EMERGENCY NUMBER SYSTEMS BOARD

9-1-1

REPORT TO THE GENERAL ASSEMBLY

"NEXT GENERATION 9-1-1 UPGRADE PLAN"

DECEMBER 2006

ROBERT L. EHRLICH, JR.
GOVERNOR

MICHAEL S. STEELE
LT. GOVERNOR

MARY ANN SAAR
SECRETARY, DPSCS

DEPARTMENT OF PUBLIC SAFETY AND CORRECTIONAL SERVICES

MARYLAND

Department of Public Safety and Correctional Services

EMERGENCY NUMBER SYSTEMS BOARD

December 2006

Joint Chairman's Report

2006 Session

Request For Information

9-1-1 Call Center Technology Upgrade Plan:

The committees would like Maryland to continue to accommodate the latest technology at its 9-1-1 call centers. As such, the committees direct the Emergency Number Systems Board to develop a plan for upgrading the 9-1-1 call centers to Internet Protocol-capable technology. The plan should include a timeline for implementation, an estimate of anticipated costs and recommendations for increasing to currently assessed fees, if necessary. The plan should also include a proposal for educating Voice Over Internet Protocol (VoIP) consumers about the need to purchase Global Positioning System-capable (GPS) attachments for their VoIP equipment or upgrade to a GPS-capable device.

MARYLAND

Department of Public Safety and Correctional Services

EMERGENCY NUMBER SYSTEMS BOARD

December 2006

Report To The Maryland General Assembly

"9-1-1 Call Centers Technology Upgrade Plan"

The Emergency Number Systems Board (Board) is pleased to provide this preliminary report regarding a technology upgrade plan for Maryland's 9-1-1 Call Centers. The report details the significance and benefits of Internet Protocol capable Next Generation 9-1-1 (NG 9-1-1) technologies including a preliminary timeline for implementation and a budgetary estimate of anticipated costs. Based on the findings in this report, the Board is not recommending an immediate change to the current 9-1-1 fee structure. The Board will continue to monitor the evolution of NG 9-1-1 technologies and will make recommendations in the future should a change to fee structure become warranted.

In June of 2005 the Board, due in large part to efforts of local 9-1-1 Call Center Directors, reached a significant milestone in becoming only the eighth state in the nation to implement wireless Phase II technology on a statewide basis. Wireless Phase II technology enables each of the twenty-four Primary 9-1-1 Call Centers to receive call location information for wireless 9-1-1 calls. Unlike wireline callers, wireless 911 callers tend to be transient or less familiar with the location of the emergency. The ability to identify a wireless caller's location enhances accurate and timely response of emergency services.

In recognition of the Phase II achievement, the Legislative Committees expressed the desire for Maryland to continue to accommodate the latest technology at its 9-1-1 Call Centers and directed the Board to develop a plan for upgrading the 9-1-1 Call Centers to Internet Protocol- capable technology also referred to as Next Generation technology. To assist the Board in this effort, a Task Order Request for Proposal, ("TORFP") was developed to secure a consultant familiar with NG 9-1-1 technologies and implementation strategies. In July 2006, L. Robert Kimball and Associates (Kimball) was awarded this consulting contract. The Kimball team is recognized nationally for its leadership and assistance in advancing 9-1-1 systems both on a local and national level. Kimball's report to the Board characterizes NG 9-1-1 technologies, examines Maryland's current NG 9-1-1 system readiness, identifies projected implementation and recurring costs, and outlines a Maryland NG 9-1-1 implementation timeline as the foundation for

establishing the following recommendations. A copy of the Kimball report is attached for review.

NG 9-1-1 Technologies

The proliferation of cell phone technology placed an additional burden of increased call volumes and less accurate call location information on the 9-1-1 system. With those issues addressed through Phase II technology, 9-1-1 must now respond to new Internet Protocol technological advances in the wireless, wireline and cable industries.

Communicating through text messaging, sending pictures, and now streaming video utilizing your wireless phone or computer service is quickly becoming the preferred method of sharing information. New wireless technologies are either now or will shortly be available to permit sending voice and data at the same time, permitting a picture or other information to be transmitted without losing voice connectivity. Currently, 9-1-1 has no means to receive, process, display, or store this type of data. National efforts are currently underway to create regulations and standards that uniformly address these issues. It is expected that the implementation and testing of these standards, as well as the industry's response to developing new technology and software, will be a prolonged process.

The next generation 9-1-1 system is expected to evolve into an information highway utilizing Internet Protocol (IP) based broadband connectivity in which voice, data, video, and other informational sources will be available to Call Centers for receiving, processing, and dispatching requests for emergency services. To ensure the security and integrity of emergency information, an independent Maryland Public Safety IP Network (PSN) will likely need to be established. At a minimum, the PSN will need broadband capacity sufficient to handle anticipated demands and have connectivity to each of Maryland's primary PSAPs. Redundancy of network connectivity and equipment will be required to further ensure integrity and prompt disaster recovery. Secondary Call Centers (including Maryland State Police) will also need to be connected to the PSN for seamless transfer of calls and sharing of emergency information.

