarized zones (DMZs). In the example in Table 15 above, the VLANs numbered 1201 through 3600 would reside outside the firewalls and SBCs since they are connections to outside agencies. With over 4,000 VLANs available, there should be no need to reuse VLAN numbers on each side of the firewalls even though this is technically possible.

VLAN Management

Management of VLANs is important. Best practice dictates that VLAN 1 is never used for user traffic. By default, it handles spanning tree protocol (STP) traffic (and STP's newer variants, Rapid Spanning Tree [RSTP] and Per-VLAN Spanning Tree [PVST]). This traffic is vital to controlling the switch's behavior at Layer 2. While it can be used as a management VLAN, best practice is to have a separate management VLAN. The reserved block at the end results from rounding so the boundaries end on even numbers.

VLAN information should be maintained in a database or spreadsheet. Some IP Address Management (IPAM) systems also have the ability to manage VLAN information. MCP believes open source packages similar to [IPplan](#) would be able to handle VLAN management. If not, VLAN management is typically a small task and a spreadsheet will suffice.

4.5.2.2. IP Addressing

Closely related to VLAN design and management is IP address design and management. MCP recommends using private⁵⁸ address space internally and publicly routable IP address space in the DMZs for connections to partners and providers. VITA will need to determine if it has sufficient public IP

⁵⁸ Request for Comment (RFC) 1918, Address Allocation for Private Internets. <https://tools.ietf.org/html/rfc1918>



version 4 (IPv4) space available or if they will need to request space from the American Registry for Internet Numbers (ARIN). Public IPv4 space is very limited.

All network devices will be assigned static addresses. Dynamic address assignment creates security holes. This is discussed in more detail in Section 4.5.2.6, Network Services.

IP Subnetting

The private block 10.0.0.0/8 is a good starting place for IP addressing, and breaking it into supernets (/16, /18, or /20) by county will help keep the core routing tables to a minimum. Additional private address blocks that may be used are 172.16.0.0/12 and 192.168.0.0/16.

One way to manage the space would be to use state and county Federal Information Processing Standards (FIPS) codes to break up the address space. The state FIPS code for Virginia is 51, and the counties are numbered with odd numbers starting at 1. Because the FIPS codes for cities and other governmental subdivisions begin with numbers outside the legal range of IP addresses, those entities could be assigned in the even-numbered block above the county. An example is Bedford County, whose FIPS code is 19. The city of Bedford (FIPS code 515) would then use 20 as the third octet of the IP address. Table 17 depicts an example of assignments in the 10.0.0.0/8 block.

Table 17 – IP Subnet Assignments

IP Network Address	Assignment
10.0.0.0/16	Network Backbone
10.1.0.0/16	Data Center 1
10.2.0.0/16	Data Center 2
10.51.1.0/24	Accomack County
10.51.3.0/24	Albemarle County
10.51.19.0/24	Bedford County
10.51.20.0/24	City of Bedford

The example in Table 17 is not exhaustive, and the listed supernets would actually be subnetted further into appropriately sized networks, typically Class C (/24). MCP recommends using private address space where address limitations are not a concern. For a frame of reference, a /8 network contains 256 /16s and a /16 contains 256 /24s.

IP address management can quickly become cumbersome, especially in a large, statically addressed network. It is highly recommended that an IPAM system be implemented for a statewide ESInet. Based on information provided on its website and prior staff experience, MCP believes open source packages similar to [IPplan](#) would be able to handle both IPAM and VLAN management. There are also a number of commercial packages available. If VITA has already implemented IPAM, the ESInet governing body may be able to use that, depending on the licensing terms.



IPv6 Addressing

It is not advisable to run IPv4 and IP version 6 (v6) stacks at the same time on the same network for extended periods (only during conversion from IPv4 to IPv6). This is primarily due to the processing and memory overhead required for supporting both stacks in a given device. However, any network equipment or system procurement Requests for Proposals (RFPs) must specify that the systems and software being procured must support IPv6.

Given the scope of devices affected by migrating to IPv6 and the administrative details of acquiring routable blocks, verifying equipment functionality, operating system support, etc., this needs to be its own project. A list of tasks should include:

- Developing the project plan for the conversion
- Documenting systems and software for IPv6 compliance
- Replacing incompatible equipment and software (could spawn more projects)
- Preparing DNS for conversion
- Acquiring IPv6 address space
- Allocating the address space to VLANs (IP address database)
- Defining static address requirements
- Developing the conversion Methods of Procedure (MOPs)
- Setting up a test VLAN and running through the conversion MOP
- Converting live VLANs

Updating system documentation was not included as a discrete step as that is something that should be a part of almost every item listed above.

4.5.2.3. Uniform Resource Identifier Taxonomy

URI taxonomy, or format, is discussed in the *Detailed Functional & Interface Specifications for the NENA i3 Solution – Stage 3*, and specifications for generic URI formats are given in RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*. The general format is as follows:

Agency-Jurisdiction-Type@State.XX.US.

An example of the URI syntax for Accomack County is: ACCOMACK-CO-SO@State.VA.US

If Accomack County is part of a larger organization such as an emergency communications district, the URI would have the district identifier first, then a hyphen, followed by the sample text above. There is no Jurisdiction identifier for cities and towns. Using Bedford County and City as an example yields the following:



BEDFORD-CO-SO@State.VA.US
BEDFORD-PD@State.VA.US

Example jurisdiction and type identifiers are shown in Table 18.

Table 18 – URI Taxonomy

Identifier	Type
CO	County
SO	Sheriff's Office
PD	Police Department
FD	Fire Department
EMS	Emergency Medical Services
EOC	Emergency Operations Center
TNG	Training

4.5.2.4. IP Routing

The primary network view of the statewide ESInet should be at Layer 3. Routing protocols are necessary to control traffic and ensure packets reach their proper destination by the most expeditious route. MCP recommends the use of OSPF combined with BFD as the routing protocol for internal routing on the network. The BFD addition brings fast packet reroute down to the order of 50–100 ms in the event of a failure. For external routing, MCP recommends using BGP. These protocols are the primary protocols used by service providers and large enterprises, and the skillsets required for planning, configuration, and implementation are widely available.

Open Shortest Path First Routing Protocol

Because OSPF floods routing updates to all routers in the network, areas are used to reduce the size of the routing updates and restrict them only to the affected area(s). Thus when adding networks to OSPF, it is necessary to assign them to an area. The area number is 32 bits long and may be expressed as an integer or in dotted decimal format like an IP address. Thus area 0 and area 0.0.0.0 are equivalent, as are area 51 and area 0.0.0.51. Area 0 (0.0.0.0) is always assigned to the backbone (core) area and then other area numbers are assigned outward from there. In a large network such as a statewide ESInet, it will be simpler to manage the dotted decimal format. Much like the VLANs, the OSPF areas should be broken up into network and transport areas, and server or service areas.

OSPF is configurable for fast packet reroute. This, in conjunction with BFD, can dramatically improve network resiliency over a basic OSPF configuration. This high level of resiliency is a key attribute of a robust ESInet.



Another important option to consider is authentication, which provides a means for a router to verify its neighbors' identities and ensures that a rogue router cannot be easily inserted into the network and poison the routing table. It also protects against "man-in-the-middle" attacks in which someone sends malicious packets in an attempt to disrupt normal routing. MCP recommends MD5 authentication as the keys are not transmitted in clear text across the network. Even though the keys are not transmitted in clear text, it is vital to maintain their physical security. OSPF supports authentication at both the area and interface level.

Bidirectional Forwarding Detection Protocol

BFD is a protocol designed to provide notification of outages to routing protocols in milliseconds rather than the seconds or minutes normally required for the router to become aware of a problem and reroute traffic. It functions at Layer 2 and provides notification to higher protocols, such as OSPF and BGP, to trigger a reroute of traffic. When properly tuned, it is possible to get failovers in the 50–100 ms range on Ethernet links, which is necessary in the critical networks supporting 9-1-1 calls and services. In this range, a route change is imperceptible to either the caller or the call taker.

Border Gateway Protocol Routing Protocol

BGP is normally used to route between unrelated networks, as in the Internet. MCP recommends using BGP for routing outside the ESInet. As with OSPF, implementation of MD5 authentication with neighboring routers is highly recommended. The "man-in-the-middle" attack is a common form of BGP attack, forcing BGP session resets. Each neighbor should use a different key. As previously mentioned, the MD5 keys are not transmitted as clear text across the network, and it is vital to maintain the keys' physical security.

BGP uses the Autonomous System Number (ASN) to determine the best path to a destination. Since BGP will be used to connect to outside networks, public ASNs issued by ARIN will be used. However, BGP is also used for MPLS connections and in that case private ASNs are used. These are typically assigned by the service provider managing the MPLS network. If multiple MPLS clouds exist within the network, the private ASNs will need to be coordinated by the network administrators.

Multicast Routing

All routers and switches must support multicast routing and switching. The applicable base protocols are Internet Group Management Protocol (IGMP) and Protocol Independent Multicast (PIM). These protocols handle the routing of join and leave requests for the multicast streams across both local and wide-area networks. IGMP version 3 (IGMPv3) is the most current version and is defined in [RFC 3376](#). This RFC was amended by [RFC 4604](#), which added Multicast Listener Discovery (MLDv2), the equivalent functionality for IPv6. There are four varieties of PIM: sparse mode ([RFC 4601](#)), dense mode ([RFC 3973](#)), bidirectional mode ([RFC 5015](#)), and source-specific mode ([RFC 3569](#)). Multicast uses IPv4 Class D address space from 224.0.0.0 to 239.255.255.255.



The basic theory of multicast is that a stream is broadcast on the network once, and whoever needs to listen to that stream sends a request to join it. This reduces bandwidth utilization since multiple listeners can join the same stream without impacting network bandwidth utilization. Multicast is widely used in IP video distribution systems, since each channel only appears on the network once no matter how many people are watching it.

4.5.2.5. Security Considerations

MCP recommends that all router and switch ports that are not in use be explicitly shut down, and that trunk and access ports be explicitly configured for the VLANs allowed on those ports. Ports should also be limited to a single Media Access Control (MAC) address for added security. If it is necessary to allow multiple MAC addresses on a single port, this should be handled as an exception and documented through change management. The primary reason for needing multiple MACs on a single port would be to use a network sniffer in troubleshooting a problem. An alternative would be to turn up a temporary port on the core switch and span it to the port under test.

The ESInet will have interconnections with other agencies via encrypted connections. As part of building an ESInet, the state-level network authority should require direct connections (still firewall-protected) from their partner agencies to DMZs established solely for partner agencies at each data center. To the extent possible, these connections should be via fiber rather than copper to keep the physical network as uniform as possible, and allow for maximum network flexibility and expansion. The traffic would thus not cross the public internet, though it should still be encrypted. This will also allow the agencies to better maintain QoS classing across their networks.

A firewall and SBC are all that is currently required to accept IP traffic, both VoIP and data (multimedia, text, pictures, etc.), from service providers. Although this traffic could come through the same DMZ as partner agency traffic, for added security, service provider traffic should be handled through a separate set of DMZs at each data center. The service provider DMZs could exist on the same physical piece of equipment as the partner DMZs. The SBCs should be service provider-grade or at least chassis-based with power, processor, and interface redundancy. The SBCs and firewalls must be in place before the statewide IP network can host the IPSR functionality.

Some wireless companies offer a private data network service across their 3G/4G data service. Verizon Wireless, for example, refers to it as Private VPN, though it is really more of a VLAN service in that it isolates traffic from other users' traffic on the network. Performance is the same as its commercial wireless data service, but security is enhanced because the traffic is not visible to other users. The network can be designed to separate the traffic of the individual agencies if desired. Agencies could each have their own VPN or could operate in a larger regional VPN. The service uses customer-supplied private addressing. There are some limitations on QoS with certain wireless service providers, which will present problems with the VoIP streams. If this type of service is implemented as a backup anywhere in the ESInet, the connections between the service provider and the ESInet will have to be made through firewalls for security purposes.



Figure 19 illustrates partner and service provider connections to the ESInet via redundant, resilient firewalls located at the data centers. For simplicity, only three data centers are shown.

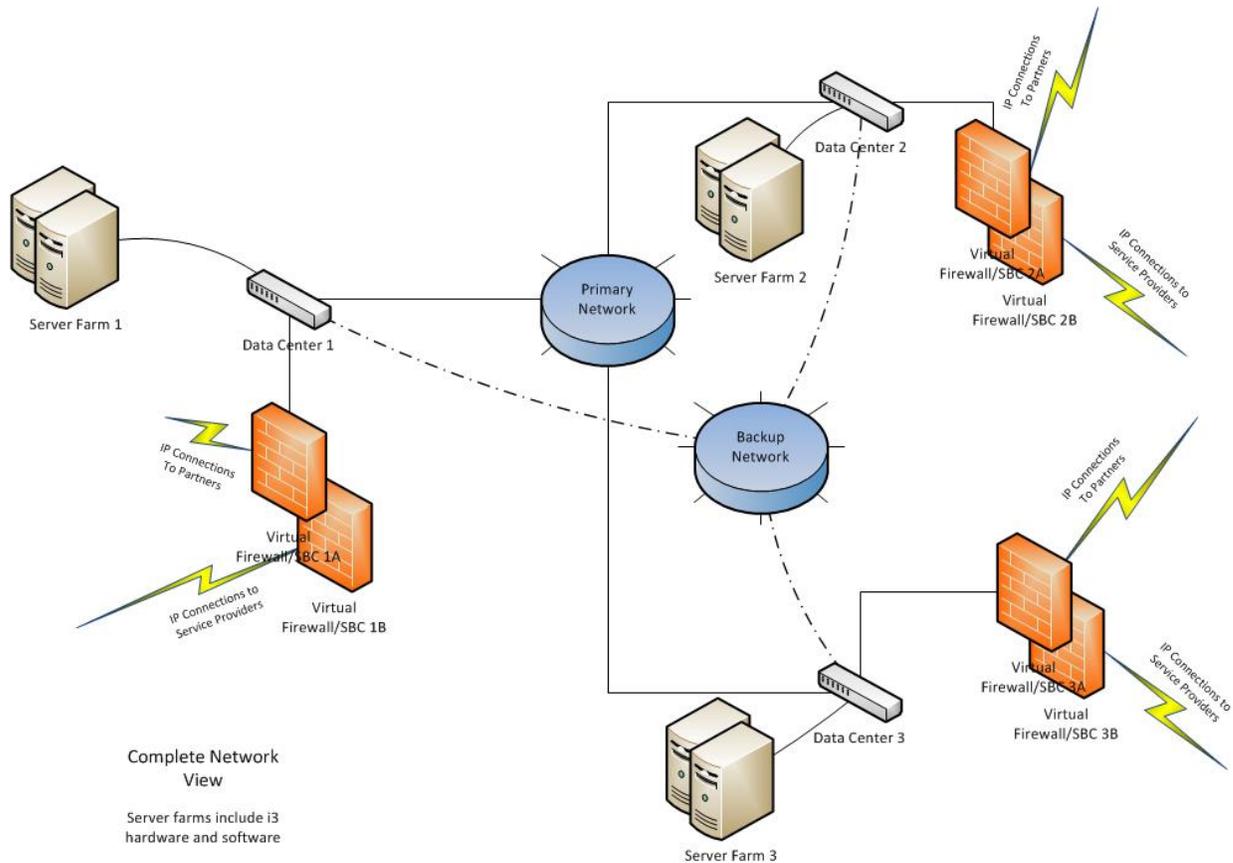


Figure 19 – Complete Network Overview

4.5.2.6. Network Services

Domain Name Service

DNS is a system for naming servers, components and network services in an ESInet, and is a core network service that must be supported. The DNS should be standardized for enabling the hierarchy of regional and state-level networks to translate user-friendly agency identifiers to its IP address. An example of an agency identifier is psap.stafford.va.us for Stafford County Sheriff's Communications, which in turn will have a discreet IP address on the ESInet.

DNS is best implemented using the Linux operating system and open source software such as ISC's [BIND](#) (DNS) package. Server virtualization systems easily support virtual Linux servers, and allow for



very resilient network services. An alternative would be to evaluate network appliances to implement this service. A network appliance is simply hardware and software that are closely integrated and configured to do one thing well, such as DNS/Dynamic DNS (DDNS). These appliances are typically built around Linux and the ISC BIND package.

Simple Network Management Protocol

SNMP is the underlying protocol for transmitting management information such as alarms, resource utilization, network, and server statistics to one or more management systems that translate the data to usable information such as alarm notifications, bandwidth utilization graphs, and processor utilization graphs. Version 3 of SNMP (SNMPv3) is the latest release and added cryptography and configuration enhancements. For optimal security, this should be the version implemented. The applicable RFCs are [RFC 3411–RFC 3418](#); SNMPv3 is also known as [Standard 62](#). MCP recognizes that not all devices that may require monitoring will support version 3, and there are workarounds that may be implemented to protect version 2 from attack.

Other Common Network Services

Other common network services include email, web hosting (HTTP/HTTPS), File Transfer Protocol (FTP), AD⁵⁹, Secure Shell (SSH), and Network Time Protocol (NTP). Email, web hosting, FTP, and AD require a server in order to provide the service. Active Directory is a Microsoft Windows operating system service that manages network login and access to resources in the Windows environment. There are similar services in the Unix/Linux environment. SSH and NTP run as processes on servers for access and time synchronization purposes, respectively. SSH provides, at the command line level, secure remote access and file transfer capabilities for maintaining servers and the software running on them.

NTP synchronizes the i3 components and system servers' clocks to a time standard, usually a network clock device (netclock) with an Ethernet interface. These netclocks typically receive their synchronization signals from a global positioning system (GPS) satellite or similar radio signal. There are also NTP sources available via the Internet, but for the purposes of the ESInet, internal netclocks are recommended at each data center. These netclocks can also provide time synchronization to the PSAPs, either as the primary or backup clock.

As a security best practice, only the services that are required for a given server to function and be accessible for management purposes should be enabled on systems. For instance, SSH is preferred over telnet for command line access on servers. Telnet should be disabled on the server(s), and the access lists for that VLAN should block it, but allow SSH to pass from allowed address ranges.

⁵⁹ Active Directory



4.5.2.7. State-level Data Centers

This section is intended as guidance should VITA decide to own and operate the systems behind the i3 services and/or call handling solutions. It should also serve as guidance for vendors implementing either of the above under an SaaS model.

The network and i3 services are provided by an array of firewalls, routers, gateways, and servers. The servers may also include SAN or Network Attached Storage (NAS) devices, which are high-capacity, redundant, resilient hard drive storage systems. These are the devices that will be housed in the VITA data centers. If VITA decides to co-locate hosted CPE solutions for the localities in these centers, those systems will also be comprised of similar equipment.

The data centers should meet Tier 4 standards as detailed in ANSI/Telecommunications Industry Association/Electronic Industries Association ([ANSI/TIA/EIA 942](#) Data Center Standards, but at a minimum must meet Tier 3 standards to be considered a viable location. The ultimate goal for the Tier 3 data centers should be to upgrade to meet Tier 4 standards. The data centers must be a minimum of 100 miles apart for good geographic separation in case of a widespread disaster.

Cabinets and Power Distribution

For data center square footage and height requirements, plan for racks that are 30 inches wide times 48 inches deep times 84 inches high (30"Wx48"Dx84"H) with 19-inch spacing of the mounting rails. The rails should be centered in the cabinet. This allows the installers to neatly dress the cables on the left and right sides of the equipment as appropriate. This size cabinet provides 45 rack units (RUs) of space. Many equipment vendors ship rack rails that snap into square holes in the cabinet mounting rails; this should be kept in mind when specifying racks and mounting kits. To accommodate devices without snap-in rails, caged nuts and matching machine screws are available in both #10-32 and #12-24 thread. Threaded mounting rails are also available with standard threads of #10-32 and #12-24. The #12-24 is preferred for all equipment and required for the heavier chassis-based routers and switches such as the Cisco 7600 series or the Brocade MLX series.

The front and rear doors should be vented. Switches and routers should be specified with front-to-back rather than side-to-side air circulation. If this is not possible for some reason, the cabinets should have fans in the top capable of moving the hot air out of the cabinet. There should be a minimum of two top-mounted fans. Otherwise, a mesh top may be sufficient. The extra space inside the cabinet (roughly 5.5 inches on each side) allows room for power and data cable management, and most rack vendors have internal cable management options for their racks, which should be considered in any RFP.

Many options are available for power distribution units (PDUs) for providing power inside the rack. At a minimum, the PDU should be remotely manageable via SNMP, and provide load information back to the network management system (NMS). Given the wide geographic dispersion of the data centers, it is recommended that VITA require PDUs with individually controllable outlets. This will allow the network operations center (NOC) to remotely power-cycle equipment that may be otherwise unresponsive.



Though these are typically twice the price of PDUs that do not have individual outlet control, the ability to remotely power-cycle equipment quickly becomes cost effective as opposed to the alternative of having to dispatch technicians each time the equipment needs to be power cycled. This should be coupled with remotely accessible console servers to allow console access into devices in the data centers. Power cords should be labeled with their source and destination.

Some system vendors will try to package their system in the shortest rack possible. As part of any RFP, it is advisable to specify a particular model cabinet or equivalent, subject to approval of the cabinet specifications, in order to maintain a standard data center design. The 9-1-1 authority should also standardize on one PDU vendor.

Data and Power Cabling

Cable color coding and labeling in the data centers is strongly recommended. When faced with bundles of cables all the same color, tracing becomes difficult if not impossible. When labeling, there are many choices for how to do so. For instance, TIA-606 lays out a complete marking standard for data centers using a 2-foot grid of the room and designating each square with letters and numbers starting at AA01. All cabinets, racks, patch panels, and devices within the cabinets and racks should be identified and labeled front and rear.

Whether the 9-1-1 authority uses TIA-606 or an in-house standard, the real issue comes not at installation, but as things change over the years. It is very important not only to label in the beginning, but to maintain the correct labeling through additions, moves, and changes. From a governance standpoint, this should be a part of the change management process. A key component of standard methods is labeling both ends of the cable with the source and destination. Color coding of cables is also recommended, and a sample color code appears in Table 19. Avoid yellow and orange for twisted pair cables as these are standard colors for single mode and multimode fiber, respectively. One other cautionary note when choosing colors: grey and purple are referred to as slate and violet by cable manufacturers.

Table 19 – Cable Color Code

Function	Color
Primary Data	Red
Secondary Data	Green
Management	Black
Serial	Blue
Console	Violet
Voice	Slate

The primary and secondary data refer to dual Ethernet network interface cards (NICs) in a given server or storage device. Management refers to Ethernet management ports typically found on routers,



switches, gateways, servers, and network appliances. Serial refers to any serial traffic other than serial consoles; an example would be ALI links (during the transition period). Console cables are any serial console port, not Ethernet. Voice could be either legacy TDM voice circuits or dedicated gateway ports for VoIP traffic.

Proper spacing, typically greater than four inches, should be maintained between data and power cables. Data and power cables should not run parallel to each other; however, this does not apply to fiber optic cable. Fiber optic cable and jumpers should, to the extent possible, be run separately from twisted pair cable to avoid the possibility of physical damage. Where this is not possible, the fiber optic jumpers should be protected with split cable loom (a corrugated plastic sleeve) or spiral wrap. This method of protection should also be used at any point in the cable management system where the fiber transitions from one ladder rack or cable trough to another ladder rack or cable trough. Cable transitions to or from a ladder rack should be via a cable dump over the side, not through the rungs of the ladder rack.

4.5.2.8. Servers and Software

This section is intended as guidance should the 9-1-1 authority decide to own and operate the systems behind the i3 services and/or call handling solutions. It should also serve as guidance for vendors implementing either of the above in an SaaS model.

The physical servers should be running a virtual server environment such as VMware or Citrix, which extends the redundancy and resiliency to the software level. The same theory applies to the hard disk storage systems. Implementing a SAN or NAS brings redundancy and resiliency to the data storage components.

Server and Storage Hardware and Software

Server virtualization and network storage systems, either SANs or NAS, provide a more robust environment than discrete servers. Building a server environment around multicore servers, highly redundant SAN/NAS systems, and virtualization software will make for a very robust, fault-tolerant server infrastructure. Vendors typically implement systems in the Unix/Linux operating environment for security reasons. There are some that use tightly controlled versions of Windows Server.

Each SAN or NAS must have the ability to provide backup services to the devices in their neighboring data centers. This is usually a separate license from all the other pieces required, and needs to be specified in an RFP. Some systems may require another type of backup license for databases as well.

Just as a replacement schedule was noted above for switches and routers, server hardware should be replaced every 3–5 years. Old servers may be relegated to less critical uses within the network, such as lab systems. Software should be upgraded as recommended by the vendor, pursuant to testing requirements implemented under strict change management controls.



Server Installation

The servers will be installed in the racks mentioned above. It is recommended that one empty RU be left between devices in the racks. This allows for some air circulation around the devices in the case that one overheats. Some systems will be pre-racked from the manufacturer or integrator. In either case, all devices in the racks need to be labeled front and back with their device name. This name will be used in the power and data cable labeling as well. It is also important from the maintenance perspective, especially for remote data centers where someone tasked to be hands-on support may not be intimately familiar with the systems. In the case of pre-racked systems, this labeling requirement should be specified in an RFP.

4.5.2.9. Network and Application Management and Monitoring

Network and Application Management

Network and application monitoring will require significant attention. Having both internal and external entities, and potentially other ESInets, adds complexity to the level of monitoring that public safety ESInets require. It will be important that all ESInet, i3 call handling, and i3 service providers have a clear understanding of the interworking and management requirements. As neighboring states' ESInets are connected to the Virginia ESInet, part of the governance plan will need to address this just as it will address interconnections with networks within the Commonwealth.

There will be a number of entities involved in building the network. Each will have their own monitoring and management system for their infrastructure, their own NOC for trouble tickets and reporting, and their own operating policies and procedures for the aforementioned. VITA should select a single entity to have overarching monitoring and management responsibilities for the ESInet. This includes monitoring out to the call taker workstations at the PSAPs, preferably with full access to the workstations, but at least at the level of being able to monitor if a workstation port is available or unavailable. The selected entity, be it a service provider or public agency, must maintain a trouble ticketing and change management system for tracking and reporting outages and changes. The selected entity also must be prepared to handle the issuance of Reason for Outage (RFO) reports when outages occur.

While this is primarily a governance issue, it bears mention because of requirements related to change management and its various aspects. The management and monitoring vendors must provide the following services and supporting documentation:

- Maintain a 24/7/365 NOC
- Provide Levels 1, 2, and 3 technical support
- Provide a service portal for opening trouble tickets, and checking status of existing tickets
- Provide statistics including, but not limited to, uptime, latency, jitter, packet loss, bandwidth utilization, and Mean Opinion Score (MOS) via a web portal
- Provide documented escalation procedures



- Provide documented change management procedures
- Provide monthly trouble reports showing tickets opened, resolved, and unresolved
- Provide regular change reports showing changes requested, approved, completed, in progress, and failed/backed out
- Issue RFOs within a reasonable time to be determined

Vendors should also provide critical network services to other customers similar in nature to 9-1-1 such as governments, hospitals, or financial institutions. Change management is an important aspect of network and application monitoring and management. Vendors must demonstrate a grasp of the concepts of change management as well as explain their implementation of change management policies, processes, procedures, and systems. Figure 20 below illustrates the principle aspects of change management as implemented under the ITIL model.



Figure 20 – Aspects of Change Management



Monitoring Plan

As Virginia reviews monitoring capabilities, it should be evaluating tools and services from two perspectives. One perspective is to review what will be required for VITA to effectively monitor their system. VITA will need to review hardware and software capacity on existing management system(s), software licensing requirements, reporting capability versus needs, alerting requirements versus existing capabilities, and staffing (both NOC and support staff). There will need to be SLAs in place between VITA and the monitoring agency. The other perspective is for VITA to contract this as a service from an outside entity. In that case, some of the system-level concerns go away, but are replaced with security concerns since the entity will require access to the entire network. The NOC, support, alerting, and reporting issues will need to be addressed through SLAs. Reporting is also an issue, as the reports offered will need to be reviewed, and it is likely some new reports will be required.

If Virginia elects to extend i3 services and i3 call handling CPE capabilities to other entities, then the reporting and alerting concerns change as these entities will require additional capabilities. In addition, deploying NG9-1-1 and other public safety-related applications across networks requires that interworking governance agreements, processes, and procedures be developed for monitoring the network before any live NG9-1-1 calls are handled at a PSAP where Virginia is extending their services. Table 20 highlights monitoring considerations.

Table 20 – Monitoring Information

Monitoring Considerations	Comments
Devices with which VITA will be connecting	In instances where the Commonwealth is connected to other entities, written processes and procedures for discovery and documentation of added devices, and documentation of when devices are taken off-line or changed, must be captured and agreed upon as part of the contract or agreement.
Multiple applications and protocols	Applications are implemented across servers, which are connected to various gateways and other devices. NG9-1-1 requires that the Commonwealth have a strategy for real-time monitoring of network traffic congestion, equipment problems, services availability, security violations, application availability, etc., across the LANs and wide area networks (WANs) in real-time or as close to real-time as can be provided to the system administrator. This strategy may incorporate managed services providing monitoring and management services for some or many of the elements of the total NG9-1-1 solution. As the Commonwealth evaluates these NG9-1-1 solution elements, it will be necessary to determine whether self-maintained or managed services are in its best interest. Most entities find that having a third-party entity manage all or a significant portion of these elements with SLAs is more cost-effective than developing and staffing their own NOC. Even if the Commonwealth utilizes managed services, a system administrator will need to be available to provide support and monitor vendors and service providers.



Monitoring Considerations	Comments
	Because NG9-1-1 technology involves multiple applications, these application vendors will most likely desire the ability to both connect and have access to not only their software, but related hardware elements. This is usually part of their support and maintenance and their contract should include SLAs to which their performance should be evaluated.
Shared information	As the Commonwealth extends services to other entities, the governing body will need to determine what information will be shared with those entities. The processes and procedures for providing information and notification to those entities must then be developed and made part of any contracts and agreements. Thought must be given to how VITA will mitigate breaches of SLAs with their providers. Consequences for breaches of SLAs should be spelled out in the RFPs and subsequent contracts.
Hardware and software faults and alarms	Notification processes of hardware and software faults and alarms will need to be thoroughly described and understood. Scripts for communicating with entities will need to be developed.
Network QoS	VITA will require processes and procedures for end-to-end monitoring of network QoS features. Clearly, 9-1-1 calls have a priority over map updates, for example. As VITA reviews the implementation of NG9-1-1 functions, many of the functions will require that QoS be evaluated and given a priority value. Likewise, if the Commonwealth looks at extending other applications, such as call recording/logging and others, QoS will need to be evaluated and monitored iteratively, as there may well be uncompressed voice traffic. A different priority may be given for recording the call than for re-playing the call, for example.
Bandwidth	9-1-1 voice traffic can experience significant peaks when there is an event, such as a hurricane, train wreck or large fire. The ability to dynamically adjust bandwidth and traffic should be considered along with other capabilities that will help avoid network saturation.
Reporting	The perception of the system administrator's ability to monitor the network will be greatly impacted by communications and information sharing processes. The system will require the ability to provide timely reports on network status, malicious network activity, and other information.

Management Software

Software packages are widely available for capturing, analyzing, and reporting the network health based on the SNMP traffic it receives.

There are a number of commercial packages such as SolarWinds, Monolith, and OpenView, as well as many full-featured open source packages such as OpenNMS, Nagios (primarily for servers), and Network Management Information System (NMIS). Prices on commercial packages vary greatly, and



features usually vary with price. Also, commercial packages usually have some sliding scale of price versus number of devices monitored.

Vendor Considerations in Monitoring Plans

NENA i3-compatible call handling and i3 services vendors will use their monitoring and managed services as a critical component of their SLAs. Vendors must provide documented evidence of their policies, processes, and procedures for monitoring and managing their systems. Any RFPs and vendor contract negotiations will need to clarify vendor network access requirements. Likewise all i3-compatible call handling and i3 services vendors must be aware of each other and the various entities that may require read-only status of their components.

When considering the products and services of potential i3-compatible CPE vendors and i3 service vendors, critical network elements such as security must be kept in mind. Requirements that can impact providing secure services for all entities may impact the viability of a vendor being considered as a potential product or service provider.

Though many vendors are reluctant to share management information, it is recommended that VITA require at least read-only access to the management information from the CPE and i3 systems to feed into the VITA management system.

4.6. PUBLIC SAFETY-GRADE CONSIDERATIONS

Public safety-grade is a term loosely used to describe the expectations of users for the availability of services delivered by a network, be it land mobile radio (LMR), legacy TDM, or an ESI-net. The National Public Safety Telecommunications Council (NPSTC) in their [*Defining Public Safety Grade Systems and Facilities*](#) report dated May 22, 2014, defines public safety-grade as "...a conceptual term that refers to the expectation of emergency response providers and practitioners that their equipment and systems will remain operational during and immediately following a major natural or manmade disaster on a local, regional, and nationwide basis."⁶⁰

The definition of public safety-grade should be regarded more as a collection of other definitions, best practices, performance metrics, and SLAs for each component that makes up the entire system under discussion.⁶¹ The NPSTC report was written for FirstNet, and included LMR systems, but the concepts and recommendations presented in it are applicable to any public safety communications system including ESI-nets, as well as the systems and services on the ESI-net. The following subsections discuss the concepts that generally encompass public safety-grade: security, reliability, survivability,

⁶⁰ "Defining Public Safety Grade Systems and Facilities," National Public Safety Telecommunications Council report, May 22, 2014, page 2 of 123.

http://www.npstc.org/download.jsp?tableId=37&column=217&id=3066&file=Public_Safety_Grade_Report_140522.pdf

⁶¹ Ibid.



redundancy, resiliency, and diversity. It is worth noting that the end results of reliability and survivability are heavily influenced by the application of redundancy, resiliency, and diversity during network and system design and deployment.

4.6.1. Security

Security covers a wide range of areas, from physical security of facilities, personnel, and equipment, to logical security of the network, servers, and applications. Attacks may focus on destruction, corruption, removal, disclosure, or interruption of facilities, data, and communications. Monitoring of the security and access systems is an important consideration as well. Cameras should be monitored 24/7 in the NOC, and security personnel should routinely review logs of the access control systems and network security devices for any anomalies.

Security also includes thoroughly vetting personnel with access to sensitive areas and information, protecting those personnel, and training them on various aspects of security such as social engineering, and agency policies and procedures.

Data security primarily involves logical protections such as firewalls, SBCs, VPNs, usernames and passwords, access permissions, and data encryption. There is also a physical aspect such as locking server cabinets, removing console cables from equipment, disabling use of removable media on workstations, and protecting communication services access and entry points.

Physical destruction of information or communications systems renders them unusable. Some forms of physical destruction are difficult to protect against, such as tornadoes, hurricanes, floods, and bombs. Proper facility design principles and construction methods can greatly reduce the risks associated with losing a given building. Construction of a hot backup facility mitigates some of the risk. A hot backup facility typically has all systems available at a moment's notice to assume the duties and functions of the primary facility.

Critical communications networks and systems should also be designed with a hot standby architecture. Systems should be implemented using virtual server designs with redundant, resilient hardware configurations. The underlying virtual server management software, when properly configured, detects failures and takes action to recover from them with little or no interruption in service. From a network perspective, implementing multiple routers and switches with physically diverse facility entrances and properly tuned routing and forwarding protocols mitigates the risk of destruction of any given node on the network. These measures also apply to interruptions of communication systems and networks. Interruption is the intentional interference of communications such that legitimate users cannot send or receive messages.

Corruption is the changing of information such that it is no longer accurate or useful. Most operating systems implement some form of error detection and correction to recover from data corruption caused by a hardware or software failure. From a security standpoint, data backups are the primary protection



against intentional data corruption by outside actors. Backup systems should provide several levels of backup, including allowing for offline backups.

Removal is the copying and subsequent deletion of information so that it cannot be accessed, but is not destroyed. Basic data security measures should include ensuring authorized users have only the level of access to data required for them to perform their duties, disabling removable storage devices on workstations, and restricting physical access to systems. These measures also apply to disclosure, the unauthorized release of confidential or sensitive information to the detriment of the owner or subject of said data.

Federal Bureau of Investigation (FBI) CJIS standards are designed to protect sensitive information. Like many security standards, the [CJIS Security Policy](#) covers management, operational, and technical security requirements. CJIS standards apply to any law enforcement connection to the National Crime Information Center (NCIC) and other federal law enforcement systems. It lays out roles and responsibilities for partner agencies.

Transport Layer Security (TLS) is an encryption protocol used to secure transmissions between two points. It establishes an initial connection using public keys, then exchanges private keys to encrypt the actual user data being exchanged. Version 1.2 is defined in [RFC 5246](#), and amended by [RFC 6146](#). It is commonly used in web browsers, mail clients and servers, and many other applications.

The National Institute of Standards and Technology (NIST) has published two standards applicable to NG9-1-1. [FIPS 140-2](#)⁶², *Security Requirements for Cryptographic Modules*, specifies the security requirements that will be satisfied by a cryptographic module utilized within a security system protecting sensitive but unclassified information (which may apply to most 9-1-1 information). In addition, in February 2014, NIST published a [Framework for Improving Critical Infrastructure Cybersecurity](#) consisting of standards, guidelines, and practices to promote the protection of critical infrastructure. This document provides an excellent source of information for the cyber security design, implementation, and operations and monitoring of an ESInet.

NENA's standard [75-001](#), *Security for Next-Generation 9-1-1 (NG-SEC)*, identifies the basic requirements, standards, procedures, or practices to provide the minimum levels of security applicable to NG9-1-1 entities. Published in February 2010, this standard is under revision.

Other security standards should be evaluated, including: [ISO/IEC 27001:2013](#), published by the International Organization of Standardization, details the process to plan, establish, implement, operate, monitor, review, maintain, and improve a service management system. Also, the North American Electric Reliability Corporation (NERC) established [Critical Infrastructure Protection \(CIP\)](#) standards to address the security of cyber assets essential to the reliable operation of the electric grid.

⁶² A revision, [FIPS 140-3](#), has been developed, but not yet officially released.



4.6.2. Reliability

Reliability is usually expressed in terms of percentage of system up-time. Each component or subsystem should have its own up-time rating or requirement. The overall system reliability will only be as good as the weakest component. The goal of a system or network design of this nature is to have no single point of failure. To that end, redundancy, resiliency, and diversity are the design characteristics that contribute to network and service reliability, by providing equipment, links, paths, and methods to take over quickly in the event of a failure or attack.

4.6.3. Survivability

Survivability is the ability to ensure that users continue to receive the services expected from the network. Redundancy, resiliency, and diversity are design characteristics that contribute to survivability by allowing the network and services to heal themselves rapidly when failures or attacks occur.

4.6.4. Redundancy

At the network level, redundancy is achieved through geographically diverse routes for network links, and dual routers or switches in the PSAPs, POIs, and data centers. An alternative to dual routers and switches in the data centers is the use of chassis-based Layer 3 switches with multiple power supplies, dual route switch processors, and multiple line interface cards. These are commonly referred to as carrier-grade devices.

4.6.5. Resiliency

At the network level, resiliency is the ability to rapidly switch from the primary route or device to the backup route or device, and is achieved through the use of fast packet reroute protocols such as BFD and fine-tuning of the underlying routing protocols such as BGP and OSPF. Given the nature and typical Layer 3 design of an ESInet, control of these routing protocols will be of paramount importance in preventing routing loops and still providing for the shortest path between any two nodes and the desired resiliency.

Service resiliency is the ability to maintain access to a given network service in the event of a failure of the hardware or software providing that service. This can be achieved through the use of virtual server systems running on multiple physical servers distributed across multiple data centers. The speed with which a backup system can take over in the event of a failure is based on the vendor's system design and failure detection methodology.

4.6.6. Diversity

At the network level, diversity refers to having two or more physically and geographically diverse communications paths. These paths may be fiber, copper, microwave, or any other IP-capable media. The important point is that the paths not share any trenches, poles, or building entrance points.



From a service and system standpoint, installation of systems and the services those systems provide should be in multiple geographically diverse data centers, with a minimum of 100 miles between centers.

4.7. LOCATION DATA CONSIDERATIONS

A fundamental baseline element of the i3 architecture is the use of geospatial data for validating caller location and determining the proper location to route the 9-1-1 call. Among other things, this shift in data validation and call routing determination will require the Commonwealth to migrate from legacy ALI and selective routing to geospatial database management, geospatial data validation, and call processing systems. This migration will require a systematic process for preparing each PSAP's GIS data for use in NG9-1-1. With this migration also comes a shift in the approach to data access, from storing location data locally to a federated data model that allows for the constant update of vital data.

4.7.1. Legacy versus NG9-1-1

In E9-1-1, the location information is either stored in an ALI database or the ALI database will request location information from auxiliary databases such as MPCs and VPCs. The wireline telephone location is validated against the MSAG as soon as a new phone service order is placed. The MSAG is typically a range of valid addresses for a street with defined low and high end street numbers.

In NG9-1-1, the location of the calling device is either stored or it can be acquired by the LIS. Locations are validated by querying the 9-1-1 authority's GIS data, providing a more granular level of validation than what is possible with today's MSAG. Where the MSAG is a range of possible addresses along a street, an LVF with detailed, accurate GIS data enables the CSP to validate a location down to the apartment, suite, floor, or room level. Alternatively, the user location may be validated against the road centerline data or the address point data. The validation process is more flexible in that it may be configured to first try to validate against the address point data and "fall back" to the road centerline data, if the address information is not found within the address point data.

4.7.2. GIS Data Preparation

The preparation of NG9-1-1 data is the most critical step in enabling the system to locate both the 9-1-1 caller and the emergency event. This data includes the emergency services boundaries and street centerline data. All data, spatial and non-spatial alike, has the potential to support the public safety mission. Therefore, all data stewards must prepare for and develop for the highly demanding data standards of NG9-1-1. Data stewards must understand and, more importantly, embrace the necessity of high quality, robust and complete information in their data creation process.

The spatial data network supporting NG9-1-1 is comprised of hundreds of individual datasets that must be aggregated into a single seamless database to support the needs of NG9-1-1. Each entry in a GIS database references a unique feature on the earth's surface. These features are grouped together as



databases of points, lines, and polygons. Lines can represent streets, pipelines, creeks and railroads. Points may represent fire hydrants, cell tower locations, building structures, or mileposts. Polygons represent areas such as jurisdictional boundaries, counties, and lakes. It is imperative that the data, created independently by each individual jurisdiction, is consistent in accuracy, attribution, and topology both within and between jurisdictions. Neighboring jurisdictions must collaborate on edge-matching datasets that create or cross jurisdictional boundaries. Natural and criminal events do not respect jurisdictional boundaries and may require close collaboration between neighboring jurisdictions. Mutual aid response necessitates data consistency across the Commonwealth to avoid delaying response times.

The Commonwealth has taken the first step towards data preparedness for NG9-1-1 in conducting the Virginia GIS Additional Data Collection survey with the PSAPs. The information from this survey can be used to establish a baseline for data readiness, defining gaps in data availability and refocusing efforts in data development and collection to fill the gaps. In parallel to the data collection and development effort, PSAPs and the Commonwealth should “scrub” existing data to ensure that each dataset meets the standards of an NG9-1-1 system. In addition to edge-matching within the Commonwealth, there is an opportunity to reach out to neighboring states that are also in the process of developing regional datasets for data matching across state lines.

Additionally, VGIN is in the process of updating the Commonwealth’s GIS Strategic Plan. This document provides guidance to state and local GIS programs on general GIS efforts, some of which will directly affect public safety efforts such as NG9-1-1. While this update is currently in progress, alignment between recommendations in the GIS Strategic Plan and this study are vital to the success of both implementations. Together, the recommendations provided within each document will enable a cohesive roadmap for GIS data preparation in the Commonwealth.

While the data being developed does not necessarily have to become the legal record, care should be used to ensure that either the data is defined as NG9-1-1-specific or meets the requirements to become the legal record for the jurisdiction or the Commonwealth. For example, while a statewide road centerline file could easily become the legal record for the Commonwealth, manipulating jurisdictional boundaries to dissolve topology issues could also redefine school attendance zones, tax liabilities, or even residency rights. For the latter, such an undertaking could also delay the development of the NG9-1-1 system through internal politics or public litigation.

Once data stewards are identified and data created, the Commonwealth must manage the distribution and service of the data. The strength of GIS lies within the data. That same data, if it is allowed to become dated, is the weakness of NG9-1-1. The complexities of the “ask” of the data requires robust, accurate, and current data capable of “answering” such a complex query. If the data providing this service cannot be collected and stored without jeopardizing the integrity of the results, then how does this integration of GIS and NG9-1-1 play out? Data for the NG9-1-1 system may be provided from different sources at each of the participating jurisdictions within the Commonwealth resulting in the number of data stewards quickly climbing into the hundreds. Weighing the risks of centralizing the data storage for such a diverse source list against the benefits of real-time data from the source drives the



preferred architecture towards a federated model wherein the individual data stewards offer their data to the central system through a middleware brokerage, which allows for the most current data to be available to the NG9-1-1 system in near real-time, without compromising the integrity of the data stewards' processes or data security standards. A GDX does not require centralized storage of data, only centralized access to the data stored therein. Federating the data development, storage, maintenance, and provision allows for the greatest gain in data availability while minimizing cost to the Commonwealth.

Federating the data maintenance also allows for the continued use of current methodologies. It is not necessary to standardize the tools used to develop and maintain the data. As long as the end result is a sharable dataset that meets the standards, data stewards may continue to use the tools with which they are familiar.

4.7.3. 9-1-1 Location Data Preparation

Location validation processes will evolve over the lifetime of a statewide ESInet. The transitional elements of an i3 solution enable a phased migration for both location data management and network transport. Without these transitional elements, the Commonwealth would be faced with a much more difficult migration process. The LDB enables a migration to the ESInet without a wholesale replacement of the long-standing location validation and storage processes.

One preparatory step that is recommended, but not required, is developing or refining the address point layer data. Much of the existing address point layer data will locate the address point in the middle of the parcel, also known as the parcel centroids. This location data risks being misleading for first responders as the parcel centroid may have a significant distance to the buildings on the property. Especially in rural areas, parcel centroids do little to help identify the location of a structure, which is the most likely location of where help is needed. The refinement of the address point data will require significant time investment from the localities in validating address points to the buildings on properties and moving the address point to a building where appropriate. Additionally, address point tests should be conducted to determine if two or more address points are stacked and placed in exactly the same location. Address points should never be stacked. Even if the primary address is the same but the unit number differs, the address point placement is as close as possible to the entry of the structure or unit. NENA has developed a best practice document for the development of site/structure address point data for 9-1-1, which should become public in the first quarter of 2015. MCP recommends that a statewide policy be established for defining address point standards, based on that document when available.

Another statewide policy that should be considered is embracing and refining the NENA standards related to GIS data, data collection, data maintenance and synchronization of MSAG, GIS, and ALI databases, to best meet the needs of the Commonwealth.

The migration from today's MSAG and ALI to the i3 equivalent systems begins with the synchronization of MSAG and ALI with the GIS centerline and address point data, if available. This process is covered in [NENA 71-501](#), *NENA Information Document for Synchronizing Geographic Information System*



Databases with MSAG & ALI. The process starts with each locality importing their MSAG and ALI tabular data into a GIS data management tool such as Esri™'s ArcGIS™ and comparing the legacy E9-1-1 MSAG and ALI data to the address point and centerline layer attributes. Discrepancies between the data sets must be resolved by public safety addressing specialists; the data synchronization will need to be maintained from that point thereafter. While the process of synchronizing MSAG, ALI, and GIS data is straightforward, many 9-1-1 GIS vendors offer tools and data maintenance software solutions that specialize in maintaining 9-1-1 data. It should be noted that while the means in which the MSAG and ALI is maintained will change, the knowledge and care for accuracy will continue to persist in the NG9-1-1 environment.

4.8. COMMUNICATIONS SERVICE PROVIDER CONSIDERATIONS

In both the E9-1-1 and NG9-1-1 environments, CSPs are generally responsible for validation of subscriber location information, delivery of 9-1-1 calls, and delivery of call, caller, and location information. While the responsibilities are generally the same, significant efforts must be made to support the transition to NG9-1-1. Fortunately, the transitional components ease the impact to the CSPs, which enable a more collaborative foundation in the migration to i3.

Table 21 provides a comparison of the systems, processes, and protocols supporting CSP responsibilities in E9-1-1, NG9-1-1 using i3 transition recommendations, and NG9-1-1 in an i3 end state.

Table 21 – CSP Responsibility Comparison

Responsibility	System, Process or Protocol	E9-1-1	NG9-1-1 – i3 Transition	NG9-1-1 – i3 End-State
Validation of Subscriber Location Information	System	SOI to ALI DBMS	SOI to LDB	LoST query
	Process	MSAG	MSAG	LVF
Delivery of 9-1-1 Calls	System	Selective Router	LNG	BCF
	Protocol	SS7	SS7	SIP
Delivery of call, caller, and location information	System	ALI, MPC/GMLC, or VPC	LDB with ALI, MPC/GMLC, or VPC interfaces	LIS and CIDB
	Process	ALI query	ALI query to LDB by LNG	HELD dereference; SIP with Additional Data in XML; or HTTPS GET with XML object

As represented in Table 21, the implementation of the i3 transitional elements lessens the impact to the CSPs in carrying out their primary responsibilities. The transitional elements provide a phased approach in the journey to the i3 end state. However, this is not to say that there will be no impact to



the CSPs as they support a transitional i3 solution, as there will. The CSPs will have to submit their SOI to a new database provider as well as migrate their traffic from the legacy selective routers to the LNGs. The SOI submission process represents the simpler of the two impacts as it is a matter of directing their provisioning interface, with the possibility of minor software coding, to accommodate the NG9-1-1 LDB provider's SOI interface.

4.8.1. CSP Call Delivery

Network connectivity to the LNGs will pose the greatest CSP-related challenge for the Commonwealth. Today, there are dozens, if not hundreds, of CSP switches connected to the 18 selective routers serving the PSAPs in the Commonwealth. Adding more interconnection points for the delivery of 9-1-1 traffic is often viewed by CSPs as an unnecessary cost due to the expense of installing new circuits, potential LNG port fees, circuit aggregation fees, and the resources to provision the circuits and migrate traffic. This roadblock is exacerbated as more LNGs are deployed in the Commonwealth, having an even greater financial impact to the CSPs. Service providers with a national footprint see the migration to NG9-1-1 as a major cost center. In an interview with one major NG9-1-1 service provider, MCP was informed that several CSPs have simply denied requests to directly interconnect with their LNGs.

The potential for CSPs' lack of support to direct connect to ESInet LNGs has left other states faced with a migration strategy alternative that is both costly and a less than desirable architecture. Without the ability to have CSP direct connection, the NG9-1-1 provider is left with two choices: utilize the existing connectivity to the legacy selective route or not deploy at all. With the latter option not of interest to the early adopters, many states and counties have found themselves in situations where the legacy selective router receives the traffic and selectively routes calls to the LNGs. While this is a reasonable interim design for consideration in order to coordinate the initial migration to the ESInet, it is far from an optimal long-term design as it inserts an extra leg in the call delivery, providing one more point of failure. Additionally, since the legacy 9-1-1 service provider continues to provide services, the PSAPs are charged for both legacy selective routing fees and NG9-1-1 services fees.

4.8.2. ESInet Ingress

MCP recommends that the Commonwealth take a balanced approach in designing its ESInet ingress design. CSPs will seek a balance between having as few new locations to deliver calls with the distance their circuits traverse and the LATA boundaries that have to be crossed to reach the new locations. On one hand, the Commonwealth and/or regions could provide two interconnection points within the same LATA as the current legacy selective router. With 12 LATAs in the Commonwealth, this could result in up to 24 potential POIs for the carriers to deliver their traffic. From the Commonwealth's perspective, the sheer volume of 24 LNGs presents high capital and operating expenses, which is difficult to justify when LNGs may only be required for the next five to eight years as ingress SIP call delivery becomes a reality. On the other hand, the Commonwealth could provide two geographically diverse LNGs for aggregating all ingress traffic to the ESInet. This would provide the fewest potential POIs, but requires carriers to provision more costly distance-sensitive, inter-LATA circuits. The Commonwealth will likely receive little to no support from the CSPs in either scenario, as they are not



mandated to provision new circuits to new POIs and both scenarios have a high cost impact to their operations.

The challenge in designing the ingress network will be finding a reasonable and efficient manner for asking the carriers to deliver their traffic. Reasonable and efficient being considered as the Commonwealth providing LNGs in the closest proximity to the highest concentration of originating switches with the fewest number of LNGs as possible. This process is most effective when analyzed with a comprehensive view at the state level. In order to develop the most optimal design, the Commonwealth will need to coordinate a design process with the existing 9-1-1 service providers and CSPs.

The Commonwealth should consult with the originating CSPs to determine if any special arrangements, network consolidations, or other scenarios exist that may affect the ingress network design. For example, with the high number of telecommunication consortiums in the Commonwealth, it may be discovered that these carriers aggregate their traffic at a regional central office for delivery to the legacy selective router. This information will be very valuable in determining each end point that must be considered. Basic information such as the originating end offices and trunk groups should be provided to the Commonwealth, or its agent, with letters of agency (LOAs) from each Commonwealth locality.

Similarly, the Commonwealth should discuss the ingress network design layout with CenturyLink and Verizon, the existing legacy 9-1-1 service providers. These providers should have drawings of each ingress trunk group to their legacy selective routers including trunk counts, circuit identifications (IDs), originating switch provider, and other pertinent information. Discussions should focus on the ingress trunk data that may be made available, as well as services that may be useful during and after transition. Examples of services include trunk aggregation or trunk muxing services at central offices and long-haul circuits. This information should be available to the Commonwealth, or its agent, with LOAs from each Commonwealth locality.

With data collection completed and initial understandings of the networks solidified, the design process may begin by mapping the location of each originating end office or central office from which carriers aggregate their traffic before delivering the calls to the legacy selective router. Then consideration should be taken to the number of egress trunks to the legacy selective router from each originating switch. Next, the location of qualified LNG host site data centers needs to be inserted in the map. When qualifying host sites, special consideration will need to be taken to ensure that the candidate sites have the capacity for TDM connectivity, such as those found at wire centers. New data centers may place a significant focus on high bandwidth facilities and have limited TDM facilities. Finally, an overlay of LATA boundaries should be inserted to see how estimated route paths and circuit costs could be impacted.

4.8.2.1. Concept of a Public Safety Gateway

As a current competitive 9-1-1 service provider in Virginia, Intrado was provided with the opportunity to discuss their 9-1-1 services in the Commonwealth. On December 12, 2014, MCP conducted a due



diligence meeting with Intrado via teleconference. During the call, Intrado introduced the concept of a public safety gateway (PSGW) for facilitating migration to the ESInet. The concept was presented in a discussion about minimizing the number of POIs required by CSPs in an effort to expedite the migration to a statewide ESInet. The concept is for the Commonwealth to deploy a pair of LNGs that would serve the entire Commonwealth for legacy and NG9-1-1 PSAPs. CSPs would provision new trunk groups to each LNG and deliver all of their Virginia 9-1-1 traffic to those two locations. The LNGs would determine the destination of the call and route the call to either the serving ESRP or utilize LSRG functionality for interfacing with the existing legacy selective routers. Legacy PSAPs would maintain their existing connectivity to their legacy selective routers. Once all traffic is routed through the new PSGWs, then CSPs would decommission their egress legacy selective router trunks. Reducing their network connections from 18 selective routers to two LNGs would greatly simplify their trunk volume and associated costs. In addition to the benefit provided to CSPs, it would enable the Commonwealth, or its NG9-1-1 service provider, to be in complete control of migrating legacy PSAPs to the ESInet.

MCP believes that this concept has merit. Consideration would be needed in determining the appropriate number of PSGWs. To enable a more diverse network design, MCP recommends four to six geographically diverse PSGWs. This would provide the greatest opportunity for east/west or north/south path diversity from the originating switches across the Commonwealth. This could be combined with PSGW-provider diversity to minimize the potential for a provider-specific issue to affect 100 percent of the Commonwealth's calls.

The PSGW solution would also eliminate the potential double billing for both legacy and NG9-1-1 services. Without a PSGW solution, the best method for minimizing the double billing issue is for a coordinated, regional ESInet deployment where all PSAPs off a legacy selective router migrate to the ESInet at the same general timeframe. The ability to coordinate the migration of all PSAPs off a given legacy selective router pair poses significant challenges due to the myriad of procurement, political, and operational complexities across the Commonwealth. The PSGW solution would enable PSAPs across the Commonwealth to migrate to the ESInet in a timeframe that meets their own specific needs.

Additionally, since LNG and LSRG services will be required of any ESInet migration, the PSGW solution will largely be viewed by the NG9-1-1 service provider as a sunk cost. The difference being the significant coordination and egress trunking required to each legacy selective router, but again that work would have to be coordinated by a single NG9-1-1 service provider. Conceptually, there could be vendor-diverse PSGW providers and i3 core providers. However, complexity of the solution increases as more vendors are required to interoperate across the path of a call. As more complexity is added, more opportunity for failure exists.

4.9. SOLUTION PROVIDERS AND THEIR NICHE

There are a variety of NG9-1-1 solution providers in the 9-1-1 arena that offer varying solutions and/or NG9-1-1 components. Table 22 provides a sampling of the various NG9-1-1 solution providers in the industry and the components they offer to the marketplace. The list is for illustrative purposes only and should not be considered all-inclusive.



Table 22 – NG9-1-1 Solution Providers and their Niche

	LSRG	LNG	BCF	LDB	LIS	CIDB	ESRP/PRF	ECRF/LVF	GDX/SIF	Terminating ESRP	LPG	Event Logger	ALI DB
TCS	x	x	x	x			x	x		x	x		x
Intrado	x	x	x	x	x	x	x	x	x	x	x		x
Airbus	x	x					x			x	x		
Solacom	x	x		x		x	x			x	x		
Emergency CallWorks										x			
Geo-Comm								x	x				
911 Datamaster				x	x	x		x	x	x	x		x
Synergem	x	x	x				x	x		x			
Bandwidth	x	x	x				x	x					
Verizon													
CenturyLink	x	x	x	x	x	x	x	x	x	x	x	x	x
Motorola	x	x	x	x	x	x	x	x	x	x	x		x
General Dynamics Information Technology (GDIT)	x	x	x	x	x	x	x	x	x	x	x		x
Rave Mobility						x							
AOS	x	x	x		x		x	x		x	x	x	x
Avaya							x						
RedSky										x			
Emergitech										x			
Tri-Tech										x			
Eventide												x	
NICE												x	
Verint												x	
Carolina Recording												x	
ECaTS												x	
Digital Data Technologies (DDTi)								x	x	x			



4.10. STANDARDS REVIEW

Adoption of standards is key to achieving interoperability across multiple local, regional, and state-level ESNets, both within and beyond Virginia's borders. Identifying and adhering to specific standards will guide the selection of vendor solutions and provide for a consistent method of sharing information among 9-1-1 entities throughout the Commonwealth. It also helps ensure the level of system compatibility required to realize the full potential of NG9-1-1.