The technology required to receiving, processing, and storing data through a NG 9-1-1 system will also require upgrading the Customer Premise Equipment (CPE), storage media, and software applications at each 9-1-1 Call Center. Current Call Center CPE equipment is IP enabled but software applications need to be developed before data, other than voice, can be processed. Plant/CML, a primary CPE vendor, informed the Board that until national standards are established Plant/CML does not anticipate developing software and related interfacing programs. This delay provides additional time for the Board to upgrade equipment at Maryland's primary Call Centers in response to NG 9-1-1 technologies.

VoIP and Global Position Technology

In Maryland, VoIP service providers currently offer enhanced 9-1-1 service (E9-1-1) to subscribers. Local VoIP emergency service calls to 9-1-1 are processed through the same selective router (Verizon) as traditional phone service and forwarded to the appropriate Call Center, with callback and location information (ANI/ALI) displayed to the Call Taker. This solution works well for fixed location calls where the customers have correctly pre-registered their location with the VoIP service provider.

The use of "nomadic" (mobile) VoIP devices (including laptops) is increasing resulting in a rise in the number of calls routed to the incorrect Call Center due to questionable location information. The VoIP industry established "call centers" to answer undeliverable 9-1-1 calls to determine the appropriate 9-1-1 Call Center to transfer the caller for emergency service. This interim solution is fraught with impediments including delaying an emergency services response.

The Federal Communications Commission (FCC) regulates the basic oversight of 9-1-1 capabilities for Voice Over Internet Protocol (VOIP) services. In June 2005 the FCC released the "*First Report and Order and Notice of Proposed Rulemaking*" (FCC 05-116), which states the following:

> **1.** *In this Order**, we adopt rules requiring providers of interconnected voice over Internet Protocol (VoIP) service to supply enhanced 911 (E911) capabilities to their customers**. Interconnected VoIP providers may satisfy this requirement by interconnecting indirectly through a third party such as a competitive LEC, interconnecting directly with the Wireline E911 Network, or through any other solution that allows a provider to offer E911 service. The characteristics of interconnected VoIP services have posed challenges for 911/E911 and threaten to compromise public safety. Thus, we require providers of interconnected VoIP service to provide E911 services to all of their customers as a standard feature of the service, rather than as an optional enhancement. We further require them to provide E911 from wherever the customer is using the service, whether at home or away from home.*
>
> **2.** *We adopt an immediate E911 requirement that applies to all interconnected VoIP services. In some cases, this requirement relies on the customer to self-report his or her location. **We intend in a future order to adopt an advanced E911 solution for interconnected VoIP that must include a method for determining a user's location without assistance from the user as well as firm implementation deadlines for that solution.***

As of December 2006, the technologies to provide nomadic VoIP 9-1-1 caller locations are still being developed. In the time since the release of the above order the FCC and various national 9-1-1 organizations are working with VoIP providers to develop technologies and/or regulations to address this issue.

It has been a common belief that VoIP providers could use the same Global Positioning System (GPS) that the wireless industry currently uses to locate callers but that solution has not yet been embraced. As a result, recommendations to add GPS technology to a user's VoIP equipment would not provide any benefit at this time. It would be premature to tell consumers to purchase GPS attachments or equipment to augment their systems without this being enabled by the VoIP service provider. **Upon the development of VoIP location technologies and subsequent regulations the Board is ready to educate the public utilizing different media sources including distribution of VoIP informational pamphlets at public venues.**

Maryland's Current 9-1-1 System

It should be noted that Maryland currently has a robust 9-1-1 system, maintained in large measure by Verizon, capable of transmitting and processing over 5M voice calls annually from wireline, wireless, and VoIP services. Maryland's twenty-four primary 9-1-1 Call Centers have redundant path routing for 9-1-1 calls and back-up facilities for efficient disaster recovery. The current 9-1-1 system remains responsive to present needs and is not expected to be replaced until the PSN and technological NG 9-1-1 service standards have been established.

Costs

The attached report by L. Robert Kimball and Associates indicates three kinds of expenditures for establishing a NG 9-1-1 System in Maryland. Anticipated costs include the costs associated with 1) planning the network, 2) purchasing and installing network equipment including connectivity and software, and finally 3) the on-going maintenance of the NG 9-1-1 network.

Initial planning costs would be associated with designing the network, selecting a vendor to install the system, and providing oversight of the installation process. The first step in this process would be developing a Request for Information/Request for Proposal (RFI/RFP) for a NG 9-1-1 PSN to identify eligible vendors, specific network designs, and associated implementation costs. Once a vendor is selected, providing independent oversight of network installation and Call Center connectivity will be essential as the PSN is established.

Once the NG 9-1-1 System is operational there will be costs associated with its maintenance. These on-going costs will ensure that the system remains robust and responsive to emergency service demands.

The Board has examined the estimated costs associated with each of these phases, appearing in the attached Kimball report, and concludes that planning, operational, and <u>initial</u> recurring maintenance cost can be met with no increase in the State portion of the 9-1-1 surcharge.