The International Organization for Standardization (ISO) defines a standard as:

*A document established by consensus and approved by a recognized body that provides for common and repeated use, rules, guideline, or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.*⁶³

The National 911 Program published a *Next Generation 911 (NG911) Standards Identification and Review* document that compiles a list of existing and planned standards for NG9-1-1 systems, describes standards as mostly voluntary (not mandated by law), consensus-based, and open (“non-proprietary and available for anyone to use”).

Table 23 lists organizations that are known to develop standards that are of interest to the 9-1-1 community and the systems that are needed as part of development, implementation, and operation of an ESNet.

Table 23 – Standards Development Organizations

NENA	National Emergency Number Association	www.nena.org
APCO	Association of Public-Safety Communications Officials – International	www.apcointl.org
IETF	Internet Engineering Task Force	www.ietf.org
ATIS	Alliance for Telecommunications Industry Solutions	www.atis.org
NFPA	National Fire Protection Association	www.nfpa.org
NIST	National Institute of Standards and Technology	www.nist.gov
ISO	International Organization of Standardization	www.iso.org
NERC	North American Electric Reliability Corporation	www.nerc.com
TIA	Telecommunications Industry Association	www.tiaonline.org

Appendix D contains a list of applicable standards.

⁶³ International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) Guide 2:2004, definition 3.2



4.11. THE PATH FORWARD: A STEP-BY-STEP SUMMARY OF IMPLEMENTATION STEPS AND OPTIONS TO CONSIDER

This technical feasibility study provides details and recommendations on the technical design requirements for implementation of a statewide and/or regional ESInets. The Commonwealth must give consideration to many options as it deploys a statewide ESInet. The following section provides a high-level, step-by-step summary of how to implement an ESInet and options to consider during each stage of implementation.

1. Develop an SDBMS

In order to implement a reliable i3 data validation and call routing platform, the Commonwealth must develop a statewide SDBMS. The system must be supported with statewide policies and procedures for how the platform will be managed and maintained, as data maintenance is the crux of its existence. This is a platform that may be developed within the state or by one of many vendors. Additional details regarding the SDBMS function may be read in Section 4.2.10, Spatial Database Management System.

2. Gather and Verify NG9-1-1 System Requirements

a. Operational Requirements Gathering

In parallel to the development of the SDBMS, the Commonwealth should begin working within each ISP region to gather specific operational requirements of each PSAP and responding agency. These operational requirements will be added to the component requirements discussed in Section 4.2, NG9-1-1 System Components, and network requirements discussed in Section 4.5, Network Design Considerations, which are outlined in Appendix C, Invitation to Bid (ITB) Template. The culmination of the requirements will assist the Commonwealth in determining the optimal solution design as to whether a single statewide ESInet, a network of regional networks, or a combination of a state-level and regional ESInets will be implemented.

Due to the extreme variance of the political and operational landscapes across the Commonwealth, the most practical solution may not be the most cost effective or the simplest to operate. Typically, the most cost effective and simplest ESInet operation is provided by a single vendor. This is due to economies of scale that are able to be achieved by a single vendor, and it has the fewest entities to coordinate and manage. The limited authority of the E-911 Services Board to mandate a single solution provider for the entire Commonwealth will likely result in the deployment of multiple regional ESInets. This type of configuration is technically feasible and may be optimized by coordinating efforts across the Commonwealth. The multi-regional ESInet approach will allow for existing and planned local and regional networks and NG9-1-1 pilots to co-exist.

If a regional approach is best, then the Commonwealth will need to determine where the regional boundaries lie. MCP recommends starting by looking at regional alignment with



selective router pairings to minimize potential double billing by the legacy 9-1-1 service provider and enable the decommissioning of selective routers as early as possible. Once regions are determined, each region will need to develop a definitive PSAP that shall be served by the respective regional ESInet. This list must include all secondary and specialty PSAPs, such as the VSP, which will require interoperability for call transfers, PSAP abandonment, and overflow routing. This list will enable the solution vendors to develop accurate sizing of the network and the serving core components. Additionally, the development of regions will enable discussions about shared CPE and logging services for the localities that may be interested.

b. Network Requirements

The Commonwealth and/or its regions need to determine what type of operational model is best for the implementation and on-going management of the network that will serve as the backbone between data centers and transport to each PSAP. There are two primary models to choose from: assemble a network of regional networks or procure a managed network services from a single vendor. The first model of assembling a network-of-networks will require the most resources from the region and/or Commonwealth; however, some of the work may be outsourced. This model will enable the greatest capability of using existing regional networks and therefore potential cost savings may be realized. The second model puts all responsibilities on a managed services vendor to design, monitor, and maintain the network. This model reduces complexities, requires fewer resources, and enables the efficiencies afforded by working with a single vendor.

Related to network requirements is the ingress network solution design. The Commonwealth will need to determine how it would like to migrate originating 9-1-1 traffic to the ESInet(s). Section 4.8.2.1, Concept of a Public Safety Gateway, discusses the concept of a PSGW and the merits it brings to NG9-1-1 implementation. It is effectively a solution where all CSP switches will interconnect to LNGs and the ESInet will then manage the delivery of calls to legacy PSAPs through an LSRG connection to its legacy selective router or to an NG9-1-1 PSAP through the ESRP. Its greatest advantage is that it enables a coordinated migration enabling the PSAPs in the Commonwealth to have full control as to when they migrate from the legacy selective router to i3 call routing. The next best alternative is a coordinated regional migration where selective router pairs migrate to an ESInet.

c. Integration with Other Data Systems Requirements

The next step in the requirements gathering process is a more creative process in brainstorming the possibilities of networks, data providers, and systems in the Commonwealth that could directly contribute to improving emergency response. As discussed in Section 4.2.6, Call Information Database, the i3 architecture provides the ability to bring new data sets into PSAP operations. While no one has a crystal ball to see into the future on the systems that will contribute to enhancing data, now is the time to gather requirements on existing systems and future systems that can contribute additional data. These systems should be listed in future procurement vehicles, such as the i3 ITB. Examples to consider are as follows:



- Geospatial data systems for GDX feeds:
 - Evacuation routes
 - Common Place names
 - Critical infrastructure
 - Utilities, including infrastructure status
 - Fire hydrants
 - Automated external defibrillator (AED) locations
- Camera Feeds
 - VDOT cameras
 - Security cameras at municipal buildings, banks, and airports
- Health Department databases
- Alarm Systems
 - Nuclear facilities
 - Bank alarms
 - Tidal wave alarms
 - Seismograph alarms
- Third-party vendors such as Rave Mobility's Smart911™

3. Procure Network and System

The completion of Stage 2 enables the Commonwealth to develop a set of network and system requirements for developing an ITB that meets the Commonwealth's and/or its region's operational and technical needs. MCP recommends that the procuring entity combine the ESInet i3 system requirements procurement with the ESInet network transport requirements to determine if a single vendor can fulfill all the needs of the Commonwealth and/or region in a single procurement. Alternatively, the procurement may allow for vendors to bid on the i3 systems and the ESInet transport separately. This could provide an environment where the procuring entity may have the best of both worlds in a cost effective i3 system and a managed network services provider who specializes in designing and maintaining high availability networks.

4. Refine the Migration Strategy

Once the ESInet i3 solution provider and network transport solutions are selected, the next step is to work with the existing 9-1-1 service providers to jointly develop the migration strategy. This is a critical step in the implementation process and will greatly affect the efficiency of the project. In the due diligence meeting with Verizon, they stated that they were currently in the middle of supporting a migration and were brought in late in the process. Verizon stated that the lack of interconnection agreements with the new 9-1-1 services provider and disjointed migration planning was causing delays as these issues were not addressed prior to the implementation kickoff.

Migration planning meetings will address interconnection agreements, optimal means for the delivery of CSP traffic, legacy selective router interoperability requirements, ALI provisioning during



the migration, and the phased approach of migrating clusters of PSAPs. This will be a joint planning meeting between the legacy 9-1-1 service provider, the ESInet transport provider(s), the ESInet i3 solution provider, and, optionally, the representatives of the localities. The interworking with the existing areas with carrier agreements will be discussed as well as the order in which PSAPs should migrate. This process will take into consideration each PSAP's abandonment, backup, and overflow routing needs. Lastly, the discussions will address the database migration process and requirements of the respective solution providers.

5. Implement

The final step is moving from the planning stage to the implementation stage. This is where the solution providers will execute on their project plans. Commitments made during the proposal and contract phases will be realized and the years of NG9-1-1 discussions will soon become a reality. Due to the high complexity of the deployment process, it is critical that the Commonwealth and/or its regions work very closely with the solutions providers to ensure that milestones are being met and risks are mitigated through strong project management. A punch list of deliverables should be developed and cross-referenced for completion as each milestone is reached. During the implementation phase, training of PSAP personnel will be conducted. Non-live testing will be completed prior to any cutover and feature functionality will need to be verified in both non-live and live environments.

Since the migration to the ESInet will not be a flash cut, the service providers will need to begin supporting the maintenance of the solution in parallel to the on-going implementation tasks as PSAPs migrate to the ESInet. This includes 24/7 monitoring and maintenance, outage reporting per FCC rules, and on-site support. The implementation process should address the integration of neighboring ESInets, where they exist.

Once a PSAP has successfully migrated to the ESInet, a predetermined soak period should expire with zero instances of failures prior to decommissioning connectivity to the legacy selective routers. As the footprint for a legacy selective router successfully migrates to the ESInet, the selective router may be decommissioned, assuming all CSP traffic is either direct connected to the ESInet or delivered through an alternate trunk aggregation system. Similarly, as all PSAPs off of a legacy ALI system have successfully migrated to the ESInet, the legacy ALI platforms may be decommissioned.

4.12. FINDINGS AND RECOMMENDATIONS

NG9-1-1 enables new technical and operational capabilities for all stakeholders in the 9-1-1 call path. From the CSPs originating calls to the 9-1-1 service providers processing calls to the PSAP equipment handling the calls, a network with greater system interoperability awaits.



As presented throughout this section, there are multiple options for the Commonwealth and its localities to consider in preparation for the deployment of an ESInet. Table 24 summarizes the technical feasibility findings and recommendations.

Table 24 – Technical Feasibility Findings and Recommendations

Technical Findings and Recommendations	
Findings	Recommendations
1. Eighteen selective routers serving the Commonwealth resulting in greater number of ingress trunk groups to the legacy network.	The Commonwealth should develop a solution design that will reduce the number of POIs as the Commonwealth migrates to an ESInet.
2. SIP call delivery will reduce call set-up times.	VITA should work with carriers to implement SIP call delivery to the ESInet.
3. Shared CPE platforms are capable of much greater capacity.	The implementation of more shared CPE platforms where IP networks and operational alignment exist is recommended.
4. A single NG9-1-1 vendor solution contributes risk to a statewide outage.	Consideration should be given to a multi-vendor approach to minimize risk of a statewide vendor causing a statewide outage.
5. There is limited insight to route paths, path diversity, and network vulnerabilities.	ITB requirements should be developed for network providers to document route paths and identify single points of failure in the network. These requirements need to be carried through to the contracts and documented during implementation of the network.
6. Almost one out of three PSAPs send their overflow calls to their own administrative lines or fast busy during peak call volume.	Regional Town Hall meetings should be held to discuss how call routing could potentially change in an NG9-1-1 environment where a policy routing function could distribute calls geographically or hierarchically.
7. LIS and CIDB support by the carrier community is lagging.	The Commonwealth should require the i3 solutions provider to deploy an LDB to provide legacy and i3 interfaces and protocol support to enable a phased transition from ALI to LIS and CIDB.
8. Stored data becomes stale and outdated.	The Commonwealth should implement a GDX in conjunction with an SDBMS to enable usage of best available data.
9. A single statewide provider of NG9-1-1 services will be difficult to meet the requirements of all localities.	<p>The Commonwealth should consider working with each region to develop a list of common requirements for the ESInet and NG9-1-1 services. The findings should be consolidated into an executive report and the level of support determined from each locality for a single, statewide ESInet based on the jointly developed requirements.</p> <p>If the majority of the localities are in support of a state-level ESInet, then through a competitive ITB process, Virginia should procure and deploy a state-level ESInet with an i3 solutions provider offering the services to all localities. PSAPs will have the choice of opting in to the state ESInet or deploying their own regional NG9-1-1 solution. Regional ESInets may be deployed but would be required to interoperate with the state-level ESInet and other regional ESInets.</p>



Technical Findings and Recommendations	
Findings	Recommendations
	However, if a majority of the localities are not in support of a state-level ESInet, then a less optimal and more costly solution would be for localities to develop their own regional solutions. To minimize double billing challenges, it is recommended that regions align as closely to existing legacy selective router groupings as possible. Each region should require solution providers to provide interoperability with adjacent legacy and NG9-1-1 routing systems.
10. Multiple data centers are required for support of a statewide ESInet.	Virginia's statewide ESInet should have three to five Tier 3 or better data centers located strategically around the Commonwealth, with a minimum distance of 100 miles between the centers. The data centers will house the i3 services, and also may be used to house a hosted call handling solution if acquired separately from the i3 systems.
11. Multiple networks options exist in the Commonwealth.	VITA should work in cooperation with the localities to assess needs and requirements of the Commonwealth. Network requirements should be determined and a competitive ITB issued for network services. The solution that best meets the requirements of the Commonwealth while achieving the greatest level of carrier, path and network diversity should be procured.
12. VLANs and IP addressing management are critical to network service alignment across an ESInet.	A VLAN and IP addressing database should be deployed for tracking of additions, changes, and deletions to the VLAN assignments in the ESInet.
13. Fast failover protocols are required for achieving public safety-grade resiliency of call delivery.	Fast packet reroute protocols (BFD, BGP, OSPF) should be deployed.
14. One of the greatest opportunities for failure in an ESInet is due to human error.	A strong change management process for thorough documentation and process management for the implementation of change within the NG9-1-1 network and systems is recommended.
15. Synchronization of the MSAG with the GIS centerline and address point data is critical to the preparation for NG9-1-1.	Each locality should analyze their MSAG and ALI tabular data to their GIS data. Discrepancies between the data sets must be resolved by public safety addressing specialists. GIS, MSAG and ALI data should all align. The on-going maintenance of the MSAG and ALI may be managed directly in the GIS data management tool with tabular data export to maintain the legacy MSAG and ALI databases.
16. Detailed due diligence discussions are required with network providers.	Minimum network provider requirements should be discussed with each network provider vendor so that the Commonwealth may assess network provider capabilities and develop detailed network requirements for the Commonwealth's ESInet.
17. Multiple NG9-1-1 solutions exist in the marketplace today.	The Commonwealth should deploy an ESInet that adheres to industry standards utilizing transitional elements such as LNGs, LPGs, LSRGs, and LDBs to facilitate a phased migration.
18. IP addressing space has limitations.	Private address space should be used internally and publicly routable IP address space used in the DMZs for connections to



Technical Findings and Recommendations	
Findings	Recommendations
	partners and providers.
19. CSPs may not be inclined to connect to LNGs.	The number of new POIs should be minimized. Implementation of a PSGW for easing the CSP's migration to the ESInet should be considered.

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5. STATUTORY, REGULATORY AND POLITICAL CONSIDERATIONS

Ensuring the statutory and regulatory environments have been addressed is essential to a successful implementation of NG9-1-1. Existing laws, rules and regulations, and tariffs specifically reference older technologies or limit system capabilities. It is prudent to examine Virginia's current statute as these laws may also inhibit the migration to IP-enabled 9-1-1.

Statewide 9-1-1 system assessments also provide a method for state coordinating agencies, such as the E-911 Services Board and VITA, to gauge the status of state and local programs, and to identify areas within the current system that may require modification to remain effective and true to respective missions.

The vision of a state oversight entity, such as the E-911 Services Board supported by a state agency (VITA), supports PSAPs and 9-1-1 authorities and is critically important to the advancement of 9-1-1 technologies. As NG9-1-1 introduces more complexity and interconnections, effective coordination and oversight becomes more important to all public safety entities. Technical and operational standards that have their foundation within the 9-1-1 community are essential elements to the long-term effectiveness of a statewide NG9-1-1 program. The PSAP community should be engaged at the earliest opportunity to develop standards for the on-going success of 9-1-1 service in Virginia.

5.1. BACKGROUND

Many states are taking steps to assess the need to update or create statewide 9-1-1 systems, revise statute, restructure governance and policy, adjust funding formulas, and implement technologies and operations that enable greater inter-jurisdictional functionality. Until now, the development and maintenance of E-911 has largely been a local issue, driven by the capabilities and limitations of local telephone companies to deliver various levels of service and the needs of local jurisdictions.

With the advent of wireless technologies, a new governance and oversight need was identified as wireless technology and 9-1-1 delivery methods did not fit well with the traditional wireline service and governance structure. Many realized that wireless would not happen in the timeframe required by the FCC unless a state entity governed its deployment. States and local jurisdictions are now facing a similar situation with the entry of NG9-1-1. As more advanced technologies are integrated, states with strong state-level coordination will realize a greater benefit from the enhancements in technology and integrated operations; demonstrating that state-level 9-1-1 coordination and leadership has been and will continue to be paramount to the successful evolution of NG9-1-1.

Text, data, images, and video are increasingly common in personal communications. As such, users expect the 9-1-1 system to accommodate these mobile, dynamic communications modes. Trends in these consumer-based technologies have made the current 9-1-1 system and the methodology for governing and managing 9-1-1 less than optimum. 9-1-1 networks and PSAPs must transition from the



current analog, circuit-switched, wireline technology to a digital, IP-based infrastructure. As networks and infrastructures advance, so too should the statutory and regulatory environments that govern 9-1-1.

The adoption of IP networks as the future infrastructure for 9-1-1 networks is generally supported by service providers, public safety professionals, and standards development organizations. However, the current laws and regulations in the Commonwealth may not effectively enable the implementation of newer, new, and future technologies. Coordination and partnerships between government and public safety stakeholders—including PSAPs, local 9-1-1 authorities, state agencies and service/equipment providers—will be required to implement IP-enabled 9-1-1 systems.

5.2. CURRENT STATUTORY, REGULATORY AND FUNDING FRAMEWORK IN VIRGINIA

The Commonwealth's existing 9-1-1 legislation demonstrates a progressive series of changes that reflect a fairly common transition of 9-1-1 emergency communications in the state; beginning with legacy wireline service implemented by local governments by way of tariffs and rules/regulations with regard to common carriers within the Commonwealth to the establishment of a state Wireless E-911 Services Board to oversee and manage wireless 9-1-1. The Commonwealth is now exploring the changes needed to continue the effective management of 9-1-1 as it migrates towards NG9-1-1.

5.2.1. E-911 Services Board

Virginia statute §[56-484.13](#) established the Wireless Enhanced 9-1-1 (E-911) Services Board, its structure and powers and duties. According to statute,

A....The Board shall plan, promote and offer assistance:

- 1. In the statewide development, deployment, and maintenance of enhanced wireless emergency telecommunications services and technologies; and*
- 2. In the development and deployment of enhanced wireline emergency telecommunications services and technologies only in specific local jurisdictions that were not wireline E-911 capable by July 1, 2000.⁶⁴*

In 2008, the Wireless E-911 Services Board was continued as the E-911 Services Board.

As defined in statute, the Board consists of 15 members:

- The Director of VDEM, who shall serve as chairman of the Board
- The Comptroller, who shall serve as the treasurer of the Board
- The CIO
- 12 members appointed by the Governor:
 - One member representing VSP

⁶⁴ <http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-484.13>



- o One member representing an LEC providing E-911 service in Virginia
- o Two members representing wireless service providers authorized to do business in Virginia
- o Three county, city or town PSAP directors or managers representing diverse regions of Virginia
- o One Virginia sheriff
- o One chief of police
- o One fire chief
- o One EMS manager
- o One finance officer of a county, city, or town⁶⁵

D. All members appointed by the Governor serve five-year terms. The CIO and the Comptroller shall serve terms coincident with their terms of office. No gubernatorial appointee shall serve more than two consecutive terms.⁶⁶

5.2.2. Legislative Process

Vestiges of the influence of common law can still be found in some legal concepts and principles in the commonwealths, particularly in Virginia with its independent cities and strong counties, which have their origin in the old English shire system and are a part of how early Virginia was organized.

The General Assembly meets annually, beginning on the second Wednesday in January, for 60 days in even-numbered years and for 45 days in odd-numbered years, with an option to extend annual sessions for a maximum of 30 days.

5.2.3. State Corporate Commission

The State Corporation Commission (SCC or Commission) is an independent state agency established by Article IX of the Constitution of Virginia. The General Assembly, through the legislative process, gives responsibilities to the Commission. Additionally, the Commission is authorized to issue its own rules and regulations to help it carry out its statutory responsibilities.⁶⁷ The SCC in Virginia, much like a Public Utilities Commission (PUC) or Public Service Commission in other states, interprets Virginia Code. Its administrative rules have the full force and effect of law.

5.2.4. 911 Funding and Tax Structure

Effective January 1, 2007, Virginia House Bill 568⁶⁸, *Communications tax reform*, replaced the then current state and local communications taxes and fees with a centrally administered communications

⁶⁵ Ibid.

⁶⁶ Ibid.

⁶⁷ <http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC1201000>

⁶⁸ <https://leg1.state.va.us/cgi-bin/legp504.exe?061+sum+HB568>



sales and use tax, and a uniform statewide E-911 tax on landline telephone service. This law repealed the local consumer utility tax on landline and wireless telephone service, the local E-911 tax on landline telephone service, and the Virginia Relay Center assessment on landline telephone service. The state E-911 fee on wireless telephone service was not affected by House Bill 568.

The tax is applicable to landline and wireless service (local, intrastate, interstate and international), and VoIP. At the same time of the tax restructuring, the tax also became applicable to prepaid calling services.⁶⁹ Revenues from the communications sales tax are collected and remitted monthly by CSPs to the Department of Taxation (TAX) and deposited into the Communications Sales and Use Tax Trust Fund (Communications Fund).

The statewide E-911 tax on landlines is a state tax also administered by TAX and is imposed on the end user at the rate of \$0.75 per access line. The tax appears as a line item on customers' bills. Providers are allowed a dealer discount of three percent of the amount of the landline E-911 tax revenues.⁷⁰ Collected revenues are remitted monthly to TAX by each provider and deposited into the Communications Sales and Use Tax Trust Fund (Communications Fund).

Wireless providers are required to collect a postpaid wireless E-911 surcharge of \$0.75 per cell phone. Collected revenues are remitted monthly with communications taxes and are deposited into the Wireless E-911 Fund.

While there is no legislative audit requirement for wireline, wireless or prepaid fees to ensure providers are remitting accurate amounts, audits are inherently authorized under TAX, but have not been conducted to date.

When a customer purchases landline telephone services from an out-of-state provider that is not registered in the Commonwealth, and therefore has no provider mechanism to remit the landline E-911 tax, the customer is required to remit the tax directly to TAX.

After transferring monies from the Communications Fund to TAX to pay for the direct costs of administering the communications sales tax, the monies in the Fund are allocated and distributed to localities after payment to the Virginia Department of Deaf and Hard of Hearing (VDDHH) to fund the Virginia Relay Center and any franchise fee amount due to localities in accordance with any cable television franchise agreements in effect. Each locality's share of the net revenue is distributed at the end of the month based on the locality's share of total local revenues received from the taxes and fees collected. Funds are deposited in the local jurisdiction's general revenue fund. Local jurisdictions fund 9-1-1 services from their respective general fund through individual budgeting procedures. The monetary amount that a local jurisdiction receives from TAX and the amount distributed to fund 9-1-1 operations may or may not be equal.

⁶⁹ Code of Virginia [§58.1-647](#).

⁷⁰ Code of Virginia [§58.1-1730](#).



Many local jurisdictions report that they have observed a decrease in funding support since House Bill 568 went into effect eight years ago. This is attributed to the change to the wireline funding mechanism.

5.2.4.1. Program and Grant Funding

[Much of the information in this and the following sub-sections is from the [Commonwealth of Virginia E-911 Services Board FY2014 Annual Report](#), published October 1, 2014. Text in *italics* is a direct quote.]

Monies in the Wireless E-911 Fund are allocated as follows: 60 percent is distributed to the localities, 10 percent is used for the E-911 PSAP Grant Program, and 30 percent is earmarked for Commercial Mobile Radio Service Cost Recovery.

The percentage for wireless services cost recovery was established through a legislative change in 2006 and was based on the known, on-going costs of the wireless service providers. The current percentage has proven sufficient to fund the cost recovery requests of some of the wireless providers⁷¹, although in future years this may not be the case. The FCC, in what has become known as the King County letter⁷², determined that cost recovery was not required and could not be either expected or demanded by the wireless carrier in order to provide wireless 9-1-1 service in a jurisdiction. However, many states that already had cost recovery in place either by statute, by practice, or by contract with the carriers, such as is the case in Virginia, have continued the cost recovery practice. As reported in the E-911 Services Board FY2014 Annual Report, the total amount of funding received by the carriers for the recovery of costs incurred during FY2014 was \$3,217,093.

Financial assistance is available to the PSAP community through the E-911 Services Board's PSAP Grant Program. In addition to the 10% allocation of the Wireless E-911 Fund, the grant program will also receive the remaining funding from the portion of the fund earmarked for Commercial Mobile Radio Service Cost Recovery. Remaining funding in FY2013 was transferred into the PSAP Grant Program for the FY2014 funding cycle.

Historically, the PSAPs have received approximately 48% of the wireless fund for recurring and operational costs. The current funding process distributes 60% of the fund to the PSAPs...The PSAPs received a total of \$26,171,287 through the 60% formula distribution and were allocated another \$5,386,812 from the FY2014 PSAP Grant funding cycle.

Since FY2011, the monies available for PSAP support has been significantly reduced as a result of several causes, not the least of which is the \$8 million transfer to the Compensation Board and the \$3.7

⁷¹ Currently Verizon Wireless and T-Mobile do not request cost recovery.

⁷² <http://transition.fcc.gov/Bureaus/Wireless/Orders/2001/kingco.pdf>



million transfer to the VSP. Since that time, the Board has been unable to fully fund PSAP grant requests.

The current funding formula is perceived to be somewhat inequitable in that not all PSAPs have benefited to the same degree. *Those PSAPs located within the fastest growing localities have received a greater portion of the fund than those PSAPs located in the smaller, slower growing localities. Many PSAPs, mostly small and rural, have experienced a significant decrease in funding since the current funding distribution methodology was put into place in 2006.* To refute this perception, larger more urban PSAPs make the argument that greater population requires greater cost to operate larger 9-1-1 centers than the smaller operations needed in more rural PSAPs. Local governments operating 9-1-1 PSAPs have *come to rely on the wireless E-911 funding source to operate and maintain their PSAPs.* Any reduction to the overall funding has significant detrimental impact on service delivery. *The surcharge rate must be sufficient so that the distribution formula and amount available results in consistent funding to the local jurisdiction.*

5.2.4.2. VITA Support

The E-911 Services Board's operational expense for its own activities, including payment to VITA for administrative support, was \$2,648,233.93 for the fiscal year ending June 30, 2014. This amount represents all costs associated with personnel support to the Board and the program, financial support services, training, supplies and equipment necessary to carry out the duties of the Board and program management.

5.2.4.3. Other Draws on Wireless Funding

The Division of Public Safety Communications (PSC), a portion of the Virginia Geographical Information Network (VGIN) Division, and centralized billing agreements for PSAP wireless 9-1-1 services with Verizon and CenturyLink are funded through wireless E-911. Since this funding is contained in the Appropriation Act, it is subtracted before the distribution of funding based on the formulas, thus evenly reducing the amount of funding across the three funding programs.

5.2.4.4. Appropriations/Transfers to Other Agencies

Transfers to other agencies in the current biennial budget include an \$8 million transfer from the wireless cost recovery portion of the Wireless E-911 Fund *to the Compensation Board's budget to support sheriff's [sic] dispatchers* and a \$3.7 million appropriation to the Virginia State Police (VSP) for *wireless 9-1-1 call taking.*

Similar to the Compensation Board transfer, the appropriation to the VSP *reduces the amount of funding available to the PSAPs and wireless service providers.* The \$3.7 million appropriation was originally created to compensate for the *transfer of wireless 9-1-1 calls from the state police dispatch centers to the local PSAPs.* However, local PSAPs are currently answering all wireless 9-1-1 calls originating in the Commonwealth and VSP is no longer receiving any wireless 9-1-1 calls directly. The



transfer of funds to VSP for receiving wireless 9-1-1 calls can no longer be justified. There is concern that such an appropriation from funds collected for 9-1-1 purposes and used for service unrelated to wireless 9-1-1 service delivery *could jeopardize the Commonwealth's ability to receive federal funding in the future.*

Federal legislation⁷³ was signed into law on December 23, 2004, that requires *states that apply for federal E-911 grant funding (or the PSAPs within the states), to certify that no E-911 funding was diverted to other areas. A state that has diverted funding shall be ineligible for federal funding for 18 months after the diversion.* In the Town Hall meetings, a number of local PSAPs questioned the equitability of what is perceived as an arbitrary fund transfer amount to the Compensation Board at the expense of local PSAP grants. In addition, there was concern expressed about the access to federal grant funding, should that be made available in the future, and the potential to interpret this fund transfer as a diversion of 9-1-1 funds.

5.2.5. Regulatory Standards

There are no regulatory standards currently in place in Virginia related to 9-1-1 service. National guidelines suggest that both technical and operational standards for NG9-1-1 systems and call handling be considered.

In early 2013, E-911 Services Board support staff was tasked with a comparison of the national standards and the current legislation and state level functions. In the spring of 2013, the results were presented to the Board Policy Committee and a Standards and Guidelines Initiative was set in motion. The activity of that initiative was put on hold pending the outcome of this feasibility study. The findings and recommendations in this study suggest that the activity has come full circle and the time to re-energize the rulemaking and standards setting is now. Town Hall meeting discussions with PSAP managers and directors also suggest that the PSAP community understands both the necessity for and the importance of standards for their work. As NG9-1-1 is implemented, the need for standardized protocols and practices between entities will be increasingly valuable and essential for effective call processing and call management. The development process for standards and performance metrics development can occur today without any legislative changes.

It will be necessary for the E-911 Services Board to recommend and the SCC to engage their rulemaking process to establish such standards.

As discussed later in this document, MCP encourages the E-911 Services Board to engage the 9-1-1 stakeholder community and other interested parties, such as service providers, in the development of recommended standards as well as the performance metrics and measurements for those standards.

⁷³ Ensuring Needed Help Arrives Near Callers Employing (ENHANCE) 911 Act of 2004, [Pub. L. No. 108-494](#)



5.3. CURRENT NATIONAL LEGISLATIVE LANDSCAPE AND TRENDS

The evolution of 9-1-1 services throughout the United States has generally been community by community, where 9-1-1 implementation in a particular jurisdiction was left up to local authorities. While the call taking and public safety response to a 9-1-1 call needs to be and should remain a local jurisdictional responsibility, the next phase in the evolution, NG9-1-1, will necessarily be more statewide in nature and authority.

In the course of preparing the February 2013 [Report to Congress on the Legal and Regulatory Framework for Next Generation 9-1-1 Services](#), the FCC sought public comment on the role of state governments in the transition to NG9-1-1. It was reported that the consensus view expressed by commenters is that state and local authorities should retain their primary roles in the management and development of NG9-1-1.

However, many commenters contended that the transition to NG9-1-1 will be achieved more quickly and cost-effectively where decision-making and coordination oversight authority are focused at the state level, rather than at the local level. NENA stated that “[e]xtensive experience in the laboratory of the states has demonstrated that this type of oversight and coordination [at the state level] is most effective when undertaken by an independent body of representative stakeholders.”⁷⁴

NENA and the National 911 Program compiled a status report on the progress of NG9-1-1. Figure 21, based on 2012 data, demonstrates considerable planning activity, but little actual deployment of full next generation statewide.

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⁷⁴ <http://www.fcc.gov/document/legal-and-regulatory-framework-ng9-1-1-services-report-congress>.



Combined NENA and National 911 Program NG911 Progress (2012 data)

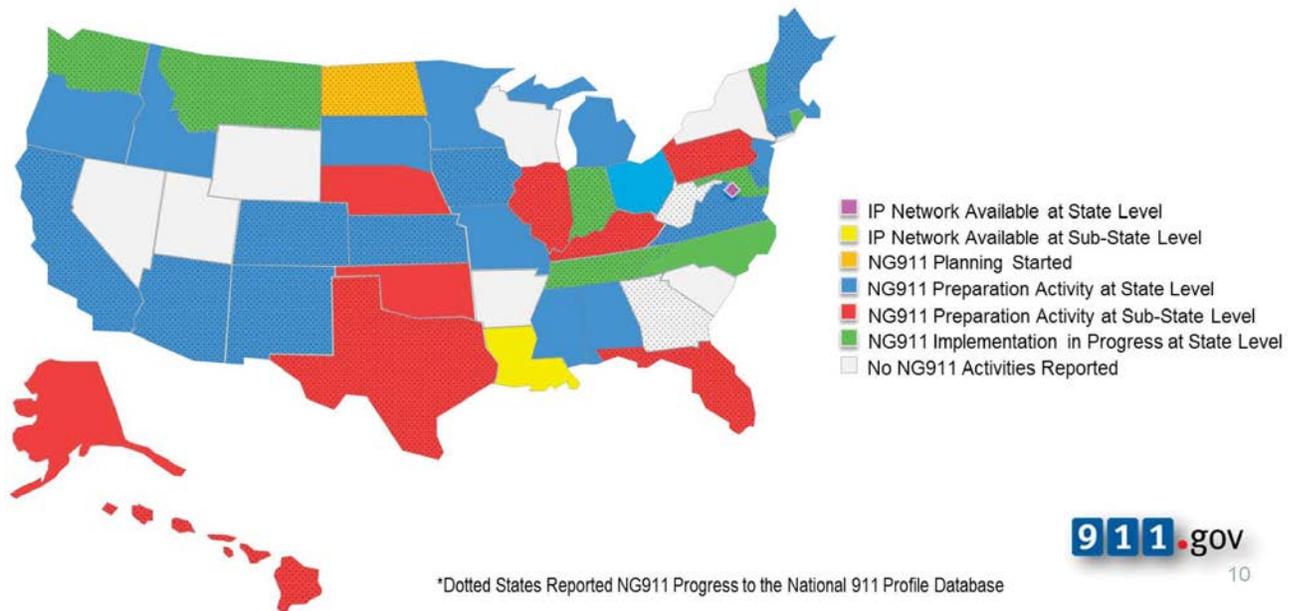


Figure 21 – NG9-1-1 Progress

Much progress has been made since 2012, but transition is slow largely due to statutory and funding modifications necessary to eliminate impediments to implementation. The Commonwealth will face these same challenges.

5.3.1. *Early Adopter Approaches*

Table 25 represents an overview of several areas in the country considered by many to be early adopter examples of NG9-1-1 implementation that can provide insight and perspective on the elements necessary to consider.



Table 25 – Early Adopters

Vermont	<p>Vermont was one of the first states to implement the initial components of a statewide NG9-1-1 system. Initiating its planning in 1998, Vermont was able to garner unanimous support from the Vermont Enhanced 9-1-1 Board and state legislators. The anticipated cost is approximately \$10 million through 2015, which is funded through the state's Universal Service Fund, by a 1.65 percent fee for 9-1-1, lifeline and teletypewriter (TTY) services.</p> <p>This single statewide funding source meant local agencies and governments did not have to dedicate local funds to implement NG9-1-1.</p> <p>The 9-1-1 Board was one of the first to implement a statewide NG9-1-1 system that delivers 9-1-1 calls from the PSTN to a PSAP using VoIP over its ESInet. Vermont's 9-1-1 system consists of eight diverse locations collectively serving as one statewide PSAP. 9-1-1 calls are initially routed to one of these answering points based on the originating caller's location.</p>
North Carolina	<p>A pilot program in the city of Durham, launched in August 2011, was designed to test SMS text messages to 9-1-1. Durham could do so because the state of North Carolina had laid the groundwork with system upgrades several years earlier to link all 128 of the state's PSAPs on the same wireless 9-1-1 system. Now the ESInet infrastructure provides advanced voice capabilities and the building blocks to support text messaging, video and other data services.</p> <p>North Carolina had also streamlined funding with a single statewide 9-1-1 fee for every telecommunications device, and the state's 9-1-1 board worked with East Carolina University, Greenville, North Carolina, to determine the actual costs of providing 9-1-1 service, and how much it would need to transition to NG9-1-1; the result was a 50 percent savings in expenses. The device fee, combined with state grants totaling \$2.4 million, has allowed North Carolina to pay for its NG9-1-1 transition.</p>
Salt Lake County, Utah	<p>Salt Lake Valley Emergency Communication Center (VECC), a consolidated county PSAP, received a state grant, and a moderate amount of state funding, to build a pilot multi-node IP-based call handling network that integrates the traditional wireline network and the wireless network and creates an appropriate platform for NG9-1-1. The County has the ability to dynamically route circuits and use advanced functionality for a population of 850,000, handling about 800,000 calls a year. The Salt Lake area system is a shared solution that links several counties in the Salt Lake City area known as the Greater Wasatch Multi-node Project.</p>
Connecticut	<p>Connecticut's NG9-1-1 system will use the state's public safety data network, a transport infrastructure consisting of 8,800 fiber miles. Connecticut will roll out their NG9-1-1 system as a pilot test at ten PSAPs during the first quarter of 2015. Over the following 12–18 months, the system will be installed in all of the state's 104 PSAPs.</p>



	<p>Complete shutdown of the legacy network should occur by the end of 2016. This more diverse set of IP-based communication is designed for seamless, location-based routing and information sharing between 9-1-1 centers and the response teams with which they communicate. As the migration progresses, local 9-1-1 centers will also be able to receive automated data from in-vehicle crash notification systems.</p>
Minnesota	<p>The Statewide Radio Project provided Minnesota public safety communications officials with the example that statewide efforts can produce effective infrastructure and systems management to be replicated in other areas of service. In that project, the state built and owns the 800 megahertz (MHz) radio system and local jurisdictions built and own regional systems interconnected to the state system. This interdependency illustrates the effectiveness of statewide leadership in governance and planning while protecting the autonomy and rights of local governments to carry out their mission.</p> <p>As with the radio project, state officials provided the leadership structure for planning, assessment of options, incentives for locals to consolidate services, as well as base infrastructure and legislative reform that has prepared the state for NG9-1-1. This model is the basis for the initial planning for NG9-1-1 in Minnesota.</p>

5.3.2. National Guidelines for State NG9-1-1 Legislative Language

Comprehensive benchmarks exist for State 9-1-1 authorities to measure the progress and status of a state's 9-1-1 system. The consensus guidelines illustrate what an effective 9-1-1 system encompasses, but does not dictate how to achieve an end result.

MCP used these guidelines, which provide three levels of criteria (Minimum, Advanced, and Superior) or are binary in nature⁷⁵, as the benchmark for the assessment of Virginia's 9-1-1 systems and state operations. The guidelines were used to gauge the status of the state's program(s), and to identify areas where changes, enhancements, or modifications are necessary to bring the Commonwealth closer into compliance with the national guidelines.

Using the direction and guidance provided in the [National 9-1-1 Guidelines Assessment](#) report and the companion document [Guidelines for State NG9-1-1 Legislative Language](#), both prepared by the National 911 Program Office under the direction of NHTSA, MCP reviewed current Virginia statutes and evaluated compliance with the 27 statutory and regulatory elements identified in the national guidelines.

The assessment demonstrates that the E-911 Services Board, supported by VITA, has achieved a significant amount of coordination and compliance with national guidelines and its defined criteria, but also has areas where greater compliance is possible. Further discussion of any suggested

⁷⁵ For binary guidelines a state either meets the stated guideline or does not.



improvements for higher compliance with the guidelines may be found in Section 5.7, Findings and Recommendations.

Table 26 depicts a comparison of the National 9-1-1 Assessment Guidelines' statutory/regulatory (SR) environment with the current statutory/regulatory environment in Virginia, based on the defined guideline criteria.

Table 26 – National 911 Program Guidelines Comparison

National 911 Program Guideline	VA Legislation Status
Guideline SR 1: The statutory environment provides for comprehensive statewide 9-1-1 coordination.	Partially meets guideline criteria ⁷⁶
Guideline SR 2: The state has a designated state 9-1-1 coordinator.	Partially meets guideline criteria
Guideline SR 3: The statutory environment defines jurisdictional roles and responsibilities.	Meets minimum guideline criteria
Guideline SR 4: The statutory environment provides for dedicated and sustainable 9-1-1 funding.	Does not meet guideline criteria
Guideline SR 5: The statutory environment prohibits the use of 9-1-1 funds for purposes other than those defined in the state's 9-1-1 statute.	Does not meet guideline criteria
Guideline SR 6: The statutory environment authorizes the operation of a 9-1-1 system.	Partially meets guideline criteria
Guideline SR 7: The statutory environment provides for interlocal cooperation.	Meets minimum guideline criteria
Guideline SR 8: The statutory environment enables and allows public and private cooperation in providing 9-1-1 services required by statute.	Partially meets guideline criteria
Guideline SR 9: The statutory environment provides contractual authority to procure and/or operate statewide 9-1-1 components.	Partially meets guideline criteria ⁷⁷
Guideline SR 10: The state fosters an open and competitive procurement of 9-1-1 services.	Meets guideline criteria
Guideline SR 11: The statutory environment provides liability protection.	Meets advanced guideline criteria
Guideline SR 12: The statutory environment fosters the adoption of technical and operational consensus standards for the statewide system.	Does not meet guideline criteria
Guideline SR 13: A mechanism is in place for periodic reviews of statutes and regulations.	Meets advanced guideline criteria

⁷⁶ As far as the responsibilities of the PSC Coordinator and the E-911 Services Board extend, the coordination is highly functional. However, the Board's authority is limited to wireless, VoIP, and other future technologies, The National Guideline definition of statewide authority is inclusive of all services types. Further discussion can be found in Section 5.7.

⁷⁷ While the statutory authority exists to allow the E-911 Services Board to enter into contracts to carry out its mission, its mission scope is currently limited to only wireless, VoIP and future technologies. While that works for NG9-1-1, it is MCP's view that the Board should have authority over many more aspects of 9-1-1 service than they currently do, such as technical and operational standards, quality assurance programs, etc.



National 911 Program Guideline	VA Legislation Status
Guideline SR 14: The statutory environment provides for stakeholder involvement.	Meets superior guideline criteria
Guideline SR 15: Service providers that deliver and/or enable telecommunications services to the public are involved in the 9-1-1 system.	Meets superior guideline criteria
Guideline 16: The statutory environment provides for a comprehensive quality assurance (QA) program for the 9-1-1 system.	Does not meet guideline criteria
Guideline 17: The statutory environment provides comprehensive quality assurance (QA) for call handling.	Does not meet guideline criteria
Guideline 18: The statutory environment provides for training.	Does not meet guideline criteria
Guideline 19: The statutory environment provides for professional certification and accreditation.	Does not meet guideline criteria
Guideline 20: Statute exists for the provision of emergency medical dispatch (EMD).	Does not meet guideline criteria
Guideline 21: Statutory environment provides for medical oversight of the policies and procedures governing the use emergency medical protocols.	Does not meet guideline criteria
Guideline 22: The statutory environment provides for public education.	Meets guideline criteria
Guideline 23: The statutory environment provides for the collection of 9-1-1 system data.	Meets minimum guideline criteria
Guideline 24: The statutory environment has rules for retention of 9-1-1 call records and 9-1-1 related data.	Meets guideline criteria
Guideline 25: The statutory environment defines confidentiality and disclosure of 9-1-1 records.	Meets guideline criteria
Guideline 26: A statute/regulation exists that addresses multi-line telephone systems (MLTS) statewide for 9-1-1.	Meets superior guideline criteria
Guideline 27: The statutory environment identifies 9-1-1 as an essential government service for states that are able to make the distinction. ⁷⁸	Does not meet guideline criteria

The Commonwealth excels at statewide coordination efforts for a portion of the 9-1-1 system (wireless and future technologies), a strong process for review of the needs of the state as it relates to 9-1-1 and emerging technologies impacting service to the citizens, and a comprehensive MLTS statute to protect that vulnerable population. The stated objectives of the National 911 Guidelines for Legislative Language that apply are noted below.

⁷⁸ 9-1-1 as an “Essential” Service needs to be explicitly stated in statute as it is for health care and other governmental responsibilities:

1.1. § 23-50.16:2. Findings and declaration of necessity.

The General Assembly finds that: 1. Provision of health care, including indigent care, is an essential governmental function protecting and promoting the health and welfare of the citizens of the Commonwealth



- ✓ The statutory environment provides for comprehensive statewide 9-1-1 coordination and a statewide coordinator role is clearly defined. (National Guideline SR1 and SR2.)⁷⁹
- ✓ The advisory board⁸⁰ responsibility for planning, evaluating and coordinating 9-1-1 service is delineated and anticipates future technologies as well as broad stakeholder participation. (National Guideline SR3, SR13, SR14 and SR15)
- ✓ The MLTS legislation is broad and addresses the necessary statewide protections for the 9-1-1 caller using MLTS devices or systems. (SR26)

The Commonwealth should concentrate on full statewide coordination of all 9-1-1 service types, achieving dedicated and sustainable funding, QA elements, and the establishment of technical and operational standards that will be essential to highly effective NG9-1-1 system(s) and as migration to NG9-1-1 moves forward. The stated objectives of the *Guidelines for State NG9-1-1 Legislative Language* that apply are noted below.

- x The statutory environment should provide for dedicated and sustainable 9-1-1 funding at both the local and state levels for all 9-1-1 funds. (SR4)
- x The statewide coordination should include a quality assurance program for both 9-1-1 systems and call handling to ensure, to the degree practical, a minimum level of service throughout the state. (SR16 and SR17)
- x The advisory board should function as the developer of consensus-based standards, and the statutory or regulatory environment should be responsible for the adoption and monitoring of technical and operational consensus standards for the statewide system. (SR12)

The Commonwealth meets or exceeds 63 percent of the national SR guidelines.

⁷⁹ Coordination is effective as far as it goes, but does not include all elements of 9-1-1 service as inclusive in the statewide definition.

⁸⁰ The *National 9-1-1 Assessment Guidelines* refer to the term advisory board to mean the 9-1-1 authority entity in the state. The *Guidelines for State NG9-1-1 Legislative Language* describe this advisory board as a “...*State-level entity with statewide authority to address necessary State level functions and responsibilities, with a clearly defined 9-1-1 program coordination role...*” MCP acknowledges that the E-911 Services Board is clearly a policy board with appropriate authority to develop policy governing the NG9-1-1 system in Virginia.

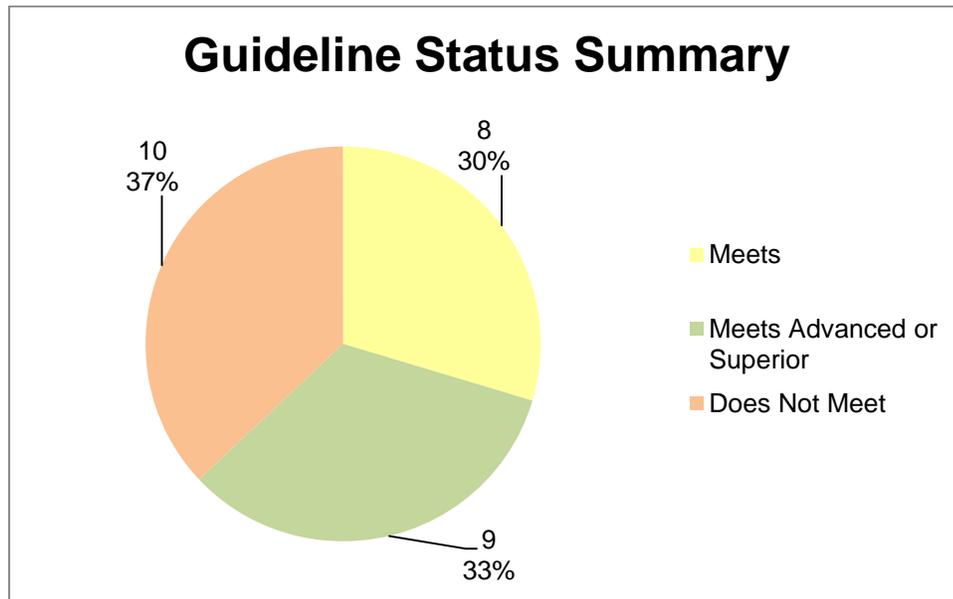


Figure 22 – Guideline Status Summary

Fifteen SR guidelines were only partially met or not met at all and should be strengthened to achieve full compliance with national guidelines. Some of these benchmarks focus on full statewide coordination authority, QA and standards, into which the E-911 Services Board has not ventured to this point in its history. Statewide coordination of NG9-1-1 will require the Board to accept a more expanded policy role and representation on the E-911 Services Board should reflect this change.

Appendix F provides the E-911 Services Board an assessment of the current statutory and regulatory framework as it relates to the grading criteria of the guideline.

A more detailed comparison with the National 9-1-1 Assessment Guidelines, the range of compliance considerations, and current statute in Virginia is included in Appendix G.

5.3.3. Guiding Policy Principles

Based on the national guidelines, a set of guiding principle statements can be derived and would be critical to the Commonwealth in the development of appropriate legislation to advance preparations for the transition to NG9-1-1 services.

- 9-1-1 is an essential governmental service for the citizens of the Commonwealth and core to the mission of government.
- Comprehensive statewide coordination of 9-1-1 services in Virginia is imperative.
- Authority for the development of policy and rules governing future 9-1-1 service(s) should continue to be vested in a statewide entity.



- The responsibility for coordination of the statewide 9-1-1 network(s) is a duty and responsibility of the E-911 Services Board.
- Inclusive representation by all appropriate stakeholders to provide input to the E-911 Services Board and the legislature on matters related to the 9-1-1 system has functioned well in the Commonwealth.
- QA is important to the design, implementation, and management of a 9-1-1 system in the Commonwealth.
- Equality of service provisioning across all jurisdictions and across all 9-1-1 access methods is important.
- Development of technical and operational standards for Virginia's 9-1-1 system will be an important element of a successfully integrated NG9-1-1 system.
- Dedicated and sustainable funding for NG9-1-1 is essential.
- A dedicated and sustainable funding mechanism is necessary.
- Roles and responsibilities for 9-1-1 operations should be clearly defined.
- Local governing bodies should retain responsibilities for PSAP operations.
- Public education to assist citizens in the effective and efficient use of the 9-1-1 system is paramount.

These guiding principles are the framework for the proposed changes and recommendations made by MCP to existing legislation or for new statute language, organizational structure, or funding recommendations.

5.3.4. Current Commonwealth Policy Comparison with Other Areas

In addition to analyzing current statute in relation to national guidelines, it is also beneficial to review the current statute in relation to other states' 9-1-1 related legislation. This second tier of review helps to frame the Commonwealth's position as it compares to the status of other states' statutes in the event that concepts can either be confirmed or suggested for positive change going forward.

The elements used for the review are taken from the *Guidelines for State NG9-1-1 Legislative Language* and focus on the high-level elements that provide the framework for successful and resilient legislation. Components such as the governance structure; role of the state 9-1-1 office; funding and resource statutory language; how records are treated, and how confidentiality and privacy are protected, as well as the critical need for attention to system security; and, finally, the rulemaking and regulatory environment were selected for comparison. The states used in the comparison—Minnesota, Vermont, Kansas, Alabama, Indiana and Pennsylvania—were determined to be representative of a broad range of both early adopters, those involved at various stages of NG9-1-1 planning, and a Commonwealth governance structure. Table 27 is a summary of that comparison.



Table 27 – State Summary Comparison

State	State 9-1-1 Governance Structure	Role of State 9-1-1 Office	9-1-1 Funding and Resources	Records, Confidentiality, Privacy and Liability Protection	Rulemaking and Regulatory Environment	Statute Reference
VA	E-911 Services Board supported by VITA	Comprehensive, statewide enhanced 9-1-1 plan for wireless E-911, VoIP E-911, and any other future communications technologies; monitor trends and advances in enhanced emergency telecommunications technologies, plan and forecast future needs and formulate strategies for effective delivery of enhanced 9-1-1 services.	<p>The Communications Sales and Use Tax statute stipulates the 9-1-1 collection fee on wireline and wireless and the distribution rate for local jurisdictions; pre-paid rate differs; statute does not dedicate wireline funds (Communication Funds) for 9-1-1.</p> <p>Wireless E-911 Fund for state initiatives; uses stipulated; moderate protection. 60% of the Wireless E-911 Fund is distributed to the PSAPs monthly by TAX, according to each PSAP's average pro rata distribution from the fund for fiscal years 2007-2012; 30% of the Wireless E-911 Fund is reserved for the CMRS provider's cost reimbursement; and 10% for the PSAP Grant Program.</p> <p>The PSAP Grant Program (10% and any remaining funds for the previous fiscal year from the 30% for the CMRS providers) is</p>	9-1-1 data and confidentiality protected; limits on liability; enforceable by penalty.	Yes – Corporate Service Commission	§56-484.12-§56-484.25



State	State 9-1-1 Governance Structure	Role of State 9-1-1 Office	9-1-1 Funding and Resources	Records, Confidentiality, Privacy and Liability Protection	Rulemaking and Regulatory Environment	Statute Reference
			<p>available for distribution to the PSAPs or on behalf of PSAPs based on grant requests received by the Board each fiscal year. The E-911 Services Board administers the PSAP Grant Program, the primary purpose of which is to financially assist Virginia primary wireless PSAPs with the purchase of equipment and services that support the continuity and enhancement of wireless 9-1-1.</p>			
MN	Department of Public Safety, Emergency Communications Networks	Coordinate 9-1-1 systems; aid counties in improving the operation of 9-1-1 systems; establish design standards and rules.	<p>Equitable fee across all service types for network and database elements; established to cover the costs of on-going maintenance and related improvements.</p> <p>Funds are dedicated and fee is capped.</p> <p>Distribution formula and use of funds outlined.</p> <p>Fund is audited annually.</p>	Strong liability protection for 9-1-1 and service providers; confidentiality and record retention provided; significant data privacy language.	Yes – Minnesota Rules, chapter 1215; Minnesota Public Utilities Commission (PUC)	Statute: Chapter 403 Rules



State	State 9-1-1 Governance Structure	Role of State 9-1-1 Office	9-1-1 Funding and Resources	Records, Confidentiality, Privacy and Liability Protection	Rulemaking and Regulatory Environment	Statute Reference
VT	Vermont Enhanced 9-1-1 Board	Established to develop, implement and supervise the operation of the statewide enhanced 9-1-1 system; technical and operational standards; diverse membership.	Special fund; allowed to carryover and not revert to General Fund; annual review and amount approval. Uses of fund stipulated.	9-1-1 data protected; limits liability; enforceable by penalty.	Yes – Vermont Enhanced 9-1-1 Board	Title 30, Chapter 87
KS	9-1-1 Coordinating Council	Monitor the delivery of 9-1-1 services, develop strategies for future enhancements and distribute available grant funds to PSAPs. Authorized to adopt Rules. Diverse membership. Service Providers are non-voting members.	Set 9-1-1 fee pursuant to rules and regulations; cap on fee. PSAPs report on use. Annual report to legislature. Grant and 911 service fee fund rules protect funds and stipulate use. Fee capped. Distribution formula based on population. Fund audited every three years.	Liability protection defined.	Yes – 9-1-1 Coordinating Council	KS 911 Act



State	State 9-1-1 Governance Structure	Role of State 9-1-1 Office	9-1-1 Funding and Resources	Records, Confidentiality, Privacy and Liability Protection	Rulemaking and Regulatory Environment	Statute Reference
AL	State 9-1-1 Board	<p>Study the operational and financial condition of the current 9-1-1 systems; publish a report detailing same.</p> <p>Study the rate charged for 9-1-1 services and make recommendations to the board regarding adjustments to the rate.</p> <p>Develop recommendations for the most efficient and effective delivery of 9-1-1.</p> <p>Requires representative and diverse group membership.</p>	9-1-1 Fund established in 2012; single statewide fee imposed on each active voice communications service connection that is technically capable of accessing 9-1-1 system.	<p>Section 11-98-12 protects the confidentiality of audio recordings of calls to 9-1-1.</p> <p>Section 30-5B-6 Immunity provides immunity for government actions; unable to find any reference to immunity for telecommunications companies or carriers.</p>	State Board has authority to “adopt rules and regulations to efficiently and effectively insure the delivery of 9-1-1 service within the state.”	Code of Alabama 1975 §11-98-1 through 15



State	State 9-1-1 Governance Structure	Role of State 9-1-1 Office	9-1-1 Funding and Resources	Records, Confidentiality, Privacy and Liability Protection	Rulemaking and Regulatory Environment	Statute Reference
IN	Statewide 9-1-1 Board	Administer the statewide system, administer grants, collect records and statistics, appropriate monies from the fund; specify the permissible uses of funds distributed to a PSAP; requires annual reporting by PSAP; requires a communications provider to provide the necessary user data to enable the PSAP to implement and operate a 9-1-1 system; requires PSAP consolidation under certain conditions.	Establishes Statewide 9-1-1 fund; collection rate set at \$0.75 "on each standard user of communications service in Indiana;" uses of fund stipulated.	<p>IC 36-8-16.7-18 "Proprietary information" Sec. 18 provides that proprietary information submitted to the board is considered Confidential; applies to telecommunications company and wireless carrier supplied data such as customer lists, technology descriptions, trade secrets, developmental costs.</p> <p>IC 36-8-16.7-43 Immunity from civil or criminal liability includes the board, PSAP, political subdivisions, providers, employees.</p>	Yes – Statewide 9-1-1 Board; IC 36-8-16.7-27 Powers of board; contracts for communications service and equipment; Indiana transparency Internet web site (7) Adopt rules under IC 4-22-2 to implement this chapter.	IC 36-8-16.7 Chapter 16.7. Statewide 911 Services



State	State 9-1-1 Governance Structure	Role of State 9-1-1 Office	9-1-1 Funding and Resources	Records, Confidentiality, Privacy and Liability Protection	Rulemaking and Regulatory Environment	Statute Reference
PA	<p>Pennsylvania Emergency Management Agency (PEMA) and PEMA Council; statewide coordination for wireless service; E-911 Emergency Services Advisory Committee</p>	<p>Adopt rules, regulations and guidelines; review or reject county 9-1-1 system plans; establish minimum training and certification standards for emergency dispatchers, call takers and supervisors; establish technical standards; 9-1-1 database accuracy standards; standards for performance and QA.</p> <p>Advisory Committee makes recommendations to the agency regarding technical, administrative and operational standards for use in overseeing 9-1-1 programs statewide.</p>	<p>Wireline: Local 9-1-1 “contribution rate” for each subscriber may be established by counties; amount varies by population; use stipulated; fixed and only changeable every three years; triennial audit authorized.</p> <p>Also separate Wireless and VoIP E-911 Emergency Services Fund; per subscriber fee; uses stipulated.</p> <p>Wireless E-911 Emergency Services Fund and prepaid was scheduled to sunset June 30, 2014, but was extended for one year.</p>	<p>Liability protection defined.</p> <p>Confidentiality of records protected.</p> <p>Telecommunications company tariffs offer liability protection.</p>	<p>Yes – PEMA and the Pennsylvania PUC</p>	<p>4 PA Code Chapter 120b Public Safety Emergency Telephone Act</p>



As illustrated in Table 28, the six states used for comparison have addressed prepaid services as it relates to 9-1-1 funding and equal treatment by the law for wireless service. In all instances, prepaid collection entities are permitted to keep a portion of the fee collected for administration.

Table 28 – Comparison States and Prepaid

State	MLTS	Prepaid
Virginia	X	X
Minnesota	X	X
Vermont	X	X
Kansas	X	X
Alabama		X
Indiana	⁸¹	X
Pennsylvania		X

The review of these same states’ legislation shows they have not uniformly addressed MLTS requirements to the same degree as prepaid service; only three had MLTS legislation requiring that the basic elements of 9-1-1 call and location data be provided to the PSAP. Virginia’s MLTS legislation is strong and meets the national criteria at a superior level. Currently only 17 states have MLTS legislation in place.

5.4. POLICY

Virginia enabling legislation providing the authority and direction for wireless 9-1-1 in the Commonwealth can be found in Virginia Code Title 56, Chapter 15, section 484.14, which describes the duties and responsibilities of E-911 Services Board.

Code of Virginia Chapter 20, section 2.2-2031, establishes the PSC, appointment of Virginia Public Safety Communications Coordinator and duties of the Division.

A. There is established within VITA a Division of Public Safety Communications (the Division), which shall be headed by a Virginia Public Safety Communications Coordinator, appointed by the CIO with the advice and consent of the E-911 Services Board. The Division shall consist of such personnel as the CIO deems necessary. The operating expenses, administrative costs, and salaries of the employees of the Division shall be paid from the Wireless E-911 Fund created pursuant to § 56-484.17.

⁸¹ Indiana Statewide 911 Plan for 2013 discusses recommended legislation to include MLTS; unknown if legislation enacted.



B. The Division shall provide staff support to the E-911 Services Board and encourage, promote, and assist in the development and deployment of statewide enhanced emergency telecommunications systems.⁸²

Other sections of Virginia Code, specifically [§56-484](#) enable the wireless fund, provide operative definitions, describe MLTS service requirements, explain the use of 9-1-1, discuss liability protections, and outline prepaid collections and remittances.

There are other parts of the Virginia Code that support or provide guidance related to 9-1-1 service in the Commonwealth. For example, the statute related to the Communications Tax Code addresses the former wireline 9-1-1 fee collections process and distribution methodology. There are also a number of related policies and guidelines, such as the IT Purchasing Policies Guidelines, effective March 1, 2014, to provide guidance to the Commonwealth for acquisition of technology infrastructure.

5.5. REGULATORY

The Virginia SCC derives its authority to establish administrative rules and regulations interpreting the laws of the Commonwealth of Virginia by the Virginia General Assembly and [§12.1-13](#) of the Code of Virginia. The rulemaking process, much like the legislative process, operates by accepting recommendations for changes to existing rules or a request for new rules, takes testimony and comment from interested parties, consults technical experts, holds hearings and ultimately writes rules based on the input from the above noted persons and entities. The time period for rules development and approval is not specifically prescribed.

In the administration and enforcement of all laws within its jurisdiction, the Commission shall have the power to promulgate rules and regulations, to impose and collect such fines or other penalties as are provided by law, to enter appropriate orders, and to issue temporary and permanent injunctions. The Commission is empowered to suspend or revoke any Commission-issued license, certificate, registration, permit, or any other Commission-issued authority of any person who fails to satisfy any fine or penalty imposed by an order of the Commission.⁸³

The 9-1-1 Program and the Board work in partnership with the SCC to promulgate rules for 9-1-1 service that have the full effect of law. The SCC scope, however, is limited only to regulated industry such as the 9-1-1 service provider or CLEC. This limitation prohibits the SCC from promulgating rules on other communications services that are more and more commonly used for 9-1-1 calling. Wireless 9-1-1 calls now comprise 70 percent of the calls handled by PSAPs in the Commonwealth, according to input from the survey. If the SCC cannot adopt rules for communications services that impact most of the work done in the modern 9-1-1 operations, they are ineffective. The SCC also does not promulgate

⁸² <https://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+2.2-2031>

⁸³ Ibid.



rules for local jurisdictions. One of the great attributes of NG9-1-1 is the ability to transfer calls between and among jurisdictions; as such, the need for technical and operational standards to ensure that calls are transferred properly, with the correct data elements appearing at the other PSAP, in the proper format, is essential. These technical and operational standards need to be adopted by the governing body that has responsibility for 9-1-1 services in the Commonwealth—the E-911 Services Board.

5.5.1. Current Commonwealth Regulatory Environment Comparison with Other Areas

Like many other areas of the country, Virginia derives rulemaking authority from statute, the Virginia Code, and authority for the promulgation of rules is currently assigned to the regulatory body in the Commonwealth, the SCC. With some exception, where a statewide board, such as the 9-1-1 Coordinating Council in Kansas and the Alabama 9-1-1 Board, are given authority to make rules and regulations for 9-1-1, the traditional regulatory bodies are responsible for this function. This will certainly change in the future as less and less regulation becomes the norm in the telecommunications field.

Appendix H contains all states and information regarding their respective rulemaking authority for 9-1-1. Most states have some form of rules related to 9-1-1 or the provision of public safety services.

5.6. E-911 SERVICES BOARD GOVERNANCE STRUCTURE

The current configuration of the E-911 Services Board, depicted in Figure 23 below, was implemented when the Board was formed to address the needs of enhanced 9-1-1 and wireless 9-1-1 services. The Board was established to represent the needs of the 9-1-1 program at the time and has functioned well over the years.

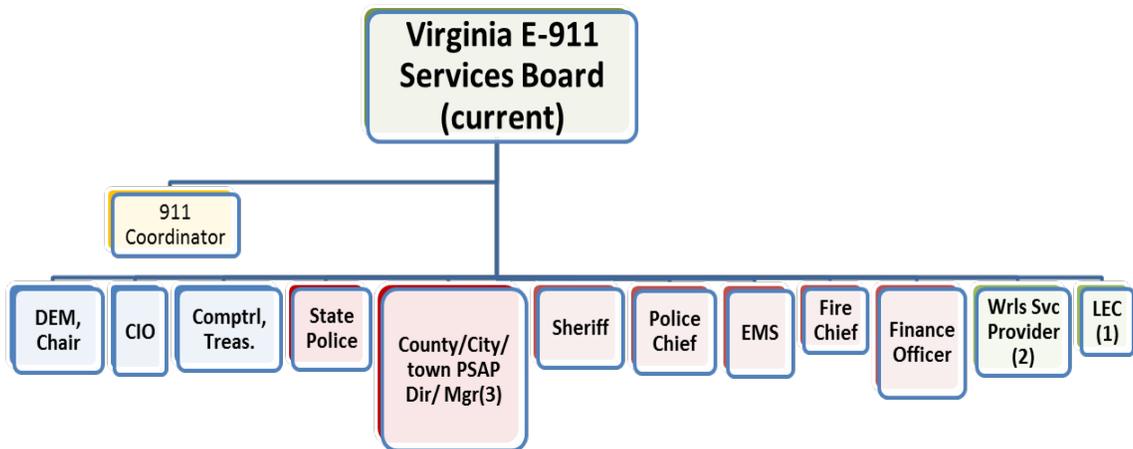


Figure 23 – State of Virginia E-911 Services Board



As the 9-1-1 community begins its transition to NG9-1-1, the Commonwealth must ensure a sound foundational governance structure. Governance should be designed for effective program delivery with the future of 9-1-1 services in mind. As a result, looking forward, the recommendations included in this section rely on effective best practices MCP has directly experienced and observed, and propose how the Board's composition could be altered to continue to improve 9-1-1 governance in the Commonwealth.

5.6.1. State-Level Department Representation

Based on the current configuration of the Board, MCP recommends that the three state-level department positions, the Department of Emergency Management, the Comptroller, and the CIO, be retained as voting members. These three department-level positions provide valuable insight and expertise to the Board related to their respective offices and their collaboration with 9-1-1 services. The CIO, for example, will be increasingly relied upon for advice and guidance as NG9-1-1, which is highly reliant on IT infrastructure, becomes part of the work plan of the Board going forward.

These aforementioned state-level positions are state departments with the appointments made by the Governor. MCP recommends that the method of appointment remain the same.

Currently, the Department of Emergency Management representative is the Chairperson. Going forward under the proposed structure, MCP recommends that the Chairpersonship rotate on a scheduled basis through all voting Board positions. Shared leadership is empowering and increases an organization's opportunity to have all members more fully engaged and involved in the Board's decision-making. Members who serve in leadership positions, such as a rotating chair position, each take a higher level of ownership in the mission of the board by serving as its chair and the responsibility that brings. Rotating the chair position sends a message to the entire Board that each member is valued and respected for the perspective they offer. It also shows that each discipline and interest represented is important to the overall activity and function of the Board.

MCP also recommends that the Board retain its Policy and Finance Committees and consider rotating the position of Board Treasurer on a scheduled basis through all voting Board positions. This will provide all Board members, over the course of time, a more full understanding of the Board finances and how they are managed, as well as a solid financial understanding of 9-1-1 program funding. While this recommendation may not specifically enhance the fulfillment of NG9-1-1 in the Commonwealth per se, it does help to ensure a more well-rounded board with more than one member educated on the fiscal aspects of the program including its financial constraints and opportunities. Currently financial guidance is provided by the Comptroller as a member of the Board and Chair of the Finance Committee and that should continue going forward as the Board continues to rely on the Comptroller's expertise and involvement with the Board program. NG9-1-1 implementation will require an increased awareness of the financial underpinnings of state 9-1-1 program activities and the financial health or challenges faced by the Board as implementation progresses. The more educated all Board members can become on the financial matters facing the Board, the better that will be for decision-making. More transparency in financial transactions and an understanding of what funds are required to accomplish the mission



and, therefore, more advocates for sound fiscal and accounting practices, is rarely a detriment to a body of decision-makers.

5.6.2. Commercial Member Representatives

MCP recommends the positions currently held by two WSP representatives and the LEC be moved to non-voting Technical Advisor positions. The expertise of these representatives and others, such as representatives from GIS, Internet service providers, legal, IT, Broadband providers, telecommunications companies, etc., can and will be invaluable to the Board and should augment the subject matter expertise provided by the PSC Coordinator, whose job description includes the duties of the 911 coordinator, and VITA staff.

The membership of the Technical Advisors may change over time. For example, the 9-1-1 service provider role may change in the next generation environment from what it is today. Or, as other partners such as internet or broadband providers become more active in the provision of services and are involved in NG9-1-1 implementation in the Commonwealth, their expertise will be of great value.

Maintaining flexibility with the ability to integrate new advisors as the Board identifies the need to call upon additional technical advisors to provide information, guidance and expertise is recommended. The advisory positions will play an essential role in the Board's ability to make sound decisions. As such, the advisors should change as the needs of the Board change.

5.6.3. City/County/Town PSAP Director or Manager Representatives

Currently there are three local PSAP representatives on the Board. MCP recommends that this representation not change at this time. The method of selection and term of appointment also do not need to change.

5.6.4. Regional Advisory Council

MCP's recommendation that the new NG9-1-1 network be a statewide backbone with regional networks means potential changes in regional representation on the Board. Through the Town Hall meetings and surveys, local public safety communications officials made known their desire for a greater voice, representation, and input into the work plan and program of the Board.

To address this concern, MCP recommends the formation of a Regional Advisory Council, supported by the VITA Regional Coordinators. This recommendation offers the local PSAP community a supported forum for discussing issues and bringing concerns or ideas for improvement to the Board, while allowing for the individual requirements of each region of the Commonwealth to be heard and considered. This Council also provides for specific expertise in 9-1-1 operations and services and can be the bridge between the legacy and NG9-1-1 environment. MCP recommends that this Council be advisory to the Board.



Representatives to the Regional Advisory Council should be elected or appointed from a respective region in a manner they deem appropriate. There are seven regions designated by the Governor as homeland security regions based upon existing state police regions. They vary slightly from the VDEM regions, but have been accepted by VITA in the past. Another potential option is the RPAC-Is which were based on homeland security regions. Some of these regions are more active than others at this point due to reduction in state support. MCP recommends that the Board consider maintaining the regions as designated by the Governor for Regional Advisory Council representation.

Chairpersonship of the Regional Advisory Council should be determined by the regional representatives.

The role of the Regional Advisory Council will likely evolve over time. It is envisioned to act as the generator of many initiatives and programs that will be brought to the Board for action. The PSC Coordinator and the Regional Coordinators may discuss and vet ideas, concepts or plans for 9-1-1 services in the Commonwealth, develop initiatives, and design the 9-1-1 program for the coming year with this Council. The Council can express the collective viewpoint of the PSAP community and advocate for those concerns that are of impact to local operations.

5.6.5. Public Safety Representatives

Based on the current configuration of the Board, MCP recommends that the four public safety representatives (Virginia State Police, Sheriff, Police Chief, and Fire Chief) be retained as voting members. These representatives also provide valuable insight and expertise to the Board related to their respective disciplines and their collaboration with 9-1-1 services. MCP recommends that the method of appointment remain the same. The constituencies they represent can also become advocates for the mission of the Board. The representatives are in a position to liaison with members of their disciplines to educate and inform them on the activities of the Board and how NG9-1-1 will affect them. Likewise, they can advocate for the needs of their respective disciplines with the Board as policy is developed that impacts their ability to conduct their work and carry out their public safety mission.

MCP also recommends that the current EMS representative be retained as a voting member. The Virginia Office of Emergency Medical Services (OEMS) is “responsible for planning and coordinating an effective and efficient statewide EMS system.”⁸⁴ At a national level, the Office of Emergency Medical Services, located within NHTSA, provides leadership and coordination “in assessing, planning, developing, and promoting...emergency medical services and 9-1-1 systems.”⁸⁵ This further highlights the importance of EMS to the implementation of NG9-1-1. As noted earlier in the report, the National 911 Office, housed within NHTSA’s Office of Emergency Medical Services, has been instrumental in establishing NG9-1-1 guidelines for states. This effective partnership model, i.e., 9-1-1 and EMS,

⁸⁴ <http://www.vdh.state.va.us/OEMS/>

⁸⁵ <http://www.nhtsa.gov/Driving+Safety/Office+of+Emergency+Medical+Services>



should continue in Virginia. MCP recommends that the method of appointment for the EMS representative remain the same.

5.6.6. *Elected Official Representatives*

MCP recommends one representative from the House and one representative from the Senate be appointed to the Board as voting members by the Governor. This proposed representation by members of the General Assembly will provide continuity between the electorate, the 9-1-1 program and services, and the laws, rules and regulations required in the Commonwealth to be both functional and responsive to the needs of the people. The General Assembly representatives can also be helpful in guiding legislation that will be needed to accomplish the 9-1-1 program, specifically the NG9-1-1 Master Plan and the respective changes to the state 9-1-1 program, and in having bill sponsors within the framework of the Board. These representatives can become built-in champions and advocates for the needed policy. As members of the Board, their significant in-depth understanding of the issues facing 9-1-1 in the Commonwealth will allow them to be a bridge between legislative colleagues and the 9-1-1 public safety community.

As most PSAP operations in the Commonwealth are county-based, MCP believes it is also appropriate to have a County representative on the Board appointed by the Governor.

5.6.7. *Information Technology Representative*

MCP recommends increased support representation from the IT community on the Board. It is well understood by leaders in the 9-1-1 industry that IT is going to play an increasingly significant role in the planning, policy, implementation and on-going management of NG9-1-1. It is because of the importance of IT to the future of an effective NG9-1-1 system that increased support representation be considered. MCP recommends that an IT representative from a City or County, such as a CIO or a Chief Technology Officer (CTO), be appointed to the Board as a voting member by the Governor. This will provide a local perspective to complement the State CIO's perspective.

5.6.8. *Public Representatives*

MCP recommends a representative from the deaf and hard of hearing or other special needs communities be appointed to the Board by the Governor. The special needs communities offer a significant voice in the implementation of an ESInet. The VDDHH might be an appropriate source for such representation. An active public member of this special needs community might be another source. Other states such as Kansas have adopted this same approach and it is not without precedence to ask this representative to fully participate in the policy decisions at the Board level. Alternatively, if the Board is considered too large, or if a voting position for this representative on the Board is not desired, the special needs community could serve at the Ex Officio level or as a Technical Advisor.

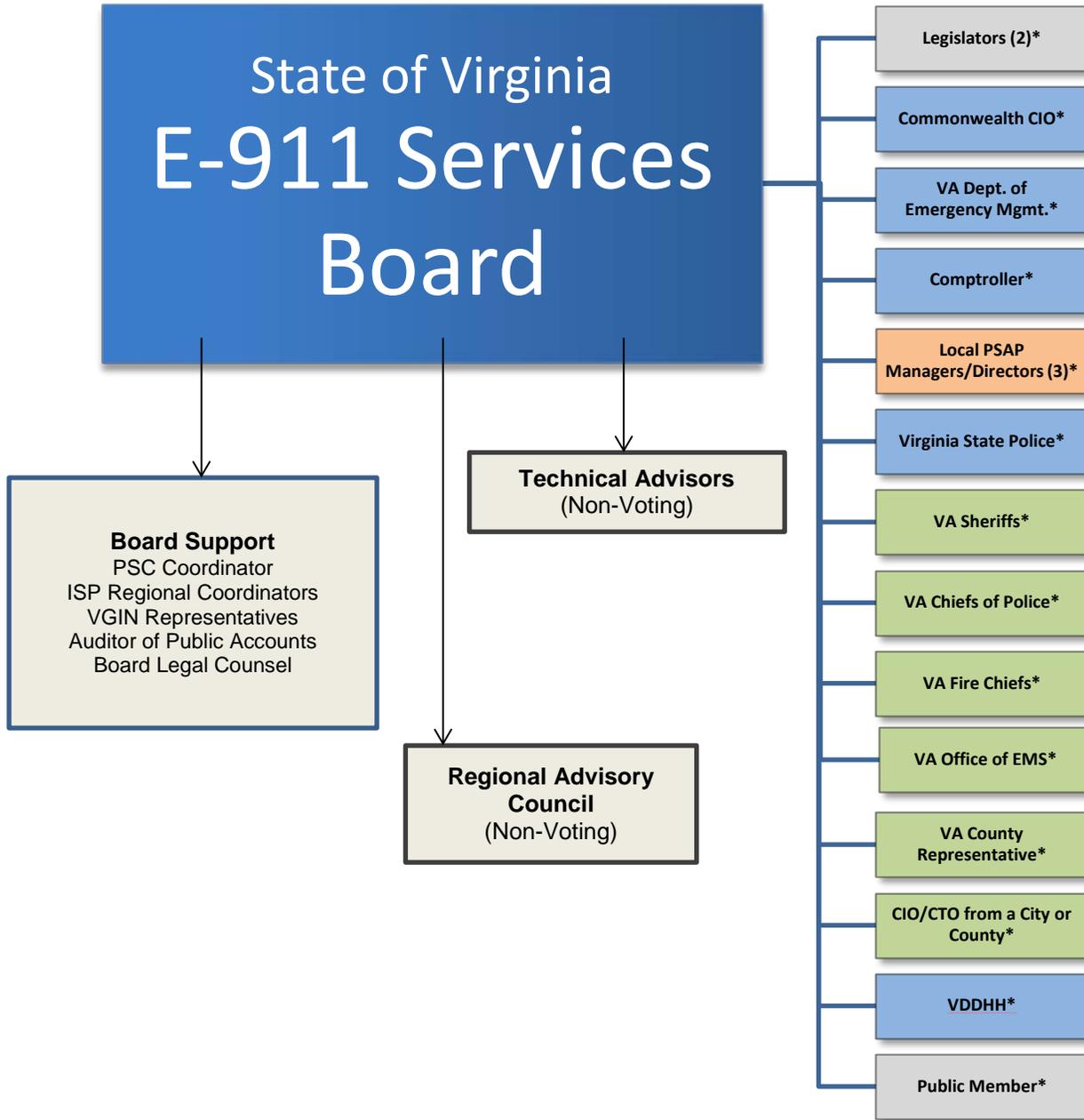


MCP also recommends a member of the public be appointed to the Board by the Governor. This representative can ensure the needs of the general public, as it relates to 9-1-1 services in the Commonwealth, are represented in a full and equitable manner. A member of the public, even one with little or no direct expertise in 9-1-1, can be an immensely valuable asset to the Board making sure that the policy makes sense to those outside of the field. A board with too many representatives who are intimately involved with 9-1-1 can become blind to the common sense realities of what the public thinks and expects of their 9-1-1 service. A public member can help bridge that potential divide between expectations and what is fiscally and technologically possible.

5.6.9. Proposed Board Configuration

The proposed State of Virginia E-911 Services Board is depicted in Figure 24.

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*Denotes appointment by the Governor

Figure 24 – Proposed State of Virginia E-911 Services Board Configuration



5.6.10. Technical Advisors (Non-voting)

The recommended Board restructured configuration continues to rely on the expertise and advice from private partners, which will be essential in the NG9-1-1 environment. While other states' board structures sometimes reflect a commercial member on the board, in many cases these board structures have not been updated or revised to take into account the evolving role of the commercial partner in the provision of 9-1-1 services. National guidelines do suggest that active participation in 9-1-1 governance is important and necessary. MCP recommends that the essential expertise of the commercial/vendor community be advisory to the Board to fulfill this recommendation.

The Technical Advisors can also be augmented as the need arises. For example, additional financial expertise may be necessary if financing the NG9-1-1 system(s) is to be researched; perhaps additional GIS expertise is necessary to augment the support received from the VGIN, or the new primary technology in the next generation network is from a provider that should become a member of the Technical Advisors. As the Board's needs change, Technical Advisors should be added or removed.

5.6.11. E-911 Services Board Support (Non-voting)

The PSC Coordinator position will continue in its present function, although the role may change as the Board's needs change and as NG9-1-1 is planned and implemented throughout the Commonwealth. The PSC Coordinator acts as an "executive director" and is the chief advisor to the Board as it relates to policy, agenda setting, direction, and the decision-making process.

VITA staff support will also continue to be essential to the Board and the Virginia 9-1-1 program. The role of the Regional Coordinators should continue to be viewed as the entity that carries out the work product of the Board and provides the necessary support for the individual PSAPs as well as regional systems, programs, and operations. As a Regional Advisory Council is formed and begins its work, the Regional Coordinators will take on additional responsibility as well. The Regional Coordinators should be the link between the local PSAPs, the Regional Advisory Council representative(s), and the PSC Coordinator. The Regional Coordinators will provide the support structure for the work plan the Board might assign to the Council.

Another support position that will be critical to the work of the Board and the implementation of NG9-1-1 is a formal representative from VGIN, such as the VGIN Coordinator. GIS will be an integral and essential element of the NG9-1-1 system(s) in the Commonwealth, whether the proposed structure in this report or a variation of it is implemented. The E-911 Services Board should not underestimate the time and effort that will be required to establish statewide GIS rules related to NG9-1-1, and transitioning from the flat file, tabular database that is currently used in the present 9-1-1 platform to the geospatial needs of NG9-1-1. Consistent, high-quality GIS data will be needed to route calls, determine or change response jurisdictions, and locate callers. GIS will be the basis for many call processing functions in the NG9-1-1 environment and will play an ever increasingly significant role as a partner in an effective NG9-1-1 program. As such, a formal representative from VGIN will be necessary to advise



the Board on the use, importance, and all matters of GIS, especially as it relates to migration to NG9-1-1 and the on-going maintenance of quality GIS data.

Staff are support to the Board and do not vote.

5.6.12. Board Name Change

MCP recommends the E-911 Services Board consider a change to its name. The Statewide 911 Services Board is more descriptive of the Board's further evolutionary role in implementing statewide services for NG9-1-1. As the systems and methodology for NG9-1-1 services will change the function and role of the Board, so too should its name.

In 2008, the Board was statutorily continued as the E-911 Services Board, eliminating the name "wireless" from its title and expanding its duties to be clear that it would be the responsible authority not only for wireless, but also for future technologies. This change established the E-911 Services Board as the entity responsible for overseeing the next generation of 9-1-1 services in the Commonwealth.

A name change might not be accomplished immediately, it might be an evolutionary process as the migration to NG9-1-1 will be, but it is a change that should occur and MCP recommends it to strengthen the Board's position. The name change is also meant to help ensure that those involved in 9-1-1 in the Commonwealth, those who will be appointed to the Board to direct the statewide program, and those interested parties and other agencies understand the statewide authority for NG9-1-1 resides with the statewide board. It also ensures the understanding that the Board's authority is for statewide services and does not intrude on the local jurisdictions' authority and responsibility for the local 9-1-1 services of call taking and public safety service delivery in response to a 9-1-1 call in their area.

It is especially important to consider a name change as the Board is still only able to utilize 9-1-1 funds collected from wireless service. This fact alone still colors the Board as a "wireless board" and needs to be overcome. There is a clear demarcation, resident with the recommended name change, which cannot be misconstrued.

Enhanced 9-1-1, also known as E-911, will soon be an outmoded reference as rapidly as NG9-1-1 begins to be implemented. The change to eliminate "E" from the Board title will help inform all that the Commonwealth has made the transition to full NG9-1-1 planning with an eye to full implementation.

MCP recommends that the Board begin referencing themselves with the full name that exists today—the State of Virginia E-911 Services Board—to put emphasis on the "state" aspect of their jurisdiction and responsibility while minimizing the emphasis on the "enhanced" 9-1-1 services that are being replaced with NG9-1-1. MCP also recommends that any references to the Wireless E-911 Services Board, such as those still on the VITA website, be removed. For example, Wireless E-911 Board is a link under the Integrated Services Program tab.



At a point in the planning process when a change to statute is required and where a name change in statute might be codified along with other important elements of NG9-1-1 transition, MCP recommends pursuing the name change.

5.6.13. Summary

The recommended configuration of the Board has 17 members representing statewide agencies or public safety disciplines, and the local public safety communications community. The recommendations provide a firm foundation and deviate only slightly from the current configuration. Terms of the recommended additions to the Board should be consistent with existing members.

The proposed Board restructuring continues to have balanced representation, including state departments that have or will have significant interaction in an NG9-1-1 system, elected official representation to increase the understanding and the linkages between the mission of the Board and its statutory/regulatory needs, the establishment of a Regional Advisory Council as a forum for the local jurisdictions and the continuation of PSAP representation, representation of the special needs community and the public, and establishment of highly regarded Technical Advisors to the Board.

MCP encourages the Board to consider these recommendations and believes they will help advance the effectiveness of the Board and the 9-1-1 Program during the transition to NG9-1-1 services in the Commonwealth.

5.7. FINDINGS AND RECOMMENDATIONS

5.7.1. Governance

Wireline communications technologies of the 1960s provided the basis for enabling local 9-1-1 service. Development of advanced communications technologies over time has driven the need for parallel advancement in 9-1-1 network capabilities and service offerings. The public has an ever increasing expectation that the communications technology they use every day to locate shops, order pizza delivery, buy products, take and send photographs, and transmit non-voice messages will also be available, in a similar manner, to request emergency response services.

Technology enhancements and applications have enabled numerous forms of communication and information transmission and the need to expand the 9-1-1 system to a more interconnected platform with a multitude of communications and response partners is just simply expected of state and local governments operating 9-1-1 systems and networks.

NG9-1-1 services will require a next generation governance structure that is also managed at a higher level of authority, has representation that reflects the appropriate level of oversight, as well as more agility and service consistency and less reliance on legacy systems and the traditional ways of doing things. NG9-1-1 will require an enhanced level of interaction with a multitude of system participants and service suppliers as well as broader interagency and intergovernmental collaboration. This means a



greater reliance on standard protocols so that the multitude of systems can interconnect and facilitate information sharing without compromise to service quality. It also requires a greater focus on statewide coordination and oversight to ensure service levels are equalized for all citizens and across all technologies. State legislation enabling the policy for this to be accomplished will be the most effective.

Governance, where strong collaborative elements are present, will increase Virginia’s opportunities for a fully integrated system. Elements such as a strong state coordination role, clearly defined and supported in statute; an advisory group broadly represented by the appropriate key stakeholders in the public safety communications and response fields, with the necessary support from providers and network design expertise; appropriate levels of fiscal and personnel support; and accountability measures that help to ensure the authority is properly maintained, are essential to effective governance structure.

MCP’s analysis and findings are based on the *Guidelines for State NG9-1-1 Legislative Language* and seek to compare what is currently in statute or practice in the Commonwealth with an established set of effective practices. These guidelines were prepared by a broad group of 9-1-1 practitioners and subject matter experts and provide a basis for evaluating a state program as it looks forward to NG9-1-1 implementation.

5.7.1.1. Governance Findings and Recommendations

Table 29 – Governance Findings and Recommendations

Governance	
Findings	Recommendations
1. Statute provides for statewide coordination for wireless and future technologies.	<p>The coordination of all 9-1-1 service types (wireline, wireless, VoIP, etc.) should be specifically stated in statute as part of the statewide program and should be a responsibility of the E-911 Services Board. Currently the Board only oversees wireless, VoIP, and future technologies.</p> <p>If it is determined that there is any question for the statewide responsibility to be within the purview of the E-911 Services Board for the design, procurement and implementation of statewide ESNet, statute should be modified to specifically stipulate this responsibility.</p> <p>MCP recommends the Board consider legislative changes that will move the program into closer compliance with the national guidelines for statewide coordination of all 9-1-1 service types.</p>
2. Designated state 9-1-1 coordinator.	<p>Having a designated statewide coordinator for the 9-1-1 system is imperative with the migration to NG9-1-1 on the horizon. Currently this function is not completely the responsibility of a State agency. The State should designate a responsible party, which should be the 9-1-1 Coordinator (now the PSC Coordinator). The State 9-1-1</p>



Governance	
Findings	Recommendations
	<p>Coordinator needs to be the recognized authority for all elements of the 9-1-1 program and all service types as defined by national guidelines. Effectively and efficiently performing the requirements of this role requires authority and staff. (National 9-1-1 Guidelines Assessment Report, 5-24-12).</p> <p>Duties and responsibilities of the state 9-1-1 Coordinator (now the PSC Coordinator) should be expanded to specifically call out aspects of all statewide 9-1-1 service in the state. Any expanded responsibility of the E-911 Services Board should be appropriately supported by the state 9-1-1 Coordinator and an appropriate level of VITA staffing.</p>
<p>3. Statute defines jurisdictional roles and responsibilities.</p>	<p>Once an NG9-1-1 plan and network topology are determined, legislation should be reviewed to ensure that it clearly describes the authority and responsibility between the various interested parties such as VITA and other state agencies, e.g., PUC, IT departments, TAX, emergency management agencies, and other public safety departments.</p> <p>Roles and responsibilities may need to be amended in statute as the E-911 Services Board assumes more responsibility for NG9-1-1, such as being able to procure statewide components of an ESInet, or rulemaking authority and standards development.</p>
<p>4. Statute authorizes state advisory board to plan and implement a wireless and future technology system.</p>	<p>VITA should be responsible to coordinate and collaborate with State and regional public sector entities and should have the functional responsibilities affecting statewide 9-1-1 networks as directed by the E-911 Services Board. This might include planning, regulation recommendations, contracting, development of interlocal agreements across or between jurisdictions or states, resource sharing, etc.</p> <p>VITA should be authorized to monitor compliance of any adopted standards for the 9-1-1 system, the PSAP, or call handling, which have been adopted by the Board. When standards are not applicable, or have not yet been developed, VITA should have the authority to require compliance with specified requirements, if appropriate.</p> <p>Statute should prescribe a state board that appropriately represents the key stakeholders of the next generation environment.</p> <p>Commercial partners should be moved to an advisory, not policy, role. The composition of the E-911 Services Board should be revised based on the statewide design that is selected. For example, if</p>



Governance	
Findings	Recommendations
	<p>regional ESInets are part of the NG9-1-1 design, then regional representatives should be members of the board. (Additional discussion may be found in Section 5.7.)</p> <p>MCP recommends the E-911 Services Board develop and adopt a comprehensive state NG9-1-1 Master Plan.</p>
5. Local authority.	<p>Any changes to statute should preserve a local jurisdiction's duty to manage response to 9-1-1 calls for service and local networks.</p> <p>MCP recommends the authority to manage local 9-1-1 services and local response is codified in statute; currently it is implied.</p>
6. Statute allows for interlocal cooperation.	<p>Current statute adequately covers this guideline. NG9-1-1 will continue to require the ability for the E-911 Services Board to enter into interlocal agreements, which already exists in Code.</p>
7. Statute allows public and private cooperation related to the provision of 9-1-1 services.	<p>Current statute adequately covers this guideline. NG9-1-1 will continue to require the ability for the E-911 Services Board to enter into private cooperative agreements or contracts, which already exists in Code.</p> <p>Policy makers should utilize the expertise of stakeholders representing the key commercial industry partners in a support or advisory capacity.</p>
8. Statute provides for the authority to procure 9-1-1 components, but does not explicitly stipulate statewide authority for all types of 9-1-1 service.	<p>Statute should be modified to explicitly state that the E-911 Services Board and the supporting infrastructure of 9-1-1 coordination through VITA has responsibility for all statewide 9-1-1 services in the Commonwealth and should stipulate the extent of those responsibilities (statewide network design, system performance rules, standards development and compliance monitoring, minimum training requirements for call takers, QA, etc.)</p>
9. Statute does not prohibit, but does not foster adoption of technical and operational standards for the statewide system.	<p>Statute and supporting rules and regulations should stipulate that the E-911 Services Board has the authority to develop and adopt technical and operational standards for the statewide 9-1-1 system, the authority and responsibility to monitor compliance with those standards and any required enforcement of non-compliance.</p>
10. There is a documented process in place for annual review of statute and regulations and the ability to recommend changes to legislation.	<p>As cost projections become more specific and the need for funding the transition from legacy networks to NG9-1-1 networks becomes clearer to the E-911 Services Board, it may be necessary to request a change to the wireline (Communication Tax), wireless (and prepaid) 9-1-1 fee; it may be necessary to review the entire funding structure for 9-1-1 in the Commonwealth.</p> <p>MCP recommends elimination of the distribution to the Compensation Board, wireless cost recovery, and the VSP fund transfer in order to help fund NG9-1-1 implementation.</p>



Governance	
Findings	Recommendations
<p>11. Statute provides for stakeholder involvement.</p>	<p>While statute outlines a broad spectrum of representation on the E-911 Services Board, a review of the Board composition is recommended as the Board takes on a stronger and more direct statewide coordination role for NG9-1-1 with additional members representative of the electorate and general public.</p> <p>The input and expertise of the private enterprise partners should continue, but in an advisory capacity. Commercial representation as it exists today may not be an effective representation of the NG9-1-1 configuration in the future network. If commercial entities have a seat on a policy board when their role in NG9-1-1 may significantly change and new partners are not represented, issues of fairness and competitive neutrality can be questioned. There is also no guarantee that the current 9-1-1 provider will continue to play the same role in the systems employed by the Commonwealth going forward. MCP recommends that commercial members be made non-voting Technical Advisors to the Board.</p>
<p>12. The state has fully implemented balanced stakeholder involvement.</p>	<p>Town Hall meetings revealed that increased local jurisdiction or representation is desired.</p> <p>Depending on the ultimate plan for how NG9-1-1 will be structured and implemented in the Commonwealth, the composition of the Board may need to be revised to better reflect the NG9-1-1 environment. Other agencies or disciplines such as an IT/systems management, or a GIS practice representative, Internet service provider or Broadband representative, which could be integrated either as voting members or as Technical Advisors, should also be considered. MCP recommends that an additional CIO/Communications Technology Officer (CTO) representative be added to the Board.</p> <p>A special needs community representative is also an important consideration. MCP recommends that a new member representing the deaf and hard of hearing community be added to the Board.</p> <p>The health and safety of the public, life and property is the reason for 9-1-1. A public representative can provide the necessary “sanity” check and real-world experience that will help the Board make sound policy decisions that will withstand taxpayer scrutiny and desire for sound government actions. MCP recommends that a member of the public be added as a voting member of the Board,</p>
<p>13. Statute addresses MLTS as they relate to providing adequate information to 9-1-1.</p>	<p>§56-484.19 requires that the MLTS provider maintain the ALI database. However, there is no audit requirement or any standards to provide guidance to the MLTS provider or the state to verify/certify</p>



Governance	
Findings	Recommendations
	<p>the accuracy of MLTS provider records or to ensure they are following the law.</p> <p>MCP is not aware of any proactive enforcement of this portion of the statute.</p> <p>It is recommended that the proposed Regional Advisory Council, supported by the Regional Coordinators, make recommendations to the Board regarding rules development.</p>
<p>14. Statute is silent on the definition of 9-1-1 as an essential service of government.</p>	<p>The E-911 Services Board should determine if statute should be modified to define 9-1-1 as an essential service. Codifying 9-1-1 as a core function of government will have the effect of ensuring its rightful place in the funding and policy priorities of the Commonwealth.</p> <p>This is how the public views the 9-1-1 service and it should be so stated in statute. There may be labor implications with this recommendation that should be investigated before it is fully pursued.</p>

5.7.2. E-911 Services Board and State 9-1-1 Office

The effective migration to, and implementation of, NG9-1-1 will require state-level 9-1-1 authority that is both comprehensive and accommodates all types of technology that may be able to access 9-1-1. The closest entity to a state 9-1-1 office in Virginia is VITA, as directed by the E-911 Services Board. Statute that defines the role of a state 9-1-1 office to facilitate the coordination of statewide 9-1-1 service and network(s), including the authority to support the functionality of state-level systems, will be critical to the success of NG9-1-1 within Virginia. However, the authority of the Board is only related to wireless and future technologies.

Virginia statute outlines the responsibilities of the Board and the role that VITA plays in support of the Board. Coordinating the development of NG9-1-1 services throughout the state at a consistent level of service, clearly identifying and defining State, regional and local roles and responsibilities, involving stakeholders in the process, will be essential. The composition of the Board is prescribed in statute. If recommended changes are made, either to the authority and scope of the Board’s responsibilities or the Board membership and composition, they will need to be codified in statute revisions.

Reviewing, and rewriting if necessary, statute and/or rules and regulations to conform to the new state functions and the needed coordination and cooperation between all government levels helps to ensure the authority is placed where it is most effective to achieve the desired outcomes. This responsibility belongs to the Board, as outlined in current statute.



Policy related to standards of operation, performance and related QA measures, for both networks and personnel who handle 9-1-1 calls for service, will become more necessary with future technologies and as more regional and interrelated approaches to call processing are implemented. As functional operations become more fluid and service demands begin to cross traditional jurisdictional boundaries, the need for consistent training, policy, and protocols will become increasingly more important in the goal to achieve an effective, fully integrated system.

This area has traditionally not been seen as within the scope of the E-911 Services Board for anything other than service related to wireless funding. Network and system performance standards, as well as operational standards to ensure a consistent level of service, have not been formally developed. The closest thing to a standard is the implementation of wireless 9-1-1, under the scope of the E-911 Services Board and VITA, which has been conducted in a consistent manner so as to ensure quality wireless services.

5.7.2.1. State 9-1-1 Office Findings and Recommendations

Table 30 – State 9-1-1 Office Findings and Recommendations

State 9-1-1 Office	
Findings	Recommendations
1. Statute designates a state 9-1-1 Coordinator.	Duties and responsibilities of the state 9-1-1 Coordinator (now the PSC Coordinator) should be stipulated and expanded to include all aspects of 9-1-1 service in the state as it relates to NG9-1-1. Any expanded responsibility of the E-911 Services Board should be appropriately supported by a state 9-1-1 Coordinator (now the PSC Coordinator) and additional VITA support staff.
2. Statute defines jurisdictional roles and responsibilities.	Roles and responsibilities will need to be amended in statute if the E-911 Services Board assumes more responsibility for NG9-1-1, including how support will be provided by a 9-1-1 Coordinator (now the PSC Coordinator).
3. Representation on the E-911 Services Board includes commercial interests impacted by the policy adopted by the Board.	Recommendations may be found in Section 5.7 regarding the commercial members on the Board.
4. Roles and responsibilities of the E-911 Services Board are limited to wireless and future technologies.	NG9-1-1 will significantly change the way 9-1-1 services are provided in the Commonwealth. A new governance model for the statewide NG9-1-1 system will be required. The structure of the Board should change to be more representative of the NG9-1-1 services and systems. If the proposed E-911 Services Board structure, as recommended, is codified, the two legislative representatives would be key to offering



State 9-1-1 Office	
Findings	Recommendations
	support in legislative outreach efforts.
5. The E-911 Services Board has not formally established standards for either the state’s 9-1-1 network or service levels provided to citizens statewide.	National 9-1-1 Assessment Guidelines recommend a comprehensive review of the necessary technical and operational standards to ensure the NG9-1-1 system is effective. MCP concurs and recommends the Board undertake such a review and establish those standards deemed important to an effective program.
6. The statute allows for public education using 9-1-1 funds and includes it as a role of the state office.	Public education should be part of a comprehensive statewide 9-1-1 plan. As part of the work plan of the Board, it is recommended that the Board assign to the Regional Advisory Council the task recommending a public education program to inform and educate the public on NG9-1-1 opportunities and challenges.
7. VITA provides support to the E-911 Services Board and administers the wireless program as directed by the Board.	VITA should continue to provide the necessary support to PSC. The role of the Regional Coordinators should be enhanced. Duties and responsibilities include many of the recommended activities in this report, as deemed appropriate by the E-911 Services Board. Appropriate funding to carry out the program and mission of the E-911 Services Board should be provided.
8. An annual review of current legislation and a comprehensive report to the Virginia legislature on the status of 9-1-1 in the Commonwealth is required of the E-911 Services Board.	Current statute adequately covers this guideline. The annual review of current legislation should continue.

5.7.3. Funding and Resources

MCP’s research revealed that in many cases across the country existing state statutes’ governance structures and funding mechanisms have not yet been modified to address newer technologies in preparation for NG9-1-1. Some states have advanced the issue and revised statute to accommodate changes to service definitions, acknowledging who might be a provider of service in the NG9-1-1 environment, and how funding mechanisms need to be amended to address collections from future technologies.

While the Commonwealth is in a good position to accommodate future technology oversight in its legislation, more can be done to enhance the Commonwealth’s ability to move forward with NG9-1-1 in an effective manner. One opportunity focuses on the funding priorities for grants. The Finance Committee and the E-911 Services Board should re-evaluate the funding priorities to incentivize movement to more advanced technologies and NG9-1-1 components, such as requests that help to develop regional networks. In addition, unless there is a compelling need such as an emergency



equipment replacement, adding legacy equipment that does not advance implementation of NG9-1-1 should not be high on the funding priorities, if considered at all.

5.7.3.1. National Funding Trends and Observations

A number of studies, working groups, and commissioned reports have attempted to wrestle with the issue of funding for the future of 9-1-1.

In March 2011, the FCC established a CSRIC working group dedicated to the issue of funding NG9-1-1. Section 4.4 of the working group's report, *Transition to Next Generation 9-1-1* is a lengthy discussion regarding the funding challenges currently confronting all governments and PSAPs as they plan for the transition to NG9-1-1.⁸⁶ While a specific funding model was not recommended, the challenges are clearly discussed. The CSRIC report recommended further research and federal involvement in identifying funding solutions for NG9-1-1 implementation.

Following the CSRIC recommendation, a Blue Ribbon Panel was formed to further study the issue. Its mission was to "analyze current funding and financing strategies and governance models and explore new possibilities that could be applied at the local, state, or national levels of government."⁸⁷ In the December 2013 Blue Ribbon Panel on 911 Funding *Report to the National 911 Program*, three major challenges were identified regarding funding the transition to NG9-1-1:

- "Lack of a comprehensive cost estimate for both the transition to NG911 and ongoing operation and maintenance costs
- "Existing legislation that excludes new methods for revenue generation for 911, making it difficult to keep pace with the dynamics of the telecommunications user base
- "Diversion of revenues collected for 911 services through existing means to other uses."⁸⁸

5.7.3.2. Cost Recovery

Virginia, like a number of other states, still has a wireless cost recovery mechanism codified in statute. Carriers continue to collect cost recovery funds and may protest if cost recovery did not remain in statute. However, wireless implementation cost recovery is not required by the FCC and is a drain on the available funds for NG9-1-1 transition and on-going operations. This cost recovery "reserve," as it is described, is currently budgeted at 30 percent of the Wireless E-911 Fund. The percentage was established through a legislative change in 2006 and was based on the then-known on-going costs of the wireless service providers.

⁸⁶ Federal Communications Commission, Communications Security, Reliability and Interoperability Council, Working Group 4B. (2011, March). *Transition to Next Generation 9-1-1 Final Report*.

⁸⁷ <http://www.911.gov/pdf/BlueRibbonPanel-911Funding-report-dec2013.pdf>

⁸⁸ Ibid., page 9 of 88.



5.7.3.3. Diversion of 9-1-1 Funds

The same challenges noted in both the CSRIC effort and the Blue Ribbon Panel on 911 Funding report face the Commonwealth. VITA has taken the initial step in helping the Commonwealth prepare for future technologies and the funding element of NG9-1-1 service. Not only are future technologies referenced in the statute, but some moderate protection for wireless 9-1-1 and future technologies' fees is also present in existing statute to encourage that the funds are not used for non-911 purposes. That section of the statute is, however, subject to interpretation, and this fact is highlighted in the *E-911 Services Board FY2014 Annual Report*:

...moving forward, an existing appropriation and transfer from the wireless fund to other agencies and programs will challenge the board's ability to meet financial obligations to both the wireless carriers and the PSAPs and maintain the viability of the fund. The current biennial budget includes a \$3.7 million appropriation to the Virginia State Police (VSP) for wireless 9-1-1 call taking. However, all localities in the Commonwealth are currently accepting wireless calls and no longer rely on the VSP to transfer wireless 9-1-1 calls to them. Thus, the justification for the VSP to receive Wireless E-911 funding no longer exists...⁸⁹

... in the current biennium budget is an \$8 million transfer from the portion of the Wireless E-911 Fund that is earmarked for wireless cost recovery to the Compensation Board. The intent of this transfer is to pay for sheriffs' dispatchers. In FY2014 sufficient funding was available from the remaining portion of this earmark to pay all wireless service cost recovery requests, but in future years this may not be the case, especially when considering forthcoming compliance testing guidelines from the FCC.⁹⁰

While it can be argued that the transfer to the Compensation Board for Sheriffs' dispatching services may be a permissible use of wireless 9-1-1 funds because many Sheriff's Offices answer 9-1-1 calls, which is directly related to 9-1-1, the same cannot be argued for the transfer to VSP. It is also true that the needs of the E-911 Services Board going forward to plan and implement NG9-1-1, and the support costs of the PSAPs' transition or connectivity to the statewide network, may require those funds heretofore transferred remain under the control of the E-911 Services Board for the express purpose of building an NG9-1-1 system in the Commonwealth. Alternately, new sources of funding for the Compensation Board requirements or VSP will need to be found.

5.7.3.4. Fund Sustainability

The question of Wireless E-911 Fund sustainability is a significant one and clearly a cause of concern for the E-911 Services Board and local jurisdictions. The funding distribution requirements identified in

⁸⁹ [Commonwealth of Virginia E-911 Services Board FY2014 Annual Report](#), page 2.

⁹⁰ *Ibid.*, page 5.



the Appropriations Act are subtracted before the distribution of funding is made. The E-911 Services Board cautioned this in their *FY2014 Annual Report*:

...Beginning July 1, 2012, 60% of the Wireless E-911 Fund is being distributed to the PSAPs monthly by the Department of Taxation...The current distribution percentages will be recalculated on or before July 1, 2017 but there is already interest within the PSAP community to forecast the impact of the upcoming recalculation on current distribution percentages.⁹¹

...financial assistance is also available to the PSAP community through the E-911 Services Board's PSAP Grant Program. This program was included in the 2006 legislative changes and is funded by the remaining 10% of the wireless fund and any remaining carrier funding from the previous fiscal year.⁹²

...The Appropriations Act for the current biennium budget continues the transfer of \$3.7 million to the Virginia State Police and the \$8 million transfer from the Wireless E-911 Fund to the Compensation Board to support Sheriffs' dispatchers.⁹³

...As a result of the \$8 million transfer from the portion of the wireless fund that is earmarked for wireless cost recovery to the Compensation Board, the amount of funding available since FY2011 has been significantly reduced.⁹⁴

Other distributions further reduce the funds available to the PSAPs and wireless service providers from the Wireless E-911 Fund.

The Division of Public Safety Communications (PSC), a portion of the Virginia Geographical Information Network (VGIN) Division, and centralized billing agreements for PSAP wireless 9-1-1 services with Verizon and CenturyLink are funded through wireless E-911. Since this funding is contained in the Appropriation Act, it is subtracted before the distribution of funding based on the formulas, thus evenly reducing the amount of funding across the three funding programs.

5.7.3.5. Wireless E-911 Fund

The Wireless E-911 Fund is the result of a \$0.75 monthly surcharge collected from each wireless customer whose place of primary use is in Virginia. In its annual report to the legislature, the Board is asked to comment on whether the surcharge rate should be adjusted. The current funding process is to distribute the majority of the Wireless E-911 Fund based on a specified formula and the sufficiency of

⁹¹ Ibid., page 6.

⁹² Ibid.

⁹³ Ibid., page 10.

⁹⁴ Ibid., page 6.



the surcharge should be reviewed. As noted earlier in this document, nearly one-third of the Wireless E-911 Fund is reserved for wireless services cost recovery.

NG9-1-1 planning and implementation costs and the on-going costs of networks or systems to run both legacy and next generation elements may prove difficult with the current funding level. In addition, forthcoming compliance testing guidelines from the FCC may further stress the account.

Another option for evaluating the sufficiency of the surcharge is the impact to PSAP funding. As noted in the *FY2014 Annual Report*, local jurisdictions “have come to rely on the wireless E-911 funding source to operate and maintain their PSAPs. Any reduction to the overall funding would be detrimental to service delivery.”⁹⁵ The 9-1-1 tax rate must be sufficient so that the distribution formula results in consistent funding to the local jurisdiction.

5.7.3.6. Communication Tax (Wireline E-911 Fund)

Wireline E-911 funds are treated differently in Virginia than wireless E-911 funds. Local municipalities receive a portion of the statewide landline E-911 tax collected by TAX in accordance with the state statute. Those funds are combined with other communications sales and use taxes to make up the Communications Tax. The distribution formula for the combined collected tax is based on the community’s pro rata share of revenues they derive from the communications services within their jurisdiction. The pro rata share was calculated in 2006 and is not expected to ever be recalculated. The distribution of the communications tax portion is made to the general fund of a respective jurisdiction.

It has been viewed as not within the purview of the E-911 Services Board to establish guidelines for use of the local funds. Local PSAP jurisdictional agencies compete for funding in their normal budget process. The lack of uniform guidelines or protection for the specific revenues derived from that portion of the communications tax that can be directly attributed to E-911 wireline revenues could potentially jeopardize the Commonwealth’s (or even a local jurisdiction’s) ability to receive federal grant funding in the future as cautioned in the *FY2014 Annual Report*.

5.7.3.7. Funding and Resources Findings and Recommendations

Table 31 – Funding and Resources Findings and Recommendations

Funding and Resources	
Findings	Recommendations
1. Statute provides for dedicated funding only for wireless and future technology collections.	Statute should include language that assures that E-911 funds collected, whether statewide or locally, are protected and dedicated to 9-1-1 purposes. MCP recommends that transfers to other departments for

⁹⁵ Ibid., pages 5-6.



Funding and Resources	
Findings	Recommendations
	operational expense should be either limited or eliminated at least until such time as NG9-1-1 is fully operational and fully funded. If elimination of the transfers is not supported, an increase in the communications tax (wireline E-911 fee) and the wireless E-911 fee should be pursued.
2. Sustainability of funding is not determined.	<p>Once a plan for NG9-1-1 has been developed and agreed upon and costs determined, a comprehensive fund growth projection study should be undertaken to ensure sustainability of the fund; adjustments to the E-911 fees may need to be considered and statutes amended as appropriate.</p> <p>An audit of collections on wireline by the local jurisdiction, and on wireless and VoIP by the E-911 Services Board may also be necessary to ensure the Commonwealth is receiving all the revenues it is due.</p>
3. Cost of future service is not yet determined.	This report includes ROM cost projections for implementation of NG9-1-1 in the Commonwealth. Future budgeting should be included in the recommended Master Plan and Strategy for Implementation.
4. Local jurisdictions report that the current funding tax formula has diminished available funding directly to 9-1-1 operations in some situations; in other cases, the jurisdiction is receiving more funding than they did previously.	An assessment of the funding formula impact on local jurisdictions since its inception might help evaluate the effect of the taxing and formula change. The assessment should include other factors that might have impacted the lower or higher revenues, such as diminishing wireline subscribers or population changes in the communities.
5. Local funding is not dedicated or protected for 9-1-1 only and is distributed to a local jurisdiction's general fund.	Changes to legislation should include specific language protections for both local and state E-911 tax collections and stipulate dedication of those funds strictly for 9-1-1 support, technology, staffing, etc.
6. Wireless 9-1-1 providers are allowed to be reimbursed for their administrative costs by statute similar to wireline providers' ability to retain administrative cost reimbursement.	The FCC has declared that cost recovery is no longer a requirement for implementation of wireless 9-1-1 and the Commonwealth is fully deployed with wireless Phase II services. Cost recovery should be eliminated. The funds received from wireless E-911 fee collections should be used for NG9-1-1 and other aspects of a statewide 9-1-1 program. If this recommendation is perceived as politically unfeasible, an increase in the wireless E-911 fee should be requested.
7. PSC, as supported by VITA program staff, is funded through the wireless 9-1-1 fee.	Current statute adequately covers this guideline. The E-911 Services Board should continue current budgeting and program oversight.



Funding and Resources	
Findings	Recommendations
8. The E-911 Services Board reviews and approves the Division's budget prepared by VITA.	Adequate staffing will need to be ensured as responsibilities of the Board and PSC Coordinator are enhanced for statewide initiatives and NG9-1-1 transition.
9. Available grant funding is diminished by distributions to other agencies and funds.	In order to incentivize NG9-1-1 implementation in the Commonwealth, additional grant funding should be made available to PSAPs, especially those interested in pursuing regional approaches; an increase in the wireless E-911 fee should be requested.
10. Funding formula is not viewed as equitable by all local jurisdictions.	Discussions with TAX should be initiated to determine if annual adjustments to the Communications Tax rate could be considered.
11. The distribution to VSP and the Compensation Board from wireless E-911 revenues will compromise the Commonwealth's ability to receive federal funding and is contrary to federal law.	Changes to legislation should include specific language protections for both local and state E-911 tax collections and stipulate dedication of those funds strictly for 9-1-1 support, technology, staffing, etc.
12. VSP and Compensation Board distributions from the wireless E-911 fund are likely to continue unless and until new sources of revenue are found.	An increase in the wireless E-911 fee should be requested especially if the fund transfer to VSP and the Compensation Board continue.
13. The average pro rata distribution rate is based on a five-year average (2007-2012) and not a rolling average recalculated annually.	<p>The five-year average is currently being used to distribute the communications tax revenues (wireline E-911 fee) to the local jurisdiction and is based on cost studies done in the 2005-2006 timeframe. A recalculation of that rate, according to the Communications Tax legislation, is not due until 2017.</p> <p>Changes to the methodology of calculating the Communications Sales and Use Tax rate, either on a rolling average or an annual basis, will provide a more realistic average pro rata distribution rate based on current usage and not aged data. MCP's observations in Town Hall meetings indicate that the PSAP jurisdictions are in support of this endeavor and endorse a reevaluation of the current funding formula.</p>
14. The average pro rata distribution percentage, on which funding for local jurisdictions is based, will not be recalculated until 2017.	
15. The length of time before recalculating the rate could mean a large fluctuation in funding at the time of recalculation.	
16. Current funding structures may not be sufficient to support both legacy 9-1-1 services and the changes and upgrades required for NG9-1-1 during the migration period.	<p>A comprehensive growth analysis of the current communications tax collections, in light of the projected costs of NG9-1-1 deployment reported in this document should be conducted.</p> <p>If determined to be appropriate, an increase in the current communications tax rate for wireline E-911 should be requested and adjusted based on the costs for NG9-1-1 implementation and the need to fund the legacy systems and NG9-1-1 system(s).</p>
17. Virginia 9-1-1 legislation must address	An increase in the current communications tax rate for wireline



Funding and Resources	
Findings	Recommendations
the unique funding issues to be faced in the Commonwealth related to the planning and implementation of a comprehensive NG9-1-1 program, including the continuation of legacy 9-1-1	E-911, and the wireless E-911 fee, should be requested and adjusted based on the costs for NG9-1-1 implementation and the need to fund the legacy systems and NG9-1-1 system(s).
18. Fiscal planning for NG9-1-1 requires a comprehensive plan and realistic projected cost estimates.	A growth plan projection study to evaluate the current collection rate level projected into the future, in relation to the cost estimates herein, will help the Commonwealth determine the level of funding needed in the future.
19. Determination of cost estimates for both the transition to NG9-1-1 and on-going system management will provide the basis for evaluation of current funding levels available to VITA and allow for assessment of a sustainable level of service or will lead to necessary changes in funding levels.	An increase in the current communications tax rate for wireline E-911, and the wireless E-911 fee, should be requested and adjusted based on the costs for NG9-1-1 implementation and the need to fund the legacy systems and NG9-1-1 system(s).
20. IT rules and policy fosters open and competitive procurement practices.	Current statute adequately covers this guideline. Current policy should continue.

5.7.4. Records, Confidentiality, and Liability Protection

With the implementation of NG9-1-1, callers, public safety agencies, and service providers will be able to share increasing amounts of data and information both with PSAPs and response agencies through advanced technologies and benefits that are part of NG9-1-1.

As enhanced systems facilitate the sharing of data with first responders and others in the public safety community, issues of confidentiality, privacy, and system security must be considered and addressed. State governance provisions should enable the sharing of essential information while protecting the necessary data confidentiality, address privacy issues of individuals and information, and focus on the network and data security issues that will become an even greater part of overall system management. As statutes are revised, the use of technology-neutral terms will be essential in ensuring that the intent to maintain privacy and increase system security withstands the progress of technology.

5.7.4.1. Records

Under Code of Virginia §[42.1-85](#), the Library of Virginia (LVA) has the authority to issue regulations governing the retention and disposition of state and local public records. In keeping with the Code's mandate, LVA has developed records retention and disposition schedules for public records. Under this



policy, the LVA issues two types of schedules, general and specific. General schedules apply to the records of common functions performed by or for all localities and state agencies. Specific schedules apply to records that are unique to an individual state agency.

Before a state agency or locality can destroy public records:

- A records officer for the organization must be designated in writing and filed with the LVA.
- Records to be destroyed must be covered by an LVA-approved general or specific records retention and disposition schedule and the retention period for the records must have expired.
- All investigations, litigation, required audits, and Virginia Freedom of Information Act requests must be completed or fulfilled.
- The organization's designated records officer and an approving official must authorize records destruction by signing each [Certificate of Records Destruction Form](#).

Dispatch (communications) and emergency call recordings that are not retained as evidence must be retained for six months after the event. Dispatch (communications) and emergency call records and supporting documentation includes the radio communications between dispatch/central communications and officers in the field; the recording of incoming calls (including NG9-1-1) for fire, police, and rescue services; and the actions taken in response. This may also include, but is not limited to, audio recordings, video recordings, text messages, and photographs.

The recording of radio communications at law enforcement dispatch centers may include, but is not limited to, logs, reports, and supporting documentation including CAD system software and calls for service reports.

5.7.4.2. Confidentiality

Confidentiality of data, records and company proprietary information has long been an essential ingredient of competition in America. The need to protect information that a company holds proprietary and ensuring it is within the control of the company generating the data has been a part of agreements and tariffs with service providers in the past and needs to continue to be protected going forward in the NG9-1-1 environment. Proprietary information in the 9-1-1 arena is generally considered to include subscriber lists, subscriber counts, technology descriptions, technical information, or trade secrets that are developed, produced, or received internally by a voice communications service provider or by a voice communications service provider's employees, directors, officers, or agents.

Confidentiality and trade secret protections for companies doing business in Virginia are outlined in the Code of Virginia. Confidential proprietary records are defined as those that are voluntarily provided by private business pursuant to a promise of confidentiality from a public body, and used by the public body for working papers or prepared by a public body, where competition or bargaining is involved and



where, if such records are made public, the financial interest of the public body would be adversely affected.⁹⁶

In addition, the 911 Service Provider tariff stipulates that “[t]he Company is obligated, by the requirements of the Electronic Communications Privacy Act of 1986 (18 USC 2703), to take prudent action to protect its subscribers’ rights to privacy and to protect its proprietary ALI databases – except as mandated by Federal Law 47 USC 222(g).”⁹⁷

Trade secrets is defined in the Uniform Trade Secrets Act (§[59.1-336](#) et seq.) of Title 59.1, submitted by CMRS providers as defined in §[56-484.12](#) to the Wireless Carrier E-911 Cost Recovery Subcommittee created pursuant to §[56-484.15](#), relating to the provision of wireless E-911 service.

Confidential records and trade secrets developed by or for a local authority created in accordance with the Virginia Wireless Service Authorities Act (§[15.2-5431.1](#) et seq.) as determined by the provider, and where they have determined disclosure of such information would be harmful to the competitive position of the company, are considered proprietary and are protected.

5.7.4.3. Liability Protection⁹⁸

Liability protection is another element that is exceedingly important to service providers. As the number and types of service providers accessing 9-1-1 increases, and information is shared among the broader public safety community, state legislation must ensure that liability coverage is consistently applicable to all public and private entities involved in the provision of emergency 9-1-1 communication systems and services. Code of Virginia §[56-484.24](#) addresses liability. Both MLTS providers (owners and operators of private systems) and other telecommunications service providers are afforded liability protection under the statute.

A. An MLTS provider, its employees or agents shall not be liable to any person for damages incurred as a result of any act or omission by it, except gross negligence or intentional, willful or wanton misconduct, in connection with maintaining or operating the MLTS in a manner required by this article.

*B. A telecommunications service provider, its employees or agents shall not be liable to any person for damages incurred as the result of the release of information not in the public record, including, but not limited to, unpublished or unlisted telephone numbers, to a PSAP, its employees or agents, or to emergency responders, made in connection with an emergency call.*⁹⁹

⁹⁶ §[2.2-3705.6](#)

⁹⁷ Verizon Virginia LLC. [Miscellaneous Service Arrangements Tariff. S.C.C.-Va.-No. 211, Section 14A](#), May 11, 2012, p. 14.

⁹⁸ <http://www.scc.virginia.gov/puc/tariff.aspx>

⁹⁹ §[56-484.24](#)



9-1-1 Service Provider liability limitations are also discussed in Verizon's tariff section G-Liabilities. Typical language stipulates the following:

Except for errors and omissions caused by gross negligence, willful or wanton misconduct, fraudulent conduct or violations of law by the Company, and, to the extent not caused by acts, omissions or other occurrences attributable to the Customer or any other person or entity, the Company's entire liability in tort, contract or otherwise for damages arising out of mistakes, interruptions, delays, failures, errors, acts, omissions, defects in transmission or other occurrences related to the Company's provision of this E9-1-1 Service is limited by the terms set forth in this Section and in other tariffs of the Company. This limitation of liability extends to, but is not limited to, claims in connection with designing, developing, installing, implementing, maintaining, or operating the 9-1-1 Service, attachment to, or use of any Customer-provided equipment in conjunction with the 9-1-1 Service, advice, recommendations or analysis provided, or for releasing subscriber information, including non-published or non-listed information, in connection with the provision of the 9-1-1 Service.¹⁰⁰

E9-1-1 Service liability is not to exceed an amount equivalent to the proportionate charge to the customer for the period of service during which the mistake, interruption, delay, failure, error, act, omission, other occurrence or defect in transmission occurs after notice by the customer to Verizon.

In addition, section G.4 of the tariff indicates that "[i]n no event shall the Company be liable in tort, contract or otherwise for any personal injury, property damage or death arising out of or related to use of the E9-1-1 Service. Under no circumstance shall the Company be responsible or liable for special, indirect, incidental or consequential damages.¹⁰¹

Further, section G.5 states the following:

To the extent permitted by applicable law, the Customer (VITA or the local PSAP jurisdiction) indemnifies and saves the Company (aka 911 Service Provider) harmless against:

G.5.1 Claims for libel, slander, or infringement or copyright arising from the material transmitted over its facilities;

G.5.2 Claims for infringement of patents arising from combining with or using in connection with facilities of the Company, apparatus, equipment or systems of Customer;

¹⁰⁰ Verizon Virginia LLC. [Miscellaneous Service Arrangements Tariff. S.C.C.-Va.-No. 211, Section 14A](#), May 11, 2012, p. 20.

¹⁰¹ Ibid, pg. 20



G.5.3 All other claims arising out of any act or omission of the Customer in connection with the service and facilities provided by the Company.¹⁰²

Statements and clarifications such as those noted above are typical liability clauses seen in tariff's for 9-1-1 and offer a sufficient level of liability protection that has thus far satisfied the service providers.

5.7.4.4. Records, Confidentiality, and Liability Protection Findings and Recommendations

Table 32 – Records, Confidentiality, and Liability Protection Findings and Recommendations

Records, Confidentiality, and Liability Protection	
Findings	Recommendations
1. Statute provides liability protection.	So long as future technologies providers are defined as telecommunications service providers, the liability language in statute does not need modification. If another term is used to define a future technology provider, the respective term will need to be added to the liability clause of the statute.
2. The statute allows the collection of 9-1-1 system data.	It may be necessary to review the statute to ensure that the types of data collection the E-911 Services Board or VITA may need to manage the NG9-1-1 services is appropriate. Ensuring proper terminology to allow the Board or VITA to collect the necessary data will be essential.
3. Statute has rules for retention of 9-1-1 call data.	Current statute adequately covers this guideline as it includes known future capabilities such as text messages; no changes are necessary.
4. Statute defines confidentiality of 9-1-1 calls records.	Current statute adequately covers this guideline as it includes known future capabilities such as records of text messages; no changes are necessary.

5.7.5. Rulemaking and Regulatory Environment

NG9-1-1 provides a number of new functionalities that address current deficiencies in the legacy 9-1-1 network. Increased network reliability and resiliency is one enhancement that addresses risk management issues of single networks without adequate backup and rerouting capabilities. The ability to transfer calls with associated data between and among all PSAPs on an NG9-1-1 network is another enhancement that improves service. In the current infrastructure, many PSAPs cannot transfer calls to neighboring jurisdictions when an incident requires that the call get handed off to the next jurisdiction, or when a wireless caller moves from one jurisdiction to another. This limitation is not only dangerous for responding law enforcement officials, it is a liability issue for governments that operate 9-1-1. The standards and protocols for how the various networks will integrate, as well as call handling procedures

¹⁰² Ibid.



to assure that all PSAPs are essentially handling calls in a like manner will be essential to a successful NG9-1-1 program. There should be a state 9-1-1 office responsible for the coordination and collaboration with state and regional public sector entities, with the requisite authority to establish minimum rules for all communications types and all 9-1-1 service in the Commonwealth. Legislation should vest in that state agency the functional responsibilities affecting 9-1-1, which might include planning, rulemaking, contracting, resource sharing, etc.

Legislation should describe the authority and responsibility between interested parties such as VITA and other state agencies, e.g., PUC, IT departments, VGIN, EMAs, and public safety departments.

“State legislation should grant the state 9-1-1 office the authority to adopt rules to implement its coordination and oversight responsibilities, in accordance with existing State rulemaking processes... Rulemaking authority is provided to specific State agencies and delineated according to the explicit issue requiring regulation.”¹⁰³ As an example, “PUCs typically retain rulemaking authority affecting regulated telecommunications providers; [CIOs] typically oversee rulemaking as it relates to information technology service providers.”¹⁰⁴ Purchasing rules may govern how contracts are to be bid and let. The E-911 Services Board should be the authority for rules affecting both the technical and operational aspects of NG9-1-1.

“In addition, other State entities may oversee rulemaking with regard to record retention, employee training, and professional certifications. These entities will be critical stakeholders in 9-1-1 and will likely be involved in any rulemaking that affects 9-1-1. The shared rulemaking responsibilities of these state and regional entities with regard to 9-1-1 should be clarified within State processes.”¹⁰⁵

As statute changes are pursued for implementation of NG9-1-1 services, a change to rulemaking authority should also be made. Currently the State of Virginia E-911 Services Board and VITA can propose rules to the SCC for deliberation and action, but the process is long and arduous. As the telecommunications industry becomes less and less regulated as the components of 9-1-1 begin to diminish as NG9-1-1 becomes a reality in the Commonwealth, the SCC will have less and less necessity, jurisdiction, and involvement as the rulemaking body for 9-1-1 in Virginia. There is also less desire on the part of the SCC to remain involved in 9-1-1 rules without the expertise and background necessary to promulgate effective rules. The evolution to NG9-1-1 carries with it the need to move rulemaking authority to the State of Virginia E-911 Services Board. The Board should rely on the expertise of its support staff in the PSC Coordinator, the Regional Advisory Council and the Regional Coordinators as drafters of the standards and rules required for 9-1-1 service in the Commonwealth.

¹⁰³ [Guidelines for State NG9-1-1 Legislative Language](#), page 13.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid.



5.7.5.1. Rulemaking and Regulatory Environment Findings and Recommendations

Table 33 – Rulemaking and Regulatory Environment Findings and Recommendations

Rulemaking and Regulatory Environment	
Findings	Recommendations
1. The state regulatory environment requires service providers to be actively involved in the 9-1-1 system.	In the E-911 Services Board proposed structure, service providers continue to be actively involved in the 9-1-1 system as essential Technical Advisors to the Board.
2. The statutory environment does not provide for a comprehensive QA program for the 9-1-1 system.	<p>Statute and supporting rules and regulations should explicitly stipulate that the E-911 Services Board has the authority to establish a comprehensive QA program, standards, and rules for the 9-1-1 system with input and recommendation from the Regional Advisory Council.</p> <p>The Regional Advisory Council should be directed to establish consensus recommendations for presentation to the Board regarding a comprehensive QA program for the 9-1-1 system.</p>
3. The statutory environment does not provide for a comprehensive QA program for call handling.	<p>Statute and supporting rules and regulations should stipulate that the E-911 Services Board has the authority to establish a comprehensive QA program, standards, and rules for call handling (call answer time, call processing time, call recording, announcing transfers to other agencies, etc.)</p> <p>The Regional Advisory Council should be directed to establish consensus recommendations for presentation to the Board regarding a comprehensive QA program for 9-1-1 call handling.</p>
4. The statutory environment does not require a minimum training program for 9-1-1.	<p>While a best practice and not directly related to NG9-1-1 implementation, existing gaps in training within the Commonwealth are so significant that they need to be looked at foundationally, and in coordination and cooperation with DCJS.</p> <p>The E-911 Services Board should determine if statute and supporting rules and regulations should stipulate that the E-911 Services Board has the authority to establish a training requirement for 9-1-1. MCP recommends that this be an explicit responsibility of the Board with input from advisors, such as the Regional Advisory Council, as supported by VITA and the Regional Coordinators.</p> <p>The Regional Advisory Council should be directed to establish consensus recommendations for presentation to the Board regarding requirements for a minimum training program for 9-1-1.</p>
5. The statutory environment does	The E-911 Services Board should determine if statute and



Rulemaking and Regulatory Environment	
Findings	Recommendations
not address professional certification and accreditation.	supporting rules and regulations should stipulate that the E-911 Services Board has the authority to adopt or endorse professional certification and accreditation requirements, in close coordination with DCJS. The Board should consult with the Regional Advisory Council, as supported by VITA and the Regional Coordinators. The Regional Advisory Council should be directed to provide recommendations to the Board regarding the merits and challenges of adopting a professional certification and accreditation program for 9-1-1.
6. The statute does not address emergency medical dispatch (EMD).	While a best practice and not directly related to NG9-1-1 implementation, EMD is a public expectation and should be addressed in coordination and cooperation with DCJS, and in consultation with Virginia OEMS. The E-911 Services Board should determine if it is appropriate for the Board to address EMD as a requirement of 9-1-1 call handling. The Board should consult with the Regional Advisory Council, as supported by VITA and the Regional Coordinators. The Regional Advisory Council should be directed to provide recommendations to the Board regarding the merits and challenges of requiring EMD as part of the 9 -1-1 system.

5.8. CONCLUSIONS

9-1-1 is no longer merely a local issue. The demands and expectations of advanced communications and NG9-1-1 affect regions and states in a new way.

The guiding policy principles, which may be found in Section 5.3.3, have been established to help shape the recommendations in this feasibility study. The alignment of these guiding policy principles and recommendations can assist the E-911 Services Board in determining the most appropriate and successful path forward to achieve full integration of NG9-1-1 capabilities and improved emergency services for the citizens of the Commonwealth.

- Guiding Principle 1:** *9-1-1 is an essential governmental service for the citizens of the Commonwealth and core to the mission of government.*
 - Proposed changes to statute and policy reflect the public's view of 9-1-1 services and their expectations, and highlight 9-1-1's significance to the core mission of government to people of the Commonwealth.



2. **Guiding Principle 2:** *Comprehensive statewide coordination of 9-1-1 services in Virginia is imperative.*
 - o Recommendations are made to enhance the Commonwealth's statewide initiatives and strengthen the statewide services provided to local PSAP jurisdictions, and integrate 9-1-1 in a more cohesive manner going forward to NG9-1-1 implementation.
3. **Guiding Principle 3:** *Authority for the development of policy and rules governing future 9-1-1 service(s) should continue to be vested in a statewide entity.*
 - o Governance recommendations focus the policy development and oversight in a statewide board with appropriate representation in order to further the coordination that will be required of an effective NG9-1-1 plan.
4. **Guiding Principle 4:** *The responsibility for coordination of the statewide 9-1-1 network(s) is a duty and responsibility of the E-911 Services Board.*
 - o Recommendations for a moderate restructuring of the Board, augmenting their work with Technical Advisors and enhancing the roles and responsibilities of regions and local PSAPs at a more comprehensive level increases the Commonwealth's ability to implement an effective NG9-1-1 plan that is responsive to the needs of local jurisdictions while meeting national guidelines.
5. **Guiding Principle 5:** *Inclusive representation by all appropriate stakeholders to provide input to the E-911 Services Board and the legislature on matters related to the 9-1-1 system has functioned well in the Commonwealth.*
 - o Recommendations to reconstitute the Board representation to increase the stakeholder participation of those more directly responsible to the electorate and to utilize the technical expertise of service providers and vendor partners in a more functional manner should help to ensure the policy established by the Board is responsive.
6. **Guiding Principle 6:** *QA is important to the design, implementation, and management of a 9-1-1 system in the Commonwealth.*
 - o Recommendations focus on the establishment of standards and performance measures, based on national guidelines, to help ensure quality 9-1-1 service to citizens while being responsible to taxpayers.
7. **Guiding Principle 7:** *Equality of service provisioning across all jurisdictions and across all 9-1-1 access methods is important.*
 - o Recommendations that focus on a master plan for NG9-1-1 and standardized service requirements, offerings, and metrics will assist the Commonwealth in ensuring that calls within the state, and those transferred to others jurisdictions or states, are handled with the same level of service and efficiency regardless of their jurisdiction or location.



8. **Guiding Principle 8:** *Development of technical and operational standards for Virginia's 9-1-1 system will be an important element of a successfully integrated NG9-1-1 system.*
 - o Recommendations related to the development of technical and operational standards will assist the PSC and local jurisdictions in implementing a highly functional NG9-1-1 system.
9. **Guiding Principle 9:** *Dedicated and sustainable funding for NG9-1-1 is essential.*
 - o Recommendations related to funding are made for consideration by policy makers to increase the opportunity for the Board and the Commonwealth to carry out its mission of continual improvement, maintaining effectiveness and efficiency in service, and resiliency in 9-1-1 services functionality for its citizens. It will also help to ensure that the Commonwealth is well positioned to receive federal grant funding if the opportunity arises.
 - o Keeping pace with current and future technologies that the public is using and will use to connect with 9-1-1, and providing responding agencies with the additional data to assist them in providing the necessary and quality response services is consistent with the stated goals of the Board and the Commonwealth.
10. **Guiding Principle 10:** *Roles and responsibilities for 9-1-1 operations should be clearly defined.*
 - o Recommendations related to stated roles and responsibilities of the Board, PSC, and VITA are made to provide the Board and the Commonwealth with a roadmap to help align the governance structure to be most effective as implementation for NG9-1-1 services becomes the work plan going forward.
11. **Guiding Principle 11:** *Local governing bodies should retain responsibilities for PSAP operations.*
 - o Recommendations related to jurisdictions retaining local responsibility for the provision of 9-1-1 call taking and dispatching services completes the necessary and appropriate chain of authority to, not only achieve a greater degree of compliance with national guidelines, but places the direct authority for 9-1-1 service delivery squarely in the hands of local jurisdictions. The design, oversight and overall management of 9-1-1 service to the citizens are the missions of the Board.
12. **Guiding Principle 12:** *Public education to assist citizens in the effective and efficient use of the 9-1-1 system is important:*
 - o Public education and outreach efforts, discussed in Section 3.3.7, will move 9-1-1 in the Commonwealth into closer alignment with the national guidelines.

As technology advances, particularly networks and end-user devices with increasingly higher levels of functionality, legacy public safety networks and associated technology are approaching the end of their useful lives. Notification has already been received that Verizon, a 9-1-1 service provider in the Commonwealth, is exiting the 9-1-1 market and will no longer sell or maintain PSAP equipment after a certain date. In other states, legacy 9-1-1 systems providers are asking for deregulation and the ability to decommission the selective routers used for 9-1-1 call processing. Other providers are initiating



migrations to retire their current analog technologies as more customers opt for IP-based services. When 9-1-1 becomes the only service that is still using the PSTN for transport of 9-1-1 calls, the cost becomes prohibitive for the remaining one user rather than the multitude that shared the cost in the past. The transition from legacy networks to NG9-1-1 networks will happen — it's simply a matter of when it will happen.

Although the transition to NG9-1-1 often involves a high initial cost and capital investment, savings occur over time, especially considering the challenges of maintaining and upgrading legacy technology, which will become increasingly more expensive to operate as less and less legacy equipment and services are utilized for mainstream communications. NG9-1-1 offers many opportunities to share technologies and costs.

In order to take advantages of these opportunities, the Commonwealth of Virginia must ensure that appropriate policy and governance is in place that is foundationally sound, yet flexible and responsive. These policy and governance recommendations are intended to help Virginia ensure that its citizens and 9-1-1 practitioners can reap the full benefits of more advanced public safety and emergency services technology in the future.

5.8.1. Processes and Timelines

After completing a review of existing 9-1-1 statutes and regulations, changes are being proposed to existing policies. Some revisions are required to be made to statutes, while other modifications or additions to agency rules and regulations or tariffs should be considered. It is important to determine which issues require statutory treatment and which issues can more effectively be addressed through creation or changes in rules or regulations. When considering ideal governance structures for the NG9-1-1 system, stakeholders need to assess whether statutory or rule changes are necessary or whether existing governance structures are sufficient to implement and operate NG9-1-1 systems.

MCP has compiled suggested milestones and a policy change schedule for both statutory and regulatory activity; this is designed to assist VITA with the planning and processes to migrate from the existing regulatory environment to a regulatory environment necessary to implement NG9-1-1.

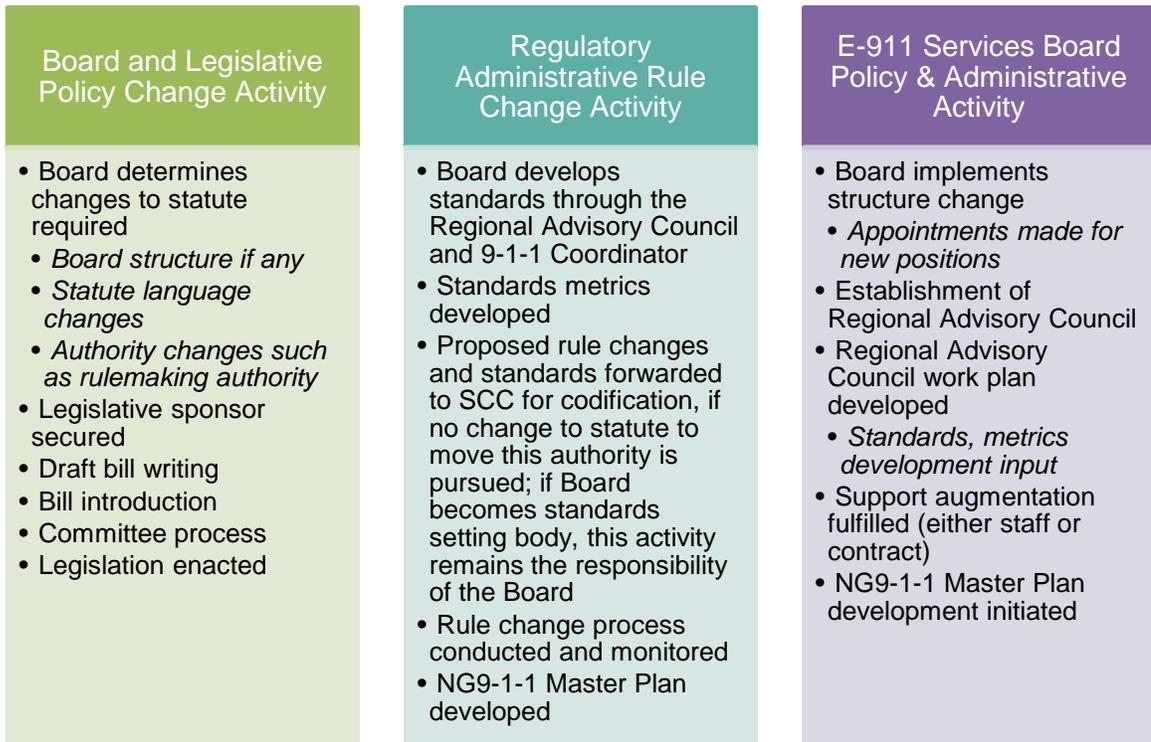


Figure 25 – Change Process Activities

5.8.1.1. Legislative Change Process (1–24 months)

The Virginia legislative process is complex and consists of bills to amend current laws or introduce new laws in one of two houses of the Virginia General Assembly. As discussed earlier in this document, some vestiges of old English law remain as part of the unique Commonwealth legislative process and it is good to reiterate the process in order to understand how VITA, the E-911 Services Board, and the public safety community can have input to the legislative change process.

Only a member of the General Assembly, either a member of the House of Delegates or the Senate, can introduce a bill. Once a bill is assigned a number and referred to the appropriate committee for discussion and debate, testimony may be requested or required of the 9-1-1 community, interested parties, or the public during committee debate. Testimony from subject matter experts, 9-1-1 practitioners, public safety responders, and other advocacy efforts from interested parties is particularly important at this stage of the legislative process. Education and information sharing and interaction by the 9-1-1 community to assist lawmakers in understanding the impact of the proposed legislation, as well as the impact of not enacting the proposed changes, will be critical to the creation of good governance elements and good law. During committee hearings is the only time the public or the 9-1-1 community can have input into the legislation. Once the bill leaves committee and is debated on the



floor of either house of the General Assembly, that debate is only conducted by members of the General Assembly. If the committee hearing the bill believes it will make a good law or the proposed amendment to the current law is determined to be valid, the bill will either be referred to other appropriate committees or to the other house of the legislature. The committee may also amend the bill. If the bill is in its final form, it is returned to the chamber (House or Senate) in which it was introduced.

The bill is heard three times in the General Assembly. At the first reading by the clerk of the chamber, there is no debate or discussion. During the second reading of the bill it may be amended and/or discussed. Upon the third reading of the bill, the title is read and then the bill vote is taken to pass or not pass the bill. If the bill passes in one chamber, it will go through a similar process in the other chamber of the legislature. The bill must have the same wording when it is complete in both chambers before it is ready to go to the Governor for signature.

If the bill passes both chambers, it is sent to the Governor for approval. The Governor may request a fiscal note to identify the financial impact of the proposed legislation. The Governor has four choices; approve, veto, propose changes or amendments to the bill, or ignore the bill. If the Governor approves the bill it becomes law. If the Governor vetoes the bill, the House and Senate may overrule the veto by a two-thirds vote of both chambers. If the two houses cannot obtain a two-thirds approval to override the Governor's veto, the bill does not become a law. If the Governor proposes changes to the bill, it will be returned to the House of Delegates and the Senate for deliberation on the Governor proposed changes. If both houses of the General Assembly approve the Governor's proposed changes, the bill becomes law. If the Governor neither signs the bill, nor vetoes it, the bill still becomes a law. Bills can become laws during the regular session (45 days in odd years and 60 days in even years). Bills take effect on July 1 of each year.¹⁰⁶

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¹⁰⁶ Information about the Commonwealth of Virginia legislative process can be found in the Citizen's Guide at <http://viriniageneralassembly.gov/>

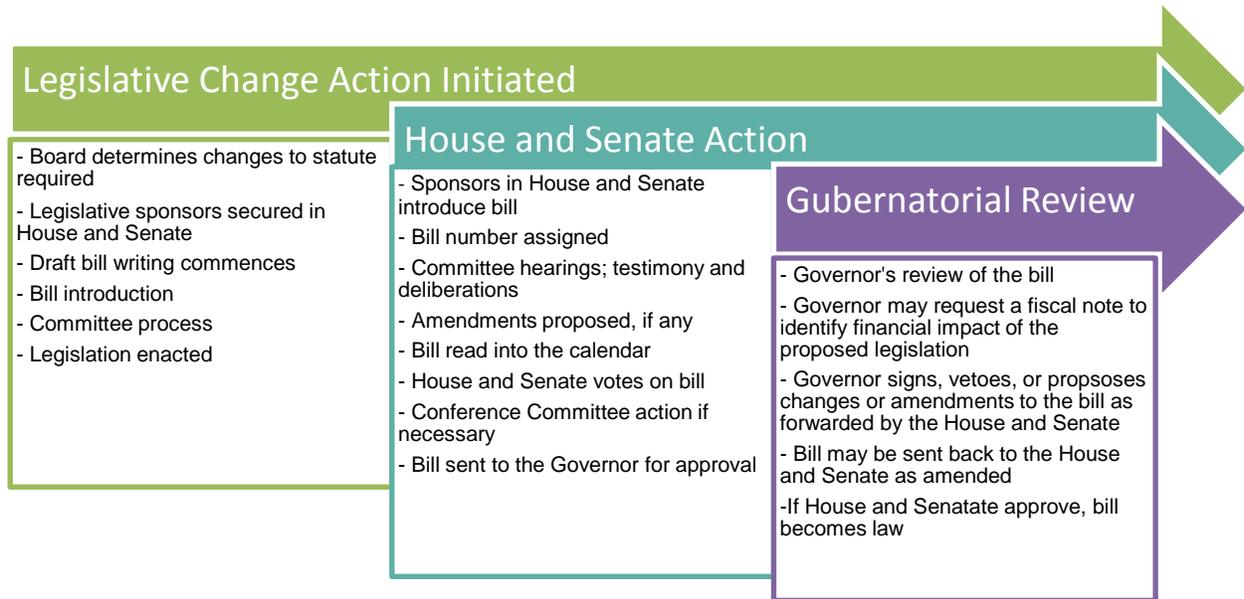


Figure 26 – Legislative Change Process

If the E-911 Services Board wishes to pursue any of the recommendations proposed in this study that require legislative changes, the Board should begin drafting those legislative changes immediately. Some of the recommendations can be accomplished without change to legislation either because the Board already has the authority or the recommendation does not require a change to current law. Discussions in the Policy Committee, as well as with the full Board, will help to formulate which of the recommendations are to be formulated into statutory changes at once and which can or should be held for a longer legislative session in the next session.

Another consideration is the priority for changes; those that need to be made to enable the authority or a structure to enact some of the recommendations will have to occur in order to allow other recommendations to be adopted. As 2015 is an odd-numbered year, there will be only 45 days in the upcoming regular session in which to move recommendations through the process. The Board should consider what is possible in the short session and pursue those changes of highest priority first.

The first step might be to undertake the proposed changes to the Board, such as membership (legislative change), rulemaking authority (legislative change), and development of the Regional Advisory Council (within current Board authority; no legislative change required). The E-911 Services Board and VITA should determine what is to be pursued this year, draft legislation to accomplish those changes, and move through the legislative process.

If membership changes on the State of Virginia E-911 Services Board and the Regional Advisory Council is formed, representatives can be appointed and the policy discussion regarding how to implement the remaining recommendations, and NG9-1-1 and modification to 9-1-1 within the



Commonwealth can actually begin. Without the appropriate governance structure in place, the activity on NG9-1-1 may be limited or delayed.

Changes to statute that are not processed in the 2015 regular session can be prepared for the 2016 session. This session will provide a longer opportunity for testimony, input and discussion, information sharing regarding the proposed legislation, and the approval process, and will coincide with the 2016 budget cycle process.

5.8.1.2. Regulatory Change Process (12–24 months)

The Virginia SCC derives its authority to establish administrative rules and regulations interpreting the laws of the Commonwealth of Virginia by the Virginia General Assembly and §[12.1-13](#) of the Code of Virginia. In an NG9-1-1 environment, the SCC will no longer be the appropriate agency for developing rules that apply to unregulated services. The E-911 Services Board, with input from advisory groups such as its Technical Advisors and Regional Advisory Council, is in the best position to both develop and effect those standards and rules.

There is precedent for policy boards, such as the E-911 Services Board, to promulgate rules affecting the programs for which they are responsible. The Board has the authority to establish advisory committees such as the recommended Regional Advisory Council. The Board also has the authority today to task the Regional Advisory Council with development of consensus standards on 9-1-1 system performance and 9-1-1 call handling as identified in the national guidelines. The development of technical and operational standards is not only a guiding principle of effective 9-1-1 service, but a recommended national guideline for NG9-1-1 effectiveness. Standards will improve 9-1-1 service to the public. MCP recommends the E-911 Services Board pursue the transition of rulemaking authority from the SCC to the Board at its earliest opportunity. MCP also recommends that technical and operational standards development should be initiated.

5.8.1.3. Budget Process (1–18 months)

Any amendments the E-911 Services Board may wish to make to the current funding or program budget will need to be made by the third quarter of 2015. Changes, if approved, will be enacted the following July 1, 2016.

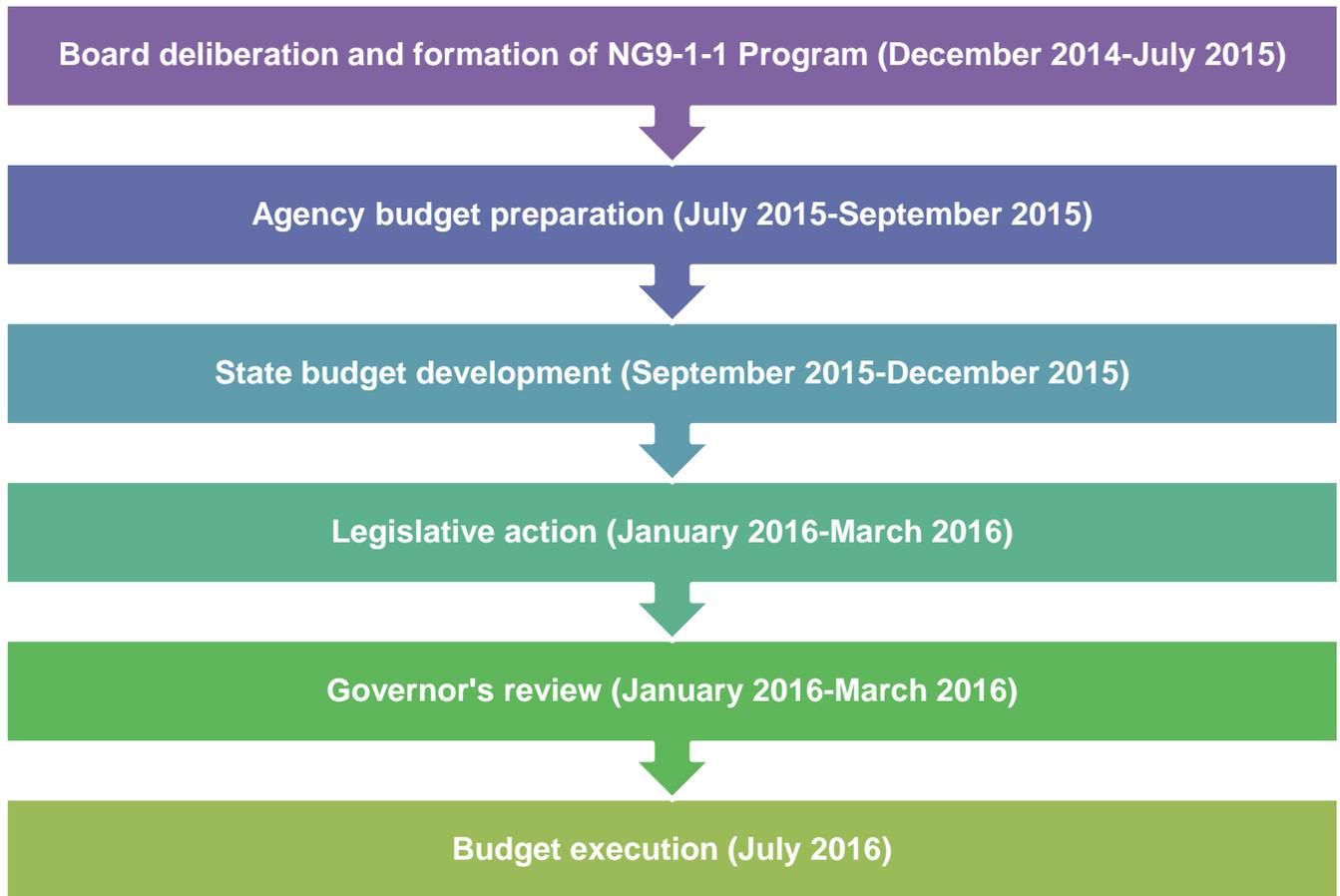


Figure 27 – Budget Process

5.8.1.4. Policy, Administrative and Implementation Change Process (1–24 months)

Some of the proposed policy and administrative changes can be accomplished much more quickly than others, and not all require legislative action, which accounts for the wide range estimated in the timeline. As suggested, the Policy Committee of the E-911 Services Board should first consider the establishment of the Regional Advisory Council, initiation of technical and operational standards development, Board governance structure changes and authority enhancements, such as rulemaking authority changes proposed, and pursue the necessary legislative changes to accomplish the governance that will allow the E-911 Services Board to move forward with NG9-1-1 design.

- Governance (December 2014 – February 2015)
 - Policy Committee deliberates on recommended Board structure revisions
 - Submits policy recommendations to the Board
 - Board reviews recommendations
 - Board acts on recommendation



- Draft legislation initiated, if applicable
- Sponsors identified in House and Senate
- Legislative Process Phase 1 (December 2014 – February 2015)
 - Draft governance bill introduced, if applicable
 - Committee(s) assigned
 - Committee testimony and deliberation
 - Legislative action
 - Governor review
 - Governance changes enacted
- Board Administration (January 2015 – June 2015)
 - Regional Advisory Council representatives secured
 - New Board members secured, assuming legislative changes have been pursued
 - Technical Advisors identified and invited
 - Regional Advisory Council representatives meet to determine Council chair, operating rules, by laws, etc., with direction from PSC Coordinator and support of Regional Coordinators
 - Board meets to elect officers¹⁰⁷
 - Board discusses operating rules, by-laws, meeting frequency, etc. if any changes are to be made
 - Staff develops by-laws for Regional Advisory Council and Board based on direction if appropriate
- Standards and Rule Development Phase 1 (January 2015 – September 2015)
 - Board, with assistance from Regional Coordinators and PSC Coordinator, establishes work plan and requests Regional Advisory Council develop operational standards based on the national guidelines and recommendations in this study
 - Standards metrics developed by Regional Advisory Council and submitted to the Board for approval
 - Board receives and deliberates on proposed consensus standards
 - Board finance committee determines fiscal impact of standards
 - Board reviews financial recommendations
 - Board submits proposed standards and rule changes to SCC if they remain rulemaking body or Board adopts rules/standards if authority has transitioned to the Board
 - SCC rulemaking process commences if they remain rulemaking body

¹⁰⁷ Even though the recommendation is that the Board chair, vice-chair and treasurer rotate through Board membership, there should be a formal action by the Board, captured in official minutes, to establish the positions.



- NG9-1-1 Master Plan Development (March 2015 – September 2015)
 - NG9-1-1 Master Plan developed by the E-911 Services Board with support from the Regional Advisory Council, the Regional Coordinators, the PSC Coordinator, and technical advisors
 - PSC Coordinator, with input from Regional Advisory Council and Regional Coordinators, develops the statewide 9-1-1 program to carry out the NG9-1-1 Master Plan approved by the Board
 - Staffing requirements determined and submitted with NG9-1-1 Master Plan and budget request

- Standards and Rule Development Phase 2 (January 2015 – December 2015)
 - E-911 Services Board requests Regional Advisory Council develop technical and operational standards based on the NG9-1-1 Master Plan, remaining recommendations in this study and national guidelines
 - Board receives and deliberates on proposed consensus standards
 - Standards metrics developed by Regional Advisory Council, with support from Regional Coordinators and guidance from the PSC Coordinator, and submitted to the Board for approval
 - Board finance committee determines fiscal impact of standards
 - Board reviews recommendations
 - Board submits proposed standards and rule changes to SCC if they remain rulemaking body or Board adopts rules/standards
 - SCC rulemaking process commences if they remain rulemaking body

- 9-1-1 Program Development and NG9-1-1 Master Plan Legislative Process Phase 2 and Budget Process Phase 1 (June 2015 – February 2016)
 - PSC Coordinator develops the statewide 9-1-1 program to carry out the NG9-1-1 Master Plan approved by the Board and codified in statute
 - Support for program development is received from the Regional Coordinators and the Regional Advisory Council, VGIN, and other technical advisors as appropriate
 - Draft NG9-1-1 Master Plan and 9-1-1 Program presented to Board for approval
 - Draft NG9-1-1 Master Plan and 9-1-1 Program bill introduced
 - Board submits budget requirements related to 9-1-1 Program, NG9-1-1 transition and implementation, purchasing, contracting, standards development publishing and compliance monitoring, staffing, etc. to VITA and the Department of Planning & Budgets reflecting NG9-1-1 Master Plan requirements
 - Committee(s) assigned
 - Committee testimony and deliberation
 - Legislative action
 - Governor review
 - Governance and Budget changes enacted



- 9-1-1 Program Development (June 2015 – February 2016)
 - PSC Coordinator refines the statewide 9-1-1 program to carry out the NG9-1-1 Master Plan approved by the Board and as codified in statute
 - Support for program development is received from the Regional Coordinators and the Regional Advisory Council, VGIN, and other technical advisors as appropriate
 - Approved staffing requirements/changes fulfilled
 - Public information campaign developed with input from Regional Advisory Council and Regional Coordinators
 - Public Information Campaign presented to Board for approval
- Budget Process Phase 2 (September 2016 – February 2017)
 - Board submits budget requirements related to 9-1-1 Program, NG9-1-1 transition and implementation, standards publishing, compliance monitoring, etc.
 - Committee(s) assigned
 - Committee testimony and deliberation
 - Legislative action
 - Governor review
 - Governance and Budget changes enacted

If it is the desire of the E-911 Services Board to initiate governance changes offered in this study, the Board should focus first on the changes to Board membership, structure and authority. Legislation that will give the Board the jurisdiction to formulate rules and standards will begin to establish the foundation for all other legislative action and planning for NG9-1-1. Significant deliberation for these changes will be essential. Long-term successful establishment of sound processes, policy, procedures, and budget-related support will be predicated on thoughtful deliberation and consideration of the options and opportunities.

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6. ECONOMIC FEASIBILITY

The economic aspects of a technology transition require planning and forethought to provide technologists and operational staff with the resources necessary to implement new and improved systems. Some communities across the U.S. have concerns about their current funding methods and whether they are sufficient to fund today's 9-1-1 systems. These doubts are magnified when discussing a transition to NG9-1-1. However, there are many examples of local, regional, and state-level efforts where NG9-1-1 technologies are being implemented and real examples of cost savings after the transition is complete.

Important benefits of establishing a statewide ESInet can be realized through the sharing of network capacity, routing, security, and monitoring. While fiscal savings are achievable, there are also operational and functional benefits, including enhanced situational awareness, emergency response, disaster recovery, and interoperability. A statewide network can offer PSAPs within the Commonwealth an IP-enabled network with broadband capability upon which NG9-1-1 functions and various emergency call management applications can be built.

6.1. BACKGROUND

Revenues from long-established funding methods are eroding as more and more wireline subscribers disconnect their traditional wireline service in favor of more flexible and alternatively funded payment methods or lower-revenue generating services such as prepaid wireless. In the U.S. today, 97 percent of households report having a mobile phone and the average household owns 5.2 connected mobile devices.¹⁰⁸ In addition, based on recent survey results, “wireless-only” households continue to rise, with “[m]ore than two in every five American homes (44.0%)”¹⁰⁹ owning only a wireless communications device. This fundamental shift in consumer behavior is expected to continue and has significant ramifications for the ways in which 9-1-1 is funded.

While there is a monthly \$0.75 statewide E-911 tax on landlines and a monthly \$0.75 E-911 surcharge for wireless and VoIP in the Commonwealth, a significant inequity still exists in that prepaid wireless only collects \$0.50 per transaction. Total U.S. prepaid subscriptions increased 100 million as of June 2013, growing by 12 percent over the previous year, while traditional wireless telephone services with monthly bills remained flat. Approximately one in three U.S. cellphone owners now opt to pay as they go.¹¹⁰ The variance in collections presents not only an inconsistency, but incentivizes subscribers seeking to reduce costs to move to services that do not contribute the same level of support.

¹⁰⁸ <http://www.ericsson.com/res/docs/2014/ericsson-mobility-report-november-2014.pdf>

¹⁰⁹ National Health Interview Survey (NHIS) January – July 2014 preliminary results. <http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201412.pdf>

¹¹⁰ Lifsher, Marc. *More cellphone users switch to prepaid plans*. February 22, 2013. <http://phys.org/news/2013-02-cellphone-users-prepaid.html>



In many states and localities across the country, 9-1-1 funding is challenged by a variety of factors, including inequity in taxes and by extension collections, shifting use of communications technologies by subscribers, lack of defined reporting and auditing procedures, and diversion of funds for non-9-1-1 purposes. This holds true for the Commonwealth, as evidenced below.

- Virginia has already undergone a shift in traditional 9-1-1 funding methodology and moved to a communications sales and use tax basis for collections and distribution of funds based on a pre-determined rate.
- Over the past several years, national trends indicate that communications services have shifted from traditional wireline to wireless subscribers, not necessarily a decline in the number of subscribers. This shift has remained relatively flat in the Commonwealth, especially in highly urban areas; as the rate for wireline and wireless are equal, the revenue produced has also remained flat.
- When there is not parity in surcharge rates across all technologies and services, declining 9-1-1 revenues are experienced.
- Methods for funding 9-1-1 are limited and generally include surcharges or taxes as is demonstrated in Virginia.
- When funding mechanisms are dependent on the number of subscribers, any decline in subscribers is a significant concern. For example, those opting for prepaid, which is a lower revenue generating services in the Commonwealth.
- The December 2013 Blue Ribbon Panel on 911 Funding [Report to the National 911 Program](#) noted that in states, locales, or regions where 9-1-1 fund management is sound (good collection mechanisms, transparency in fund management, appropriate auditing and accountability, fund is used for intended purpose), there is less concern about funding shortfalls today or in the foreseeable future.
- When diversion of 9-1-1 funds (or questionable distributions) from the express and stated purpose occurs, the ability to adequately fund future 9-1-1 technologies and operations is compromised and increases threats to an entity's ability to attract federal grants, and potentially erodes the public trust in government and the system.
- NG9-1-1 will further test even adequate funding as it will need to operate in parallel with the current legacy system for a yet undefined period of time, resulting in costs for both systems.
- Current economic conditions in the Commonwealth present challenges for increased surcharges or taxation to fund NG9-1-1.

Given the challenges of adequately funding and financing the current 9-1-1 system, as well as additional technological requirements and capabilities on the horizon with NG9-1-1, further research and analysis can clarify the nature of these challenges as economic issues. With an understanding of the economic stressors and principles, policymakers and stakeholders can better assess current and future opportunities to finance the transition to NG9-1-1, as well as sustain the system in the future.



6.2. CURRENT COSTS

Key to providing VITA with the information requested is survey data from the PSAPs within the Commonwealth; it provides a first-hand look at expenditures and expected future costs. This information is self-reported by PSAP respondents. Appendix A – PSAP Survey Results contains a link to the survey data.

This study first analyzes current costs as there are a number of legacy 9-1-1 cost considerations.

- As existing equipment ages, the associated maintenance costs continue to rise, while the performance of older systems starts to diminish.
- End-of-life equipment represents significant risks to Virginia’s 9-1-1 operations as applications and software versions fall behind current versions, leaving systems vulnerable, especially from a security posture.
- As vendors exit the market or become defunct, PSAPs face operating without vendor support or maintenance abilities.
- Forced upgrades or system replacements as the result of a component or system failure increase costs and complexities, requiring 9-1-1 entities to be reactive, without sufficient fiscal and operational planning and time.
- There are a number of external factors, such as changes in consumer behaviors, carrier networks and support, regulator intervention, and other support vendor activities that are beyond the 9-1-1 community’s control.

Several types of PSAP expenditures are directly and positively affected by a transition to NG9-1-1. In particular, in the context of legacy 9-1-1 costs, the cost to maintain a PSAP’s CPE is one of the largest costs incurred, both in CAPEX and OPEX.

As mentioned previously, there are seven different CPE manufacturers in operation within the Commonwealth with 29 different versions of software. This results in PSAPs replacing their CPE without the benefit of cost efficiencies through shared resources or collective purchasing power. Based on survey results from 106 responding PSAPs for this question, the following results describe the PSAPs’ reported annual CPE maintenance costs:

- Lowest reported annual cost was \$895
- Highest reported annual cost was \$339,189
- Average annual cost for the 106 respondents was \$39,743
- Total *reported* annual costs statewide were \$4,212,723

Further breakdown of CPE maintenance costs by region is illustrated in Figure 28.

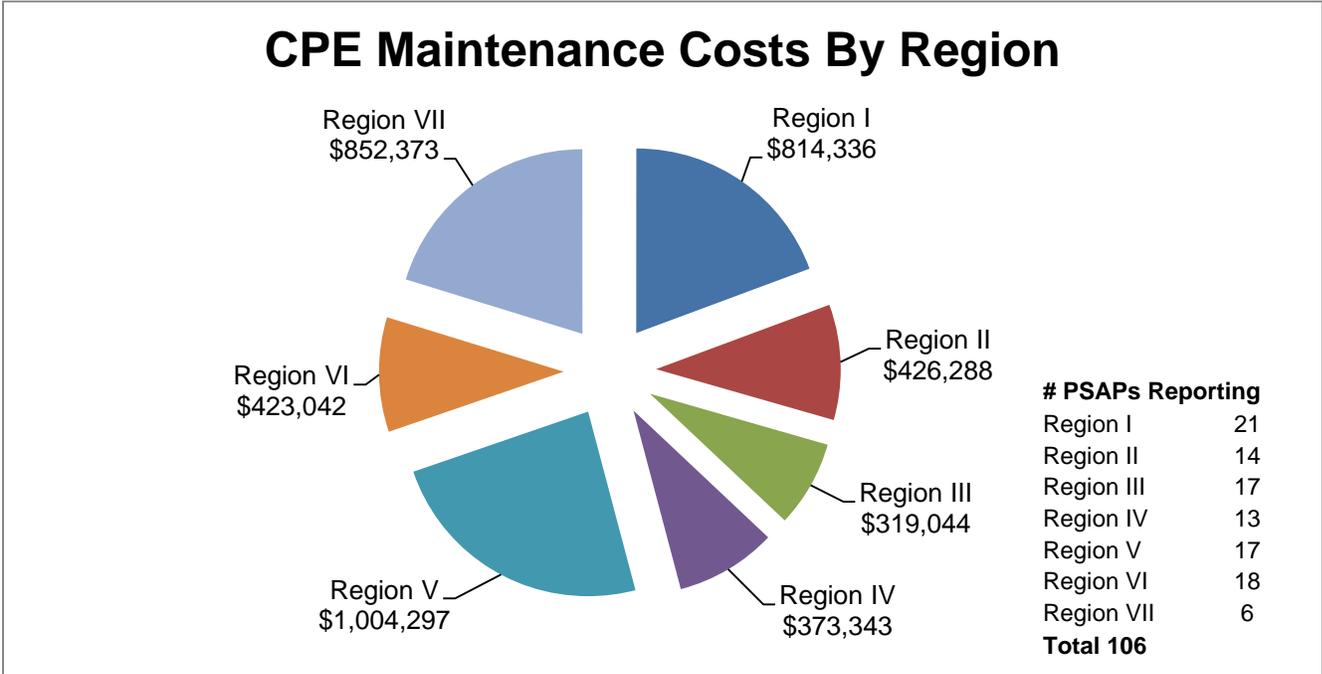


Figure 28 – Total CPE Maintenance Cost by Region

Although Region VII reports approximately 20 percent of the CPE maintenance costs, it does so with only six PSAPs. However, this percentage is consistent with call volume. Based on the [FY2014 True-up Report](#), Region VII's six PSAPs receive 21 percent of the Commonwealth's total 9-1-1 call volume.

Based on 87.6 percent of the 121 primary PSAPs responding to this question, CPE maintenance costs for all 121 primary PSAPs within the Commonwealth are estimated at \$4.8 million annually, and this is to maintain mostly legacy 9-1-1 CPE. Within the IT community, many commercial IT organizations see a 3–7 year life cycle for hardware systems, which is dependent on several factors such as operating system, workload, and manufacturer. Due to fiscal constraints, the public safety community at large has stretched the normal technology life cycles for the most mission critical systems.

Based on industry knowledge and Town Hall meetings, there are many systems in the Commonwealth, notably CAD systems, that are 15–20 years old. While the hardware has been updated or replaced over the years, the core applications are essentially the same as when the systems were first installed.

During one Town Hall meeting, a PSAP representative indicated that a major 9-1-1 application was running on Windows XP and that they had no viable option to replace that system. Further, it was tied to a specific piece of hardware, so if that device failed, their system would be unrecoverable. With



extended Microsoft support for Windows XP having ended in April 2014¹¹¹, the risk to that county's 9-1-1 operation is magnified by the lack of future security patches. Unquestionably, security is a top concern for 9-1-1 systems and use of a 12-year old operating system without benefit of security patches is a difficult position for all involved.

Based on survey results from 93 responding PSAPs for this question, the following results describe the PSAPs' legacy network costs (ANI/ALI and selective router costs, CAMA trunk costs, ALI circuit costs, and wireless costs not paid for through the billing agreements within the Commonwealth):

- Lowest reported annual cost was \$324
- Highest reported annual cost was \$1,074,948
- Average annual cost for the 93 respondents was \$59,429
- Total *reported* annual costs statewide were \$5,526,896

Further breakdown of legacy network costs by region is illustrated in Figure 29.

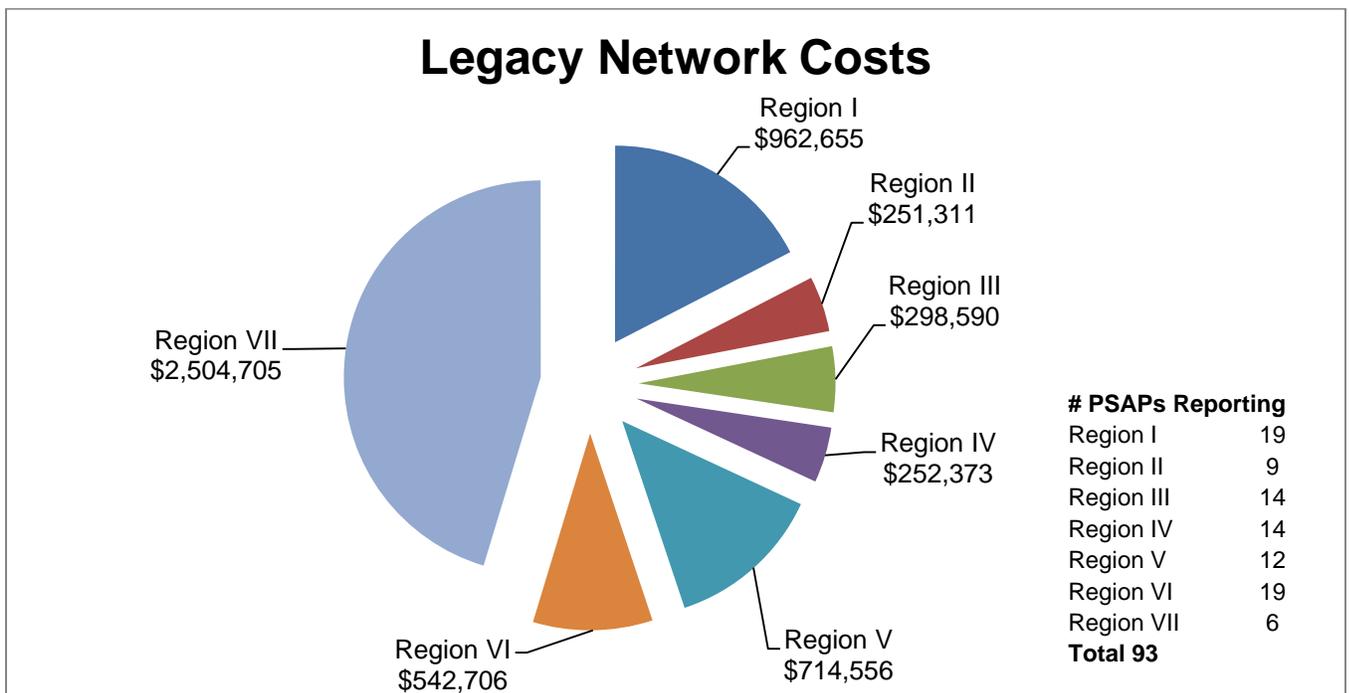


Figure 29 – Total Legacy Network Cost by Region

Region VII has disproportionately reported much of the legacy network costs (45 percent of the total cost), which could be attributed to higher-than-average population density in the region and possibly because this region is known to have a higher number of CPE positions and backup PSAP capabilities.

¹¹¹ <http://www.microsoft.com/en-us/windows/enterprise/end-of-support.aspx>



While nearly 77 percent of the 121 primary PSAPs were able to respond to this question on legacy network costs, there were difficulties in identifying the total amount of costs because of how the carriers bill for these services. Some counties were unable to report because they either did not have access to the information or the charges were bundled as part of a larger cost for telecommunications services and could not be separated. During the survey period, 30 counties submitted scanned copies of their monthly 9-1-1 telecommunications bills. Initial analysis of the bills suggests that different counties are being charged different rates for identical services; however, a more detailed review and audit was beyond the scope of this study and may be warranted.

Table 34 – Current Costing

	PSAP Survey Response	Total Cost for Responses	100% at Same Rate
CPE Maintenance Costs	87.6%	\$4,212,723	\$4,808,863
Legacy ANI/ALI Costs	76.9%	\$5,526,896	\$7,190,908
Total Annual Expense		\$9,739,619	\$11,999,771
Estimated Cost Over 5 Years			\$59,998,855

After collecting this data and comparing to other states, the estimated cost for 121 PSAPs in these two categories was lower than expected for a state with the number of PSAPs and call volume currently reported. However, this summary excludes several cost categories, notably PSAP personnel costs and PSAP/VITA operational costs.

6.3. TRANSITION FROM LEGACY SYSTEMS TO NG9-1-1

The underlying systems that support 9-1-1 emergency calling today will no longer be affordable or may not even be available as the industry transitions to digital, IP-based technologies and NG9-1-1. Existing 9-1-1 systems are built on a core technology that was based on a point-to-point infrastructure that provided service to a fixed location with voice as its primary service. The diverse and rapidly evolving collection of services available through an IP-based network offers richer functionality, a lower cost structure, and capabilities beyond geographically fixed services that are being widely adopted on a competitive market basis.

As a result, the PSTN no longer functions as the universal communications infrastructure, and as the number of users of core PSTN services decreases, the corresponding cost per user will increase until maintaining the 9-1-1 systems that rely on the PSTN become prohibitive. The situation is best summed up by AT&T in a recent filing with the FCC:

In short, the IP-transition is well past the tipping point, and at some point in the not-too-distant future it will no longer be possible to maintain traditional TDM-based telephone



*networks and services. The demand won't be there, the economics won't support it, and the parts and labor to keep these networks going will not be available.*¹¹²

According to Bob Quinn, AT&T's Senior Vice President-Federal Regulatory and Chief Privacy Officer:

*We have been very clear about our efforts to transform our network to one that is all Internet Protocol (IP). Our request for the Commission to oversee trials came on the same day we announced Project Velocity IP, a multi-year, multi-billion dollar investment plan to accelerate the historic national transition to all-IP networks and services, and we announced in our Annual Report that we expect to have fully transitioned our customers from decades-old technologies to an all-Internet Protocol network architecture by 2020.*¹¹³

This transition is not unique to AT&T, as noted in Section 4 of this study, and other service providers have similar investments in anticipation of future transitions. Based on experiences by early adopters across the nation, legacy 9-1-1 systems will be required to work in tandem with NG9-1-1 systems for a period of time. The length of this overlap will mostly depend on the time required to deploy NG9-1-1 throughout the Commonwealth.

As indicated throughout this study, the transition from legacy systems to NG9-1-1 will require a phased approach. In most cases, NG9-1-1 will likely not be implemented on a PSAP-by-PSAP basis, but rather as a regional approach in partnership with other system users or initiatives. Collaboration will be essential. It is anticipated that as regions come together to organize their NG9-1-1 efforts, costs will be shared. This process will require increased coordination from a statewide program or plan. However, the longer the transition from the legacy technology to NG9-1-1, the more costly it will be in terms of additional maintenance costs, overlapping technology costs, as well as project implementation and transition costs.

6.4. NG9-1-1 ASSOCIATED BENEFITS

The benefits of implementing an ESInet with i3 services can be quantified in both monetary and non-monetary aspects as experienced by early adopters and described by various studies conducted within the 9-1-1 industry.

Generally, the benefits for a NG9-1-1 solution include the following:

- Drastically improving 9-1-1 call setup time
- Enabling or improving the ability to transfer 9-1-1 calls from PSAP to PSAP
- Eliminating impacts of legacy 9-1-1 technologies, such as technical, operational, and equal access issues

¹¹² http://connected.att.com/external/PublicPolicyViewsNews/As_Filed_Redacted_Wire_Center_Trial_Plan.pdf

¹¹³ <http://publicpolicy.att.com/the-end-of-the-beginning-of-the-ip-transition>



- Aligning 9-1-1 operations with consumer expectations and behaviors
- Embracing changes in technology to enhance performance, operability/interoperability, cost efficiencies, and even reduce environmental impact
- Improving lifesaving capabilities

The first two benefits listed above, in particular, are key objectives for the Commonwealth and are primary drivers for undertaking this study. As the Commonwealth considers its options to implement a statewide ESInet, in the long-term, the expected and planned benefits must be evaluated and appear to far outweigh the additional costs to implement new technologies.

6.5. QUANTIFIED COST BENEFITS

6.5.1. Long-term Cost Savings

Multiple avenues exist for the Commonwealth to realize long-term cost savings. Initially, cost savings will be seen in the transition from legacy trunks to IP connectivity and by retiring legacy selective routers. As recommended in Section 4.8, Communications Service Provider Considerations, the opportunity exists to reduce the number of selective routers currently operating within the Commonwealth from 18 statewide to 6 or less. This transitional step, prior to eliminating selective routers completely, will reduce the legacy costs borne by the PSAP community.

Elimination of duplicative data centers at every PSAP through shared services allows for additional long-term cost savings. All 121 primary PSAPs have some form of a “data center” or equipment room to house servers and other IT/telecommunications infrastructure to support 9-1-1 operations. Due to the organization of 9-1-1 operations within the Commonwealth, CPE, CAD, and other non-integrated 9-1-1 systems exist at nearly every PSAP. Taking a shared resource approach will reduce costs and has already been demonstrated in a few areas across the Commonwealth.

Several other states have already taken this approach. For example, Pennsylvania recently highlighted the success of their “WestCORE” regional approach to implementing a shared CPE and retired several legacy selective routers.¹¹⁴ In addition to replacing end-of-life CPE equipment with an IP-enabled, NG9-1-1-capable CPE, WestCORE reduced the number of physical CPE switches from 13 to 3. Further, WestCORE enhanced PSAP disaster recovery and continuity of operations and shared the cost of the system across a 13-county area in southwestern Pennsylvania.

During the planning phase of WestCORE, estimates to individually replace 13 CPE systems and 169 positions were approximately \$9.4 million in capital costs, plus an estimated \$564,000 in annual recurring operational and maintenance costs. However, by investing in a regional-based NG9-1-1-capable CPE, the result was a \$5.1 million capital cost with a \$392,000 annual operational cost. This

¹¹⁴ National 911 Program Webinar Series, David Holl, Pennsylvania Emergency Management Agency (PEMA), September 10, 2014. <http://www.911.gov/webinars.html>



savings of \$4.3 million and \$865,000 over a 5-year period of operational costs are particularly notable.¹¹⁵ In addition to the cost savings, the region has a fully-functional and redundant ESInet available for additional applications and services, such as NG9-1-1 and backhaul to support a regional radio system.

Beyond the primary capital cost to acquire the equipment, the on-going recurring cost for 121 individual primary PSAP operations within the Commonwealth is significant. Also worth noting is the environmental costs to power and cool the equipment that operates 24/7/365. To that end, a white paper on the cost of aging IT infrastructure states, “[the] maintenance/management costs generated twice as much in total IT costs as server acquisition—and power/cooling costs grew enough to nearly equal [and in some sites exceed] server acquisition costs worldwide...”¹¹⁶

6.5.2. PSAP Interoperability

Implementing an ESInet and NG9-1-1 services enables data sharing between PSAPs. Current PSAP operations are hampered by legacy E9-1-1 technology that does not easily or efficiently share data. PSAPs rely on ANI/ALI data (up to 512 characters) associated with the call; in many instances, when a caller is transferred from one PSAP to another, that basic ANI/ALI data does not transfer. Without the electronic sharing of data, the ANI/ALI must be transferred via voice, which increases call handling time for call takers and introduces the chance for transcription errors to occur.

Automatic and electronic sharing of data supports increased responder safety by providing responders with faster access to more accurate information. As exemplified in Pennsylvania’s WestCORE project, the regional ESInet is being used as a transport mechanism for Radio over IP (RoIP) packets, enhancing radio coverage areas.

6.5.3. Redundancy and Flexibility

PSAPs within the Commonwealth have limited options for backup solutions. Some of the larger communities have established warm or cold backup facilities that could provide 9-1-1 service if their primary facility fails due to component failure, natural disaster, or other extreme situation. However, virtually every backup PSAP capability is located nearby the primary facility and is susceptible to being affected by the same situation as their primary facility.

One of the basic design features of NG9-1-1 is the ability to enhance PSAP backup capability by automatically and efficiently rerouting 9-1-1 callers due to PSAP failure, natural or manmade disaster, or during periods of peak 9-1-1 usage. Policy-based rules established by the local jurisdictions enhance system reliability and availability, but keep local control over their call handling policies.

¹¹⁵ Ibid.

¹¹⁶ IDC, *The Cost of Retaining Aging IT Infrastructure*, February 2014.
<http://www.lenovo.com/images/products/server/pdfs/whitepapers/IDC%20Whitepaper%20246755.pdf>



The FCC agrees that NG9-1-1 implementation will improve the reliability of 9-1-1 service delivery as stated in a recent Report and Order:

...the transition to NG911 will likely drive improvements in network reliability and resiliency compared to the current circuit-switched system because of the inherently diverse nature of IP networks. Network architecture, backup power, and network monitoring technologies may also evolve as new entities begin providing NG911 services.¹¹⁷

Other mission critical networks that have similar requirements for reliability, availability, redundancy, and security are already in place for critical infrastructure systems that support national defense, energy, healthcare, and the banking industry.

6.5.4. Improved Lifesaving Capabilities

One of the most significant benefits of NG9-1-1 is the ability for PSAPs to deliver improved lifesaving capabilities, such as the ability to **directly** serve callers who are unable to speak (e.g., the deaf, hard of hearing, or those fearing for their personal safety). While the Americans with Disabilities Act of 1992 has long established the requirement for TTY or telecommunications device for the deaf (TDD) for every PSAP in the nation, the deaf and hard of hearing have mostly abandoned these antiquated and outmoded technologies in lieu of smartphones and other communication devices. As a result, deaf and hard of hearing 9-1-1 callers do so typically through a relay center, which increases the call handling times and can introduce the chance of making an error, versus being able to interrogate the caller directly, by trained 9-1-1 call takers, instead of adding a relay center operator into the conversation.

Currently, only 6 of 121 primary PSAPs reported in the survey process that they have the ability to accept text messages to 9-1-1:

- Dinwiddie County
- James City County Emergency Communications Center (ECC)
- Martinsville – Henry County 9-1-1
- Roanoke Communications Department
- Southampton County
- York County Fire Communications

It should be noted that not all wireless carriers provide text-to-9-1-1 service for these six PSAPs and there are three different methods of implementation in use (SMS to TTY, web browser, and direct IP connection). Additional survey results indicate that 44 Virginia jurisdictions have plans to accept text messages at their PSAP within the next 12 months.

¹¹⁷ Federal Communications Commission, *Improving 911 Reliability Report and Order*. FCC 13-158 (PS Docket 13-75), Adopted December 12, 2013. https://apps.fcc.gov/edocs_public/attachmatch/FCC-13-158A1.pdf



6.6. COST OF STATUS QUO

The transition to NG9-1-1 will be a process that takes time; however, the current expenditure rate to support 121 legacy standalone systems cannot be justified or sustained indefinitely. Deployment of IP network technology can reduce overall cost by enabling the adoption of regionally shared systems, which are inherently more cost-effective than individual systems. While public safety capabilities can be enhanced via the ESInet, the capabilities of the network, if properly planned, can support multiple 9-1-1 entities. VITA, in coordination with the E-911 Services Board, has the opportunity to provide direction, functional requirements, and authorization for individual PSAPs and regions seeking to deploy regional ESInets and connect to the statewide ESInet in support of NG9-1-1.

The Commonwealth faces costs and additional risks to its 9-1-1 operations if it does not choose to establish a statewide ESInet, including the following:

- Increased costs of sustaining legacy 9-1-1 systems and technologies
- Lack of consistent standards across regional ESInets efforts and within PSAPs, creating an increased risk of incompatibility or solutions that require modification to fit within the Commonwealth's vision
- Lack of interoperability between regional ESInets and PSAPs, creating barriers to communications, decreasing caller satisfaction, and potentially introducing errors or call handling delays
- 9-1-1-related policies, training, level of service, and PSAP operations remains inconsistent across the Commonwealth

Saving lives and reducing risks are the main goals and objectives for implementing NG9-1-1. Based on the benefits described in this study, implementing NG9-1-1 services will assist PSAPs to save lives and reduce overall risk to 9-1-1 operations by improving the likelihood of positive outcomes for 9-1-1 callers. Taking no action (the cost of “doing nothing”) increases legacy 9-1-1 costs and existing risks will persist.

When discussing the benefits of improving 9-1-1 delivery within the Commonwealth, it is necessary to provide some measurable quantification of the benefit in monetary terms. To do so, this study applies research methods developed and used by the USDOT to assess the valuation of reduction in risks, in particular to preventing a transportation-related fatality. The USDOT terms this as the “Value of a Statistical Life (VSL)” or the “additional cost that individuals would be willing to bear for improvements in safety ... that, in the aggregate, reduce the expected number of fatalities by one.”¹¹⁸ Current VSL is \$9.1 million (2012 base year).

¹¹⁸ U.S. Department of Transportation, *Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses*. <http://www.dot.gov/sites/dot.dev/files/docs/VSL%20Guidance.doc>



Assuming (conservatively) that only 1 percent of Virginia's 4,392,212¹¹⁹ 9-1-1 calls in FY2014 involve a life and death matter (43,922)¹²⁰, a reduction in call handling duration for just 1/10,000 of those life and death calls, could **save 4 lives**. Improvements in direct access to 9-1-1 (for deaf and hard of hearing) or decreased error rate during PSAP transfers are specific examples and benefits offered by NG9-1-1 that would reduce call handling duration.

Based on survey data, nearly 9 percent of all 9-1-1 calls in Virginia result in a transfer to another PSAP. Again, assuming (conservatively) that just 5 percent of Virginia's 4,392,212 9-1-1 calls includes a PSAP transfer (219,611), a reduction in errors and/or call handing time for 1/1,000 of those life and death PSAP transfers could **save 2 lives**.

With the VSL estimated at \$9.1 million, saving these lives reduces PSAP risk and exposure each year by **\$36.4 million** and **\$18.2 million**, respectively.

6.7. COST PROJECTIONS

Cost for the different elements of NG9-1-1 will be staggered over time. Based on experience with other states, it takes approximately nine months to provide the time needed for a vendor to acquire, install, and test data centers in preparation for providing call handling services. There have been instances where SaaS has been implemented in seven months. Using existing data centers to which service providers may already have access, or easily have access, may also collapse the nine months to seven months of initial implementation. However, the nine-month period is a safe estimate.

Figure 30 is representative of this timeline; a contract date of September 1, 2015, has been used as a basis. While the actual timeline will likely change, the time relationships should stay constant.

¹¹⁹ Based on the VITA FY14 "PSAP True-Up Data".

http://vita.virginia.gov/uploadedFiles/VITA_Main_Public/ISP/E-911/2015/FY14TUv2.pdf

¹²⁰ N.B. While many people would like to believe that 100 percent of 9-1-1 calls "should" be a matter of life and death, the reality is that the vast majority of calls are relatively "routine emergencies." For this illustration, a very conservative number, only 1 percent of callers, is being used. The study authors and many PSAP personnel would argue that this number is much higher in reality.

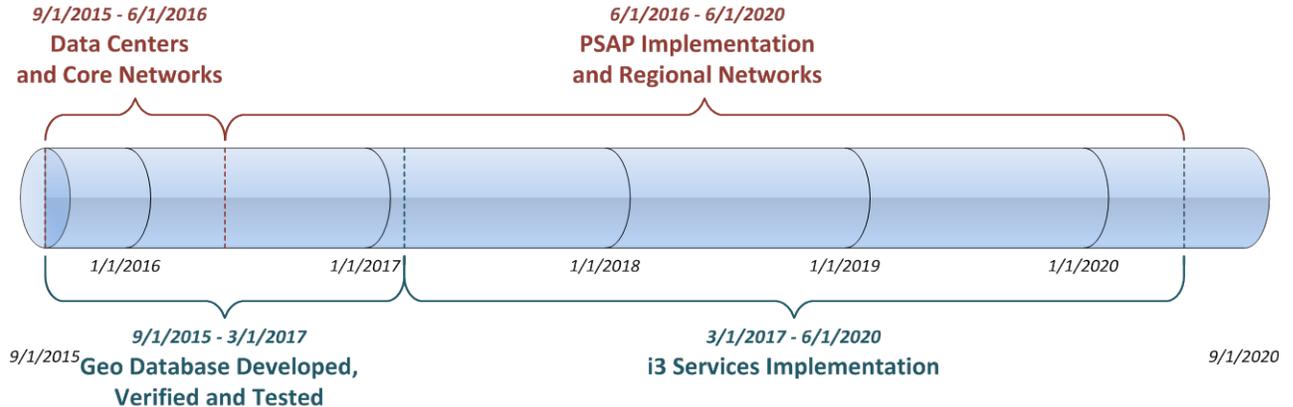


Figure 30 – Transition Timeline

As Virginia changes delivery models from each PSAP having its own standalone system to sharing technical services, many elements must be acquired, implemented, and tested to ensure that all elements are performing to a public safety-grade requirements, with strong SLAs that will be required of all vendors. Most importantly, success requires coordination with multiple teams, groups, and entities across the Commonwealth, which in turn will require time for education and buy-in to the culture change. As the schedule is developed into a working Implementation Plan for sharing services, many other tools for success will be required. These include administration and PSAP training, communications plans (both internal and external), security requirements, governance plans, and more.

Developing, verifying, and testing the GIS databases that are required for providing i3 services will require longer preparation time than is required for equipping the data centers and establishing ESInets for call handling. That said, these data centers and core networks must be created with i3 implementation and specific 9-1-1 requirements as part of their design.

There are benefits of a staggered implementation schedule. While GIS databases are being developed, verified, and tested, the implementation teams can evaluate lessons learned from early adopters of the new capabilities and ensure changes are made where necessary. For example, PSAP staff must be effectively trained on any operational changes developed from lessons learned. Policy and procedures for implementing i3 services with the chosen call handling solutions can be developed during the “gap” period. After the i3 services are available, the project implementation team has the flexibility of choosing to continue staggered implementation of call handling and i3 services in PSAPs or combine the two, based on experiences to date.

6.7.1. Projected Network Costs

As learned during the study’s information gathering process, some regional networks already exist in the Commonwealth. It is likely that a portion of the cost for these current networks can be reallocated or joined as part of the statewide ESInet. As part of the detailed network design, further analysis would



determine what modifications (if any) are required for the existing networks to be part of the ESInet. Part of the effort to identify and adopt specific technical and operational standards will help determine how closely these regional networks meet the specifications that the Commonwealth will require for participation in the state-level ESInet.

A ROM cost has been developed both for design, implementation, and operation of the physical network, plus the cost of network connectivity. Estimates are included for new network construction and network connectivity to connect each PSAP to the core network.

Cost estimates are based on 121 primary PSAPs, as identified by the Commonwealth, and 24 secondary PSAPs, as listed in the FCC PSAP Registry¹²¹, and provided in Table 35 below. The Commonwealth should review the secondary PSAP list to determine to what level these secondary PSAPs would participate in a state-level ESInet. The FCC PSAP Registry notes that some of the Secondary PSAPs listed below may be duplicate records of primary PSAPs. In addition, VSP operates a dispatch capability in each of its seven Division Headquarters across the Commonwealth, in particular answering “#77” wireless calls; however, VSP is not included in this list of secondary PSAPs.

Table 35 – Secondary PSAPs

PSAP Name
Albemarle Emergency Communications Center
Alexandria Fire Communications
Carroll County Sheriff's Office
Charlottesville Fire Department
Chincoteague Police Communications
Colonial Beach Police Communications
Fairfax City Police Communications
Falls Church Police Communications
Fauquier County Sheriff's Department
Galax City Police Department
Grayson County Sheriff's Office
Greene County Sheriff
Hampton University Police Department
Herndon Police Communications
James City County Police Department
Langley Air Force Base
Manassas City Police Communications
Manassas Park Police Communications
Old Dominion University Police Department
Smithfield Police Department Dispatch

¹²¹ FCC PSAP Registry. December 5, 2014. <https://www.fcc.gov/encyclopedia/9-1-1-master-psap-registry>



PSAP Name
South Boston Police Communications
Vienna Police Communications
Virginia Tech Police Communications
Winchester Emergency Communications Center

6.7.1.1. Network Infrastructure Costs

Table 36 illustrates estimated network infrastructure costs and includes regional networks that are connected to a state-level network. The transition schedule is based on 12-month intervals, regardless of the start date. The first year will include the transition of fewer PSAPs because it is assumed that the first deployment will be a Proof of Concept (PoC), with four or five PSAPs taking part in a controlled deployment where all processes will be verified and tested, including change management, training, and communication plans.

Notes and assumptions for the calculations are as follows:

* Calculations based on 121 primary PSAPs and 24 secondary PSAPs, for a total of 145 PSAPs. (Quantity of primary PSAPs originated from the Commonwealth; numbers for secondary PSAPs are from the FCC PSAP Registry.)
* Prices for network connectivity can vary significantly. Because of the potential for long local loops in rural areas, \$1,950 is used as the average cost for a managed circuit. Cost is representative and based in part on actual experiences for clients in other states.
* Cost of the state-level ring is estimated at \$8,500 per month. Cost is representative and based in part on actual experiences for clients in other states.
* 21 PSAPs transition Year 1
* 35 PSAPs transition Year 2
* 39 PSAPs transition Year 3
* 50 PSAPs transition Year 4

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Table 36 – Network Infrastructure Costs

Recurring Operating Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
Monthly recurring regional networks x 12	\$491,400.00	\$1,801,800.00	\$3,533,400.00	\$5,616,000.00	\$6,786,000.00
Monthly recurring state-level ring x 12 (Estimate \$8,500 per month)	\$102,000.00	\$102,000.00	\$102,000.00	\$102,000.00	\$102,000.00
Total Operating Expenditure	\$593,400.00	\$1,903,800.00	\$3,635,400.00	\$5,718,000.00	\$6,888,000.00
Non-recurring Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
Network \$350 implementation fee per T-1	\$14,700.00	\$24,500.00	\$27,300.00	\$35,000.00	
State-level ring	\$4,500.00				
Total Capital Expenditure	\$19,200.00	\$24,500.00	\$27,300.00	\$35,000.00	\$0.00

Total Capital Cost	
Total Capital Cost	\$106,000.00
Capital Cost average per year over 5 years	\$21,200.00

Average Expenditures Over Time	Average
5-year average operating expense plus 1/5 non-recurring expense per year	\$3,768,920.00
5-year average operating expense plus non-recurring expense per week	\$72,479.23
5-year average operating expense plus non-recurring expense per day	\$10,325.81
5-year average operating expense plus non-recurring expense per hour	\$430.24



6.7.1.2. Network Design Considerations

Network design considerations include using various broadband components, and bandwidth configured to support a variety of mission-critical network traffic. Broadband network availability is constantly changing in a dynamic marketplace. Through research and analysis of existing networks, several Commonwealth PSAPs may already have the capacity and/or ability to support connectivity to the statewide ESInet. As detailed technical designs are established, broadband availability and the associated current market cost for broadband construction and service will need to be revised.

Fiber, microwave, and copper-based circuits can be used and the best cost/benefit option is to create a hybrid solution to provide service. For example, a single CSP may include a combination of dark fiber and leased services to reach the desired destinations. A description of each connectivity option is provided below; it is understood, as is described in the Technical Feasibility section of this study, that there are many acceptable configurations for an ESInet backbone.

Dark Fiber

Virginia has a wealth of fiber optic-based networks. Besides the traditional commercial service providers, the Commonwealth has educational network options and network consortiums that can provide flexibility across the Commonwealth. It is important to note that not all service providers are able to meet the stringent public safety-grade requirements needed for an ESInet.

Fiber optic cabling is commonly used to physically connect locations within a communications network. When the fiber is installed without the equipment needed to transmit and receive signals, it is called dark fiber. Dark fiber represents only the physical pathway between end points. An organization that purchases a dark fiber segment or segments then will deploy the network electronics needed to “light” the fiber. The network electronic equipment is provided with optical ports that contain lasers to produce the light-based signals. Once the fiber is “lit,” it is capable of transporting signals between the end points. The network electronics usually operate at data-throughput ratings that range from 100 megabits per second (Mbps) to 40 gigabits per second (Gbps). Often, multiple cables are bound together to form higher-rate transmission lines. In many areas, the cost associated with using fiber for ESInets can be similar and sometimes even lower than meeting the same bandwidth requirements using traditional copper circuits.

High bandwidth, flexibility, and simplicity make fiber the best solution for connecting the PSAPs to the statewide ESInet. However, the high capital construction cost for fiber connectivity poses a challenge. Based on factors such as reliability, networking simplicity, and lowest recurring cost, dark fiber is preferred above other methods for providing the bandwidth that will be required as communications media become part of NG9-1-1. While fiber is the preferred network transport method, it is recognized that not all PSAPs will have access to fiber connectivity or at an affordable cost. More rural areas of the Commonwealth may not have the benefit of fiber connectivity or that “last mile” construction is cost prohibitive due to distance from a point of interconnectivity.



Microwave

Microwave communications transmit information via radio waves. Microwave networks generally operate in radio spectrum ranging from 1 gigahertz (GHz) to 30 GHz, are primarily designed for point-to-point communications, and are largely line-of-sight. Microwave dishes are placed on communications towers; they transmit and receive narrow beams that are tuned to create a path. This method allows microwave communications to avoid interference with adjacent paths, which can be a problem in land mobile radio (LMR) communications.

Microwave networks operate at a very high frequency, which allows for a large bandwidth capacity. Microwave can have some limitations since it is line-of-sight and is sometimes affected by fog, foliage, and other sight-diminishing conditions. Microwave transmissions usually provide data-throughput ratings of 3 Mbps to 150 Mbps; similar to fiber, multiple systems can be aggregated to generate higher data-transmission rates.

Microwave may be an option where the terrain makes cost-effective fiber optic deployment a challenge. Microwave can also be used in rural areas, where providing dual fiber optic paths or even copper-based services are cost prohibitive.

6.7.1.3. Network Connectivity Costs

Table 37 depicts network connectivity costs for five data centers: three in eastern Virginia and two to support more rural western Virginia. The number of data centers will have a significant impact on the overall cost of the network and network connectivity. Border control and network connectivity elements have been included.

Notes and assumptions for the calculations are as follows:

* Calculations are based on five data centers across Virginia. Reduction of data centers may provide significant reduction in estimates, but may impact performance, reliability, or other factors.
* Calculations are based on 121 primary PSAPs and 24 secondary PSAPs, for a total of 145 PSAPs. (Quantity of primary PSAPs originated from the Commonwealth; numbers for secondary PSAPs are from the FCC PSAP Registry.)
* Calculations are based on 100% of PSAPs with dual connections.
* Calculations are based on VITA acquiring a 40% discount off manufacturers' list prices for router hardware.
* 24/7, 4-hour maintenance on core routers and switches = 15% of list
* 24/7, 4-hour maintenance on PSAP routers and switches = 19% of list
* 21 PSAPs transition Year 1
* 35 PSAPs transition Year 2
* 39 PSAPs transition Year 3
* 50 PSAPs transition Year 4



Table 37 – Network Connectivity Costs

Operating Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
BCF gateway warranty plus support	\$21,000.00	\$56,000.00	\$95,000.00	\$145,000.00	\$145,000.00
24/7, 4-hour data center router and switch warranty plus support	\$675,135.00	\$1,125,225.00	\$1,125,225.00	\$1,125,225.00	\$1,125,225.00
PSAP routers and switch warranty plus support	\$212,842.56	\$567,580.16	\$962,859.20	\$1,469,627.20	\$1,469,627.20
Space and physical management of 5 data centers (3 in Year 1 plus 2 in Year 2, for a total of 5)	\$5,023,040.00	\$3,900,000.00	\$160,983.00	\$165,812.49	\$170,786.86
Integration management	\$10,584,348.00	\$941,000.00	\$969,230.00	\$998,306.90	\$514,128.05
Network monitoring and management plus solution monitoring and management	\$1,500,000.00	\$839,772.00	\$923,749.20	\$1,016,124.12	\$1,117,736.53
Total Operating Expenditure	\$18,016,365.56	\$7,429,577.16	\$4,237,046.40	\$4,920,095.71	\$4,542,503.64
Capital Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
BCF gateways (2 per PSAP = 290) (\$2,500 each)	\$105,000.00	\$175,000.00	\$195,000.00	\$250,000.00	
Data center routers (redundant in 5 data centers) (\$750,000 per pair w/redundant power supplies and licenses); pricing includes required software, firewall blades and software, and redundant Session Border Control blades	\$1,350,000.00	\$900,000.00			
PSAP routers (redundant in all PSAPS) (\$16,000 per pair w/redundant power supplies and licenses)	\$336,000.00	\$560,000.00	\$624,000.00	\$800,000.00	
Data center switches (redundant in 5 data centers) (\$750,000 per pair w/redundant power supplies and licenses)	\$1,350,000.00	\$900,000.00			
PSAP switches (redundant in all PSAPS) (\$16,000 per pair w/redundant power supplies and software)	\$336,000.00	\$560,000.00	\$624,000.00	\$800,000.00	
Total Capital Expenditure	\$3,477,000.00	\$3,095,000.00	\$1,443,000.00	\$1,850,000.00	

Total Capital Cost	
Total Capital Cost	\$9,865,000.00
Capital Cost average per year over 5 years	\$1,973,000.00



Average Expenditures Over Time	Average
5-year average operating expense plus $\frac{1}{5}$ capital expense per year	\$9,802,117.69
5-year average operating expense plus capital expense per week	\$188,502.26
5-year average operating expense plus capital expense per day	\$26,855.12
5-year average operating expense plus capital expense per hour	\$1,118.96

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6.7.2. Call Handling

6.7.2.1. Call Handling – Hosted in Data Centers

Table 38 depicts hosted call handling costs, based on 1,043 9-1-1 call handling seats in the 121 primary PSAPs and 24 secondary PSAPs. Notes and assumptions for the calculations are as follows:

* Calculations are based on 1,043 call taker positions. (Quantity determined from PSAP surveys.)
* Calculations are based on 121 primary PSAPs and 24 secondary PSAPs, for a total of 145 PSAPs. (Quantity of primary PSAPs originated from the Commonwealth; numbers for secondary PSAPs are from the FCC PSAP Registry.)
* Calculations include MIS reporting.
* 21 PSAPs transition Year 1
* 35 PSAPs transition Year 2
* 39 PSAPs transition Year 3
* 50 PSAPs transition Year 4

The largest area of potential cost changes will be based on the velocity of transitioning PSAPs. For these calculations, all primary and secondary PSAPs transition over a period of four years. If the transition is spread over a 5-year period or more, maintenance expense may be reduced, which will lower the operating expenditure pricing.

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Table 38 – Hosted Call Handling Costs

Operating Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
Maintenance and monitoring		\$498,474.90	\$1,827,741.30	\$3,774,167.10	\$6,408,963.00
Upgrades			\$250,000.00	\$600,000.00	\$975,000.00
Total Operating Expenditure	\$0.00	\$498,474.90	\$2,077,741.30	\$4,374,167.10	\$7,383,963.00
Capital Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
i3-compliant call handling	\$4,531,590.00	\$7,552,650.00	\$8,415,810.00	\$10,789,500.00	
Total Capital Expenditure	\$4,531,590.00	\$7,552,650.00	\$8,415,810.00	\$10,789,500.00	\$0.00

Total Capital Cost	
Total Capital Cost	\$31,289,550.00
Capital Cost average per year over 5 years	\$6,257,910.00

Average Expenditures Over Time	
5-year average operating expense plus 1/5 capital expense per year	\$9,124,779.26
5-year average operating expense plus capital expense per week	\$175,476.52
5-year average operating expense plus capital expense per day	\$24,999.40
5-year average operating expense plus capital expense per hour	\$1,041.64

Expenditures Per Position	
5-year average operating expense plus 1/5 capital expense per year	\$8,748.59
5-year average operating expense plus capital expense per week	\$168.24
5-year average operating expense plus capital expense per day	\$23.97
5-year average operating expense plus capital expense per hour	\$1.00



6.7.2.2. Call Handling – SaaS

When comparing the cost of a traditional system implementation, which will include capital expenditures for hardware and software plus on-going operations expense, and the SaaS model, it must be noted that SaaS traditionally is priced differently. SaaS usually will entail a fully managed service that includes the call handling and network connectivity elements.

Based on experience, MCP has found that SaaS, on a large implementation scale, is often priced with a 5-year total cost that is often at least 10 percent less than the traditional system implementation model described above, for the same elements over the same 5-year period. Many factors can impact this cost. Recurring monthly cost can be impacted by requiring all PSAP call handling be centralized as opposed to adding PSAPs to systems with shared components with segregated software solutions. Monthly recurring cost can be reduced by choosing to invest a larger non-recurring amount at the beginning of the contract. Speed in transitioning PSAPs can also impact investment in the SaaS solution, and implications of variance would be better understood during contract negotiations with potential vendors. Moreover, some entities believe that the SaaS model should incorporate a very different contract that provides options and flexibility not available to them with the capital expenditure plus on-going operations expense model.

To provide as close a comparison as possible, the same PSAP seat count is used at the same transition rate.

Table 39 depicts SaaS call handling costs, based on 1,043 9-1-1 call handling seats in the 121 primary PSAPs and 24 secondary PSAPs. Notes and assumptions for the calculations are as follows:

* Calculations are based on 1,043 call taker positions. (Quantity determined from PSAP surveys.)
* Calculations are based on 121 primary PSAPs and 24 secondary PSAPs, for a total of 145 PSAPs. (Quantity of primary PSAPs originated from the Commonwealth; numbers for secondary PSAPs are from the FCC PSAP Registry.)
* Calculations are based on 20 PSAPs utilizing ACD.
* Calculations include full managed service of call handling, network connectivity routers, monitoring and management of system and network, as integrator.
* Calculations include MIS reporting.
* 21 PSAPs transition Year 1
* 35 PSAPs transition Year 2
* 39 PSAPs transition Year 3
* 50 PSAPs transition Year 4



Table 39 – SaaS Call Handling Costs

Operating Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
Monthly Recurring Charge – Fully Managed SaaS (Including network connectivity, excluding network), includes mapping	\$811,154.61	\$2,974,233.57	\$5,832,587.91	\$9,270,338.40	\$11,201,658.90
Automatic Call Distribution for 20 PSAPs		\$96,000.00	\$192,000.00	\$240,000.00	\$240,000.00
Non-recurring Charges (NRC)	\$15,375,000.00	\$525,000.00	\$585,000.00	\$750,000.00	
Total Operating Expenditure	\$16,186,154.61	\$3,595,233.57	\$6,609,587.91	\$10,260,338.40	\$11,441,658.90

Average Expenditures Over Time	
5-year average operating expense per year	\$48,092,973.39
5-year average operating expense per week	\$924,864.87
5-year average operating expense per day	\$131,761.57
5-year average operating expense per hour	\$5,490.07

Expenditures Per Position	
5-year average operating expense per year per position	\$46,110.23
5-year average operating expense per week per position	\$886.74
5-year average operating expense per day per position	\$126.33
5-year average operating expense per hour per position	\$5.26



6.7.3. i3 Services

i3 services implementation will require significant effort; some minimum qualifications were provided earlier in this document.

There are many variables, but the numbers for developing a fully tested GIS database are approximately \$5 million to \$7.25 million. There are numerous assumptions, which are as follows:

- The selected vendor will use a third-party to adjust the data, with assistance from local 9-1-1 authorities with knowledge of the local addressing and naming conventions
- Only those data layers required for NG9-1-1 routing and validation are included (road centerlines, emergency services boundaries, PSAP boundaries, municipal boundaries); additional layers will impact cost
- Local entities (9-1-1 authorities) will work with the selected vendor to update
- Local entities will have responsibility for day-to-day data maintenance once adjustments are made

Table 40 depicts i3 services costs. Notes and assumptions for the calculations are as follows:

Includes hardware to be installed in two customer data centers.
All pricing is manufacturer's suggested retail price (MSRP).
Installation/Training time and labor billed at actual cost.
Network and Border Session Control are priced in Network Connectivity.
Installation services include on-site training.
This is an integrated solution offering.
This offering includes Managed Services for civic and geospatial routing data maintenance (i.e., data integrity service).
Call volume is based on FY2014 True-up Data (4,392,212 annual 9-1-1 calls)
Call volume is expected to increase by 3% per year in years 2–10. Semi-annual true-ups will occur on the six-month anniversary month for the following period.

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Table 40 – i3 Services Costs

Operating Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
LIS – Maintenance		\$9,000.00	\$9,000.00	\$11,000.00	\$11,000.00
ESRP – Maintenance		\$9,000.00	\$9,000.00	\$11,000.00	\$11,000.00
ECRF – Maintenance		\$5,400.00	\$5,400.00	\$6,600.00	\$6,600.00
ECRF – Routing (based on Assumptions Table, below)	\$219,610.80	\$226,199.12	\$232,985.10	\$239,974.65	\$247,173.89
LVF – Maintenance		\$10,800.00	\$10,800.00	\$13,200.00	\$13,200.00
SDBMS and SIF – Maintenance		\$7,200.00	\$7,200.00	\$8,800.00	\$8,800.00
LSRG – Maintenance		\$14,400.00	\$14,400.00	\$17,600.00	\$17,600.00
M&M – Maintenance		\$5,400.00	\$5,400.00	\$6,600.00	\$6,600.00
Total Operating Expenditure	\$219,610.80	\$287,399.12	\$294,185.10	\$314,774.65	\$321,973.89
Capital Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5
LIS – 2 (redundant, one for each data center)	\$50,000.00				
ESRP – 2 (redundant, one for each data center)	\$50,000.00				
ECRF – 2 (redundant, one for each data center)	\$30,000.00				
LVF – 4 (redundant, two for each data center)	\$60,000.00				
SDBMS and SIF – 2 (redundant, one for each data center)	\$40,000.00				
LSRG – 4 (redundant, two for each data center)	\$80,000.00				
M&M, including intrusion detection and intrusion prevention (redundant)	\$30,000.00				
Total Capital Expenditure	\$340,000.00	\$0.00	\$0.00	\$0.00	\$0.00



Services	Year 1	Year 2	Year 3	Year 4	Year 5
ALI/GIS Help Desk Support	\$1,200,000.00	\$1,236,000.00	\$1,273,080.00	\$1,311,272.40	\$1,350,610.57
Service Provider PM	\$216,000.00	\$222,480.00	\$229,154.40	\$236,029.03	\$243,109.90
Technical Support	\$200,000.00	\$206,000.00	\$212,180.00	\$218,545.40	\$225,101.76
Total Services Expenditure	\$1,616,000.00	\$1,664,480.00	\$1,714,414.40	\$1,765,846.83	\$1,818,822.23

Total 5-year Cost of Ownership (TCO)
\$10,357,507.02

Total Capital Cost	
Total Capital Cost	\$340,000.00
Capital Cost average per year over 5 years	\$68,000.00

i3 Services and Routing	Cost
Operating expense plus 1/5 capital expense per year	\$355,623.75
Operating expense plus capital expense per week	\$6,838.92
Operating expense plus capital expense per day	\$974.31
Operating expense plus capital expense per hour	\$40.60

Assumptions	
Monthly 9-1-1 Call Volume (average)	366,0018
MSRP per Transaction	\$0.05



6.7.4. Integration Management

A key component of NG9-1-1 implementation is integrating the multiple services. It often becomes apparent that the best total solution, from a cost performance perspective, is not one vendor for all the products and services. When calculating total cost, Integration Management should be considered a vital component for successful implementation of NG9-1-1. The specific roles that Integration Management will provide will be influenced by the specific selected vendors for other NG9-1-1-related products and services.

MCP has found that some service providers have been challenged in their transition from providing products and services for a PSAP or region of PSAPs to full Integration Management. Some functions of Integration Management services include the following:

- Management of all vendor and services subsystem contract negotiations, with a unified and holistic view to the complete project.
- Unified management of strategic planning for installation and testing of all subsystem vendors. This element can significantly vary depending on the vendors and service providers chosen. This can be as simple as making sure all of the specifics of contractual obligations are being met, on time with the best possible resources, to being very involved as the customer's advocate and assisting the vendors and service providers in fulfilling their contractual obligations.
- Unified project planning, which includes all vendors and providers of services, with a unified view of project timelines.
- Unified view of all implementation and test plans.
- Punch list development to protect the customer's investment.

6.8. CURRENT COSTS / PROJECTED COSTS COMPARISON

When calculating costs and associated savings that the Commonwealth can realize from a transition to statewide ESInet services, some savings are clear, while other savings require more inspection. While some pricing elements can be taken directly from the PSAP surveys, it is more difficult to determine the savings that would be realized from combined purchasing power, reducing spare parts, establishing requirements for strong SLAs, and leveraging lessons learned.

Table 41 compares estimates of current expenses (conservative) with estimates for transitioning to NG9-1-1 with either a hosted call handling solution or SaaS. An estimate of 14 percent of current legacy circuit and CPE maintenance costs is used as an estimate of overlapping costs during the transition period. Data center connectivity is often part of the SaaS solution pricing and is reflected in the pricing below.

As gathered during the PSAP survey, both the date of the most recent CPE replacement and plans for the next CPE were provided. In analyzing the data, some interesting data points were raised. On average, PSAPs report a planned 6-year replacement cycle for CPE. Within the Commonwealth today,



CPE ranges in age from implemented within the last quarter to one that is over 14 years old. Seven PSAPs are operating on CPE equipment that is 10 years or older.

Of the 119 PSAP survey responses, a full two-thirds (79) of PSAPs expect to replace their CPE in the next five years. Based on Virginia’s FY2014 Priority Grant Requests¹²², CPE project costs were reported to be approximately \$375,000 on average, with a few projects exceeding \$2 million each. Although there were 35 grant applications totaling more than \$13 million in total project costs, the grant program places a \$150,000 limit for each grant request, allowing just over \$5 million in grant awards. Should all 79 PSAPs procure independent CPE solutions over the next five years, it is estimated to cost the PSAPs \$29.625 million.

Table 41 – Cost Comparison

	Current/Proposed Expenses (5 Years)	Hosted Call Handling (5 Data Centers) (5 Years)	SaaS (5 Years)
Current Expenses (Table 34)	\$59,998,855.00		
Proposed CPE Projects	\$29,625,000.00		
Network (Table 36)		\$18,844,600.00	\$18,844,600.00
Data Center Connectivity (Table 37)		\$49,010,588.47	
NG9-1-1-capable Call Handling (Tables 38 and 39, respectively)		\$45,623,896.30	\$48,092,973.39
i3 Services (Table 40)		\$10,357,507.02	\$10,357,507.02
Overlapping Circuit / Maintenance Services (14% of current annual rate)		\$8,399,839.70	\$8,399,839.70
Total	\$89,623,855	\$132,236,431.49	\$85,694,920.11
	Cost Difference over 5 Years	(\$42,612,576.49)	\$3,928,934.89

The main difference in costs between the two options is the significant cost to implement data center capabilities within the Commonwealth. Further, current and proposed expenditures do not account for regional ESInet or NG9-1-1 projects underway or planned that would decrease the estimated costs to transition to NG9-1-1. Also, the 5-year cost would transition all 121 existing primary PSAPs and add the 24 secondary PSAPs (whose expenses are not included in current expenses) to full NG9-1-1 capabilities, versus maintaining the status quo. Finally, the improved benefits and lifesaving capabilities, plus the reduction in overall risk estimated at \$18 million to \$54 million is described, but not included in these cost comparisons.

¹²² http://vita.virginia.gov/uploadedFiles/VITA_Main_Public/ISP/E-911/Grants/FY14Priority.xlsx



6.9. PUBLIC-PRIVATE PARTNERSHIPS

A combination of taxes, general fund tax support, and grants may be required to adequately fund an NG9-1-1 system. In addition, innovative partnerships and shared costs will be necessary, as well as leveraging current infrastructures. New service provision models will be highly desired.

As noted in the [Funding 9-1-1 Into the Next Generation: An Overview of NG9-1-1 Funding Model Options for Consideration](#), prepared by the NENA Next Generation Partner Program:

*The NG9-1-1 model envisions a system with shared networks, databases and applications in which the communications costs of public safety agencies are shared amongst all participants in the NG9-1-1 system. This will result in less reliance on individual 9-1-1 centers paying for all aspects of the system at the local level, and will potentially reduce costs through sharing with many non-9-1-1 agencies.*¹²³

The practical application of this viewpoint, for example, is that the costs involved may potentially be shared by different groups of stakeholders dealing with different groupings of functions or applications.

6.9.1. Successful Public–Private Partnership Models

A public-private partnership (P3) is a “contractual arrangement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility.”¹²⁴

The December 2013 BRP [Report to the National 911 Program](#) noted:

One of the most successful methods employed by other infrastructure-related industries to improve project delivery efficiency, minimize government project risk, increase cost effectiveness, and potentially generate revenues is a P3. In addition to decreasing costs and raising new revenue, P3s can significantly reduce the time and costs required to complete a capital project while reallocating risks from the public to the private sector...

The success other countries and industries have had in utilizing P3s has led to the recognition of the P3 as an effective financing and delivery method for Federal, state, and municipal governments. Government assets procured in such transactions have

¹²³ NENA Next Generation Partner Program. *Funding 9-1-1 Into the Next Generation: An Overview of NG9-1-1 Funding Model Options for Consideration*. March 2007. page 3.

¹²⁴ <http://www.ncppp.org/ppp-basics/7-keys/>



included water and wastewater management, highways, transit, healthcare, airports, seaports, and social services (e.g., education, health).

In addition to government incentive, private sector interest in infrastructure as an investment asset vehicle has increased dramatically over the past decade, with many pension, private wealth, and insurance funds looking for P3 opportunities as a transition from the risk/return profiles of equities and bonds. Sources estimate that more than \$200 billion in private capital is currently available for investment in U.S. infrastructure.^[125]

Advantages of P3s include:

- *Additional financial capacity*
- *Lifecycle cost efficiencies met through management and integration of project phases*
- *Innovation in design owing to private sector expertise*
- *Redistribution of risk from the public to private sector*
- *Delivery and construction efficiency driven by market pressures in the private sector*
- *Ability to contract quality of service through negotiations*
- *High interest of private sector investors (pension funds, private wealth), operators, and developers in investment and partnership with governments in infrastructure projects.*

Concerns pertaining to P3s are as follows:

- *Public scrutiny and stakeholder management*
- *Loss of flexibility of public agency in managing asset*
- *Transaction risk related to more complex negotiations and contractual agreements.*¹²⁶

Another concern is the lack of experience as a P3 may not have participated in a public-private partnership before. However, as described in the *Report to the National 911 Program*, the Commonwealth has had successful experience with P3s and the Virginia Department of Transportation is “viewed nationally as a leader in funding and delivering P3s.”¹²⁷

¹²⁵ *Benefits of Private Investment in Infrastructure*, Kearsarge Global Advisors, 2010. Available at: http://www2.vlaanderen.be/pops/documenten/benefits_of_private_investment_in_infrastructure.pdf [Last accessed October 21, 2013]

¹²⁶ Blue Ribbon Panel on 911 Funding. [Report to the National 911 Program](#). December 2013. page 31.

¹²⁷ *Ibid*, page 34-35.



6.9.2. Public-Private Partnership Economics

When P3s are employed, two benefits are typically derived. The first benefit is known as Accelerated Delivery; “[t]his term refers to the benefits of having an asset and related services available earlier than if it was delivered solely by the public sector...having a modernized 911-system project delivered earlier than it would be with conventional government procurement methods”¹²⁸ and funding constraints means that the benefits can be experienced by the public sooner than later. The second benefit is known as Enhanced Delivery; “[t]his term refers to improved service as a result of P3 (e.g., applied life-cycle approach, better management of service delivery)...high service quality based on developing contractual commitments to defined service standards results in both better designed and higher-quality service delivery...”¹²⁹

There are, of course, a few potential disadvantages that need to be considered when moving forward with a P3 model, such as adequately estimating and managing the risk associated with major infrastructure projects such as NG9-1-1. “...opponents of P3 argue that experience shows that despite contract agreements the effective risk exposure of the public sector remains very high.”¹³⁰ In particular, P3 endeavors are particularly vulnerable to uncertainty. “Capital cost escalation, longer deliver [*sic*] time and even poor customer satisfaction in development and procurement are common outcomes in the P3 projects. Thus, a project which appears viable at one time may not be viable at another time.”¹³¹ In direct contrast, however, P3s can be justified by the valuation of risk transfer arrangements. Without some assumption of risk by the private sector, there should be no partnership. “When these factors are considered the difficulty of properly being able to assess the efficiency or effectiveness of P3 becomes apparent. Thus, while P3 is potentially a viable alternative, the difficulty of properly being able to evaluate risk and the overall uncertainty of P3 usually makes it difficult to assess the overall effectiveness of this alternative.”¹³²

6.10. FINDINGS AND RECOMMENDATIONS

One of the most challenging issues related to funding 9-1-1 today is to know whether current funding mechanisms established to collect 9-1-1 fees are accurate and comprehensive. There is also limited ability, even with state legislation or rules, to know whether the correct amount is being remitted.

6.10.1. Auditing

Auditing verifies whether collections match the number of subscribers. Accurate reporting of subscribers, regular true-up processes to confirm accuracy and currency, and accurate reporting of the location of subscribers in a jurisdiction are essential best practices that should be initiated. Revenue

¹²⁸ Ibid., page 60.

¹²⁹ Ibid., page 61.

¹³⁰ Ibid., page 63.

¹³¹ Ibid., page 64.

¹³² Ibid., page 65.



assessments, service analysis, and reviews of FCC Form 477 (Broadband and Voice Service Data) filings are useful tools as part of initial efforts to audit 9-1-1 funding mechanisms.

6.10.2. Wireless E-911 Fund Growth

The industry is still experiencing growth. Connected devices refer to entities that use a mobile network, but are not traditional phones, such as tablets, personal wireless hotspots (i.e., MiFi devices), and other mobile communications devices. This segment of the mobile market grew 23 percent even as prepaid mobile service rose 15 percent (both beating out postpaid growth, which only went up by 1 percent). Data now constitutes 85 percent of all mobile traffic in the United States.¹³³ Continued attention is needed to track growth of these non-phone mobile devices to assist the E-911 Services Board in evaluating whether changes to the current funding structure are needed.

6.10.3. Prepaid Collection Rate Evaluation

As of December 2013, the share of prepaid and pay-as-you-go services in the overall national wireless market (or penetration) was 22.4 percent, equal to more than 75.3 million wireless prepaid and pay-as-you-go subscribers.¹³⁴

From 2012 to 2013, prepaid experienced a slight decline in overall number of subscribers, but remains a healthy portion of all wireless subscriber connections. The fact that a lower tax rate is collected on these services in the Commonwealth means that not only does an inequity exist, but because it is a transactional-based collection and not a monthly collection, the Commonwealth is also disadvantaged. Consideration should be given to re-evaluating the method of collection on prepaid services to be both more equitable with wireline and other wireless services, and one that is a percentage of sale rather than a per transaction-based formula. Of the 33 states that collect 9-1-1 revenues from prepaid subscribers (as of January 2014), 14 states (42 percent) use a percentage-based method at the point of sale.¹³⁵ Use of a percentage allows the Commonwealth to apply an appropriate 9-1-1 fee for prepaid subscribers based on the quantity of minutes purchased versus the frequency of a transaction, which may or may not be on a monthly basis.

¹³³ Farivar, Cyrus. *Die, contract! Prepaid mobile phone use surges*. June 14, 2012.

<http://arstechnica.com/business/2012/06/prepaid-mobile-phone-users-in-america-hit-record-high/>

¹³⁴ CTIA-The Wireless Association. *CTIA's Wireless Industry Summary Report, Year-End 2013 Results, Prepaid Equals 22.4 Percent of Wireless Market*. December 2013. <http://www.ctia.org/your-wireless-life/how-wireless-works/annual-wireless-industry-survey>

¹³⁵ NENA, 9-1-1 Surcharge – User Fees By State. January 2014. <https://www.nena.org/?page=911RateByState>



6.10.4. Funding Structure Review

In a study commissioned by the (then) 9-1-1 Industry Alliance and conducted by the ColoComm Group¹³⁶, the authors discuss how to evaluate the sufficiency of existing 9-1-1 funding levels. The study recommends as a critical prerequisite the development of a statement of requirements (NG9-1-1 Master Plan) that can enable policymakers to discern whether existing funding levels and mechanisms are sufficient to support the development and migration to such a system. To develop the necessary statement of requirements, governmental representatives and 9-1-1 technology leaders should work together to identify the basic requirements of their NG9-1-1 Master Plan and develop appropriate standards to support that plan. Ideally, the standards should be crafted along functional and performance-based lines, leaving to the market the challenge of developing the necessary technical implementations. Once the statement of requirements is finalized, it will be possible to determine whether or not sufficient 9-1-1 funding mechanisms are in place.

Analysis and evaluation of projected NG9-1-1 costs and the now available historical perspective on collections since the Communications Sales Tax was implemented would assist the Commonwealth in determining what funds will be required going forward. If the projection is not sufficient to provide adequate and sustainable funding for NG9-1-1 implementation and maintenance, the E-911 Services Board may need to consider requesting an increase in the 9-1-1 tax rate¹³⁷, the actual fee on wireline, wireless, VoIP and future technologies from the current \$0.75 to a higher level of support.

Wireline subscribers continue to steadily decrease, especially with carriers pushing consumers toward non-copper-based telephone service.¹³⁸ As a result, wireline 9-1-1 revenues are dropping for all states across the U.S. In a similar fashion, wireless subscribers are not renewing long and restrictive contracts but are opting for prepaid services to afford them more flexibility. A recent report showed that “all major telecom providers in the U.S. have beefed up their prepaid offerings”¹³⁹ to cater to a growing population that is converting to prepaid wireless service.

The result is that in the Commonwealth, without equitable taxes across all service types, the increasingly more popular prepaid cellular service is not remitting sufficient 9-1-1 tax to the appropriate jurisdiction, and consequently, local 9-1-1 authorities are experiencing declines in revenue. For this reason, prepaid cellular service is often considered the most problematic collection issue facing public

¹³⁶ ColoComm Group, LLC: Dale Hatfield, Brad Bernthal, and Phil Weiser. [The Health of the 9-1-1 System](#), A study of the current state of technology, funding and governance of the United State 9-1-1 system with recommendations to ensure the future health of emergency communications. February, 2008.

¹³⁷ The Communications Security, Reliability and Interoperability Council Working Group 4B [Final Report](#). March 2011. page 89.

¹³⁸ Ars Technica *How Verizon lets its copper network decay to force phone customers onto fiber*. August 14, 2014. <http://arstechnica.com/information-technology/2014/08/why-verizon-is-trying-very-hard-to-force-fiber-on-its-customers/>

¹³⁹ Market Realist. *Why prepaid mobile plans are gaining popularity in the US*. October 7, 2014. <http://marketrealist.com/2014/10/prepaid-mobile-services-gaining-popularity/>



safety and government in general. If the goal is to be both technologically and competitively neutral, all services that provide access to 9-1-1 need to collect and remit the same level of 9-1-1 tax, preferably at the same rate. In order to change the rate collected on prepaid, a statute change would be necessary.

6.10.5. Neutral Funding Mechanisms

While all current and anticipated funding methods present challenges, a principle that should be applied to any 9-1-1 funding mechanism is that it should be technologically and competitively neutral. All service providers, both traditional and non-traditional, should be viewed as equal with regard to 9-1-1 taxes. No one service should collect or remit more than any competitor and no one technology should be responsible for collecting all of the tax. All providers and those who provide access to 9-1-1 should collect and remit the same amount, or in the case of prepaid, an appropriate percentage, whatever is deemed to be appropriate by the Commonwealth.

6.10.6. Recommendations

As discussed in Section 5.7.3, Funding and Resources, there are a number of policy issues that intersect with funding considerations within the Commonwealth that the E-911 Services Board must consider when addressing the economic feasibility of NG9-1-1.

However, at a fundamental level, NG9-1-1 is the upgrade of a publicly-available, essential governmental service that must be paid for equitably and continuously to ensure its consistent and uniform availability to all citizens. Sound fund management practices and reliance on generally accepted accounting principles is the cornerstone of an effectively and properly managed 9-1-1 fund. Public funds are frequently, and appropriately, subject to scrutiny, and the handling and use of those public funds needs to be protected with unassailable and reasonable accounting and management practices. Because the 9-1-1 fees are managed by TAX, a department which has fiscal responsibility and accounting practices at the cornerstone of their work, the problems seen in other jurisdictions that who are trying to manage such accounting themselves when it is not their normal function is not seen in the Commonwealth. However, there are other practices that might be encouraged.

It would be beneficial if best practices were developed that would assist the E-911 Services Board and local authorities to better manage their 9-1-1 funds. The Board should strongly discourage questionable practices and support mechanisms that are technologically and competitively neutral and are equitable across all service types and all communications providers, collection and reporting methods that ensure that all that is due is being correctly remitted, neutral third-party administration that ensures transparency, and auditing and accounting principles that demonstrate sound acceptable government practices.



Table 42 – Effective Fund Management Recommendations

Effective Fund Management Practices	
Findings	Recommendations
<p>1. A comprehensive and detailed cost estimate for both the transition to NG9-1-1 and on-going operations and maintenance costs has not been fully developed.</p>	<p>While this report contains much information about options and a range of costs that are available to the Commonwealth and the E-911 Services Board, until a final implementation plan has been determined, the true costs will not be known.</p> <p>A technology solution should be selected and a comprehensive cost estimate developed for the transition to NG9-1-1 as well as on-going operations and maintenance costs.</p>
<p>2. Existing surcharges and taxes alone may no longer be adequate to fund both current and future systems.</p>	<p>Existing legislation, while it includes all traditional methods for revenue generation for 9-1-1, includes a number of concerns that should be evaluated. Existing surcharges and taxes alone may no longer be adequate to fund both a legacy 9-1-1 system and a transition to next generation services. Taxes will necessarily be combined with a variety of other funding sources and options to ensure adequate funding for legacy and NG9-1-1.</p> <p>Because the current tax and surcharge methods may no longer be adequate as predictable or equitable among all service types, new support mechanisms should be considered to sustain 9-1-1 service.</p> <p>Regular review of the 9-1-1 funding structure for the Commonwealth is recommended. There is an on-going need to examine existing 9-1-1 fee structures and identify a sustainable funding model that will support NG9-1-1. The transition to NG9-1-1 will be significantly delayed and the full benefit of NG9-1-1 will not be realized without consistent, reliable funding mechanisms in place.</p>
<p>3. The need for future capital upgrades will necessitate setting aside sufficient funding for capital improvements.</p>	<p>The purchase and implementation of an ESInet and NG9-1-1 services requires a multi-phased multi-year approach and sufficient capital resources must be made available. A capital funding methodology should be established and used to incentivize regional NG9-1-1 projects and the development of a state-level ESInet and services. As recommended in other sections of this feasibility study, the Board should consider a comprehensive evaluation of the needed funding for NG9-1-1 once a design plan has been established.</p>
<p>4. Auditing and accountability for collection and use of 9-1-1 funds is essential.</p>	<p>As a further protection of the public trust, appropriate auditing and accountability for collection and use of the 9-1-1 funds should be established and encouraged.</p> <p>Conducting regular audits to ensure the Commonwealth is receiving all the appropriate revenues due is recommended. Proper auditing techniques should be required as allowed by statute. Good fund management is essential for confidence in government and in the</p>



Effective Fund Management Practices	
Findings	Recommendations
	9-1-1 system.
5. A city or community does not know how much 9-1-1 revenue comprises their communication sales tax distribution.	Currently, TAX does not report 9-1-1-specific collections to the local jurisdiction. It may be helpful to analyze trends in communications behaviors if this were reported by TAX with the distribution. In this way, local jurisdictions could also demonstrate that funds collected for the purposes of 9-1-1 were going towards the explicit purpose of supporting 9-1-1 in the community.
6. The fixed pro-rate distribution rate may not reflect current consumer behaviors.	The fixed pro rata share for jurisdictions that was based on consumer behaviors of 2006-2007 may not reflect current consumer behaviors as the technology and options available to the consumer have significantly changed in that 7-year period. The fact that TAX expects communications use behaviors to never change and that the current pro rata share will not be impacted by changes in technology and communications use or that populations in communities remain constant is of concern. The Board should direct staff to have a discussion with representatives of the PSAP community, or if the Regional Advisory Council is formed, direct the Council to review the current formula with assistance from the Regional Coordinators and the PSC Coordinator to propose recommendations for further exploration with TAX on options for potential adjustments.
7. PSAPs must better understand and plan for the wireless fund recalculation in 2017.	In 2012 rather than have VITA calculate the PSAP portion of the 60 percent set aside from the Wireless E-911 Fund, that function was transferred to TAX. It is anticipated that this fund share will not be recalculated until 2017. Since the 2012 transfer of administration of this fund distribution, some PSAPs have experienced increases in revenues, while others have seen significant decreases. It will be beneficial for PSAP planning to estimate what the 2017 recalculation would look like. If a PSAP has been experiencing a 5 percent reduction, is that reduction going to be a significantly higher percentage after five years or will it be approximately the same? These questions are important local budgeting concerns. The E-911 Services Board should direct the PSC Coordinator to develop a projection on that recalculation soon so that if any adjustment is necessary, sufficient lead time is allowed for input and discussion among the PSAP community and with the Board.
8. The current prepaid rate may be losing the Commonwealth revenue and is not technology neutral.	The prepaid 9-1-1 fee should be changed to a percentage of the sale or changed to a fixed \$0.75 fee at point-of-sale. The Commonwealth is potentially losing revenue and the present method is not technology-neutral and could be interpreted as anti-competitive by other communications services whose subscribers pay a higher tax.
9. Grant guidelines should be reviewed.	PSAP Grant guidelines should be reviewed and if necessary realigned or reprioritized in order to encourage NG9-1-1 transition.
10. Regional ESInets should be assisted and entered into agreement to ensure	The E-911 Services Board should direct staff to work with the Regional Advisory Council to develop interlocal agreements and



Effective Fund Management Practices	
Findings	Recommendations
consistency with the Commonwealth's NG9-1-1 Master Plan.	formats for regional ESInet plans to be approved by the Board, consistent with the Commonwealth's NG9-1-1 Master Plan.
11. Revenues collected for 9-1-1 services through existing means are diverted to other uses.	This policy should be reevaluated in light of the current and future needs of the 9-1-1 program in the Commonwealth. If those transfers are to continue, a reevaluation of the 9-1-1 fee on wireline and wireless/VoIP communications should be conducted in order to meet the needs of the NG9-1-1 transition and on-going management of the network(s).

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Glossary

Many of the terms found in this list are from the [NENA Master Glossary Of 9-1-1 Terminology, NENA-ADM-000.18-2014](#) and are indicated by an asterisk (*).

Next Generation 9-1-1 Glossary	
* 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.
* Back to Back User Agent (B2BUA)	A logical entity that receives a request and processes it as a user agent server (UAS). In order to determine how the request shall be answered, it acts as a user agent client (UAC) and generates requests. Unlike a proxy server it maintains dialog state and must participate in all requests sent on the dialogs it established.
Bidirectional Forwarding Detection (BFD)	A detection protocol designed to provide fast failure detection times for all media types, encapsulations, topologies, and routing protocols. BFD can detect failures, but the routing protocol must take action to bypass a failed peer. BFD is UDP-based and provides fast routing protocol independent detection of layer-3 next hop failures. BFD provides low-overhead detection of faults even on interfaces that do not support failure detection of any kind, such as Ethernet, virtual circuits, tunnels and MPLS paths.
* 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.
Border Gateway Protocol (BGP)	An IETF standard, and the most scalable of all routing protocols, BGP backs the core routing decisions on the Internet. BGP maintains a table of IP networks that designate network reach-ability among autonomous systems. BGP makes routing decisions based on path, network policies and/or rule-sets. BGP can carry routes for multicast, IPv6, VPNs, and a variety of other data.
Call Information Database (CIDB)	NENA i3 database that either stores or stages information about the call, the caller, and/or the location of the call.
* CODEC (Coder/DECoder)	In communication engineering, the term <i>codec</i> is used in reference to integrated circuits, or chips that perform data conversion. In this context, the term is an acronym for "coder/decoder." This type of codec combines analog-to-digital conversion and digital-to-analog conversion functions in a single chip. In personal and business computing applications, the most common use for such a device is in a modem.
* Communications Service Provider (CSP)	This term is used generically to refer to any and all providers of telecommunications services that may be used to generate a 9-1-1 call, and who would interconnect in any fashion to the 9-1-1 network. CSPs include wireline ILECs and CLECs, Wireless Service Providers, VoIP Service Providers, operators of large PBXs and any other entity providing telecommunications services.



Next Generation 9-1-1 Glossary	
* Computer Aided Dispatch (CAD)	A computer based system, which aids PSAP Telecommunicators by automating selected dispatching and record keeping activities.
Configuration Management Database (CMDB)	A database that contains all relevant information about the components of the information system used in an organization's IT services and the relationships between those components. CMDB provides an organized view of data and a means of examining that data from any desired perspective.
* Continuity of Operations Plan (COOP)	The ability to continue operations during and after a service impacting event through a specific set of procedures designed to reduce the damaging consequences of unexpected events resulting in the loss of 9-1-1 capabilities.
* Customer Premise Equipment (CPE)	Communications or terminal equipment located in the customer's facilities – Terminal equipment at a PSAP.
Denial of Service (DoS)	Occurs when a system is overwhelmed in such a way that messages cannot be processed, or they are processed extremely slowly.
Diff-Serv Aware Traffic Engineering (DS-TE)	Differentiated services give different treatment to traffic based on the experimental (EXP) bits in the MPLS label header and provide the ability for multiple classes of service. DS-TE provides traffic engineering at a per-class level rather than at an aggregate level; different bandwidth constraints for different class types (traffic classes), and different queuing behaviors per class, allowing the router to forward traffic based on the class type, making it possible to guarantee service and bandwidth across an MPLS network.
* Domain Name Server (DNS)	Used in the Internet today to resolve domain names. The input to a DNS is a domain name (e.g., 67elcordia.com); the response is the IP address of the domain. The DNS allows people to use easy to remember text-based addresses and the DNS translates those numbers into routable IP addresses.
* Dynamic Host Configuration Protocol (DHCP)	A widely used configuration protocol that allows a host to acquire configuration information from a visited network and, in particular, an IP address.
* Emergency Call Routing Function (ECRF)	Receives location information (either civic address or geo-coordinates) as input and uses this information to provide a URI that can be used to route an emergency call toward the appropriate PSAP for the caller's location. Depending on the identity and credentials of the entity requesting the routing information, the response may identify the PSAP, or an ESRP that acts on behalf of the PSAP to provide final routing to the PSAP itself. The same database that is used to route a call to the correct PSAP may also be used to subsequently route the call to the correct responder, e.g., to support selective transfer capabilities.
Emergency Data eXchange Language – Distribution Element (EDXL-DE)	EDXL-DE facilitates emergency information sharing and data exchange across local, regional, tribal, national, and international organizations in the public and private sectors. EDXL-DE acts as a wrapper that identifies to whom and under what circumstances emergency information is to be sent. Payloads may include a wide range of data types including geographic coordinates, text documents, and audio, video, and image files. Adoption of EDXL-DE as a standard by government agencies promotes emergency data interoperability among software and hardware systems, increasing the efficiency with which emergency managers receive information.



Next Generation 9-1-1 Glossary	
* Emergency Service Number (ESN)	A 3-5 digit number that represents one or more ESZs. An ESN is defined as one of two types: Administrative ESN and Routing ESN.
* Emergency Service Zone (ESZ)	A geographical area that represents a unique combination of emergency service agencies (e.g., Law Enforcement, Fire and Emergency Medical Service) that are within a specified 9-1-1 governing authority's jurisdiction. An ESZ can be represented by an Emergency Service Number (ESN) to identify the ESZ.
* Emergency Services IP Network (IP network)	An ESInet is 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 functional processes can be deployed, including, but not restricted to, those necessary for providing NG9-1-1 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 inter-network (network of networks).
* Emergency Services Routing Key (ESRK)	Either a 10-digit North American Numbering Plan or non-NANPA number that uniquely identifies a wireless emergency call, is used to route the call through the network, and used to retrieve the associated ALI data...As of 2012 these numbers should be non-dialable, and all new ESRKs will be non-NANPA, non-dialable ten-digit numbers.
* Emergency Services Routing Proxy (ESRP)	An i3 functional element which is a SIP proxy server that selects the next hop routing within the ESInet based on location and policy. There is an ESRP on the edge of the ESInet. There is usually an ESRP at the entrance to an NG9-1-1 PSAP. There may be one or more intermediate ESRPs between them.
Enhanced Variable Rate Codec (EVRC)	A voice coder used in code division multiple access (CDMA) networks. EVRC digitizes and compresses each 20 milliseconds (MS) of 8000 Hertz (Hz), 16-bit sampled speech input into output frames of one of three different sizes through an EVRC digital signal processor, improving CDMA bandwidth utilization.
Enhanced Variable Rate Codec B (EVRC-B)	EVRC-B is an enhancement to EVRC and compresses each 20 ms of 8000 Hz, 16-bit sampled speech input into output frames of one of the four different sizes.
Enhanced Variable Rate Codec Narrowband-Wideband (EVRC-NW)	Voice coder that uses different combinations of several kinds of frame rates according to specific conditions in order to lower the average data rate.
Enhanced Variable Rate Codec Wideband (EVRC-WB)	A wideband extension of EVRC-B, EVRC-WB provides speech quality that exceeds regular wireline telephony. EVRC-WB splits the speech spectrum into low frequency and high frequency bands and compresses them separately. Low frequency signal is coded based on the EVRC-B standard; high frequency signal coding is based on a linear predictive coding scheme. Principal applications of EVRC-WB include wideband telephony, video telephony, gaming, streaming, and ring-back tones.
Event Logger	NENA i3 component that logs all events from all elements in the call path. It logs all significant events, events related at the PSAP, events within the system itself, and for the duration of the call.
* eXtensible Markup Language (XML)	An internet specification for web documents that enables tags to be used that provide functionality beyond that in Hyper Text Markup Language (HTML). Its reference is its ability to allow information of indeterminate length to be transmitted to a PSAP call taker or dispatcher versus the current restriction that requires information to fit the



Next Generation 9-1-1 Glossary	
	parameters of pre-defined fields.
Fast Re-route (FRR)	An MPLS resiliency technology to provide fast traffic recovery upon link or router failures for mission critical services. Upon any single link or node failures, it could be able to recover impacted traffic flows in the level of 50 ms.
* Geographic Information System (GIS)	A system for capturing, storing, displaying, analyzing and managing data and associated attributes which are spatially referenced.
Geospatial Data Exchange (GDx)	A GDx is a system broker's connections to source GIS databases that enables subscribing GIS platforms to have the best available data.
* HELD (HTTP Enabled Location Delivery)	A protocol that can be used to acquire Location Information (LI) from a LIS within an access network as defined in IETF RFC 5985.
Hot Standby Router Protocol (HSRP)	A networking protocol that supports the non-disruptive failover of IP traffic in special circumstances. HSRP allows network hosts to look like they are using a single router and keep connected if the first hop router being used fails to respond. HSRP guards against the failure of the first hop router in a network infrastructure when the router's IP address cannot be found dynamically. HSRP normally joins several routers together to create a single virtual server that client machines and networks use. HSRP helps to ensure that only one of the virtual server's routers is working at any given time.
i3	The capability to receive IP-based signaling and media for delivery of emergency calls and for originating calls conformant to the NENA 08-003 i3 standards.
Initial Address Message (IAM)	The first message sent in a call set-up by a switch or exchange to another partner exchange. IAM seizes/reserves a circuit between the exchanges for the call and contains the information of numbers dialed by the calling party.
* Internet Engineering Task Force (IETF)	Lead standard setting authority for Internet protocols.
* Internet Protocol (IP)	The method by which data is sent from one computer to another on the Internet or other networks.
* Internet Protocol Multimedia Subsystem (IMS)	The IP Multimedia Subsystem comprises all 3GPP/3GPP2 core network elements providing IP multimedia services that support audio, video, text, pictures alone or in combination delivered over a packet switched domain.
IPv4	The fourth iteration of IP and the first version to be widely deployed.
IPv6	A version of IP that is intended to succeed IPv4, which is the communications protocol currently used to direct almost all Internet traffic. IPv6 will allow the Internet to support many more devices by greatly increasing the number of possible addresses.
Intrusion Detection System (IDS)	A device or software application that monitors network or system activities for malicious activities or policy violations.
Intrusion Prevention System (IPS)	Network security appliance that monitors network and/or system activities for malicious activity. An IPS identifies malicious activity, logs information about said activity, attempts to block/stop activity, and reports activity.



Next Generation 9-1-1 Glossary	
* Legacy Network Gateway (LNG)	A signaling and media interconnection point between callers in legacy wireline/wireless originating networks and the i3 architecture, so that i3 PSAPs are able to receive emergency calls from such legacy networks.
* Legacy PSAP	A PSAP that cannot process calls received via i3-defined call interfaces (IP-based calls) and still requires the use of CAMA or ISDN trunk technology for delivery of 9-1-1 emergency calls.
* Legacy PSAP Gateway (LPG)	An NG9-1-1 Functional Element that provides an interface between an ESInet and an un-upgraded PSAP.
* Legacy Selective Router Gateway (LSRG)	The LSRG provides an interface between a 9-1-1 Selective Router and an ESInet, enabling calls to be routed and/or transferred between Legacy and NG networks. A tool for the transition process from Legacy 9-1-1 to NG9-1-1.
* Local Access and Transport Area (LATA)	The geographical areas within which a local telephone company offers telecommunications services.
Location Database (LDB)	A transitional database that provides all the current ALI data, system functionality, protocols, and interfaces while adding new NG9-1-1 protocols and interfaces.
* Location Determination and Acquisition Functions	Location determination includes the functions necessary to accurately and automatically (without input from the user) determine the position of the IP device and associate that location information uniquely with that device. Location acquisition refers to the functions necessary to make that location information available to the device on request, or to make that location information available to a Proxy acting on behalf of that device so that location information can be used for emergency calling.
* Location Information Server (LIS)	A Location Information Server (LIS) is a functional element that provides locations of endpoints. A LIS can provide Location-by-Reference, or Location-by-Value, and, if the latter, in geo or civic forms. A LIS can be queried by an endpoint for its own location, or by another entity for the location of an endpoint. In either case, the LIS receives a unique identifier that represents the endpoint, for example an IP address, circuit-ID or MAC address, and returns the location (value or reference) associated with that identifier. The LIS is also the entity that provides the dereferencing service, exchanging a location reference for a location value.
* Location Interwork Function (LIF)	The functional component of a Legacy Network Gateway which is responsible for taking the appropriate information from the incoming signaling (i.e., calling number/ANI, ESRK, cell site/sector) and using it to acquire location information that can be used to route the emergency call and to provide location information to the PSAP. In a Legacy PSAP Gateway, this functional component takes the information from an ALI query and uses it to obtain location from a LIS.
* Location to Service Translation (LoST) Protocol	A protocol that takes location information and a Service URN and returns a URI. Used generally for location-based call routing. In NG9-1-1, used as the protocol for the ECRF and LVF.
Location Validation Function (LVF)	Validates that a given description of a location is both precise enough to route a 9-1-1 call and will be recognizable by dispatchers. In NENA i3 specifications, valid locations are routable locations, such as a latitude/longitude or postal address, not necessarily MSAG-validated.
Message Service Relay Protocol (MSRP)	Defined in IETF RFC 4975 as a protocol for transmitting a series of related instant messages in the context of a session.



Next Generation 9-1-1 Glossary	
Message Transfer Part	Part of the Signaling System 7 (SS7) used for communications in PSTNs. Message transfer part is responsible for reliable, unduplicated and in-sequence transport of SS7 messages between communication partners.
Multi-protocol Label Switching (MPLS)	A mechanism that allows network administrators to perform a measure of traffic engineering within their networks.
Multi-purpose Internet Mail Extension (MIME)	An Internet standard that extends the format of email to support text in character sets other than American Standard Code for Information Interchange (ASCII), non-text attachments, message bodies with multiple parts, and header information in non-ASCII character sets. Use has grown beyond describing the content of email to describe content type in general. RFC 2045, RFC 2046, RFC 2047, RFC 4288, RFC 4289 and RFC 2049 together define MIME specifications.
Network Address Translation (NAT)	In computer networking, the process of NAT, also known as network masquerading or IP-masquerading, involves re-writing the source and/or destination addresses of IP packets as they pass through a router or firewall. Most systems using NAT do so in order to enable multiple hosts on a private network to access the Internet using a single public IP address.
Network Time Protocol (NTP)	A powerful utility for synchronizing system clocks over a TCP/IP network.
Next Generation 9-1-1 (NG9-1-1)	<p>NG9-1-1 is the next evolutionary step in the development of the 9-1-1 emergency communications system known as Enhanced 9-1-1 (E9-1-1) since the 1970s.</p> <p>NG9-1-1 is a system comprised of managed IP-based networks and elements that augment present-day E9-1-1 features and functions and add new capabilities. NG9-1-1 will eventually replace the present E9-1-1 system.</p> <p>* NG9-1-1 is designed to provide access to emergency services from all connected communications sources, and provide multimedia data capabilities for PSAPs and other emergency service organizations</p>
* NG9-1-1 Specific Interwork Function (NIF)	The functional component of a Legacy Network Gateway or Legacy PSAP Gateway which provides NG9-1-1-specific processing of the call not provided by an off-the-shelf protocol interwork gateway.
Open Shortest Path First (OSPF)	An adaptive routing protocol for IP networks. OSPF uses a link state routing algorithm and falls into the group of interior routing protocols, operating within a single autonomous system.
Originating IP Network	The first emergency services network in the call flow. Originating networks (those initiating 9-1-1 calls) deliver their emergency calls to this network. An originating ESInet will make routing decisions and may forward the emergency call to another IP network for routing to the PSAP.
P-Asserted-Identity (PAI)	Used among trusted Session Initiation Protocol (SIP) entities (typically intermediaries) to carry the identity of the user sending a SIP message as it was verified by authentication. See Request for Comment (RFC) 3325 section 9.1.
* Point of Interconnection (POI)	A Physical Demarcation between an originating carrier network and an NG9-1-1 network.



Next Generation 9-1-1 Glossary	
Point-of-presence (POP)	An artificial demarcation point or interface point between communications entities. An Internet POP is an access point to the Internet. It is a physical location that houses servers, routers, asynchronous transfer mode (ATM) switches and digital/analog call aggregators. It may be either part of the facilities of a telecommunications provider that the Internet service provider rents or a location separate from the telecommunications provider.
* Point-to-Point Protocol (PPP)	A protocol that is used to establish a network link over a dedicated channel. It is widely used for internet access. PPP is modular in design and can support different authentication protocols.
* Policy Routing Function (PRF)	<p>That functional component of an Emergency Service Routing Proxy that determines the next hop in the SIP signaling path using the policy of the nominal next element determined by querying the ECRF with the location of the caller.</p> <p>A database function that analyzes and applies ESInet or PSAP state elements to route calls, based on policy information associated with the next-hop.</p>
Premise Edge	Generally a router between one network service provider's area and areas administered by other network providers.
* Presence Information Data Format (PIDF)	The Presence Information Data Format is specified in IETF RFC 3863; it provides a common presence data format for Presence protocols, and also defines a new media type. A presence protocol is a protocol for providing a presence service over the Internet or any IP network.
* Presence Information Data Format-Location Objects (PIDF-LO)	Provides a flexible and versatile means to represent location information in a SIP header using an XML schema.
* Primary PSAP	A PSAP to which 9-1-1 calls are routed directly from the 9-1-1 Control Office. (In Virginia, only primary wireless PSAPs are eligible to receive wireless 9-1-1 funding.)
* Protocol Interworking Function (PIF)	That functional component of a Legacy Network Gateway or Legacy PSAP Gateway that interworks legacy PSTN signaling such as ISUP or CAMA with SIP signaling.
* Quality of Service (QoS)	As related to data transmission a measurement of latency, packet loss and jitter.
Real-time Text Protocol (RTTP)	Object-oriented bidirectional messaging protocol for delivering data over the Internet.
Real-time Transport Protocol (RTP)	A network protocol used to carry packetized audio and video traffic over an IP network that helps ensure that packets get delivered in a timely way.
Request for Assistance Interface (RFAI)	A SIP that replaces the legacy trunks between the E9-1-1 router and an IP-based 9-1-1 PSAP.
Secure Shell (SSH)	A network protocol for secure data communication, remote shell services or command execution and other secure network services between two networked computers that it connects via a secure channel over an insecure network: a server and a Virginia.
Security Information Management (SIM)	In computer security, refers to the collection of data, such as log files, into a central repository for trend analysis.



Next Generation 9-1-1 Glossary	
* Session Border Control	A commonly available functional element that provides security, NAT traversal, protocol repair and other functions to VoIP signaling such as SIP. A component of a Border Control Function.
Session Description Protocol (SDP)	A format for describing streaming media initialization parameters for the purposes of session announcement, session invitation, and parameter negotiation. SDP does not deliver media itself, but is used for negotiation between end points of media type, format, and all associated properties.
* Session Initiation Protocol (SIP)	An IETF defined protocol (RFC3261) that defines a method for establishing multimedia sessions over the Internet. Used as the call signaling protocol in VoIP, i2 and i3.
SIP User Agent	The SIP user agent allows peer-to-peer calls to be made using a client-server protocol.
* Simple Network Management Protocol (SNMP)	A protocol defined by the IETF used for managing devices on an IP network.
Software as a Service (SaaS)	Software that is owned, operated and maintained remotely by a third-party.
Spatial Database Management System (SDBMS)	A regional or state level GIS database used to aggregate, store, standardize, validate, and perform quality assurance validations on GIS data to meet and mitigate the rigid requirements of spatial data in NG9-1-1.
Spatial Information Function (SIF)	An i3 interface between an authoritative copy of GIS data and functional elements within an ESInet such as an ECRF and LVF.
* Synchronous Optical Network (SONET)	High speed digital transport over fiber optic networks using synchronous protocol.
Text Control Center (TCC)	A messaging gateway for processing emergency text messages from wireless CSPs. The TCC interworks with the messaging with the appropriate web, TTY or i3 interface.
Traffic Engineering (TE)	A method of optimizing the performance of a telecommunications network by dynamically analyzing, predicting and regulating the behavior of data transmitted over that network.
Transmission Control Protocol (TCP)	The end to end reliability protocol that recognizes and corrects lower layer errors caused by connectionless networks
Transport Layer Security (TLS)	A protocol that ensures privacy between communicating applications and their users on the Internet. When a server and Virginia communicate, TLS ensures that no third-party may eavesdrop or tamper with any message. TLS is the successor to the Secure Sockets Layer (SSL).
* Uniform Resource Identifier (URI)	A predictable formatting of text used to identify a resource on a network (usually the Internet).
* Uniform Resource Locator (URL)	A URL is a URI specifically used for describing and navigating to a resource (e.g. http://www.nena.org).
Uniform Resource Name (URN)	An Internet resource with a name that, unlike a URL, has persistent significance - that is, the owner of the URN can expect that a person or program will always be able to find the resource. URN is a type of URI.



Next Generation 9-1-1 Glossary	
* User Agent (UA)	As defined for SIP in IETF RFC 3261[5], the User Agent represents an endpoint in the IP domain, a logical entity that can act as both a user agent client (UAC) that sends requests, and as user agent server (UAS) responding to requests.
* User Agent Client (UAC)	Refer to IETF RFC 3261 for the following definition. “A user agent client is a logical entity that creates a new request, and then uses the client transaction state machinery to send it. The role of UAC lasts only for the duration of that transaction. In other words, if a piece of software initiates a request, it acts as a UAC for the duration of that transaction. If it receives a request later, it assumes the role of a user agent server for the processing of that transaction.”
* User Datagram Protocol (UDP)	One of several core protocols commonly used on the Internet. Used by programs on networked computers to send short messages, called datagrams, between one another. UDP is a lightweight message protocol, compared to TCP, is stateless and more efficient at handling lots of short messages from many clients compared to other protocols like TCP. Because UDP is widely used, and also since it has no guaranteed delivery mechanism built in, it is also referred to as Universal Datagram Protocol, and as Unreliable Datagram Protocol.
Virtual Local Area Network (VLAN)	Logical grouping of end points on a network enabling communication between devices.
Virtual Routing and Forwarding (VRF)	A technology included in IP network routers that allows multiple instances of a routing table to exist in a router and work simultaneously. This increases functionality by allowing network paths to be segmented without using multiple devices. Because traffic is automatically segregated, VRF also increases network security and can eliminate the need for encryption and authentication.



Appendix A – PSAP Survey Data

The survey data may be accessed from the [VITA ISP](#) webpage.

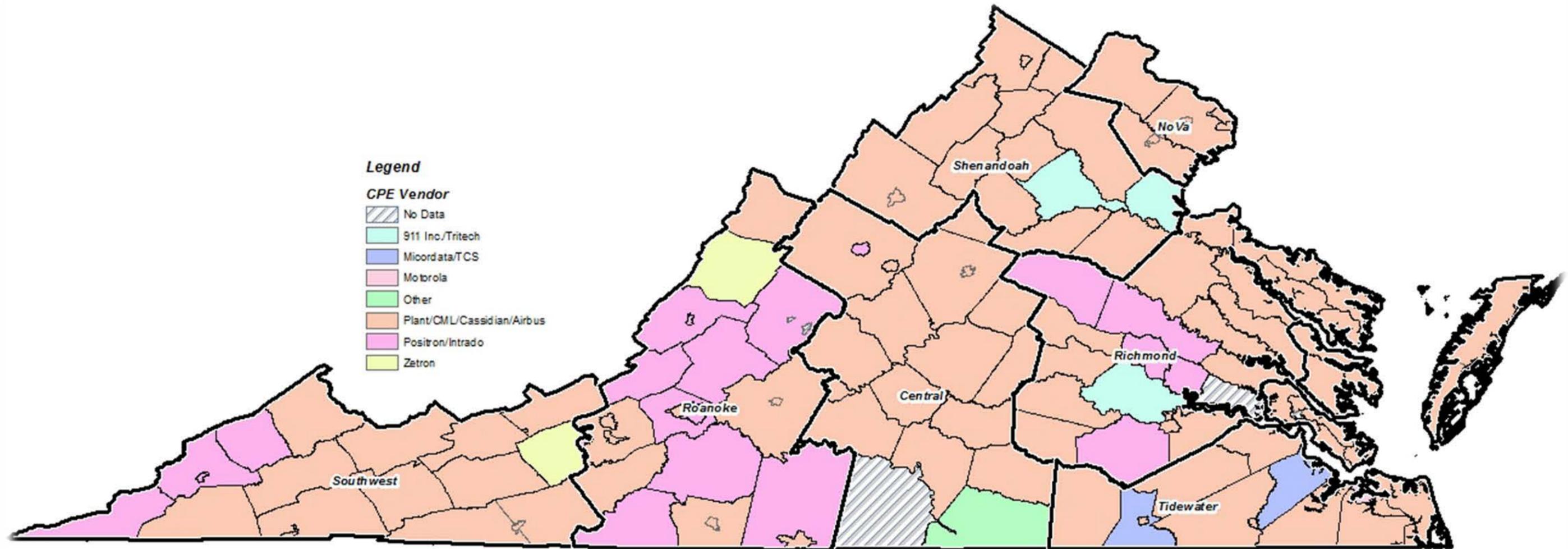
The remainder of this page intentionally left blank.



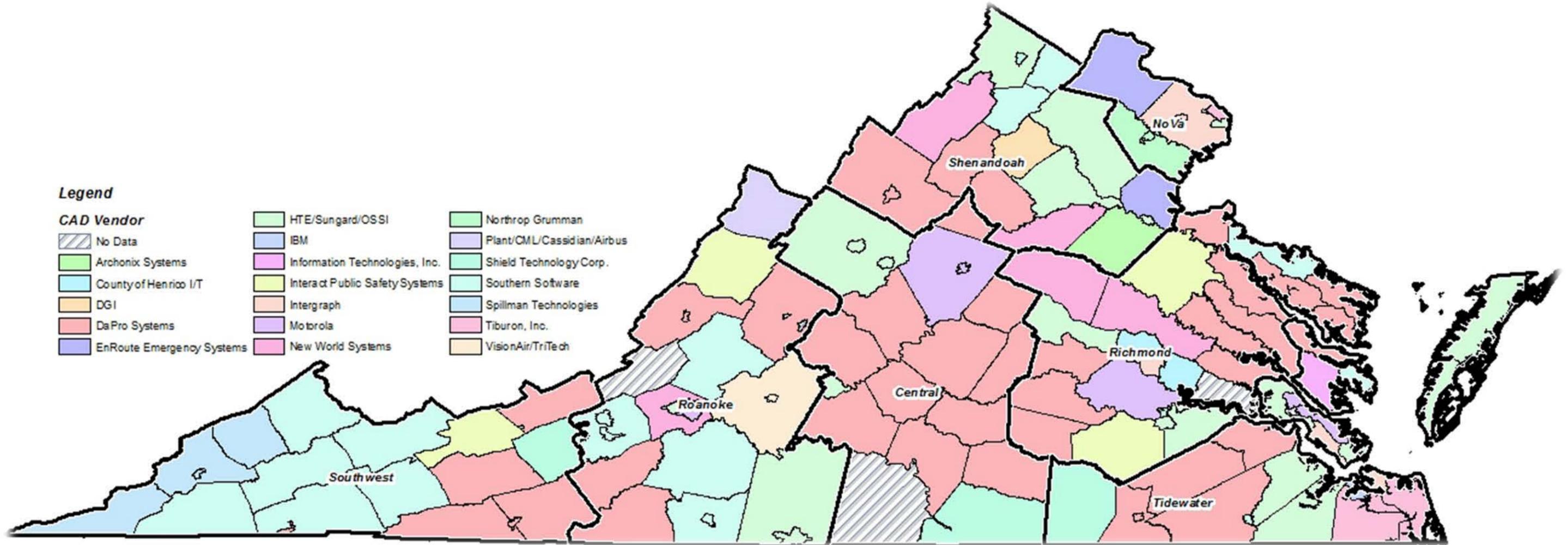
Appendix B – Technical Capabilities Maps

The maps representing technical capabilities by county may be found on the following pages.

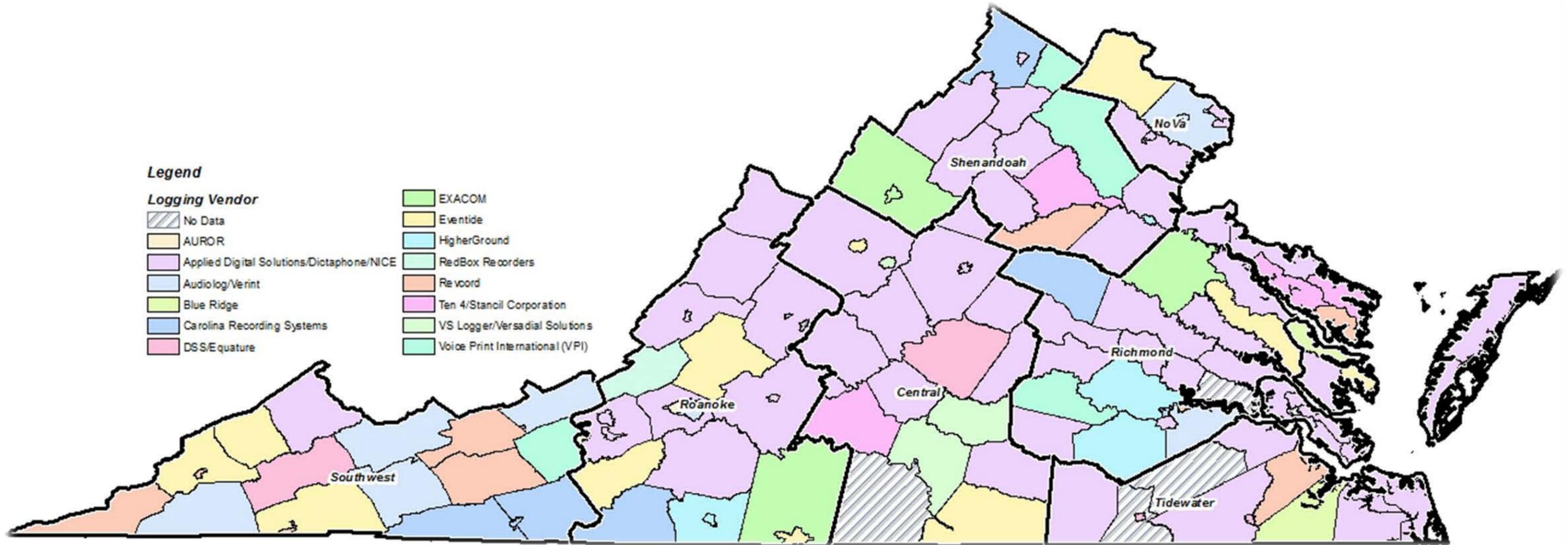
The remainder of this page intentionally left blank.



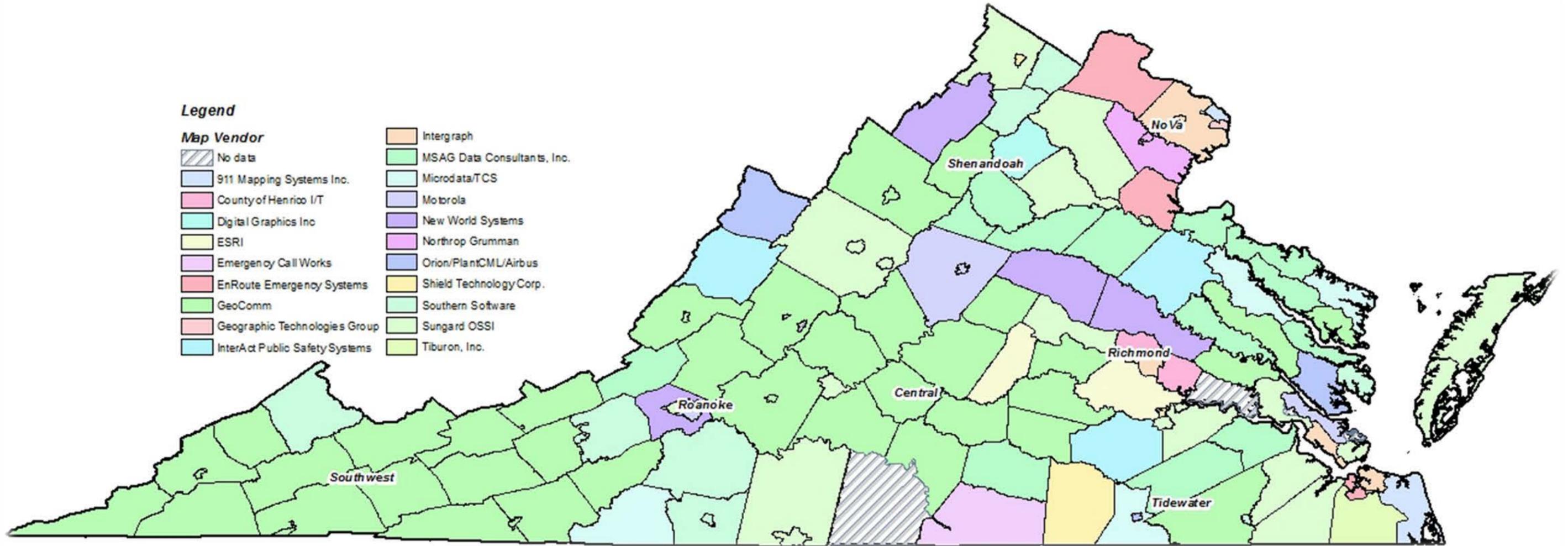
Map 1 – CPE Vendors by County



Map 2 – CAD System Vendors by County



Map 3 – Logging Recorder Vendors by County



Map 4 – Mapping Vendors by County



Appendix C – Invitation to Bid (ITB) Template

The ITB template may be found on the following pages.

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1. SCOPE AND PURPOSE

The following Invitation To Bid (ITB) document serves as an example for the Commonwealth as it considers its options, refines its requirements, and prepares its procurement documentation. The sample requirements found within apply directly to recommendations found in Section 4, Technical Feasibility. It is anticipated that the Commonwealth will need to update these requirements once conceptual system designs are considered and the Commonwealth's path forward is determined.

2. APPLICABLE DOCUMENTS

Applicable documents are as follows:

- NENA ADM-000 – Master Glossary of 9-1-1 Terminology
- NENA 08-003 v1 – NENA Functional and Interface Standards for Next Generation 9-1-1 (i3)
- NENA 75-001 v1 – NENA Security for Next-Generation 9-1-1 Standard (NG-SEC)
- NENA Baseline Next Generation 911 Description, February 22, 2011
- National Institute of Standards and Technology (NIST) 800-53 Revision 4 – Security and Privacy Controls for Federal Information Systems and Organizations
- RFC 3261 – SIP: Session Initiation Protocol
- RFC 3376 – Internet Group Management Protocol, Version 3
- RFC 4604 – Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast
- RFC 3973 – Protocol Independent Multicast - Dense Mode (PIM-DM): Protocol Specification (Revised)
- RFC 5015 – Bidirectional Protocol Independent Multicast (BIDIR-PIM)
- RFC 3569 – An Overview of Source-Specific Multicast (SSM)
- RFC 4601 – Protocol Independent Multicast – Sparse Mode (PIM-SM): Protocol Specification (Revised)
- RFC 2328 – OSPF Version 2
- RFC 4271 – A Border Gateway Protocol 4 (BGP-4)
- RFC 3411 – An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks
- RFC 3412 – Message Processing and Dispatching for the Simple Network Management Protocol (SNMP) Management Frameworks
- RFC 3413 – Simple Network Management Protocol (SNMP) Applications
- RFC 3414 – User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)
- RFC 3415 – View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)
- RFC 3416 – Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)
- RFC 3417 – Transport Mappings for the Simple Network Management Protocol (SNMP)

- RFC 3418 – Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)

3. I3 NG911 PROPOSAL REQUIREMENTS

The Commonwealth also seeks, via this procurement activity, optional proposals and budgetary pricing for delivery of NENA i3-compatible core services as described by the latest version of NENA 08-003, *NENA Functional and Interface Standards for Next Generation 9-1-1 (i3)*, including functional elements and interfaces to enable multi-vendor interoperability.

It is a requirement of the i3 solution to provide the same or equivalent functionality as legacy selective routers (e.g., ring tone, call transfer, make busy switches). Respondents shall identify any functionality described in NENA 03-005, *NENA Standard Generic Requirements for an Enhanced 9-1-1 Selective Routing Switch*, which the solution cannot provide. For ease of reference, the functionality shall be identified by paragraph number and title as found in the standard.

It is understood that NENA 03-005 uses legacy terms (e.g., selective router, selective router database). Respondents shall indicate the equivalent function in their proposed solution utilizing the terms and functions relevant to that solution. In any instance where a Respondent believes a requirement is not applicable or the solution complies with exception, an explanation shall be provided.

Respondent shall confirm an understanding of and describe how the proposed solution addresses the principles of the i3 and selective router standards and identify non-compliant selective router standard functionality.

Understood Understood with Exception (note below)

Response:

3.1. COMMON REQUIREMENTS

In the transitional state from existing systems to NG9-1-1, it is important to identify solutions that align with evolving standards. NENA published the *Baseline NG9-1-1 Description* as a tool to assist in the identification. The purpose of the document, as stated on the NENA website

(https://www.nena.org/?NG911_Baseline), is:

...not to define a lesser version of NENA NG9-1-1, but rather to provide a high level description of the basic NENA standards-based set of capabilities required to be considered NENA NG9-1-1 during transition. If an IP based 9-1-1 system does not have all the features stated in the NENA Baseline NG9-1-1 Description, then it is considered an alternate, intermediate approach that may evolve into a NENA

standards-based NG9-1-1 system over time, but it does not meet the NENA Baseline NG9-1-1 Description.

For the purposes of this ITB, Section 3 provides the minimum set of functionality required to be considered an i3-equivalent solution. The following paragraphs are a combination of locally-defined requirements and extractions from NENA's baseline description. Respondents shall indicate compliance and provide a description for each.

Understood

Response:

3.1.1. Compliance to Future Standards

Respondents shall indicate their strategy for keeping abreast of the evolution of standards and provide examples from previous experiences that demonstrate the corporate commitment to continual standards compliance.

Understood Understood with Exception (note below)

Response:

3.1.2. Product(s) Roadmap

Respondents shall provide product roadmaps with estimated dates indicating the path to a fully functional next generation solution. In the absence of dates, Respondents may provide a corporate-backed vision of the product's development to provide a fully functional next generation solution.

Fully Comply Comply with Exception Not Comply

Response:

3.1.3. NG9-1-1 Industry Collaboration Events (ICE)

The Commonwealth recognizes the benefits of NENA's NG9-1-1 ICE. It is the Commonwealth's belief that responders who participate in ICE are more likely to detect and correct interoperability issues at an earlier stage in system development.

Respondents shall respond to the following questions:

1. Which NENA NG9-1-1 ICE has your company participated in?

2. Which of your products did you test at the event(s)?
3. Have you tested all the products you are proposing in your response at the events?
4. If not, which products have you not tested?
5. If you have not participated in the events and/or not tested products proposed, please explain your reason for not participating and/or testing.
6. Do you intend to participate in future events? If so, which ones? If not, please explain.

Comply Comply with Exception Not Comply

Response:

3.1.4. Benefits Derived From Partners

Respondents shall state benefits derived from partnering with the companies that are part of the response. This might include such items as standards compliance, level of experience, and previous partnering arrangements that were successful. Special attention shall be given to how these benefits may influence early adoption of NG9-1-1 requirements by network providers.

Fully Comply Comply with Exception Not Comply

Response:

3.2. I3 FUNCTIONAL ELEMENTS AND ASSOCIATED SYSTEMS

3.2.1. Emergency Call Routing Function (ECRF)

The most important i3 core function is the ability to accurately route 9-1-1 calls to the appropriate PSAP for the caller's location or to a facility that can assist the caller. The system shall support geospatial location and call routing functions. All hardware and software shall meet the redundancy requirements applicable to the overall network design, including no single point of failure.

Respondents shall describe how their solution meets these requirements, including how each individual part interacts with one another, how data flows through the system, and how call flows are affected. Detailed diagrams shall be included in the response.

Fully Comply Comply with Exception Not Comply

Response:

3.2.1.1. Location-to-Service Translation (LoST)

LoST shall be able to determine the location-appropriate PSAP and take location information and a service Uniform Resource Name (URN), and return a Uniform Resource Identifier (URI). In NG9-1-1, LoST is the protocol used for communication between the ECRF and the Location Validation Function (LVF), as described in NENA 08-003, *Detailed Functional and Interface Specification for the NENA i3 Solution – Stage 3*. Respondents shall describe their solution and how it meets these requirements.

Fully Comply Comply with Exception Not Comply

Response:

3.2.1.2. Location Validation Function (LVF)

LVF ensures that a civic address can be used to discern a route to a public safety answering point (PSAP). Respondents shall describe their solution and how it meets these requirements.

Fully Comply Comply with Exception Not Comply

Response:

3.2.2. Emergency Services Routing Proxy (ESRP)

ESRP is a SIP proxy server that selects the next hop routing within the ESInet based on location and policy. Respondents shall describe their solution and how it meets these requirements.

Fully Comply Comply with Exception Not Comply

Response:

3.2.2.1. Policy Routing Function (PRF)

PRF determines the next hop in the SIP signaling path using the policy of the nominal next element. The ability to control call routing based upon PRF with standardized methods and user interfaces to define, build, and control policy rules is required. Respondents shall describe how the solution will determine the state of individual PSAPs so that conditional routing policies based on PSAP call processing availability are possible. Respondents shall also describe the methods and user interfaces for managing the policy rules and how their solution meets these requirements.

Fully Comply Comply with Exception Not Comply

Response:

3.2.2.2. Enhanced Routing

Respondents shall describe any enhanced routing capabilities (i.e., over and above standards) available with the proposed solution. The description shall include requirements (technical, operational, and process) of the originating network and PSAPs necessary to successfully implement the service.

The Commonwealth is particularly interested in dynamic routing capabilities that allow fast response to changing situations (e.g., major traffic incident, severe storms moving through the area) via easily understood user web-based interfaces.

Fully Comply Comply with Exception Not Comply

Response:

3.3. CYBER SECURITY

Proposed solutions shall comply with the appropriate sections of the current version of NENA's NG-SEC standard and deploy industry best practices to close any gaps.

Respondents shall describe security measures indicating compliance to NG-SEC and where industry best practices are utilized.

Fully Comply Comply with Exception Not Comply

Response:

3.3.1. Gateway Devices

3.3.1.1. Border Control Function (BCF)

Virginia's BCF will consist of several functions, to include highly resilient routers to accept connections, firewalls and other security devices for network protection, a back-to-back user agent (B2BUA) for call control for SIP calls entering the system, and continuous network and system monitoring. Options for the Commonwealth include the possibility of Respondents implementing many or all of these functions into IP routers provisioned at Points of Interconnection (POIs) to other entities. Respondents shall describe their proposed solution for BCF.

Fully Comply Comply with Exception Not Comply

Response:

3.3.1.2. Legacy Network Gateways (LNG) and Legacy Selective Router Gateways (LSRG)

The LSRG and LNG could be located either in a data center or in a carrier's central office. From a physical perspective, the functionality could reside in the same chassis. If the LSRG and LNG are located in a carrier central office, the IP traffic from them will pass through the BCF just like any other external IP traffic. Respondents shall describe their proposed solution for LNG and LSRG.

Fully Comply Comply with Exception Not Comply

Response:

3.3.1.3. Legacy PSAP Gateways (LPG)

The LPGs for non-i3 compatible call handling systems may reside at the PSAPs or in the ESInet. These devices convert the SIP voice traffic back to CAMA trunks to interface with the CPE. Like the LSRG and LNG, these will fade from service as PSAPs update their call handling system to i3-ready systems. Respondents shall describe their proposed solution for LPG.

Fully Comply Comply with Exception Not Comply

Response:

3.4. LOCATION DATABASE (LDB)

3.4.1. *Location Information Server (LIS)*

LIS is an i3 functional entity that provides locations of endpoints. A LIS can provide Location-by-Reference or Location-by-Value and, if the latter, in geodetic or civic forms. LIS can be queried by an endpoint for its own location or by another entity for the location of an endpoint. LIS also provides the dereferencing service, exchanging a location reference for a location value. Respondents shall describe their solution and how it meets these requirements.

Fully Comply Comply with Exception Not Comply

Response:

3.4.2. Service Order Input (SOI) Update Process

The SOI process shall accept files from all service providers for updating the appropriate databases with additions, moves, and changes of telecommunications services. All hardware and software shall meet the redundancy requirements applicable to the overall network design, including no single point of failure. Respondents shall describe their solution, including how each individual part interacts with one another and how data flows through the system. Detailed diagrams shall be included in the response.

Fully Comply Comply with Exception Not Comply

Response:

3.4.3. Input

Proposed solutions shall provide a user interface for implementing updates to ALI data, and generating records to be loaded into the IP selective router (IPSR). Automated interfaces are preferred. If manual, web-based is required. The solution shall be upgradeable to meet future standards resulting from i3 call types and service providers.

Fully Comply Comply with Exception Not Comply

Response:

3.4.4. Validation

Proposed solutions shall have the capability to validate SOI against the Master Street Address Guide (MSAG), and eventually, LVF data.

Fully Comply Comply with Exception Not Comply

Response:

3.4.5. Error Resolution

Proposed solutions shall have the capability to identify errors to support manual intervention, investigation, and correction.

Fully Comply Comply with Exception Not Comply

Response:

3.4.6. Discrepancy Resolution

Proposed solutions shall provide user access to data required to investigate and resolve discrepancies identified once the data passes provisioning validation and is in the live database.

Fully Comply Comply with Exception Not Comply

Response:

3.4.7. Database Updates

Proposed solutions shall have the capability of propagating approved changes to appropriate i3 databases.

Fully Comply Comply with Exception Not Comply

Response:

3.4.8. Interfaces

The LDB provides a transitional solution while carriers migrate to LIS and the Call Information Database (CIDB). The LDB must support all applicable legacy and i3 interfaces. Respondents shall indicate their level of compliance and describe their solution, including interfaces and processes supported by the proposed LDB.

Fully Comply Comply with Exception Not Comply

Response:

3.5. DATA ENCRYPTION

Respondents shall describe their overall approach and philosophy to data encryption and how it will be implemented as a future capability.

Fully Comply Comply with Exception Not Comply

Response:

3.6. NON-VOICE EMERGENCY SERVICES

Respondents shall describe any non-voice services available with the proposed solution. Such services may include, but should not be limited to, automatic crash notification, medical alerts, and alarms. The description shall include requirements (technical, operational, and process) of the originating network and PSAPs necessary to successfully implement the service.

Fully Comply Comply with Exception Not Comply

Response:

3.7. MIGRATION PLAN

The Commonwealth recognizes that the migration to an ESInet is a complex process. Respondents shall provide a detailed explanation of how they plan to migrate the primary and secondary PSAPs to the ESInet. Details should include provisioning of all components, proposed locations of datacenters, LNGs, and where each i3 functional element shall physically reside. Interconnection agreements with all communication service providers should be explained. Interconnection with the Commonwealth's 18 legacy selective routers must be described.

Fully Comply Comply with Exception Not Comply

Response:

4. NETWORK DESIGN REQUIREMENTS

4.1. PHYSICAL NETWORK

Respondents shall describe the proposed physical network and include descriptions of how the Respondent plans to address the following scenarios:

- A series of regional networks overlaid with and connected to a statewide network
- Regional networks with connection directly to the PSAPs
- Fiber optics as preferred method for connectivity
- Possible backup scenarios
 - Physically diverse fiber or T1 link
 - Wireless backup
 - No redundant circuit or service
- Network shall be private, scalable, secure, diverse, redundant, resilient, and sustainable
- Statewide network will connect the regional networks to three data centers that are geographically diverse, located at least 100 miles apart, and preferably within the Commonwealth of Virginia

- As much fiber as possible on both the transport side and the access side

This design concept would not preclude having an individual PSAP directly connected to the statewide network if necessary due to technical or financial limitations.

Fully Comply Comply with Exception Not Comply

Response:

4.2. REGIONAL NETWORK DETAIL

The regional networks will be small-scale versions of the statewide network and shall meet all requirements of the statewide network. There shall be two connections to the statewide network; links shall be physically diverse and connect to different Points of Presence (POPs).

All participating PSAPs in a given region should be connected, although this may not be technically or financially feasible for all PSAPs.

Fully Comply Comply with Exception Not Comply

Response:

4.3. GENERAL NETWORK REQUIREMENTS

The Commonwealth does not prescribe how Respondents shall implement the IP network, beyond the following:

- The use of fiber optic services when and where available at a given location or between locations
- Fiber as the preferred Open Systems Interconnection (OSI) Layer 1 media
- May also select other Layer 1 technologies (copper, wireless)
- Ethernet as the preferred OSI Layer 2 technology
- May also select other Layer 2 technologies (High-level Data Link Control [HDLC], Asynchronous Transfer Mode [ATM], Multiprotocol Label Switching [MPLS])
- VITA's view of the network is at OSI Layer 3
- Shall deliver IP packets from any IP address to any other IP address among any and all connected sites, barring security rules to the contrary
- Hardware, software and firmware shall support both IP version 4 (IPv4) and IP version 6 (IPv6)
- Deliver the most cost effective solution
- Meet the requirements of the ITB
- Provide the Layer 1 and Layer 2 facilities required to interconnect to the specified sites
- Provide redundant, physically diverse connections to each facility on the network:

- o POI
- o End office
- o Central office
- o Selective router
- o PSAP
- o Other such facilities that may be part of the IP network
- Evenly distribute the PSAP data circuits across as many provider edge devices, physical cards, and ports as practical
- Work with the Commonwealth to ensure PSAPs that back each other up are served by edge devices located in separate central offices or data centers
- Layer 3 IP service shall meet the service level requirements specified in Appendix A
- Network shall make use of switching and/or routing protocols to enable fast failover (<50 milliseconds) in the event of a link or equipment failure.
- If unable to avoid any potential single points of failure, the failure point(s) shall be noted on the drawings
 - o Reasons and mitigation strategies shall be included in the narrative

Respondents shall ensure the following are provided in their response:

- Disclose the Layer 1 and Layer 2 technologies and topologies being proposed
- Provide network diagram(s) and text that show and explain these details
 - o Diagrams need not be complete network diagrams showing all network sites
 - o Display enough information about the core network and each unique type of site connection so the topology and design of Layers 1, 2 and 3 are clear
 - o Provide a brief discussion of the rationale for the network topology, the Layer 1 and Layer 2 design, and the advantages of the design
- Hard copies and soft copies shall be included in the response
 - o Drawings shall be furnished in both Adobe PDF and Microsoft Visio formats
- Circuits provisioned on the facilities of other providers shall be identified
- Each provider shall be identified
- A description of the facilities used
- Interconnection type(s) of each provider

Fully Comply

Comply with Exception

Not Comply

Response:

4.3.1. Time Division Multiplex (TDM) to IP Conversion

Respondents shall provide geographically diverse LSRGs and/or LNGs, when and where appropriate, and gateways to allow for call transfers out of the IP network to PSAPs on legacy systems.

Fully Comply Comply with Exception Not Comply

Response:

4.3.2. Open Standards

Respondents shall provide a network based on open standards, including Institute of Electrical and Electronics Engineers (IEEE) 802.3 and IP and related protocols, as defined by IETF in applicable RFCs.

Any and all protocols that use IP for transmission shall be transported.

No protocol may be blocked by the network provider except as required by authorized security policies.

Networks and devices shall support both Alliance for Telecommunications Industry Solutions' (ATIS') Request for Assistance Interface (RFAI) specifications and NENA's i3 specifications for SIP call handling.

Use of any proprietary standards or protocols shall be revealed.

Any limitations, whether technological or philosophical, shall be revealed.

Fully Comply Comply with Exception Not Comply

Response:

4.3.3. Scalability

The overall design shall scale to include redundant interconnections to additional sites and other public safety IP networks, include a strategy for expected growth over the next five to seven years, and provide for interconnections to as many as six additional public safety IP networks without wholesale replacement, forklift upgrades or excessive non-recurring charges.

Fully Comply Comply with Exception Not Comply

Response:

4.3.4. Architectural Survivability

The core network and the redundantly connected sites shall be able to:

- Survive the total destruction, such as by fire, flood, or other disaster, of any one core network site, such as a switching center, data center, POP, or POI site.
- Survive any one failure of any one circuit or piece of equipment.
 - For sites with redundant connectivity, loss of one such connection shall not interrupt service.
- Incorporate service provider and/or facility diversity in the network core solution.
 - Redundantly connected sites shall include physically diverse routes and physically diverse building entrances.
 - Network elements not provisioned with physical diversity shall be revealed and explained in detail how network convergence activities are accomplished as a result of a network failure. Convergence at the network and transport layers should be specified.

The proposed network shall be designed to provide “five nines” (99.999 percent) availability to all sites as measured monthly.

- Service level agreements (SLAs) shall specify the performance requirements for the network as actually deployed at any time
- SLAs shall define architecture availability in terms of percentage (e.g., 99.999 percent).

Fully Comply Comply with Exception Not Comply

Response:

4.3.5. Network Upgrades and Maintenance

The proposed core network and redundantly connected sites shall not require downtime for planned maintenance.

Individual components or elements may have downtime for planned maintenance.

A fully redundant design together with appropriate methods of procedure (MOPs) for maintenance should meet this requirement.

Respondents shall provide an explanation of how the proposed solution will remain operational when planned maintenance is performed.

Fully Comply Comply with Exception Not Comply

Response:

4.3.6. Bandwidth

The proposed solution shall support a growth in bandwidth at each site to at least four times the initial requirements by simple provisioning changes, adding facilities, using faster facilities, and without replacing major components such as core or on-site routers.

Failure of a redundant link shall not affect call processing to the affected site(s).

Fully Comply Comply with Exception Not Comply

Response:

4.3.7. Network – PSAP Interface

At each redundant network site, the demarcation interface to the PSAP local area networks (LANs) shall be two redundant 100 Mb or faster Ethernet ports.

The fail-over scheme should be one that is widely used in the industry and that complies with open standards. One acceptable solution is the OSPF routing protocol combined with BFD.

Fully Comply Comply with Exception Not Comply

Response:

4.3.8. IP Addressing

All devices within the network shall be assigned static addresses.

Fully Comply Comply with Exception Not Comply

Response:

4.3.9. IP Subnetting

Respondents shall provide private IPv4 address space broken into supernets (/16, /18, or /20) by facility or region. The supernets will be subnetted further into /24 networks. The issuance of blocks smaller than a /24 should be avoided. One exception is addressing for point-to-point links, which may be accomplished with a /30 subnet.

IP address management software shall be implemented for this network.

Fully Comply Comply with Exception Not Comply

Response:

4.3.10. IPv6 Addressing

If an external network requires the use of IPv6 addresses, Respondents shall configure edge devices (firewalls, SBCs, etc.) to perform the address translation. Said devices shall have sufficient memory and processing capacity to run dual IP stacks until such time as the internal network is converted to IPv6 addresses.

Fully Comply Comply with Exception Not Comply

Response:

4.3.10.1. Migration to IPv6

Respondents' solutions shall support a seamless migration to IPv6 in the future. Respondents shall describe how they envision this process will take place.

Fully Comply Comply with Exception Not Comply

Response:

4.3.11. IP Routing

The primary network view of the statewide IP network shall be at OSI Layer 3. Routing protocols are necessary to control traffic and ensure packets reach their proper destination. Respondents shall implement a dynamic interior gateway IP routing protocol for routing inside the IP network, and an exterior gateway protocol for routing to outside agencies, partners, and providers. All routing protocols shall support both IPv4 and IPv6.

Fully Comply Comply with Exception Not Comply

Response:

4.3.11.1. Interior Gateway Routing

The Commonwealth requests OSPF as defined in IETF RFCs, including RFC 2328 and as commonly implemented in the industry.

Fully Comply Comply with Exception Not Comply

Response:

4.3.11.2. Exterior Gateway Routing

For connections outside the IP network, the Commonwealth requests Respondents use BGP as defined in IETF RFCs, including RFC 4271, and commonly implemented for routing between disparate entities.

Fully Comply Comply with Exception Not Comply

Response:

4.3.11.3. Multicast Routing

All routers and switches shall support multicast routing and switching. The applicable base protocols are IGMP and PIM.

Fully Comply Comply with Exception Not Comply

Response:

4.3.11.4. Common Routing Requirements

The IP routing protocols shall provide for the delivery of IP packets from any IP address to any other IP address in the Virginia network or in any connected IP network or in any reachable IP network through a connected IP network. The routing protocol shall be configured for fast packet reroute and shall work in conjunction with BFD.

Fully Comply Comply with Exception Not Comply

Response:

4.3.11.5. Quality of Service (QoS)

The proposed network shall implement a QoS function to assure timely delivery of critical packets even in the presence of network congestion from other non-real-time protocols, up to the limit of the available

bandwidth. QoS support for Real-time Transport Protocol (RTP) streams shall be configured into the network. The overall network design shall minimize excessive latency and jitter.

Fully Comply Comply with Exception Not Comply

Response:

4.4. DATA ENCRYPTION

The IP network will have interconnections with other agency, partner, and carrier networks via encrypted connections. The Commonwealth shall require direct firewall-protected connections from their partner agencies to demilitarized zones (DMZs) established solely for those agencies at each data center.

Fully Comply Comply with Exception Not Comply

Response:

4.4.1. Network Risks

Respondents' solutions shall account for the mitigation of possible risks. The risks outlined below are common to all participating facilities. Respondents shall discuss their mitigation strategies for:

- Route poisoning
- Major network upgrades or changes
- Service impacts due to network failure
- Lack of access circuit diversity, their lack of geographic route diversity for secondary access circuits or their lack of secondary routing (case by case)
- Lack of alternate routing for infrastructure (core) or services
- Any single point of failure within the network end-to-end
- Unsecure PSAPs or other endpoints on the network
- Unauthorized or unauthenticated users or devices on the network

Fully Comply Comply with Exception Not Comply

Response:

4.4.2. Network Diagrams

Proposed conceptual diagrams must be included in the proposal.

Fully Comply Comply with Exception Not Comply

Response:

4.4.3. *Diagrams as a Deliverable upon Completion of the Network*

The successful Respondent(s) must provide as-built diagrams down to route path and card level for the solution upon the completion of the implementation phase.

Understood

Response:

4.5. DEVICE NAMING AND LABELING, AND CABLE LABELING

Respondents shall implement device labeling, and data cable color coding and labeling in all facilities, including PSAPs. All cabinets, racks, patch panels, and devices within the cabinets and racks shall be identified and clearly labeled front and rear. All power and data cables shall be clearly labeled with their source and destination.

Fully Comply Comply with Exception Not Comply

Response:

4.6. NETWORK PERFORMANCE

The network must meet minimum level of requirements. Respondents must indicate level of compliance with the following requirements and note any exceptions.

1. Support for virtual private networks (VPNs), such as IP Security (IPSEC) to all end points.

Fully Comply Comply with Exception Not Comply

Response:

2. Public IP addresses provided to customer firewalls/edge security devices.

Fully Comply Comply with Exception Not Comply

Response:

3. Maximum 150ms round trip time through network with 50ms monthly average measurements taken every 5 minutes, assuming 500 bytes sustained for one minute without packet loss.

Fully Comply Comply with Exception Not Comply

Response:

4. Support for QoS honoring the bytes provided and not simply passing the QoS markings through unchanged.

Fully Comply Comply with Exception Not Comply

Response:

5. Virtual local area network (VLAN) support.

Fully Comply Comply with Exception Not Comply

Response:

6. One-way jitter guarantee of 20ms.

Fully Comply Comply with Exception Not Comply

Response:

7. Packet loss of less than one-half of 1 percent (<0.5%).

Fully Comply Comply with Exception Not Comply

Response:

8. 99.999 percent network availability; defined as having cumulative service downtime not to exceed 5.26 minutes per year.

Fully Comply Comply with Exception Not Comply

Response:

9. Security provisioned at physical and application layers.

Fully Comply Comply with Exception Not Comply

Response:

10. 24x7 single point of contact to troubleshoot and resolve network issues.

Fully Comply Comply with Exception Not Comply

Response:

11. Provide the client, or its designee, with the ability to monitor last mile IP network via SNMP alarms.

Fully Comply Comply with Exception Not Comply

Response:

12. Detailed change management process, including alerting the customer of upcoming maintenance windows.

Fully Comply Comply with Exception Not Comply

Response:

13. If the network provider is going to provide the entire network infrastructure including edge security, those devices need to be able to support SIP and RTP across a Network Address Translation (NAT) boundary.

Fully Comply Comply with Exception Not Comply

Response:

4.7. CHANGE MANAGEMENT

Respondents shall demonstrate an understanding of the concepts of change management as well as their implementation of change management policies, processes, procedures, and systems.

Fully Comply Comply with Exception Not Comply

Response:

5. NETWORK AND APPLICATION MANAGEMENT AND MONITORING

5.1. NETWORK AND APPLICATION MANAGEMENT

Network and application monitoring will require significant attention. Having both internal and external entities, and potentially other IP networks, adds complexity to the level of monitoring that public safety IP networks require. It will be important that all IP network, i3 call handling, and i3 service providers have a clear understanding of the interworking requirements. As neighboring states' IP networks are connected to the Virginia IP network, part of the governance plan will need to address this just as it will address interconnections with networks within the state.

Given that this is a statewide endeavor, there will be a number of entities involved in building the network. Each will have their own monitoring and management system for their infrastructure, their own Network Operations Center (NOC) for trouble tickets and reporting, and their own operating policies and procedures for the aforementioned. The Commonwealth intends to select a single entity to have overarching monitoring and management responsibilities for the IP network. This includes monitoring out to the device at the PSAP, preferably with full device access, but at least at the port up/down level. The selected entity, be it a service provider or public agency, shall also maintain a problem management system for tracking and reporting trouble and a change management system for tracking and reporting changes to the network and systems, and shall be prepared to handle the issuance of Reason for Outage (RFO) reports when outages occur.

Management and monitoring Respondents shall provide the following services and supporting documentation:

- Maintain a 24x7x365 NOC
- Provide Levels 1, 2, and 3 technical support
- Provide a service portal for opening trouble tickets and change requests, and checking status of existing tickets/requests
- Provide network and server statistics including, but not limited to, uptime, latency, jitter, packet loss, bandwidth utilization, Mean Opinion Score (MOS), and processor and memory utilization via a web portal
- Provide documented escalation procedures
- Provide documented change management procedures

- Provide monthly trouble reports showing tickets opened, resolved, and unresolved
- Provide regular change reports showing changes requested, approved, completed, in progress, and failed/backed out
- Issue RFOs within a reasonable time (to be determined)

Respondents shall also be providing critical network services to other customers similar in nature to 9-1-1, such as governments, hospitals, or financial institutions. Problem and change management are critical components of network and application monitoring and management.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2. MONITORING PLAN

Some monitoring information that shall be documented includes the following:

- Discovery and documentation of all devices with which the Commonwealth will be connecting. In instances where Virginia is connected to other entities, written processes and procedures for discovery and documentation of added devices, and documentation of when devices are taken off-line or changed, shall be captured and agreed upon as part of the contract or agreement.
- NG9-1-1 applications are implemented across servers, which are connected to various gateways and other devices. NG9-1-1 requires a strategy for real-time monitoring of network traffic congestions, equipment problems, services availability, security violations, application availability, etc. across the LANs and wide area networks (WANs) in real-time or as close to real-time as can be provided to the system administrator. This strategy may incorporate managed services providing monitoring and management services for some or many of the elements of the total NG9-1-1 solution.
- As NG9-1-1 technology involves multiple applications, respective Respondents will most likely desire the ability to both connect and have access to not only their software, but related hardware elements. This is usually part of a vendor's support and maintenance and the contract shall include SLAs against which their performance is evaluated.
- Notification processes of hardware and software faults and alarms will need to be thoroughly described and understood. Scripts for communicating with entities will need to be developed.
- The Commonwealth will require processes and procedures for end-to-end monitoring of network QoS features. Clearly, 9-1-1 calls have a priority over map updates. As the Commonwealth reviews the implementation of NG9-1-1 functions, many will require that QoS be evaluated and given a priority value. Likewise, if Virginia wants to extend other applications, such as call logging and others, QoS will need to be evaluated and monitored iteratively, as there may well

be uncompressed voice traffic. Different priorities may be given for recording the call than the priority for re-playing the call.

- 9-1-1 voice traffic can experience significant peaks when there is an event, such as a hurricane, train wreck, or large fire. The ability to dynamically adjust bandwidth and traffic shall be considered along with other capabilities that will help avoid network saturation. The perception of the system administrator's ability to monitor the network will be greatly impacted by communication and information sharing processes. The system will require the ability to provide historical and real-time reports on network status, malicious network activity, and other information.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.1. Network Monitoring

The entire network shall be monitored on a 24x7 basis, including all devices attached to the network. Respondents shall have a NOC staffed to support 24x7 restoral or mitigation of incidents. Respondents shall provide a 24x7 toll-free number accessible to Commonwealth-authorized personnel, as determined by the Commonwealth.

The use of the network provider monitoring system does not preclude the Commonwealth from installing and using its own monitoring system for remotely monitoring PSAP equipment, using the IP network for remote environmental monitoring of connected sites, or other such applications.

The Commonwealth shall require pricing for a fully-managed network to meet public safety best practices.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

The monitoring of the network and associated reporting shall encompass the areas described below in sections 5.2.2 through 5.2.21.

Fully Comply Comply with Exception Not Comply

Response:

5.2.2. Network Fault Management

Fault management shall detect, log, and notify the network operator, and depending on severity and policy, Commonwealth staff, of IP network problems such as failed circuits, equipment, or network functions. If the failure corrects itself within 60 seconds, notification is not required, but all events shall be logged and reported. It is desired that notification to the Commonwealth is via both text messaging and email.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.3. Network Performance Management

Performance management shall measure the variables that affect network performance. Network performance reports describing overall network usage, congestion events, outages, and other such data shall be required on a monthly basis. This should include a review of trouble tickets and their status.

Network performance management data access is required from all manageable IP devices as specified in contractual agreements. Network performance management and reports shall be priced as an itemized option.

Respondents shall provide detailed descriptions of what performance data shall be collected and how this data shall be logged and reported, including such details as how alarm thresholds are determined.

All IP manageable network hardware shall support SNMPv3 specifications for performance management via standard management information base (MIB) objects forwarded to or extracted by any Commonwealth designee.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.4. Information Storage and Retrieval

Respondents shall describe how their proposed solution stores and retrieves information for reporting purposes, including portal access and ad hoc reporting features. The description should include comments regarding any requirements made upon the Commonwealth for this feature. The Respondents shall maintain access to the data for the term of the contract, and any extensions.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.5. Incident Management System

The incident management system shall log all support requests, both from users and those automatically generated. The system shall interface with the change management system for correlation of outages and changes. Respondents shall provide monthly reports detailing tickets opened, resolved, and pending.

Fully Comply Comply with Exception Not Comply

Response:

5.2.6. Change Management System

The change management system shall log all change requests, both from users and those automatically generated. The system shall interface with the incident management system for correlation of changes and outages. Respondents shall provide monthly reports detailing change tickets opened, resolved, and pending.

Respondents shall also describe any other tools they intend to use to provide access to the change management system, such as web portals, client software, etc.

Fully Comply Comply with Exception Not Comply

Response:

5.2.7. Network Logging

The IP network shall allow historical tracking of events and event resolution. It is preferable that this system be a part of or interfaced (or contain cross-reference abilities) with the Respondent's trouble ticketing system. The successful Respondent(s) shall maintain historical information for the term of the contract, and provide copies of the data to the Commonwealth at the end of the contract.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.8. Security Monitoring and Management

Respondents shall have knowledge of security standards found in documents such as, but not limited to, NIST 800-53 Revision 4, *Security and Privacy Controls for Federal Information Systems and Organizations*; NENA 75-001, *NENA Security for Next-Generation 9-1-1 (NG-SEC)*; and NENA 08-003 *Detailed Functional and Interface Standards for Next Generation 9-1-1, Version 1.0 (i3)*.

Respondents' security management solutions shall control access to network resources according to public safety network security guidelines to prevent sabotage (intentional or unintentional) and the compromise of sensitive information. Security management shall use public safety network security standards to monitor users logging into network resources and refuse access to those who enter inappropriate access codes. The proposed IP-enabled network should support standard security policies that may include the use of anti-virus software, VLANs, VPNs, and secure sockets layer (SSL) protocols.

Furthermore, any system that connects to an IP-enabled network shall be required to comply with standards, including the security standards, and demonstrate compliance through an initial and recurring audit.

Although the Virginia IP network shall start as a closed network solution, security policies, processes and procedures shall be designed in such a method so that when the Commonwealth chooses to connect to adjacent IP networks, the proposed security components shall not require a forklift replacement.

Network security performance and violations shall be reported monthly, and in the case of violations within 24 hours of discovery. Performance statistics may include, but are not limited to, such items as failed access attempts, locked usernames, and attacks detected.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.9. Physical Access Monitoring and Management

Respondents shall track and log all attempts to access the colocation areas housing the Commonwealth's systems and equipment. Monthly reports shall be provided for review as part of the problem management reporting. Security violations should be reported to the NOC having overarching monitoring and management responsibility, which will inform the state designee within 24 hours.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.10. Management Software

Much is said about SNMP in network and server management discussions, but it is only the underlying protocol for transporting management information across the network. Software packages are widely available for capturing, analyzing, and reporting the network health based on SNMP traffic it receives.

A number of commercial packages are available, such as SolarWinds, Monolith, and OpenView, as well as many full-featured open source packages, such as OpenNMS, Nagios (primarily for servers), and Network Management Information System (NMIS).

Respondents shall provide the name and description of the management software they have implemented, including all functional modules associated with it (reporting, backup, IP Access Management [IPAM], etc.).

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.11. Network Configuration Management

Respondents shall describe the processes and procedures they follow for making changes to the network configuration, such as adding a connection, re-provisioning a circuit, or changing a QoS priority. Configuration Management shall follow the defined Change Management policies of the Commonwealth. The description should include procedures such as how proposed changes are planned, authorized, authored, reviewed, advertised, implemented, tested, backed out, and backed up, and the personnel involved. The role and any requirements upon the Commonwealth in this process are especially important. The Commonwealth views this process as very important to realizing 99.999 percent (five nines) network availability.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.12. Configuration Backup and Restoration

Respondents shall describe their capability to automatically or routinely backup configuration data, and the process and conditions used to restore the configuration of network elements such as routers or switches, should the need arise.

In addition to automatic, regular backups, Respondents shall describe their ability to perform on-demand backups, such as at the end of a successful configuration change.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.13. Reason for Outage Report

For major outages, the network provider shall provide the Commonwealth staff with an RFO within 24–48 hours for major outages, and upon request for minor outages. In the event a complete RFO

cannot be provided within 24–48 hours, a preliminary report is required within that time frame, and a full RFO or a resolution plan is required within one week.

Respondents shall describe the tools and techniques at their disposal to perform troubleshooting and post-event analysis.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.14. Preventative Maintenance

Respondents shall include preventative maintenance activities to be included as part of a maintenance contract. This should address how preventative maintenance is handled, as well as the frequency of preventative maintenance activities. Respondents shall use support logs to drive the development of solutions to recurring issues and follow industry best practices.

All preventive maintenance activities shall be coordinated in advance with the Commonwealth and conducted in accordance with a mutually disclosed Maintenance Operation Protocol (MOP) and shall follow the defined Change Management policies of the Commonwealth. The network provider should make all attempts to assure that a remote location and its designated backup are not affected at the same time.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.15. Scheduled Maintenance

Any maintenance by Respondents, including upgrades to the network, shall be coordinated in advance with the Commonwealth and conducted in accordance with a mutually disclosed MOP and shall follow the defined Change Management policies of the Commonwealth. The network provider should make all attempts to assure that a remote location and its designated backup are not affected at the same time.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.16. Support Contracts

Respondents shall identify and specify support contracts for the life of a network contract.

Fully Comply Comply with Exception Not Comply

Response:

5.2.17. Support Maintenance

Respondents shall identify and specify 24x7x365 maintenance support for the life of purchase or leased solution.

Fully Comply Comply with Exception Not Comply

Response:

5.2.18. Access to Technical Staff

Respondents shall detail the procedures by which selected technical personnel from participating facilities have access to the Respondent's technical staff. Respondents shall specify the level of assistance expected to participating facilities' technical staff to resolve issues. Security personnel are expected to recommend solutions to various malicious network activities.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.19. Notification

Respondents shall specify how their NOC informs participating facilities of problems with the network, scheduled outages, and upgrades. Tickets related to the services delivered to participating facilities shall be automatically forwarded.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.20. Escalation Procedure

For Severity 1 incidents, the Commonwealth expects next-level escalation 30 minutes after initial response to the problem, and escalation every 30 minutes thereafter until the problem is resolved.

For Severity 2 incidents, the Commonwealth expects escalation one hour after response and every hour thereafter until the problem is resolved.

Respondents shall outline a detailed escalation process, including time limits between escalations, to be used during service-affecting and critical service outages. It is preferable that these procedures be maintained and accessible via an online portal.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.2.21. Remedies

Respondents shall provide financial remedies to the Commonwealth and their respective specified agencies, for each event in which service levels are not maintained. The Commonwealth expects all of a Respondent's network devices and services to perform at a level of 99.999 percent uptime.

Respondents shall meet the SLAs present in Appendix B. Failure to meet SLAs shall be measured per service-affecting outage. Penalties shall be assessed for failure to meet SLAs.

Fully Comply Comply with Exception Not Comply

Response:

5.3. VENDOR CONSIDERATIONS IN MONITORING PLANS

Respondents shall provide documented evidence of their policies, processes, and procedures for monitoring and managing their systems. Contract negotiations will clarify vendor network access requirements for i3 services Respondents. Likewise, all i3 services Respondents shall be aware of each other and the various entities that may require read-only status of their components.

When considering potential i3 service Respondents as potential providers of products and services, network critical elements, such as security, shall be kept in mind. Requirements that can impact providing secure services for all entities may impact the viability of a vendor being considered for a potential product or as a service provider.

Respondents shall provide a detailed explanation and associated drawings explaining how their proposed solution meets or exceeds the above requirements.

Fully Comply Comply with Exception Not Comply

Response:

5.4. PROJECT MANAGEMENT

Respondents shall include in their bid and proposal a separate and tentative project plan for each subsystem bid. Respondents shall discuss their familiarity and experience with project management for projects of comparable size and scope as the subsystem bid. Proposals shall include experience with the Virginia Project Management Methodology, if applicable.

The project plan shall address at a minimum:

- Project management methodology:
 - Planning
 - Concept definition
 - Design
 - Requirements definition
 - Implementation
 - Integration
 - Test and Evaluation (T&E)
 - Project tracking and reporting
 - Project close-out

- Operations and Maintenance (O&M) including day 2 support
- Gantt Schedule
 - Identify critical path activities
 - Describe schedule software tools
- Major Milestones
 - Identify all critical milestones
 - Ensure that the interval between major milestones does not exceed 30 days
- Resource Plan
 - Who, by name, you intend to assign to this project
 - Their credentials, and how their credentials benefit the project
 - Length of assignment
 - Percent of their time they are dedicated
 - Include and identify any and all subcontractors and/or consultants
- Cost and Schedule Control System (C/SCS)
 - Experience with C/SCS
 - C/SCS tools, formal or informal, you will use
- Communications Plan
 - Approach for communications during project execution
 - Jeopardy and escalation process
- Change Management
 - Describe the Change Management plan, processes and procedures and how they integrate with the Commonwealth's Change Management Plan, which is included as part of this bid package
- Risk Management
 - Significant potential risks
 - Probability of occurrence
 - Impact
 - Tentative risk mitigation strategies
- Documentation Management.
 - Documentation control process
 - How it integrates with Change Management process
- Configuration Control
 - Configuration control process
 - How it integrates with Change Management process
- Facilities Management
 - Describe the facilities that you intend to use for all phases of project development
 - Include your Operational Security Plan including physical security, IT security
 - Describe Disaster Readiness and Recovery (DRR) plan
 - Describe Business Continuity Plan
- Government-furnished Deliverables

- o What you need from the Commonwealth of Virginia to accomplish the project, including such things as information, property, or other items

Respondents shall provide a detailed explanation of how their proposed solution meets or exceeds the above requirements.

Fully Comply

Comply with Exception

Not Comply

Response:

Appendix A – Service Level Agreements (SLAs)

Information Technology Infrastructure Library (ITIL) Service Level Agreements (SLAs) for Incident Management

It is expected that Respondents have processes and procedures for supporting a NOC that can rapidly triage calls. The successful Respondent shall meet the following guidelines from ITIL for tracking, responding to, and reporting on network and system outages or failures:

- Severity Level 1 Incidents resolved within 4 hours
- Severity Level 2 Incidents resolved within 8 hours
- Severity Level 1 and 2 Incidents responded to within 30 minutes
- Severity Level 3 Incidents resolved within 48 hours
- Severity Level 4 Incidents resolved within 96 hours
- Problems resolved within applicable time frame

Basic SLAs cover the vast majority of incidents. Under ITIL, the multitudes of SLAs are categorized into just a few, thus preserving penalty dollars for other metrics (like availability). ITIL's common definitions of Severity Levels are provided below.

Severity 1 Incident

An incident shall be categorized as a "Severity 1 Incident" if the incident is characterized by the following attributes: the incident (a) renders a business critical system, service, software, equipment or network component unavailable or substantially unavailable, or seriously impacts normal business operations, in each case prohibiting the execution of productive work, and (b) affects either (i) a group or groups of people, or (ii) a single individual performing a critical business function.

Severity 2 Incident

An incident shall be categorized as a "Severity 2 Incident" if the incident is characterized by the following attributes: the incident (a) does not render a business critical system, service, software, equipment or network component unavailable or substantially unavailable, but a function or functions are not available, substantially available, or functioning as they should, in each case prohibiting the execution of productive work, and (b) affects either (i) a group or groups of people, or (ii) a single individual performing a critical business function.

Severity 3 Incident

An incident shall be categorized as a "Severity 3 Incident" if the incident is characterized by the following attributes: the incident causes a group or individual to experience an incident with accessing or using a system, service, software, equipment or network component or a key feature thereof and a reasonable workaround is not available, but does not prohibit the execution of productive work.

Severity 4 Incident

An incident shall be categorized as a "Severity 4 Incident" if the incident is characterized by the

following attributes: the incident may require an extended resolution time, but does not prohibit the execution of productive work and a reasonable workaround is available.

Respondents shall provide financial remedies to the Commonwealth and their respective specified agencies for each event in which service levels are not maintained. The Commonwealth expects all of the Respondent's network devices and services to perform at a level of 99.999 percent uptime. Failure to meet SLAs shall be measured per service-affecting outage. Penalties shall be assessed for failure to meet SLAs.

For Severity Level 1 and 2 incidents, 10 percent of the monthly recurring charge (MRC) shall be assessed as a penalty whenever the initial period of resolution is exceeded. If the resolution period length of time doubles, then the penalty shall increase to 20 percent. If the resolution period length of time exceeds four times the initial period, then 50 percent of the MRC shall be waived.

SLA Reporting

The successful Respondent shall provide a measurement and reporting mechanism on a monthly schedule. The mechanism shall deliver SLA results to the Commonwealth and its designees on a monthly basis. The report shall include all performance items identified in the Respondent's proposal and documented in contract negotiations.

SLA Violations

An SLA violation shall have occurred whenever:

- The successful Respondent fails to meet any single performance level, or
- The average of any single performance item over the preceding 2-month period fails to meet the service level. This is an "early warning" of an unacceptable trend.

SLA Violation Damages

Damages shall apply whenever:

- Any single performance item SLA violation occurs for two consecutive months.
- Any single performance item SLA violation occurs the month following an occurrence of an SLA violation.

Damages are calculated as 10 percent of MRCs due the successful Respondent for network connectivity, maintenance or managed services as appropriate. The amount related to the damages is to be credited to the Commonwealth's invoice the month immediately following the violation.



Appendix D – Standards

SDO	Standard ID	Standard Title	Standard Description	Latest Revision/ Release Date
NENA	08-003 v1	Detailed Functional and Interface Standards for the NENA i3 Solution	NENA i3 introduces the concept of an ESInet, which is designed as an IP-based inter-network (network of networks) that can be shared by all public safety agencies that may be involved in any emergency.	Version 1.0 / June 14, 2011
NENA	NENA-STA-008.2-2014	NENA Registry System (NRS)	Describes how registries (lists of values) are created and maintained in NENA.	October 6, 2014
NENA	71-001 v1	NG9-1-1 Additional Data	Describes the use of additional data available with NG9-1-1 (associated with a call, a location, a caller, and a PSAP) that assists in determining the appropriate call routing and handling.	Version 1.0 / September 17, 2009
NENA	NENA-STA-003.1.1-2014	NG9-1-1 Policy Routing Rules	The PRF described in NENA standard 08-003 is the function that handles the diversion of calls. To support the PRF, Policy Routing Rules (PRRs) must be developed to define where calls are to be diverted if the target PSAP is unreachable.	December 1, 2014
NENA / APCO	NENA-INF-005 / ANS 2.105.1-201x	NG9-1-1 Emergency Incident Data Document (EIDD)	Identifies a process used to share emergency incident information between and among authorized entities and systems. An EIDD American National Standard is in process that will replace this informational document.	February 21, 2014
NENA	NENA-STA-004.1-2014	NG9-1-1 Civic Location Data Exchange Format (CLDXF)	Provides a definitive set of core civic location data elements that support emergency call routing and dispatch.	March 23, 2014
NENA	75-001	Security for Next-Generation 9-1-1 (NG-SEC)	Identifies the basic requirements, standards, procedures, or practices to provide the minimum levels of security applicable to NG9-1-1 Entities.	February 6, 2010
NENA	NENA-INF-008.2-2013 (previously NENA 77-501)	NENA NG9-1-1 Transition Plan Considerations Information Document	Focuses on the aspect of transitioning data from the legacy environment to the NG9-1-1 environment.	November 20, 2013



SDO	Standard ID	Standard Title	Standard Description	Latest Revision/ Release Date
NENA	70-xxx (In Development)	Standards for the Provisioning and Maintenance of GIS data to ECRF/LVF	Defines the operational processes and procedures necessary to support the i3 Emergency Call Routing Function (ECRF) and Location Validation Function (LVF) and identifies ECRF/LVF performance and implementation tradeoffs for 911 Authorities' consideration	n/a
APCO	ANS 1.115.1-201x (In Development)	Core Competencies, Operational Factors, and Training for Next Generation Technologies in Public Safety Communications	A comprehensive set of standards for processing, dispatch & utilization of multimedia systems	n/a
ATIS	ATIS/TIA J-STD-110	Joint ATIS/TIA Native SMS to 9-1-1 Requirements and Architecture Specification	Defines the role of the Text Control Center and its communications with Public Safety Answer Points (PSAP) in handling text-to-9-1-1 calls.	March 2013
ATIS	ATIS 0700015	Implementation of 3GPP Common IMS Emergency Procedures for IMS Origination and ESN/Net/Legacy Selective Router Termination	Defines the network to network interface for delivery of emergency calls to an ESN/Net	March 2014
IETF	RFC 3261	SIP: Session Initiation Protocol	Describes the Session Initiation Protocol (SIP), an application-layer control (signaling) protocol for creating, modifying, and terminating sessions (include Internet telephone calls, multimedia distribution, and multimedia conferences) with one or more participants.	July 2002
IETF	RFC 3986	Uniform Resource Identifiers (URI): Generic Syntax	Defines the generic URI syntax and a process for resolving URI references that might be in relative form, along with guidelines and security considerations for the use of URIs on the Internet.	January 2005
IETF	RFC 4119	A Presence-based GEOPRIV Location Object Format	Defines and describes an object format, which is an extension of the privacy-sensitive Presence Information Data Format (PIDF), for carrying geographical information (physical position) on the Internet.	December 2005
IETF	RFC 5139	Revised Civic Location Format for Presence Information Data Format Location Object (PIDF-LO)	Defines an XML format for the representation of civic location.	February 2008



SDO	Standard ID	Standard Title	Standard Description	Latest Revision/ Release Date
IETF	RFC 5222	LoST: A Location-to-Service Translation Protocol	Defines and describes an XML-based protocol for mapping service identifiers and geodetic or civic location information to service contact URIs. In particular, it can be used to determine the location-appropriate PSAP for emergency services.	August 2008
IETF	RFC 5246	Transport Layer Security (TLS) Protocol Version 1.2	Defines the TLS protocol which provides client/server applications a safe manner; preventing eavesdropping, tampering, or message forgery.	August 2008
IETF	RFC 5491	GEOPRIV Presence Information Data Format Location Object (PIDF-LO) Usage Clarification, Considerations, and Recommendations	Makes recommendations on how to constrain, represent, and interpret locations in a PIDF-LO.	March 2009
IETF	draft-ietf-ecrit-additional-data	Additional Data related to an Emergency Call	When an emergency call is sent to a Public Safety Answering Point (PSAP), the device that sends it, as well as any service provider in the path of the call, or access network may have information about the call which the PSAP may be able to use. This document describes an XML data structure that contains this kind of information in a standardized form.	Draft 25 / December 3, 2014
NFPA	NFPA 1221	Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems	Defines and describes the installation, performance, operation, and maintenance of public emergency services communications systems and facilities.	2013 Edition
NFPA	NFPA 1600	Standard on Disaster/ Emergency Management and Business Continuity Programs	Establishes a common set of criteria for disaster/emergency management and business continuity programs.	2013 Edition
NIST	FIPS 140-2	Security Requirements for Cryptographic Modules	Specifies the security requirements that will be satisfied by a cryptographic module utilized within a security system protecting sensitive but unclassified information. (Note: a revision, FIPS 140-3, has been developed , but not yet officially released.)	December 3, 2002
NIST	Cybersecurity Framework	Framework for Improving Critical Infrastructure Cybersecurity	The Framework consists of standards, guidelines, and practices to promote the protection of critical infrastructure.	February 12, 2014



SDO	Standard ID	Standard Title	Standard Description	Latest Revision/ Release Date
ISO/IEC	ISO/IEC 27001:2013	Information security management systems (ISMS)	Establishing, implementing, maintaining and continuously improving an information security management system (ISMS)	September 25, 2013
ISO/IEC	ISO/IEC 20000-1:2011	Service management system (SMS)	Plan, establish, implement, operate, monitor, review, maintain and improve a service management system (SMS)	April 12, 2011
NERC	CIP 001 – 009	Critical Infrastructure Protection (CIP)	Address the security of cyber assets essential to the reliable operation of the electric grid.	
TIA	TIA-942-A	Telecommunications Infrastructure Standard For Data Centers	Establishes the minimum requirements for telecommunications infrastructure of data centers and computer rooms.	April 2013



Appendix E – Implementation and Migration Plan

A high-level implementation and migration plan may be found on the following pages.

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1. GOVERNANCE IMPLEMENTATION STRATEGY

This governance strategy and implementation guide is loosely based on Information Technology Infrastructure Library (ITIL) methodology, and focuses on aligning 9-1-1 services with the needs of the Commonwealth as a whole, while maintaining regional and local authority over 9-1-1 services. The E-911 Services Board, of course, does not need to strictly follow this particular methodology, but a well-thought-out and comprehensive governance methodology should be considered.

Modification of the recommendations contained in this report are clearly within the purview of the Board and the Commonwealth in order to create the design and structure that is most effective for Virginia. However, there should be a process, procedure, or method for addressing each element in the integration strategy and management implementation progression. This will require significant communication and discussion once the E-911 Services Board determines exactly how the statewide network, and if appropriate, regional NG9-1-1 networks, will be implemented.

Figure 1 depicts a four-tiered approach to system integration governance strategy and management implementation for consideration by the Board.

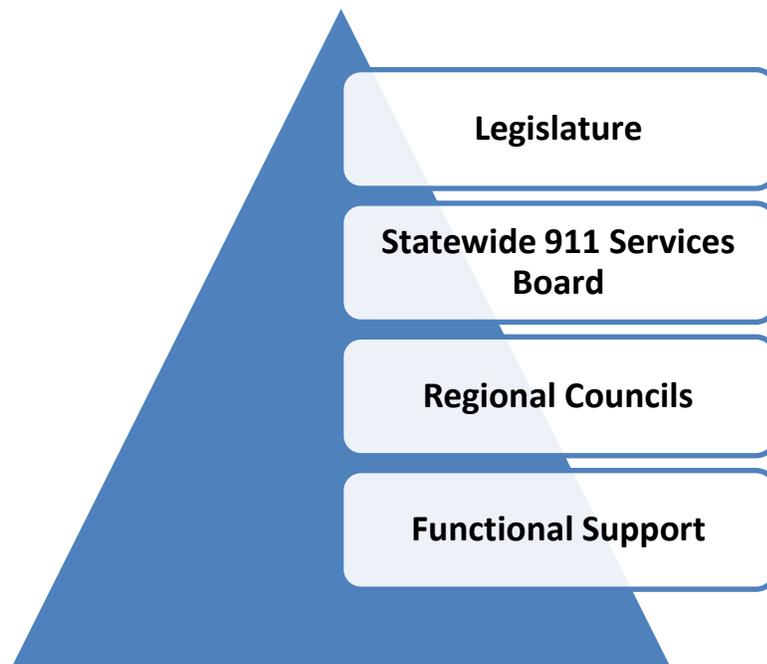


Figure 1 – Tiered Approach

The four-tiered approach corresponds to Table 1, below.

Table 1 – Tiered Approach

<p>Legislature</p>	<p>Establishes statutory authority. Supports, funds, and champions projects on a statewide basis. Assigns authority for rules and regulations to enhance functionality statewide. Represents the needs of the citizen/taxpayer. Responsible to the electorate.</p>
<p>Commonwealth of Virginia E- 911 Services Board</p>	<p>Provides policy direction for statewide programs, establishes standards and technical guidance for integrating the regional ESNets, and monitors performance of systems. Ensures compliance with national guidelines, manages funding and provides fiscal oversight to the statewide 9-1-1 program, approves grant requests, seeks grants, and establishes rules and regulations for carrying out the functions of the statewide 9-1-1 program. Reports to the Legislature annually. The Board members are all voting members.</p> <p>Supported by: State 911 Coordinator—The State 911 Coordinator functions as an executive director of the statewide program and to the E-911 Services Board. Provides the necessary administrative support to the Board, prepares discussion items, background information, and agendas, sees that requests of the Board for reports or information are carried out, implements the policy agenda of the Board, and integrates the Systems Manager, Technical Advisors, and Regional Coordinators to support the Regional Advisory Council and the Board. The State 911 Coordinator is a non-voting member.</p> <p>Technical Advisors—The Technical Advisors are respected authorities in their field and will provide invaluable background and technical information to assist the Board in establishing policy based on essential technical information. These technical advisors might be Internet Service Providers, Wireless/Wireline/VoIP providers, or other NG9-1-1-related vendors and practitioners. They might also be GIS authorities or outside financial experts needed to augment the guidance from Board members. Technical Advisors are non-voting advisors.</p> <p>Other State Support—Additional support for the Board may be representatives of VGIN, or auditing and legal counsel, if needed.</p> <p>Network Manager/Contracted Systems Management—The NG9-1-1 System will likely require a network or systems manager (SM). The SM helps to coordinate the regional ESNets activity to be a cohesive integration with the statewide NG9-1-1 network, helps support and advise the Regional Advisory Council and its representatives, and advises the State 911 Coordinator, the Regional Coordinators and the Board. The SM is a non-voting advisor.</p>
<p>Regional Advisory Council</p>	<p>Provides day-to-day operational and administrative planning and direction for the implementation and management of the different region-level ESNets. Helps coordinate policies and procedures of the statewide authority, monitors established standards of operation, and monitors and responds to the ongoing needs of operating the ESNets and associated applications and systems.</p> <p>Expectations are that this body would empanel the necessary regional subcommittees relating to technical, operational, change management,</p>

	<p>and other needs as required to bring specific expertise for planning, problem solving, and monitoring, assuring the performance and security of the integrated network.</p> <p>Provides operational expertise and reports for the E-911 Services Board as needed.</p> <p>Supported by VITA Regional Coordinators, Network Manager/Contract-provided Systems Management, and State 911 Coordinator as needed.</p>
<p>Functional Support</p>	<p>State 911 Coordinator—The State 911 Coordinator functions as an executive director of the statewide program and to the E-911 Services Board. Provides the necessary administrative support to the Board, prepares discussion items, background information, and agendas, sees that requests of the Board for reports or information are carried out, implements the policy agenda of the Board, and integrates the Systems Manager, Technical Advisors, and Regional Coordinators to support the Council and the Board. The State 911 Coordinator is a non-voting position.</p> <p>Regional Coordinators—Provide support to the Regional Advisory Council and State 911 Coordinator, as well as individual PSAP authorities within their respective regions. Carry out the Board directives as they relate to PSAPs and regional systems. Provide staff support to the Regional Advisory Council mission and work plan. Monitor compliance with statewide rules, regulations, and standards. Provide reports as requested to the 911 Coordinator and the Board.</p> <p>VITA: Provides administrative and organizational support such as office space, mailing services, electronic communication services, meeting space, webhosting, etc.</p> <p>Others: May include a combination of region/local government employees, contractors, and consultants as required and appropriate to support operational activities, standards compliance, network management, problem identification and response, and all other activities.</p>

This tiered approach to implementation aligns the mission of the Board and VITA with the necessary and appropriate governance and policies to ensure a successful work plan and support for the Program.

2. PLANNING

Proper planning is paramount to successful projects and activities; the operation and governance of 9-1-1 systems is no different.

2.1. RISK ASSESSMENT

A risk assessment, conducted in the early stages of the project, will help to determine any potential challenges to implementation. Identified risks should be addressed and mitigated as early in the process as feasible. These identified risks include:

- Legislature action on proposed legislative changes
- Lack of agreement from localities for PSAP clusters
- Carriers do not support requests for interconnection to ESInet
- Dual selective routing billing issues persist for extended periods of time due to lack of coordinated regional PSAP migrations
- Lack of availability of diverse network paths to PSAPs

2.2. KEY STAFF REQUIREMENTS

The addition of a System Manager in the form of a permanent staff member or contracted service will be necessary.

2.3. CHANGE MANAGEMENT

It will be critical for the Commonwealth to establish a Master Plan and monitor and approve any changes to that Master Plan. The E-911 Services Board will need to be the functional monitoring mechanism and manage the transition and implementation to NG9-1-1 with the assistance of the Statewide 911 Coordinator, and the support of Regional representatives, the Regional Coordinators, and the System Manager. Because changes at a PSAP level can impact regional or even state-level network dynamics, how change orders occur will need to be reviewed and potentially adjusted.

To reiterate recommendations made in the Operations section, and to establish more complete policy recommendations related to those points, we call them forward again and explain in moderate detail a process to follow. In order to mitigate negative impacts to the statewide infrastructure, and to ensure compliance with the policies and practices to be established by the Board as the network governing authority, Mission Critical Partners (MCP) recommends that a configuration and change management process be established at the appropriate time in the development of the statewide NG9-1-1 implementation schedule.

The current Comprehensive 911 Plan (<http://www.vita.virginia.gov/isp/default.aspx?id=14860>) likely will need to be revised to include the NG9-1-1 vision and a going-forward methodology. As a part of this planning and revision to the Master Plan for the Commonwealth, a revision to the structure should also be considered. Because NG9-1-1, to be most effective, will rely on a statewide infrastructure with regional ESInets interconnected to it, the Master Plan needs to reflect the process that will be followed to ensure the most functional system of networks. A strong change management process will help to ensure the highest level of functionality.

MCP recommends that a change management process includes the following:

- Policy and governance statements, including approval of Regional Plans.
- A System Manager to manage the statewide NG9-1-1 network and to coordinate regional network integration.
- A database of the current network configurations, diagrams, environmental information, and related documentation. Various individuals at the state, regional, and local levels may need to review information in this database. Because of that, the processes relating to creating and maintaining this database should include standard formats for inputting information, so that there is consistency when looking at any particular PSAP or region, when compared to any other PSAP or region.
- A process whereby an authorized entity (i.e., Regional Advisory Council) can request a change to its Regional Plan. No changes should be permitted without following the proper processes.
- A process for evaluating and identifying the impacts and risks of a proposed change to other regions and the statewide network functionality and cost.
- A change notification process so that appropriate parties are alerted to a scheduled change.
- Standard operating procedures (SOPs) or best practices that identify, step-by-step, how each kind of change is to be implemented
- Outage or recovery procedures in the event an unanticipated problem is encountered, both at a regional and statewide level.
- Database update procedures to insure all regional and statewide network records are properly maintained.

2.4. STATEWIDE AND REGIONAL PLANS

A Master Plan should be developed that communicates the vision of the Commonwealth of Virginia NG9-1-1 system to stakeholders, so that they may be actively engaged in its development and deployment. The NG9-1-1 Master Plan should present the Commonwealth's tailored perspective of the system's desired functionality, concept of operations, and governance structure, including state, regional, and local roles.

The Commonwealth, through the E-911 Services Board, should develop a Strategic Plan to establish goals, objectives, responsibilities, and timelines for the migration to the system described in the Master Plan. State, regional, and local implementation plans can then be developed to carry out the Strategic Plan.

Once a statewide Master Plan is developed, and at the appropriate level in the development of the statewide network, each Region should be required to submit a Regional Plan for their integration into the statewide network. The Regional Plan should be an established format and demonstrate, at a minimum, how the region will function, a commitment to the established standards and SOPs, and the necessary technical information required to illustrate compliance with the Master Plan.

It is generally expected that in a large, integrated system, such as an NG9-1-1 network of interrelated regional networks, a Network Authority or System Manager is necessary. The ESInet i3 solution and network providers or contracted Systems Manager (SM), in addition to actual systems management, should be responsible for outlining the division and assignment of responsibilities for the configuration and change management procedures and processes. Typically, the change management process itself will be performed by the SM under the terms of the Regional Plan agreement with the governing authority.

All change management activities should be based on Requests for Change (RFC) or Regional Plan amendments. RFCs are documented and maintained in a change management system. Once submitted to the system manager, the SM analyzes each RFC for completeness by verifying a complete method of procedure (MOP), an outage/restoration plan, required resource(s), and compliance with Board standards. Upon verification of the RFC, the change manager categorizes, prioritizes and, in some cases, consolidates RFCs and presents them to a governing authority for approval. In this case, the Regional Council would approve the Regional Plan and then forward it as a recommendation to the E-911 Services Board for approval and integration into the Master Plan.

A sample change management approval process is illustrated in Figure 2 below.

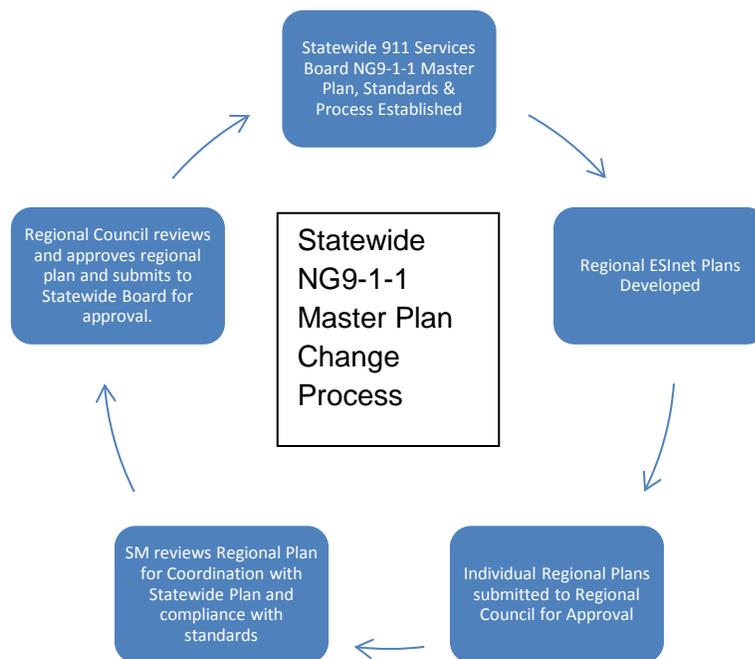


Figure 2 – Regional ESInet Plan Change Management Process

2.4.1. Change Management Results

The goal of change management is to efficiently and effectively deploy required modifications in an operational network by mitigating known risks that lead to incidents and/or problems.

Virginia ESInet change management processes can provide a consistent implementation strategy allowing technology changes to be viewed by other entities interconnecting with the Virginia state-level ESInet.

2.4.2. Change Management Modifications

Modifications made within change management include changes/revisions, corrective actions, and improvements/innovations. Changes or revisions are planned adjustments to the technology infrastructure affecting daily operations. Corrective actions remediate errors or resolve non-compliance with standards and/or technical requirements. Improvements and innovations initialize new components, services, technical capabilities, and/or technologies.

2.5. MIGRATION AND TRANSITION

This section provides a high-level roadmap for the Commonwealth to move from the existing legacy 9-1-1 network to an NG9-1-1 system. The details of this migration will become the basis for a more detailed plan, or roadmap. The roadmap will then become the foundation for the technical specifications and requirements of an RFP for a Master Plan.

The migration plan considers the current work of the NENA NG Transition Planning Committee (NGTPC), which currently has several NENA NG9-1-1 Transition Plan Blueprints. A document considered for this section is the NENA NG9-1-1 Transition Plan Considerations Information Document, NENA-INF-008.2-2013 (previously NENA 77-501), Version 1, November 20, 2013.

The migration plan provides an overall framework for NG9-1-1 implementation and attempts to identify and separate the required tasks in a logical arrangement. Some details are under the control of the E-911 Services Board, while others will be under the control of the region or selected NG9-1-1 provider. The migration plan is preliminary and should be modified as necessary.

Five major stages are executed approximately consecutively. A key challenge for the migration is to minimize the overlap, in both time and money, during which the Commonwealth must pay for the operation of both the legacy network and the ESInet. To the extent possible, activities in each stage will need to be carried out concurrently in order to minimize the total migration interval.

The challenges caused by overlap increase soon after starting Stage III. This may be partially mitigated through thoughtful contractual arrangements with the selected vendor(s). The clock stops when migration is complete at the end of Stage V.

1. Stage I – Governance and Policy and Preparation (1–18 months)
 - a) Legislative changes to recreate the Statewide 911 Services Board
 - b) Obtain association representatives to the Statewide 911 Services Board
 - c) Creation and formation of the Regional Council

- d) Obtain regional representation on the Regional Council and Council representatives to the Statewide 911 Services Board
 - e) Establish position of System Manager
 - f) Amend fiscal program support as appropriate
 - g) Establish standards and policy guidelines
2. Stage II Preparation (12–18 months)
 - a) Product/services/due diligence and vendor selection process
 - b) Vendor contract negotiations
 - c) Commonwealth of Virginia standards, policy, and administrative development
 - d) Socialization of plans with all stakeholders and regions
 - e) Identify/select POIs (may be vendor-specific)
 - f) Prepare statewide GIS database (See SDBMS in the Technical Feasibility Study)
 3. Stage III – NG9-1-1 Proof of Concept (POC) Demonstration (6–8 months)
 - a) Selected vendor completes network designs and implementation schedule
 - b) Vendor implements base public safety IP infrastructure to selected POIs
 - c) NG9-1-1 CPE provisioned at a small group of selected PSAPs
 - d) NG9-1-1 functions provisioned in the core network
 - e) NG9-1-1 region-based network provisioned, if necessary
 - f) LNGs provisioned
 - g) Agreements and arrangements with origination networks
 - h) Test/demonstrate that the NG9-1-1 platform is serviceable
 4. Stage IV – ESInet Construction (6 months to prepare for POC demonstration)
 - a) Vendor completes ESInet construction to all PSAP sites
 - b) All PSAPs equipped and ready to handle NG9-1-1 traffic from the ESInet
 - c) PSAP operator training
 - d) Origination networks interconnect with ESInet at two or more POIs
 5. Stage V – Migration (estimated 3-5 years)
 - a) Origination networks move traffic from legacy selective routers to ESInet
 - b) Legacy PSAP equipment removed as necessary
 - c) Legacy network disconnection

A key concept is to first incorporate a strategy for the state-level backbone. Once that backbone strategy is in place, the NG9-1-1 network is built, starting with PSAPs and working back toward the call originating networks. The strategy is that when a call is converted from legacy to i3 signaling and protocols, it should stay in i3 format. This strategy offers several advantages. It provides a clear path for implementation. It simplifies the migration, and simplification controls risks and reduces multiple levels of management requirements during the migration.

2.5.1.1. Stage I – Policy and Governance

Board structure enhancements, the formation of a Regional Advisory Council, rulemaking and standards-setting authority, compliance with national guidelines for NG9-1-1 implementation, and any legislative changes required to carry out these changes, functions, and responsibilities should be enacted as soon as is practical. This foundation will be essential to carry out the master planning and implementation of future stages.

2.5.1.2. Stage II – Preparation

Much of the work in the second stage will be shared by the SM, the Statewide 911 Services Board, the State 911 Coordinator and the Regional Advisory Council. The Board will need to see that statewide standards are developed and observed for interconnection with the state-level public safety IP network.

On the call origination side, these standards will encourage call providers to move rapidly to NG9-1-1 interconnections, which will reduce the costs related to use of the legacy selective routers. On the PSAP and dispatch center side, establishing state-level standards will help ensure that the desired future interoperability will be realized, and provide economic incentives for consolidation while simultaneously permitting a maximum level of local autonomy and control of CAD systems and other dispatch tools.

The Statewide 911 Services Board will likely require additional support for developing policies, developing technical requirements, assisting with the vendor selection process, and socializing the ESInet plans with stakeholders.

2.5.1.3. Stage III – Proof of Concept (POC)

Stage III involves the construction of a POC. As the POC is identified, a small core ESInet initially should be implemented rapidly, interconnecting the selected POC PSAPs. Cooperative call originating networks that agree to participate in the pilot can then begin ordering facilities and making other preparations for direct IP connections to the ESInet. The goal is to get an early group of NG9-1-1-capable PSAPs and the initial core ESInet/IP infrastructure completed at approximately the same time. This allows for testing and demonstrating that the ESInet is serviceable.

This POC network would be within a region and does not have to start with full diversity or redundancy, because in its initial form it will carry only test and demonstration traffic. This controls cost and reduces the risk. The POC ensures that the vendor supplies and integrates all necessary elements and makes them work as one NG9-1-1 system. The POC may very well expose system problems that can be remedied before complete capital outlay is required to construct redundancy and resiliency in the system.

Stage III is an opportunity for the vendor and the Regional Advisory Council to verify and troubleshoot procedures, practices, testing, network and application management, change management, and other elements of the final solution, and to make any necessary adjustments and changes before complete deployment.

Stage III is complete when the vendor can successfully demonstrate fully tested NG9-1-1 functionality, with all of the resiliency and redundancy elements, over a period of time, and when the Regional Advisory Council is satisfied that the proposed system will work as expected. This stage could be priced at a flat rate so that the chosen vendor(s) is responsible for any risks associated with delayed delivery of the demonstration system and network.

Once the Stage III demonstration is accepted, full construction of the ESInet begins.

2.5.1.4. Stage IV – ESInet Construction

The selected vendor(s) will need to provide the implementation timeline. This timeline should include a soak period where services are in live production for the first PSAP for an agreed upon timeframe with zero defects. If a functional issue occurs during the soak period, then the process re-starts until success is achieved. Upon successful completion of the soak period, additional PSAPs are migrated to the ESInet.

Should the initial construction take an estimated 12–18 months, after the initial soaked sites, and two PSAPs migrate each week with a monthly week break, the time required would be approximately 2½–3 years for full implementation. A more realistic time frame may be 3–5 years because of several factors, including funding.

Work with call originating networks must not cease during Stage IV. Carriers should complete all contracts and required paperwork and make connections to the new network at selected POIs. At the end of Stage IV, the new network should be fully functional and ready for traffic.

2.5.1.5. Stage V – Migration

The most time-consuming part of the entire effort is likely to be the actual migration of traffic from the old network to the new network by the call originating network operators. Most wireless carriers may wish to test each tower and sector with drive testers as traffic is moved. This may take weeks to accomplish.

As the new network comes on line, various incentives and penalties may need to be applied to assure their timely participation in this process. The goal is to reduce the cost of operating the legacy network as rapidly as possible. In almost every case, the originating networks will be interconnected to the legacy selective routers and to the ESInet for a period of time. During this period of time, the legacy selective routers may be required to route originating traffic to the ESInet for simplifying and expediting the migration process. The migration strategy is a critical

element that should be provided by all vendors during the procurement process and detailed in the services contract.



Appendix F – National 911 Program Guidelines VITA Assessment

National 911 Program Guideline	VITA Legislation Status	Reference Notes
Guideline SR 1: The statutory environment provides for comprehensive statewide 9-1-1 coordination.	Partially meets guideline criteria	§56-484.14 , para. 3. Wireless, VoIP and future technologies only.
Guideline SR 2: The state has a designated state 9-1-1 coordinator.	Partially meets guideline criteria	§56-484.14 . Wireless, VoIP and future technologies only.
Guideline SR 3: The statutory environment defines jurisdictional roles and responsibilities.	Meets minimum guideline criteria	§56-484.14 , para. 2.
Guideline SR 4: The statutory environment provides for dedicated and sustainable 9-1-1 funding.	Does not meet guideline criteria	§56-484.17 , para. A. Question of (1) dedicated wireline fund; and, (2) sustainability.
Guideline SR 5: The statutory environment prohibits the use of 9-1-1 funds for purposes other than those defined in the state's 9-1-1 statute.	Does not meet guideline criteria	§56-484.17 , para. A. See also: §2.2.2031
Guideline SR 6: The statutory environment authorizes the operation of a 9-1-1 system.	Partially meets guideline criteria	§56-484.14 . References wireless, VoIP, and other emerging technologies only
Guideline SR 7: The statutory environment provides for interlocal cooperation.	Meets minimum guideline criteria	§56-484.14 §5.1-35 . Powers may be exercised jointly by two or more political subdivisions
Guideline SR 8: The statutory environment enables and allows public and private cooperation in providing 9-1-1 services required by statute.	Partially meets guideline criteria	§56-484.14 . Make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers; applies to use of wireless only funds
Guideline SR 9: The statutory environment provides contractual authority to procure and/or operate statewide 9-1-1 components.	Partially meets guideline criteria ¹⁴⁰	§56-484.14 applies to use of wireless only funds
Guideline SR 10: The state fosters an open and competitive procurement of 9-1-1 services.	Meets guideline criteria	§2.2-4300 (B) and (C) and §2.2-2020 and IT Purchasing Policies

¹⁴⁰ While the statutory authority exists to allow the E-911 Services Board to enter into contracts to carry out its mission, its mission scope is currently limited to only wireless, VoIP and future technologies. While that works for NG9-1-1, it is MCP's view that the Board should have authority over many more aspects of 9-1-1 service than they currently do, such as technical and operational standards, QA programs, etc.



National 911 Program Guideline	VITA Legislation Status	Reference Notes
Guideline SR 11: The statutory environment provides liability protection.	Meets advanced guideline criteria	§56-484.24 , para. B. Liability. ¹⁴¹
Guideline SR 12: The statutory environment fosters the adoption of technical and operational consensus standards for the statewide system.	Does not meet guideline criteria	
Guideline SR 13: A mechanism is in place for periodic reviews of statutes and regulations.	Meets advanced guideline criteria	§56-484.14 See also: §2.2.2031 . (Wireless Fund review)
Guideline SR 14: The statutory environment provides for stakeholder involvement.	Meets superior guideline criteria	§56-484.13
Guideline SR 15: Service providers that deliver and/or enable telecommunications services to the public are involved in the 9-1-1 system.	Meets superior guideline criteria	§56-484.13
Guideline 16: The statutory environment provides for a comprehensive quality assurance (QA) program for the 9-1-1 system.	Does not meet guideline criteria	
Guideline 17: The statutory environment provides comprehensive quality assurance (QA) for call handling.	Does not meet guideline criteria	
Guideline 18: The statutory environment provides for training.	Does not meet guideline criteria	
Guideline 19: The statutory environment provides for professional certification and accreditation.	Does not meet guideline criteria	
Guideline 20: Statute exists for the provision of emergency medical dispatch (EMD).	Does not meet guideline criteria	
Guideline 21: Statutory environment provides for medical oversight of the policies and procedures governing the use emergency medical protocols.	Does not meet guideline criteria	
Guideline 22: The statutory	Meets guideline	§56-484.14 , para. 5.

¹⁴¹ §56-484.24. B. A telecommunications service provider, its employees or agents shall not be liable to any person for damages incurred as the result of the release of information not in the public record, including, but not limited to, unpublished or unlisted telephone numbers, to a PSAP, its employees or agents, or to emergency responders, made in connection with an emergency call.



National 911 Program Guideline	VITA Legislation Status	Reference Notes
environment provides for public education.	criteria	
Guideline 23: The statutory environment provides for the collection of 9-1-1 system data.	Meets minimum guideline criteria	§2.2-3705.2 , Para.10.
Guideline 24: The statutory environment has rules for retention of 9-1-1 call records and 9-1-1 related data.	Meets guideline criteria	200163 and 200164 of GS-17, Law Enforcement, Fire and Emergency Services Under <i>Code of Virginia</i> §42.1-85 , the Library of Virginia (LVA) has the authority to issue regulations governing the retention and disposition of state and local public records. In keeping with the Code's mandate, LVA has developed records retention and disposition schedules outlining the disposition of public records.
Guideline 25: The statutory environment defines confidentiality and disclosure of 9-1-1 records.	Meets guideline criteria	§2.2-3706 . Disclosure of criminal records; limitations. C. Records of any call for service or other communication to an emergency 911 system or communicated with any other equivalent reporting system shall be subject to the provisions of this chapter. See also: §2.2-3705.2 ., Para.10 & 11 and §2.2-3705.6 .
Guideline 26: A statute/regulation exists that addresses multi-line telephone systems (MLTS) statewide for 9-1-1.	Meets superior guideline criteria	§56-484.14 §56-484.16 §56-484.1923
Guideline 27: The statutory environment identifies 9-1-1 as an essential government service for states that are able to make the distinction.	Does not meet guideline criteria	



Appendix G – Governance Structure Analysis

[Legislative Guidance found in the tables below is quoted from the *Guidelines for State NG9-1-1 Legislative Language* (www.nhtsa.gov/staticfiles/nti/pdf/811688.pdf).]

I. 9-1-1 Governance Structure

I.A. Designate 9-1-1 as an Essential Government Service (SR 27)	
National 911 Office Legislative Guidance	Current Statute Language
To the extent that a State constitution or statute defines “essential government service” in terms of the safety or security of the public or a segment of the public, 9-1-1 service, as a critical public safety service, should be defined as an “essential government service.”	There is no reference to 9-1-1 as an essential service of government that could be found.
MCP Comment: The E-911 Services Board should consider including an explicit statement in statute that 9-1-1 is an essential government service or a core function of government, such as “a declaration of necessity” terminology used in current Virginia Code for other services, in any update or rewrite to the statute that is anticipated.	

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I.B. State 9-1-1 Office and State 9-1-1 Coordinator (SR 1, 2 & 3)	
National 911 Office Legislative Guidance	Current Statute Language
<p>The establishment of a State-level entity with statewide authority to address necessary State level functions and responsibilities, with a clearly defined 9-1-1 program coordination role, is critical to maximizing the capabilities of 9-1-1 systems. State-level 9-1-1 authority that is comprehensive and accommodates all forms of originating telecommunication services will be required for NG9-1-1 implementation. Legislation defining the role of the State 9-1-1 entity should facilitate the coordination of 9-1-1 service networks statewide, and include the authority to support those State-level system operational functions necessary to ensure a statewide 9-1-1 system of systems. While this language anticipates the location of a State 9-1-1 function within an appropriate State agency, said 9-1-1 function could be implemented through an independent State agency or administrative unit. States may have hiring and procurement laws that must be considered.</p> <p>Legislation should not prohibit inter-State communications.</p>	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 3: Develop a comprehensive, statewide enhanced 9-1-1 plan for wireless E-911, VoIP E-911, and any other future communications technologies accessing E-911 for emergency purposes. In constructing and periodically updating this plan as appropriate, the Board shall monitor trends and advances in enhanced wireless, VoIP, and other emergency telecommunications technologies, plan and forecast future needs for these enhanced technologies, and formulate strategies for the efficient and effective delivery of enhanced 9-1-1 services in the future with the exclusion of traditional circuit-switched wireline 9-1-1 service.</p> <p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 12: Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.</p>
<p>MCP Comment: Current statute is comprehensive and provides authority that accommodates wireless and future technology forms of originating telecommunication services. It defines the role of the state entity for these services; however, the coordination does not extend to all types of 9-1-1 service such as wireline. There is no prohibition to inter-State communications. The statute is consistent with national guidelines for wireless and future technologies, but that does not fully meet the definition of statewide coordination in the national guideline. A change to statute is needed to establish a statewide entity for all forms of telecommunication service to be consistent with national guidelines.</p>	

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I.C. State 9-1-1 Advisory Committee (SR3)	
National 911 Office Legislative Guidance	Current Statute Language
<p>Recognizing that an effective statewide 9-1-1 system environment will involve State, regional, and local government stakeholders, as well as private sector parties, the 9-1-1 advisory committee should represent critical stakeholders and should serve as a forum for coordination and collaborative decision-making.</p> <p>States should consider the level of authority vested in the advisory committee. In some cases, States may determine a stronger, policy “board” may be appropriate, with authority to review and approve 9-1-1 office activities.</p> <p>Regardless of the level of authority vested in the advisory committee or board, membership should include representatives of critical, diverse stakeholder groups.</p> <p>Responsibility for operational/administrative support of committee should be established</p>	<p>§56-484.13. E-911 Services Board; membership; terms; compensation</p> <p>C. The Board shall consist of 15 members as follows: the Director of the Virginia Department of Emergency Management, who shall serve as chairman of the Board; the Comptroller, who shall serve as the treasurer of the Board; the Chief Information Officer; and the following 12 members to be appointed by the Governor: one member representing the Virginia State Police, one member representing a local exchange carrier providing E-911 service in Virginia, two members representing wireless service providers authorized to do business in Virginia, three county, city or town PSAP directors or managers representing diverse regions of Virginia, one Virginia sheriff, one chief of police, one fire chief, one emergency medical services manager, and one finance officer of a county, city, or town.</p> <p>§2.2-2031. Division of Public Safety Communications established; appointment of Virginia Public Safety Communications Coordinator; duties of Division.</p> <p>A. There is established within VITA a Division of Public Safety Communications (the Division), which shall be headed by a Virginia Public Safety Communications Coordinator, appointed by the CIO with the advice and consent of the E-911 Services Board. The Division shall consist of such personnel as the CIO deems necessary. The operating expenses, administrative costs, and salaries of the employees of the Division shall be paid from the Wireless E-911 Fund created pursuant to §56-484.17.</p> <p>B. The Division shall provide staff support to the E-911 Services Board and encourage, promote, and assist in the development and deployment of statewide enhanced emergency telecommunications systems.</p>
<p>MCP Comment: There exists an overall comprehensive description of the membership of the Advisory Committee/Board (E-911 Services Board) including both public and private members. The membership is diverse and representation is delineated from key stakeholders. Staff support is provided for in the duties of the Division. Statute is consistent with national guidelines. A change to statute is recommended to add General Assembly, an additional information technologist, a member of the public, and VDDHH representation. A recommendation is</p>	



also made to establish technical advisors and an advisory council of PSAP stakeholders. The recommendations are made to enhance the Board's ability to address future challenges of NG9-1-1 design, implementation and funding and to provide for input of the 9-1-1 community into technical and operational standards.

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I.C.1. State 9-1-1 Advisory Committee Protocols (SR 1 & 3)	
National 911 Office Legislative Guidance	Current Statute Language
<p>Legislation should clearly identify the State 9-1-1 Advisory Committee protocols and the expectations of appointed members.</p> <p>Alternative to gubernatorial appointment, States may establish membership in statute, or provide authority for appointment to a State agency.</p>	<p>§56-484.13. E-911 Services Board; membership; terms; compensation.</p> <p>A. The Wireless E-911 Services Board is hereby continued as the E-911 Services Board. The Board shall plan, promote and offer assistance:</p> <p>1. In the statewide development, deployment, and maintenance of enhanced wireless emergency telecommunications services and technologies; and The Board shall exercise the powers and duties conferred in this article.</p> <p>B. The E-911 Services Board may promote and offer planning assistance:</p> <p>1. In the statewide development, deployment, and maintenance of VoIP E-911 and any other future communications technologies accessing E-911 for emergency purposes;</p> <p>2. To the Virginia Information Technologies Agency (VITA), and other stakeholder agencies, in the development and deployment of a statewide public safety network that will support future E-911 and other public safety applications;</p> <p>§56-484.13. E-911 Services Board; membership; terms; compensation</p> <p>C. The Board shall consist of 15 members as follows: the Director of the Virginia Department of Emergency Management, who shall serve as chairman of the Board; the Comptroller, who shall serve as the treasurer of the Board; the Chief Information Officer; and <u>the following 12 members to be appointed by the Governor:</u> one member representing the Virginia State Police, one member representing a local exchange carrier providing E-911 service in Virginia, two members representing wireless service providers authorized to do business in Virginia, three county, city or town PSAP directors or managers representing diverse regions of Virginia, one Virginia sheriff, one</p>



<p>States may include operational activities of the committee at various levels of detail, such as minimum meeting frequency, duties and responsibilities.</p> <p>Reimbursement considerations (e.g., per diem) should be consistent with existing State statute.</p>	<p>chief of police, one fire chief, one emergency medical services manager, and one finance officer of a county, city, or town.</p> <p>§56-484.13. E. A majority of the Board shall constitute a quorum. The Board shall meet at least quarterly or at the call of its chairman.</p> <p>§56-484.13. F. Members of the Board shall serve without compensation; however, members of the Board shall be reimbursed for expenses as provided in §2.2-2813 through §2.2-2826.</p>
<p>MCP Comment: The current statute is consistent with national guidelines. No changes to statute are necessary unless the Board pursues MCP's recommendation to clarify the statewide role of the Board and supporting staff, or enhance membership.</p>	

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I.C.2. State 9-1-1 Advisory Committee Role (SR3)	
National 911 Office Legislative Guidance	Current Statute Language
<p>Coordination among State, regional, and local level 9-1-1 roles and authorities should be clearly identified. Review and guidance provided by the State 9-1-1 Advisory Committee should ensure that all critical stakeholders are informed of, and involved as appropriate with, 9-1-1 State office activities. In addition, the expertise of committee members should be used by the State 9-1-1 office for planning and implementation purposes. Last, States may want to consider granting the committee mediation or dispute resolution authority with regard to local 9-1-1 planning and oversight disputes.</p>	<p>§56-484.13. E-911 Services Board; membership; terms; compensation.</p> <p>A. The Wireless E-911 Services Board is hereby continued as the E-911 Services Board. The Board shall plan, promote and offer assistance:</p> <p>1. In the statewide development, deployment, and maintenance of enhanced wireless emergency telecommunications services and technologies; and The Board shall exercise the powers and duties conferred in this article.</p> <p>B. The E-911 Services Board may promote and offer planning assistance:</p> <p>1. In the statewide development, deployment, and maintenance of VoIP E-911 and any other future communications technologies accessing E-911 for emergency purposes;</p> <p>2. To the Virginia Information Technologies Agency (VITA), and other stakeholder agencies, in the development and deployment of a statewide public safety network that will support future E-911 and other public safety applications;</p>
<p>MCP Comment: The Commonwealth may want to consider granting the advisory committee mediation or dispute resolution authority with regard to local 9-1-1 planning and oversight disputes, particularly if technical and operational standards are developed. No change to statute is required to meet national guidelines.</p>	

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I.C.3. State 9-1-1 Advisory Committee Annual Report (SR 13)	
National 911 Office Legislative Guidance	Current Statute Language
The annual report of the State 9-1-1 Advisory Committee should be made available to the public.	§56-484.14 . Powers and duties of E-911 Services Board, Paragraph 6: Report annually to the Governor, the Senate Committee on Finance and the House Committee on Appropriations, and the Virginia State Crime Commission on (i) the state of enhanced 9-1-1 services in the Commonwealth, (ii) the impact of, or need for, legislation affecting enhanced 9-1-1 services in the Commonwealth, and (iii) the need for changes in the E-911 funding mechanism provided to the Board, as appropriate.
MCP Comment: An annual report to the Governor is required. There is no specific mention that the annual report will be made available to the public or distributed to the public in any way. However, by virtue of it being a government-produced document, it becomes public record in the Commonwealth. No change to current statute is needed.	

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I.D. Regional and Local 9-1-1 Authorities (SR 3)	
National 911 Office Legislative Guidance	Current Statute Language
<p>Legislation should clarify the role and authority of local and regional 9-1-1 authorities, clearly delineating the shared responsibilities for 9-1-1 among State, regional, and local entities. Regional networks of interconnecting systems may develop, involving groups of PSAPs and supporting regional 9-1-1 authorities. PSAPs will likely remain responsible for local operational decisions, including staffing, call-taking, and emergency response. Local and regional entities may provide funding, administrative and functional support to PSAPs.</p> <p>Definition of “9-1-1 system” should be included in legislation.</p>	<p>While the current responsibility for implementing 9-1-1 on a local basis is understood, and practiced, there is no specific language in current statute that clearly declares this authority resides with the local jurisdiction. Consideration should be given, as other statute changes are also considered, to a declarative statement related to the local jurisdiction having responsibility for 9-1-1 call answering and response delivery.</p> <p>§56-487 – Definitions (6) “System” shall mean and include any plant, works, system, facilities, or properties, or any part or parts thereof, together with all appurtenances thereto, used or useful in connection with the transmission of voice, video or data.</p> <p>§56-484.12. Definitions. “Enhanced 9-1-1 service” or “E-911” means a service consisting of telephone network features and PSAPs provided for users of telephone systems enabling such users to reach a PSAP by dialing the digits “9-1-1.” Such service automatically directs 9-1-1 emergency telephone calls to the appropriate PSAPs by selective routing based on the geographical location from which the emergency call originated and provides the capability for ANI and ALI features.</p>
<p>MCP Comment: There is no language currently in statute that refers to local or regional 9-1-1 authorities, or any shared responsibilities for 9-1-1 among State, regional or local entities. The definition of a “system,” however, is consistent with national guidelines. A revision to statute may want to specifically define state, regional and local responsibilities or demarcation of authority especially as more regional approaches to NG9-1-1 will be considered.</p>	

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I.E. Roles of other government entities involved in 9-1-1 (SR 1)	
National 911 Office Legislative Guidance	Current Statute Language
Legislation should identify the authority and responsibility between the State 9-1-1 office and other State agencies that may have a vested interest, e.g., public utilities commissions, information technology departments, emergency management agencies and public safety departments. ¹⁴²	<p>§56-484.13. B.: The E-911 Services Board may promote and offer planning assistance:</p> <ol style="list-style-type: none">1. In the statewide development, deployment, and maintenance of VoIP E-911 and any other future communications technologies accessing E-911 for emergency purposes;2. To the Virginia Information Technologies Agency (VITA), and other stakeholder agencies, in the development and deployment of a statewide public safety network that will support future E-911 and other public safety applications;
<p>MCP Comment: There is no specific language currently in statute that identifies authority or responsibility between the PSC 9-1-1 office and other state agencies, but the language allows for the promotion of and planning assistance to VITA, and other stakeholder agencies as appropriate for the purposes of 9-1-1. In addition, officers of the E-911 Services Board are designated from other state agencies (e.g., the chair of the E-911 Services Board is the Emergency Management Director, the secretary is the state CIO, and the Treasurer is the state Comptroller, etc.) In other areas of statute, other agencies are responsible for activities related to the 9-1-1 system such as the State Department of Finance’s responsibility for collection and management of the 9-1-1 portion of the Communications Tax. A revision to statute may want to specifically define state, regional and local responsibilities or demarcation of authority especially as more regional approaches to NG9-1-1 will be considered.</p> <p>If MCP’s recommendations and proposed changes to the Board are adopted for its role in NG9-1-1, references to the specific chair position, appointment authority for recommended new Board positions and other necessary changes to statute to enact the changes will be required.</p>	

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¹⁴² See Section II.A. For more details and discussion regarding coordination with other State entities.



II. Role of State 9-1-1 Office

II.A. Planning and Coordination (SR 1)	
National 911 Office Legislative Guidance	Current Statute Language
Legislation should facilitate State level coordination of 9-1-1 service networks statewide. The State 9-1-1 office should have the authority to coordinate 9-1-1 service networks that include local, regional, and statewide systems. The authority to coordinate with tribal, Federal and military systems should also be considered as needed and as it may already exist under State statute.	<p>§56-484.13. B.: The E-911 Services Board may promote and offer planning assistance:</p> <ol style="list-style-type: none">1. In the statewide development, deployment, and maintenance of VoIP E-911 and any other future communications technologies accessing E-911 for emergency purposes;2. To the Virginia Information Technologies Agency (VITA), and other stakeholder agencies, in the development and deployment of a statewide public safety network that will support future E-911 and other public safety applications;
MCP Comment: The current statute refers to the roles and responsibilities of the E-911 Services Board and VITA to carry out the mission of the Board, which is limited to wireless and future technologies. It allows that the Board “may promote” statewide development and deployment of next generation technologies. The role of the state is passive and allows, but does not require or explicitly state, the function that is desired in this guideline. Future iterations of statute should designate the E-911 Services Board as the authority that coordinates all 9-1-1 service types and networks statewide that include local, regional, and statewide systems and, if appropriate, federal, military or tribal systems that impact the Virginia system.	

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II.A.1. Statewide 9-1-1 Plan (SR 1)	
National 911 Office Legislative Guidance	Current Statute Language
<p>The State 9-1-1 entity should have explicit authority to coordinate and oversee the development and implementation of a State Plan for emergency 9-1-1 communications. Issues to be addressed by a State Plan should include the development of statewide emergency 9-1-1 networks, coordination with neighboring States, and the adoption of industry standards and requirements, and best practices. Coordination with an extended group of stakeholders is necessary, at State, regional, and local levels. A model State 9-1-1 plan was developed by the National Association of State 9-1-1 Administrators as a resource for States...and may be used as a reference as State legislation is developed.</p>	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 3: Develop a comprehensive, statewide enhanced 9-1-1 plan for wireless E-911, VoIP E-911, and any other future communications technologies accessing E-911 for emergency purposes. In constructing and periodically updating this plan as appropriate, the Board shall monitor trends and advances in enhanced wireless, VoIP, and other emergency telecommunications technologies, plan and forecast future needs for these enhanced technologies, and formulate strategies for the efficient and effective delivery of enhanced 9-1-1 services in the future with the exclusion of traditional circuit-switched wireline 9-1-1 service.</p>
<p>The State plan should clearly address State, regional, and local roles in the control of all aspects of the statewide 9-1-1 system. Liability and jurisdictional demarcations should be clearly identified.</p>	<p>None</p>
<p>The State plan should also include quality of service requirements to specify uniform, minimum levels of 9-1-1 service that should be consistently provided across the State.</p>	<p>None</p>
<p>State-level functions and services may include such items as GIS data sources shared by PSAPs or the operation of a statewide emergency services IP network.</p>	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 9. Develop a comprehensive single, statewide electronic addressing database to support geographic data and statewide base map data programs pursuant to §2.2-2027.</p>
<p>MCP Comment: Portions of the statute address this guideline adequately. Other areas, such as clearly addressing State, regional, and local roles in the control of all aspects of the statewide 9-1-1 system, or liability and jurisdictional issues and minimum service levels are not addressed. Future legislation and/or rules should include defined roles for local and regional entities as well as liability protections and minimum acceptable services levels statewide.</p>	



II.A.2. Stakeholder involvement (SR 1)	
National 911 Office Legislative Guidance	Current Statute Language
<p>The State 9-1-1 office will benefit from the explicit authority to convene and coordinate 9-1-1 efforts among public partners at the State level, tribal and/or local governments and PSAPs, 9-1-1 authorities, regional stakeholder coalitions, and private sector services providers (wireline, wireless, VoIP, Internet, point-of-sale retailers, etc.). Such coordination may involve planning processes as well as infrastructure development, and resource sharing and management.</p>	<p>§2.2-2031. Division of Public Safety Communications established; appointment of Virginia Public Safety Communications Coordinator; duties of Division.</p> <p>A. There is established within VITA a Division of Public Safety Communications (the Division), which shall be headed by a Virginia Public Safety Communications Coordinator, appointed by the CIO with the advice and consent of the E-911 Services Board. The Division shall consist of such personnel as the CIO deems necessary. The operating expenses, administrative costs, and salaries of the employees of the Division shall be paid from the Wireless E-911 Fund created pursuant to §56-484.17.</p> <p>B. The Division shall provide staff support to the E-911 Services Board and encourage, promote, and assist in the development and deployment of statewide enhanced emergency telecommunications systems.</p> <p>C. The Board shall consist of 15 members as follows: the Director of the Virginia Department of Emergency Management, who shall serve as chairman of the Board; the Comptroller, who shall serve as the treasurer of the Board; the Chief Information Officer; and the following 12 members to be appointed by the Governor: one member representing the Virginia State Police, one member representing a local exchange carrier providing E-911 service in Virginia, two members representing wireless service providers authorized to do business in Virginia, three county, city or town PSAP directors or managers representing diverse regions of Virginia, one Virginia sheriff, one chief of police, one fire chief, one emergency medical services manager, and one finance officer of a county, city, or town.</p>
<p>MCP Comment: VoIP and prepaid could certainly be interpreted to be represented or potentially represented in the Wireless category and as the recommendation suggests as technical advisors. VITA will have to determine if Tribal representation is necessary to address the concerns of that community of interest either as a voting member or as an ex officio member or technical advisor.</p>	



II.A.3. Review proposed legislation affecting 9-1-1 (SR 2, SR 13)

National 911 Office Legislative Guidance	Current Statute Language
<p>The expertise of the State 9-1-1 office should be a valuable resource to State legislators during legislative sessions for any issues related to or affecting 9-1-1 including 9-1-1 system operations, jurisdictional roles and responsibilities and funding needs.</p>	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 6: Report annually to the Governor, the Senate Committee on Finance and the House Committee on Appropriations, and the Virginia State Crime Commission on (i) the state of enhanced 9-1-1 services in the Commonwealth, (ii) the impact of, or need for, legislation affecting enhanced 9-1-1 services in the Commonwealth, and (iii) the need for changes in the E-911 funding mechanism provided to the Board, as appropriate.</p>
<p>MCP Comment: Current statute is consistent with national guidelines for the 9-1-1 service types under the jurisdiction of the E-911 Services Board (wireless, VoIP and future technologies). A change to the statute is needed to enhance the role of the Board and allow its authority over a statewide 9-1-1 system and those network elements or standards that are statewide in nature.</p>	

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II.A.4. Cooperation with State functions as related to 9-1-1 (SR 3)	
National 911 Office Legislative Guidance	Current Statute Language
The State 9-1-1 office should coordinate and collaborate with State and regional public sector entities with functional responsibilities affecting 9-1-1. This may involve planning, rulemaking, contracting, resource sharing, etc. ¹⁴³	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 3: Develop a comprehensive, statewide enhanced 9-1-1 plan for wireless E-911, VoIP E-911, and any other future communications technologies accessing E-911 for emergency purposes. In constructing and periodically updating this plan as appropriate, the Board shall monitor trends and advances in enhanced wireless, VoIP, and other emergency telecommunications technologies, plan and forecast future needs for these enhanced technologies, and formulate strategies for the efficient and effective delivery of enhanced 9-1-1 services in the future with the exclusion of traditional circuit-switched wireline 9-1-1 service.</p> <p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 7: Provide advisory technical assistance to PSAPs and state and local law enforcement, and fire and emergency medical service agencies, upon request.</p>
MCP Comment: There are a number of references to the coordination role that the E-911 Services Board plays in the Commonwealth to plan and formulate strategies for future needs; there is no specific reference to coordination, collaboration or consultation with local or regional entities. Going forward, a redraft of statute should include the Board's requirement to collaborate with other state agencies and regional public sector entities with functional responsibilities affecting 9-1-1 as part of their strategy and planning development.	

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¹⁴³ See Section II.B.2 for more discussion of rulemaking coordination.



II.A.5. Cooperation with vendors and local governments as related to 9-1-1 (SR 7)	
National 911 Office Legislative Guidance	Current Statute Language
<p>The State 9-1-1 office should coordinate and collaborate with all entities involved in the implementation and operation of the 9-1-1 system, from local and regional PSAPs, to local governments, to private vendors, to emergency services providers. This will likely involve planning, contracting, resource sharing, etc.</p>	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 3: Develop a comprehensive, statewide enhanced 9-1-1 plan for wireless E-911, VoIP E-911, and any other future communications technologies accessing E-911 for emergency purposes. In constructing and periodically updating this plan as appropriate, the Board shall monitor trends and advances in enhanced wireless, VoIP, and other emergency telecommunications technologies, plan and forecast future needs for these enhanced technologies, and formulate strategies for the efficient and effective delivery of enhanced 9-1-1 services in the future with the exclusion of traditional circuit-switched wireline 9-1-1 service.</p> <p>§5.1-35 Powers may be exercised jointly by two or more political subdivisions.</p> <p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 12: Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.</p>
<p>MCP Comment: As stated in the previous comment, there are a number of references to the coordination role of the E-911 Services Board to plan for the future needs of 9-1-1 in the Commonwealth. Any revisions to the statute to prepare for NG9-1-1 services should include the Board's requirement to collaborate with local and regional PSAPs, local governments, private vendors, or emergency services providers as part of their planning effort.</p>	

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II.B. 9-1-1 Operations (SR 7)	
National 911 Office Legislative Guidance	Current Statute Language
As States move into NG9-1-1 implementation, the State 9-1-1 entity will require the explicit authority to coordinate the establishment and operation of intrastate 9-1-1 communication networks, as identified in the State Plan, and coordinate with neighboring States and countries, as appropriate. This authority should support the transition from traditional 9-1-1 services to IP network-based services, and be inclusive of existing and emerging technologies. A mechanism for coordinating, or sharing this authority, with other State and regional public sector agencies will be necessary to most effectively implement these networks.	§56-484.14. Powers and duties of E-911 Services Board, Paragraph 12: Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.
MCP Comment: The authority to undertake the coordination, establishment, and operation of intrastate 9-1-1 communication networks, as identified in the Commonwealth Plan, and coordinate with neighboring states is implicit rather than explicit. MCP does not think this is necessary to change to meet the national guidelines. However, it may be in VITA's and the E-911 Services Board's best interests, and in the best interest of 9-1-1 service in the Commonwealth, to explicitly state that they have this authority in order to protect their authority to undertake this responsibility. A statement to that effect should be included in the duties and responsibilities of the E-911 Services Board in updated statute language.	

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II.B.1. Implementation of State Plan (SR 1)	
National 911 Office Legislative Guidance	Current Statute Language
Legislation authorizing the 9-1-1 State office to conduct specific administrative and operational activities will ensure that the office has the necessary State powers to implement the State 9-1-1 plan.	<p>§2.2-2031. Division of Public Safety Communications established; appointment of Virginia Public Safety Communications Coordinator; duties of Division.</p> <p>A. There is established within VITA a Division of Public Safety Communications (the Division), which shall be headed by a Virginia Public Safety Communications Coordinator, appointed by the CIO with the advice and consent of the E-911 Services Board. The Division shall consist of such personnel as the CIO deems necessary. The operating expenses, administrative costs, and salaries of the employees of the Division shall be paid from the Wireless E-911 Fund created pursuant to §56-484.17.</p> <p>B. The Division shall provide staff support to the E-911 Services Board and encourage, promote, and assist in the development and deployment of statewide enhanced emergency telecommunications systems.</p>
MCP Comment: Current statute is not fully consistent with national guideline criteria definition of a statewide system, which includes all 9-1-1 service types. A change to statute is needed.	

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II.B.2. Identify or develop and adopt 9-1-1 related regulations (SR 1)

National 911 Office Legislative Guidance	Current Statute Language
<p>State legislation should grant the State 9-1-1 office the authority to adopt rules to implement its coordination and oversight responsibilities, in accordance with existing State rulemaking processes.</p> <p>In some cases rulemaking authority may rest with other State or regional rulemaking authorities, including Public Utility Commissions and State chief information officers.</p> <p>Rulemaking authority is provided to specific State agencies and delineated according to the specific issue requiring regulation. For example, PUCs typically retain rulemaking authority affecting telecommunications providers; chief Information officers typically oversee rulemaking as it relates to information technology service providers. In addition, other State entities may oversee rulemaking with regard to record retention, employee training, and professional certifications. These entities will be critical stakeholders in 9-1-1 and will likely be involved in rulemaking that affects 9-1-1. The shared rulemaking responsibilities of these State and regional entities with regard to 9-1-1 should be clarified within State processes.</p>	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 12: Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.</p> <p>State of Virginia State Corporation Commission, Division of Communications Authority: §12.1-13. Commission to have powers of court of record; rules and regulations; fines.</p> <p>In all matters within the jurisdiction of the Commission, it shall have the powers of a court of record to administer oaths, to compel the attendance of witnesses and the production of documents, to punish for contempt, and to enforce compliance with its lawful orders or requirements by adjudging and enforcing by its own appropriate process such fines or other penalties as may be prescribed or authorized by law.</p> <p>In the administration and enforcement of all laws within its jurisdiction, the Commission shall have the power to promulgate rules and regulations, to impose and collect such fines or other penalties as are provided by law, to enter appropriate orders, and to issue temporary and permanent injunctions. The Commission is empowered to suspend or revoke any Commission-issued license, certificate, registration, permit, or any other Commission-issued authority of any person who fails to satisfy any fine or penalty imposed by an order of the Commission.</p>
<p>MCP Comment: Existing statute is silent on rules and regulations specifically for 9-1-1. However, the State of Virginia SCC does have authority to adopt such rules. Since rules and regulations interpreting statute have the full force and effect of law, the statute should be changed to stipulate that the E-911 Services Board can adopt rules and should provide for local and regional stakeholders to be part of or consulted on the rulemaking process that impacts the provision of 9-1-1 service. The shared rulemaking responsibilities of these State and regional entities with regard to 9-1-1 should be clarified within statute.</p>	



II.B.3. Interlocal and interstate contracts and agreements (SR 7)	
National 911 Office Legislative Guidance	Current Statute Language
The State 9-1-1 office should have the explicit authority to coordinate 9-1-1 efforts with neighboring States, countries, and/or the Federal government. This authority should permit the State 9-1-1 office to enter into Federal, interlocal, and interstate contracts and agreements. For example, the State may apply for loans from the U.S. Department of Agriculture's Rural Utilities Program, for the purpose of building a new facility to co-locate with transportation management.	<p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 12: Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.</p> <p>§56-484.14. Powers and duties of E-911 Services Board, Paragraph 1: Make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers, including purchase agreements payable from (i) the Wireless E-911 Fund and (ii) other moneys appropriated for the provision of enhanced 9-1-1 services.</p>
MCP Comment: Current statute adequately addresses this; no change to statute is necessary.	

II.B.4. Contracting authority (SR 9)	
National 911 Office Legislative Guidance	Current Statute Language
The State 9-1-1 office will require explicit authority to procure services and contract with public and private entities to support coordinated State Plan implementation, in accordance with existing State procurement processes.	§56-484.14. Powers and duties of E-911 Services Board, Paragraph 1: Make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers, including purchase agreements payable from (i) the Wireless E-911 Fund and (ii) other moneys appropriated for the provision of enhanced 9-1-1 services.
MCP Comment: Explicit authority exists, but only for those items payable from the wireless fund. Future statute changes should include language that explicitly gives the Board authority to procure services and contract for services for statewide systems/networks.	

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II.B.5. Technical assistance to PSAPs, 9-1-1 authorities and other public safety entities

National 911 Office Legislative Guidance	Current Statute Language
<p>As part of its statutory responsibility, the State 9-1-1 office should be required to coordinate its activities with 9-1-1 and public safety entities. Within that context, the office should have the responsibility and authority to provide technical assistance to such organizations for the sake of effective Statewide 9-1-1 operations.</p>	<p>§56-484.14. Powers and duties of the E-911 Services Board, Paragraph 7: Provide advisory technical assistance to PSAPs and state and local law enforcement, and fire and emergency medical service agencies, upon request.</p>
<p>MCP Comment: Current statute does not provide that the E-911 Services Board is <u>required</u> to coordinate with local or regional entities on its activities or the 9-1-1 Plan. The Board has authority to provide technical assistance so the spirit of the national guideline is included currently. A more explicit statement of coordination and collaboration with local entities would further the Commonwealth’s compliance with this guideline.</p>	

II.B.6. Grant making authority

National 911 Office Legislative Guidance	Current Statute Language
<p>The State 9-1-1 office should have the authority to develop, implement and oversee a State 9-1-1 grant program to provide 9-1-1 grants to local and regional entities to implement NG9-1-1, as appropriate, within the State’s funding environment. Such a grant program could be used to address equity issues among PSAPs.</p>	<p>§56-484.17. Wireless E-911 Fund; uses of Fund; enforcement; audit required</p> <p>C...The remaining 10 percent of the Fund and any remaining funds for the previous fiscal year from the 30 percent for CMRS providers shall be distributed to PSAPs or on behalf of PSAPs based on grant requests received by the Board each fiscal year. The Board shall establish criteria for receiving and making grants from the Fund, including procedures for determining the amount of a grant and payment schedule; however, the grants must be to the benefit of wireless E-911. Any grant funding that has not been committed by the Board by the end of the fiscal year shall be distributed to the PSAPs based on the same distribution percentage used during the fiscal year in which the funding was collected; however, the Board may retain some or all of this uncommitted funding for an identified funding need in the next fiscal year.</p>
<p>MCP Comment: The E-911 Services Board has the authority and administers a grant program within the specific confines of the use of the wireless E-911 fund. Consistent with national guidelines. No change to statute is required; however, depending on the definition of CMRS, the Board may desire to expand their ability to utilize funds from all sources. Also, the Board may want to amend the statute (“...the grants must be to the benefit of wireless E-911”) to allow for the use of the funds for any statewide 9-1-1 related initiative.</p>	



II.B.7. Accepting grants and gifts	
National 911 Office Legislative Guidance	Current Statute Language
State legislation should enable the State 9-1-1 office to pursue, accept, implement, and/or manage Federal and private grant funds and financial gifts, within the parameters of the 9-1-1 State plan, in accordance with existing State law, constitutional authority and State policies.	<p>§56-484.14. Paragraph 10: Receive such funds as may be appropriated for purposes consistent with this article and such gifts, donations, grants, bequests, or other funds as may be received from, applied for or offered by either public or private sources.</p> <p>§56-484.13. Paragraph 3: However, the Board shall seek funding from sources other than CMRS providers or customers of CMRS to support efforts that exceed the scope of wireless E-911 service.</p>
MCP Comment: Statute is consistent with national guidelines. The E-911 Services Board is able to pursue grants and receive grants. No change to statute is required.	

II.B.8. Data collection and distribution (SR 23 & 24)	
National 911 Office Legislative Guidance	Current Statute Language
Data from all stages of a 9-1-1 response will be collected and maintained, from the initiation of a 9-1-1 call to incident resolution. The availability of this information provides an opportunity to identify the strengths and weaknesses of points within the 9-1-1 response system, and improve overall 9-1-1 service provision. In order to monitor and analyze local, regional, and State 9-1-1 response trends and issues, the State 9-1-1 office should have the authority to collect, analyze, share, and disseminate aggregate data from PSAPs and service providers, and to collect and aggregate 9-1-1 response related data for the purposes of improving and maintaining the quality of 9-1-1 service. These data should be protected in accordance with existing State statutes.	<p>Data collection is not addressed in the current 9-1-1 statute; however, §56-484.14. 12: states: <i>“Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.”</i></p> <p>Also, records retention (9-1-1 calls are a part of official government records) is addressed in 200163 and 200164 of GS-17. Under <i>Code of Virginia §42.1-85</i>, the LVA has the authority to issue regulations governing the retention and disposition of state and local public records.</p>
MCP Comment: In the existing 9-1-1 statute there is no specific reference to data collection or maintenance of 9-1-1 call data. In the next revision of the statute, the Board should consider inclusion of text such as is suggested by the national guidelines: the “authority to collect, analyze, share, and disseminate aggregate data from PSAPs and service providers, and to collect and aggregate 9-1-1 response related data for the purposes of improving and maintaining the quality of 9-1-1 service.”	



II.B.9. Public Safety and interstate coordination (SR 7)	
National 911 Office Legislative Guidance	Current Statute Language
Implementation and operation of an NG-1-1 [sic] system will require coordination, communication and information sharing among 9-1-1 authorities as well as public safety and homeland security agencies. Legislation granting the State 9-1-1 office authority to participate in and coordinate efforts with other public safety groups and agencies will facilitate the effective information sharing processes and the pursuit of common solutions for issues related to implementation and operation.	§56-484.14 . Paragraph 12: Perform all acts necessary, convenient or desirable to carrying out the purposes of this article.
MCP Comment: Changes to statute should be considered to bring the statute in compliance with national guidelines such as specifically granting the E-911 Services Board or VITA the authority to coordinate and facilitate information sharing among 9-1-1 authorities in the Commonwealth, as well as with public safety agencies and the Homeland Security Agency.	

II.C.1. Statewide 9-1-1 System (SR 12)	
National 911 Office Legislative Guidance	Current Statute Language
Legislation should ensure that the State 9-1-1 office has the authority to define and require specific outcomes and levels of service, such as call response times, data sharing capabilities, etc. (a) Network design standards and requirements need to ensure that local and regional 9-1-1 networks can communicate with each other and share information seamlessly...	§56-484.14 . Paragraph 13: Drawing from the work of E-911 professional organizations, in its sole discretion, publish best practices for PSAPs. These best practices shall be voluntary and recommended by a subcommittee composed of PSAP representatives.
MCP Comment: Redraft of legislation going forward should establish the authority of the Board to define and require specific outcomes and levels of service, such as call response times, data sharing capabilities, etc. Network design standards, interconnection to the NG9-1-1 network, and requirements to ensure that local and regional 9-1-1 networks can communicate with each other and share information seamlessly should be considered.	

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II.C.2. Confidentiality and recordkeeping (SR 25)	
National 911 Office Legislative Guidance¹⁴⁴	Current Statute Language
<p>While some portions of 9-1-1 data should be confidential in all states to avoid re-victimization, states should have leeway to establish their own rules. At a minimum, personally identifiable information should be protected, although more comprehensive protection of 9-1-1 records is desirable.</p> <p>The statutory environment should provide for the confidentiality and disclosure of automatic number identification/automatic location identification (ANI/ALI) data, 9-1-1 voice calls, and multimedia. Regulatory provisions, tariffs, confidentiality agreements, vendor non-disclosure agreements (NDAs), access to public records laws, and Health Insurance Portability and Accountability Act (HIPAA) may also be considered in this guideline. Different types of data and their use should be reviewed, such as information provided to the first responders that could be misused. In an NG9-1-1 environment, more personal data, such as medical or accident information, may be relayed to a PSAP. Therefore, issues relating to confidentiality and disclosure will become more important.</p> <p>Aggregated anonymous data can be provided in real-time to governmental, non-governmental and private entities for legitimate purposes. NENA's Next Generation Partner Program (NGPP) transition policy handbook addresses confidentiality and disclosure in terms of the concept of pieces of 9-1-1 call data sent to off-site locations, such as a central database. Data can be sent and archived anywhere in a NG9-1-1 environment.</p>	<p>§2.2-3706. Disclosure of criminal records; limitations.</p> <p>C. Records of any call for service or other communication to an emergency 911 system or communicated with any other equivalent reporting system shall be subject to the provisions of this chapter.</p> <p>§2.2-3705.2., Paragraph10: Subscriber data, which for the purposes of this subdivision, means the name, address, telephone number, and any other information identifying a subscriber of a telecommunications carrier, provided directly or indirectly by a telecommunications carrier to a public body that operates a 911 or E-911 emergency dispatch system or an emergency notification or reverse 911 system, if the data is in a form not made available by the telecommunications carrier to the public generally. Nothing in this subdivision shall prevent the release of subscriber data generated in connection with specific calls to a 911 emergency system, where the requester is seeking to obtain public records about the use of the system in response to a specific crime, emergency or other event as to which a citizen has initiated a 911 call.</p> <p>§2.2-3705.2. Exclusions to application of chapter; records relating to public safety. Paragraph11: Subscriber data, which for the purposes of this subdivision, means the name, address, telephone number, and any other information identifying a subscriber of a telecommunications carrier, collected by a local governing body in accordance with the Enhanced Public Safety Telephone Services Act (§56-484.12 et seq.), and other identifying information of a personal, medical, or financial nature provided to a local governing body in connection with a 911 or E-911 emergency dispatch system or an emergency notification or reverse 911 system, if such records are not otherwise publicly available. Nothing in this subdivision shall prevent the release of subscriber data generated in connection with specific calls to a 911 emergency system, where the requester is seeking to obtain public records about the use of the system in response to a specific crime, emergency or other event as</p>

¹⁴⁴ Legislative guidance for this section is taken from the *National 9-1-1 Guidelines Assessment* report, Guideline SR25.



	<p>to which a citizen has initiated a 911 call.</p> <p>§2.2-3705.6. Exclusions to application of chapter; proprietary records and trade secrets. GOVERNS TRADE SECRET AND PROPRIETARY RECORDS.</p>
MCP Comment: Consistent with national guidelines. No change to statute is required.	

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II.C.3. Performance-based regulations (technology neutral)

National 911 Office Legislative Guidance	Current Statute Language
<p>State legislation should require that 9-1-1 related regulatory language be performance-based and technology neutral. Performance-based language is language that focuses on the functionality and/or outcome of a service or tool, rather than the service or the tool itself, which is simply used to achieve an outcome. Consideration should include but not be limited to emerging technology and its related potential cost savings, while taking into account the embedded costs of current systems.</p> <p>Much of the existing State regulatory language relating to 9-1-1 is specific to telecommunications service providers, and is often promulgated by the State Public Utilities Commission. This specific language is directly related to the fact that telecommunications service providers were at one time the exclusive providers of access to 9-1-1 services. In addition, regulatory language may refer to specific types of equipment or technology components that, while applicable to some services and providers, may not be applicable to all, or may not be the most effective in the NG9-1-1 environment. This technology-specific language limits the ability of States to maximize the potential of advancing technology and may force the continued operation of obsolete technology. Rather than use language that specifies the type of service provided, or type of technology component to be used, States may consider regulations that use performance-based language, focusing on the outcome to be provided by the service or technology. In this manner, future technology advances may be more smoothly incorporated into the regulatory environment without requiring further modifications.</p> <p>In addition to limiting the State's ability to use advancing technology to implement NG9-1-1 and other emerging technologies, outdated, technology-specific regulations unintentionally limit competition, disallowing other types of service providers, or technology solutions, to compete in the 9-1-1 services marketplace. As States move to NG9-1-1 and other emerging technologies, where 9-1-1 service provision will occur through emergency services networks,</p>	



using a variety of software and database technologies, regulations should be performance-based.	
MCP Comment: The current statute contains language that allows the E-911 Services Board to consider future technologies impacting or which will be part of a next generation service in the Commonwealth. However, the statute legislation should require that 9-1-1 related regulatory language be performance-based and technology neutral. Any rewrite of statute should consider the recommended national guideline language.	

II.C.4. Compliance with legal requirements	
National 911 Office Legislative Guidance	Current Statute Language
The State 9-1-1 office should have the authority to address and ensure compliance with relevant Federal data sharing requirements, such as the American with Disabilities Act and the Health Insurance Portability and Accountability Act, and other similar legal issues affecting 9-1-1.	§ 56-484.14 . Paragraph 13: Drawing from the work of E-911 professional organizations, in its sole discretion, publish best practices for PSAPs. These best practices shall be voluntary and recommended by a subcommittee composed of PSAP representatives.
MCP Comment: While the current statute allows for the E-911 Services Board to publish effective practices and encourage Commonwealth PSAPs to comply with those “best” practices, there is nothing explicit in the statute that suggests the Board should “ensure compliance with relevant Federal data sharing requirements.” When a redraft of the statute is initiated, the Board should consider stronger statements as suggested in the national guideline.	

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II.C.5. 9-1-1 Database and System Security

National 911 Office Legislative Guidance	Current Statute Language
<p>NG9-1-1 systems will involve IP network infrastructure and critical supporting database functions. Security of those functions will be a paramount priority. A State entity will have rulemaking authority regarding 9-1-1 database and system security. The State 9-1-1 office should coordinate with that entity in the identification, adoption and application of industry standards and requirements regarding database and system security. These standards and requirements shall address local, regional, and State emergency network security issues, system capabilities related to role-based access controls and data rights management and emergency network system security testing protocols, as well as other relevant information security issues.</p>	<p><i>See Commonwealth of Virginia, Information Security Management Standard, SEC501-08, April 3, 2014.</i></p>
<p>MCP Comment: The Commonwealth has an extensive and comprehensive Information Security Standard that covers all aspects of network security. If the Commonwealth owns/operates an NG9-1-1 network, or any portion of a network used for 9-1-1 services, this standard will apply. Any local or regional network that touches the state network should also be required to follow this Information Security Standard. Any vendor or service provider that is employed in providing NG9-1-1 should also be required to comply with this standard.</p> <p>The Standard defines the minimum acceptable level of information security and risk management activities for Commonwealth of Virginia agencies that must be implemented in an information security program. Agencies may develop their own information security standards, based on needs specific to their environments. The Standard was created using the National Institute of Standards and Technology (NIST) Special Publication 800-53 rev. 3, Recommended Security Controls for Federal Information Systems and Organizations, as a framework. 9-1-1 rules should ensure that all aspects of the NG9-1-1 network(s) or services comply with the <i>Information Security Management Standard, SEC501-08, April 3, 2014.</i></p>	

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II.D. Quality Assurance (SR 16 & 17)	
National 911 Office Legislative Guidance	Current Statute Language
<p>The State 9-1-1 entity should be subject to the same quality assurance and improvement processes as other executive branch entities, and should implement internal quality assurance policies and processes. Such processes may involve the development and implementation of performance-based benchmarks, measured and reported at regular intervals. For example, the State 9-1-1 entity may measure and report the percentage of time the wireline ALI (automatic location identification) system is operational on a monthly basis. Any quality assurance and improvement processes should be conducted with similar legal protections as compared with other executive branch quality assurance and improvement processes.</p> <p>Similarly, the State 9-1-1 entity should encourage and support similar efforts at regional and local levels. For example, local PSAPs may be encouraged, or required, to set performance-based benchmarks related to call handling.</p> <p>In addition, the State should be responsible for the establishment and implementation of 9-1-1 network performance testing protocols, to ensure that 9-1-1 and NG9-1-1 networks function as intended, with appropriate security protections. The State entity with such authority must coordinate with the State 9-1-1 entity.</p>	
<p>MCP Comment: No performance standards exist. The E-911 Service Board has not established metrics or performance criteria for the network or for 9-1-1 operations. With the implementation of NG9-1-1 services, the Board should consider its role in developing performance-based benchmarks related to call handling to help ensure equal quality service throughout the Commonwealth. In addition, the Board should consider to what degree the Commonwealth should be responsible for the establishment and implementation of technical standards, 9-1-1 network performance requirements, functionality standards, and testing protocols.</p>	



II.E. 9-1-1 Related Public Education (SR 22)	
National 911 Office Legislative Guidance	Current Statute Language
As changes to 9-1-1 capabilities are implemented, the State 9-1-1 office may be best-positioned to coordinate, encourage and support 9-1-1 public education efforts.	§56-484.14 . Paragraph 5: Take all steps necessary to inform the public of the use of the digits “9-1-1” as the designated emergency telephone number and the use of the digits “#-7-7” as a designated non-emergency telephone number.
MCP Comment: Authority to inform the public is provided as a power and duty of the E-911 Services Board. No modification to statute is needed.	

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Appendix H – Legislation Links by State

State	State Code	State 911 Program Name	URL Link to 911 Enabling Legislation	URL Link to Rules/Regulations
Alabama	AL	Alabama 911 Board	http://alisondb.legislature.state.al.us/acas/CodeOfAlabama/1975/11-98-1.htm	http://al911board.com/rules
Alaska	AK	Alaska Department of Public Safety	http://www.touchngo.com/lglcntr/akstats/Statutes/Title29/Chapter35/Section130.htm	http://www.legis.state.ak.us/basis/folioproxy.asp?url=http://www.jnu01.legis.state.ak.us/cgi-bin/folioisa.dll/aac/query=911/doc/{@1}?firsthit
Arizona	AZ	State of Arizona Department of Administration	https://aset.az.gov/sites/default/files/documents/files/9-1-1%20Title%202%20Chapter%201%20Article%204%20R2-1-401_R2-1-411.pdf	http://www.azsos.gov/public_services/Title_14/14-02.htm#ARTICLE_5
Arkansas	AR	Commercial Mobile Radio Services (CMRS) Board	http://www.lexisnexis.com/hottopics/arcode/Default.asp	http://170.94.37.152/REGS/217.00.09-001F-10603.pdf
California	CA	State of California, California 9-1-1 Emergency Communications	http://www.weblaws.org/california/codes/ca_gov't_section_53100	http://www.cpuc.ca.gov/PUC/telco/
Colorado	CO	Colorado 911 Resource Center	https://sites.google.com/site/co911rc/resources	http://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=5843&fileName=4%20CCR%20723-2
Connecticut	CT	State of CT, Department of Emergency Services and Public Protection	http://www.ct.gov/despp/cwp/view.asp?a=4379&Q=515110&desppNav_GID=2125	http://www.ct.gov/despp/cwp/view.asp?a=4379&Q=515110&desppNav_GID=2125
Delaware	DE	State of Delaware	http://e911.delaware.gov/laws-rules.shtml	http://e911.delaware.gov/laws-rules.shtml
Florida	FL	Department of Management Services	http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&URL=Ch0365/ch0365.htm	http://www.leg.state.fl.us/statutes/index.cfm?StatuteYear=2009&AppMode=Display_Results&Mode=Search%2520Statutes&Submenu=2&Tab=statutes&Search_String=365.175
Georgia	GA	Georgia Emergency Management Agency	http://www.syfert.com/gacode/46-5-120.html	http://rules.sos.state.ga.us/cgi-bin/page.cgi?g=GRANTS_OF_THE_ONEGEORGIA_AUTHORITY%2FTHE_ONEGEORGIA_AUTHORITY_S_REGIONAL_E-9-1-1_FUND_PROGRAM%2Findex.html&d=1
Hawaii	HI	Enhanced 911 Board, State of Hawaii	http://hawaiiwirelesse911.hawaii.gov/index.php/regulatory	http://hawaiiwirelesse911.hawaii.gov/index.php/regulatory
Idaho	ID	Idaho Emergency Communications Commission	http://legislature.idaho.gov/idstat/Title31/T31CH48.htm	http://adminrules.idaho.gov/rules/2006/38/0601.pdf
Illinois	IL	Illinois Commerce Commission	http://www.icc.illinois.gov/911/	http://www.ilga.gov/commission/jcar/admincode/083/08300725sections.html



State	State Code	State 911 Program Name	URL Link to 911 Enabling Legislation	URL Link to Rules/Regulations
Indiana	IN	Indiana Wireless Board	https://iga.in.gov/legislative/laws/2014/ic/	http://www.in.gov/iurc/
Iowa	IA	Iowa Homeland Security and Emergency Management Dept.	http://www.homelandsecurity.iowa.gov/documents/e911/E911_Chapter34A.pdf	http://www.homelandsecurity.iowa.gov/documents/e911/E911_AdminRules_Sec605_Ch10.pdf
Kansas	KS	Kansas 911 Coordinating Council	http://www.kansas911.org/109/Laws-Administrative-Regulations	http://www.kansas911.org/109/Laws-Administrative-Regulations
Kentucky	KY	Kentucky Office of the 911 Coordinator /CMRS Board	http://cmrsboard.ky.gov/legislation/Pages/kar.aspx http://cmrsboard.ky.gov/legislation/Pages/chap65.aspx	http://psc.ky.gov/
Louisiana	LA	None	http://www.legis.state.la.us/lss/lss.asp?doc=91727&showback=	
Maine	ME	State of Maine, Department of Public Safety, State Police, Bureau of Consolidated Emergency Communications	http://www.mainelegislature.org/legis/statutes/25/title25ch352sec0.html	http://www.maine.gov/mpuc/legislative/rules/index.shtml
Maryland	MD	Maryland Emergency Number Systems Board	http://mgaleg.maryland.gov/2014rs/statute_google/gps/1-301.pdf	
Massachusetts	MA	State of Massachusetts, Statewide Emergency Telecommunications Board	https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter6a/Section18b	http://www.maine911.com/laws_rules/rules.htm
Michigan	MI	State 9-1-1 Program	http://www.legislature.mi.gov/documents/mcl/pdf/mcl-act-32-of-1986.pdf	http://www.michigan.gov/documents/msp/Dispatcher_Trg_Std_2012_418498_7.pdf
Minnesota	MN	Emergency Communications Networks Division; Statewide 9-1-1 Program	https://www.revisor.mn.gov/statutes/?id=403&view=chapter	https://www.revisor.mn.gov/rules/?id=7580&view=chapter&keyword_type=all&keyword=911&redirect=0
Mississippi	MS	Mississippi Emergency Management Agency	http://statutes.laws.com/mississippi/title-19/5/19-5-309	http://www.dor.ms.gov/taxareas/misc/pubutil.html
Missouri	MO	Office of Homeland Security	http://www.moga.mo.gov/mostatutes/stathtml/19000002901.html	http://www.sos.mo.gov/adrules/csr/current/4csr/4c240-34.pdf
Montana	MT	State of Montana, Montana Department of Administration Public Safety Communications Bureau	http://leg.mt.gov/bills/mca_toc/10_4.htm	http://www.mtrules.org/gateway/Subchapterhome.asp?scn=2%2E13%2E2
Nebraska	NE		http://www.nebraskalegislature.gov/laws/search_range_statute.php?begin_section=86-401&end_section=86-471	http://www.psc.nebraska.gov/rules/rules_911.pdf



State	State Code	State 911 Program Name	URL Link to 911 Enabling Legislation	URL Link to Rules/Regulations
Nevada	NV	Nevada Public Safety Communications Committee (NPSCC)	http://www.leg.state.nv.us/NRS/NRS-244A.html#NRS244ASec771	
New Hampshire	NH	New Hampshire Bureau of Emergency Communications	http://www.gencourt.state.nh.us/rsa/html/NHTOC/NHTOC-VII-106-H.htm	http://www.gencourt.state.nh.us/rules/state_agencies/saf-c7000.html
New Jersey	NJ	New Jersey Office of Information Technology	http://www.nj.gov/911/resource/statute/index.html	http://www.nj.gov/911/resource/reg/index.html
New Mexico	NM	Department of Finance and Administration, Local Government Division E-911 Bureau	http://nmdfa.state.nm.us/uploads/FileLinks/09113872164047d89bbdcdeb57cc3ff/New%20Mexico%20E-911%20Law.pdf	http://nmdfa.state.nm.us/uploads/FileLinks/09113872164047d89bbdcdeb57cc3ff/E-911%20Rules%20and%20Regulations.pdf
New York	NY	New York State Division of Homeland Security and Emergency Services	http://www.weblaws.org/new_york/laws/n.y._county_law_sec_.326	http://www3.dps.ny.gov/W/PSCWeb.nsf/All/49775FD17CDEE7F285257C910059DEED?OpenDocument
North Carolina	NC	North Carolina 911 Board	http://www.ncleg.net/EnactedLegislation/Statutes/HTML/ByArticle/Chapter_62A/Article_3.html	http://www.ncuc.net/ncrules/rulstoc.htm
North Dakota	ND	North Dakota Association of Counties 911 Program	http://www.legis.nd.gov/cencode/t57c40-6.pdf?20130722184749	http://www.psc.nd.gov/
Ohio	OH	9-1-1 Program Office	http://codes.ohio.gov/orc/128.01	http://www.puco.ohio.gov/puco/index.cfm/industry-information/industry-topics/telephone-company-procedures-and-standards/#sthash.N9nFOHFx.dpbs
Oklahoma	OK	9-1-1 Oklahoma Statewide Advisory Board	http://www.ok.gov/911/documents/Title%2063%20Section%202801%20thru%202853%20-%202011.pdf	http://www.occeweb.com/rules/CH%2055%20Effective%209-12-2014%20searchable.pdf
Oregon	OR	Office of Emergency Management	https://www.oregonlegislature.gov/bills_laws/lawsstatutes/2013ors403.html	http://arcweb.sos.state.or.us/pages/rules/oars_100/oar_104/104_080.html
Pennsylvania	PA	PA Emergency Management Agency (PEMA)	http://www.pema.pa.gov/planningandpreparedness/911/Pages/9-1-1-LEGISLATION---.aspx#.VFEJyGfwupo	http://www.puc.pa.gov/utility_industry/telecommunications/911_service.aspx
Rhode Island	RI	Rhode Island 9-1-1	http://webserver.rilin.state.ri.us/Statutes/TITLE39/39-21/INDEX.HTM	http://www.dps.ri.gov/documents/E911RulesAndRegs.pdf
South Carolina	SC	None	http://www.scstatehouse.gov/code/t23c047.php	http://www.psc.sc.gov/Documents/PSC_Forms/Telecommunications/PSP%20Guidelines.pdf
South Dakota	SD	South Dakota Department of Public Safety	http://legis.sd.gov/Statutes/Codified_Laws/DisplayStatute.aspx?Statute=34-45&Type=Statute	http://legis.sd.gov/Rules/TextSearch.aspx?SearchString=911&Catalog=&SearchFilter=
Tennessee	TN	Tennessee Emergency Communications Board	http://www.tn.gov/emergency/documents/911_February2014_TECBLaws2013.pdf	http://www.state.tn.us/sos/rules/1220/1220-04/1220-04-08.pdf



State	State Code	State 911 Program Name	URL Link to 911 Enabling Legislation	URL Link to Rules/Regulations
Texas	TX	Texas Commission on State Emergency Communication	http://www.statutes.legis.state.tx.us/SearchResults.aspx?CP=1&Code=HS&Phrase=chapter+771	http://info.sos.state.tx.us/pls/pub/readtac\$ext.ViewTAC?tac_view=4&ti=1&pt=12&ch=251&rl=Y
Utah	UT	Department of Public Safety Utah Communications Authority	http://le.utah.gov/~2014/bills/static/HB0155.html	http://www.rules.utah.gov/publicat/code/r720/r720-001.htm
Vermont	VT	Enhanced 911 Board	http://e911.vermont.gov/forms/statute	http://e911.vermont.gov/forms/statute
Virginia	VA	Virginia Information Technologies Agency (VITA)	http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+56-484.12	http://www.scc.virginia.gov/puc/laws.aspx
Washington	WA	Washington State Emergency Management Division	http://app.leg.wa.gov/RCW/default.aspx?cite=38.52.500	http://apps.leg.wa.gov/wac/default.aspx?cite=480-120-450
West Virginia	WV	West Virginia Division of Homeland Security and Emergency Management	http://www.legis.state.wv.us/legisdocs/code/07/WVC%20%2007%20%20-%20%201%20%20-%20%20%20203CC.htm	http://www.psc.state.wv.us/E911_Plans/default.htm
Wisconsin	WI	Public Service Commission of Wisconsin	http://docs.legis.wisconsin.gov/statutes/statutes/256/35/3/b/7	http://psc.wi.gov/apps40/via%5Cdocument%5C5ti1450%5C01h%20911.pdf
Wyoming	WY	State of Wyoming Public Safety Communications Commission	http://legisweb.state.wy.us/statutes/statutes.aspx?file=titles/Title16/T16CH9.htm	http://legisweb.state.wy.us/statutes/statutes.aspx?file=titles/Title37/T37CH15AR4.htm