Once the PSN is established and operational it will become the responsibility of each county to encumber funding for its portion of recurring network maintenance charges. The new network maintenance charge could be in addition to payments the counties currently make on a monthly basis for maintaining the current 9-1-1 delivery system **Once long-term network maintenance costs are determined, it may become necessary to re-examine the appropriateness of the "county additional fee" portion of the 9-1-1 Surcharge to offset these new costs.**

NG 9-1-1 Timelines

L. Robert Kimball and Associates outlines a six-year process to fully implement NG 9-1-1 in Maryland. The process of establishing a Public Safety Network is predicated on the public readiness to transmit data to the 9-1-1 Centers and the availability of premise equipment and software capable of receiving and processing such data. The Board concludes that this process may be accelerated as the industry increases its focus on NG 9-1-1 systems. Once it is evident how these conditions are going to be met the network design and implementation process should begin. The adoption of regulations and standards, followed by the industry's announcement of compliant equipment and software, will be the most accurate determination of when to commence establishing the network.

First Year

- Prepare RFI/RFP to identify network solutions and vendors
- Release the RFI/RFP, review responses and select vendor
- On-going process of upgrading PSAP equipment, as part of their normal replacement cycle, ensuring IP compatibility
- When possible, purchase work stations for secondary PSAPs that serve as a remote off of the Primary PSAPs CPE

Second Year

- Build out the network to Primary PSAPs
- Negotiate with Vendors to connect with the selective routers and ANI/ALI databases
- Begin the testing process of sending data through the system to the PSAPs and development of local processing procedures.
- Provide NG 9-1-1 Training of 9-1-1 Call Center personnel on an on-going basis
- Begin sending new NG 9-1-1 data sources to the 9-1-1 Centers (repeat these last three steps for each new information source)

Second - Third Year

- Build out the network to the Secondary PSAPs (including Maryland State Police)
- Examine the recurring maintenance costs associated with the network and work with the Legislature to re-examine the County's portion of the 9-1-1 Surcharge for adequacy
- Determine feasibility of expanding the PSN to other emergency services providers for information sharing (Emergency Operations Centers, Federal Agencies, Hospitals, State Highway, etc.)

Report on Next Generation 9-1-1 Recommendations

submitted to:

Maryland Emergency Number Systems Board

November 30, 2006

L. Robert Kimball & Associates
Architects and Engineers

EBENSBURG, PENNSYLVANIA CORAOPOLIS, PENNSYLVANIA PITTSBURGH, PENNSYLVANIA HARRISBURG, PENNSYLVANIA PHILADELPHIA, PENNSYLVANIA
STATE COLLEGE, PENNSYLVANIA WEST CHESTER, PENNSYLVANIA WILKES-BARRE, PENNSYLVANIA MELBOURNE, FLORIDA
TRENTON, NEW JERSEY ROCHESTER, NEW YORK MEMPHIS, TENNESSEE RICHMOND, VIRGINIA VIENNA, VIRGINIA CHARLESTON, WEST VIRGINIA

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 3

1.1 INTRODUCTION 3
1.2 METHODOLOGY 4
1.3 FINDINGS 4
1.4 IMPLEMENTATION OPTIONS 5
1.5 RECOMMENDED SOLUTION 5

2. NEXT GENERATION 9-1-1 7

3. METHODOLOGY 13

3.1 CURRENT INFRASTRUCTURE 13
3.1.1 PSAPs 13
3.1.2 Infrastructure 14
3.2 NEXT GENERATION NETWORK 14
3.2.1 PSAP Connectivity 15
3.2.2 Backbone 16
3.2.3 Carrier Connectivity 19
3.3 USE EXISTING STATE INFRASTRUCTURE 20
3.3.1 Overview 20
3.3.2 Timeline 20
3.3.3 Cost Projections 20
3.4 USE LEASED FIBER AND CIRCUITS 20
3.4.1 Overview 20
3.4.2 Timeline 20
3.4.3 Cost Projections 21
3.5 USE A TRANSPORT SERVICE PROVIDER 21
3.5.1 Overview 21
3.5.2 Timeline 21
3.5.3 Cost Projections 21

4. FINDINGS 22

4.1 CURRENT INFRASTRUCTURE 22
4.1.1 PSAPs 22
4.1.2 Infrastructure 24
4.1.3 Maryland ENSB 24
4.2 NEXT GENERATION NETWORK 25
4.3 USE EXISTING STATE INFRASTRUCTURE 25
4.3.1 Microwave Systems 25
4.3.2 Fiber Optic Facilities 25
4.3.3 Network Plans 26
4.4 USE LEASED FIBER AND CIRCUITS 26
4.5 USE A TRANSPORT SERVICE PROVIDER 26

5. IMPLEMENTATION OPTIONS 28

5.1 CURRENT INFRASTRUCTURE 30
5.1.1 PSAPs 30
5.1.2 Infrastructure 35
5.2 NEXT GENERATION NETWORK 36
5.2.1 Vision and Goals 36

5.2.2 Proposal Process *37*
5.2.3 Solution Providers *37*
5.3 USE EXISTING STATE INFRASTRUCTURE 38
5.3.1 Overview *38*
5.3.2 Timeline *41*
5.3.3 Cost Projections *43*
5.4 USE LEASED FIBER AND CIRCUITS 44
5.4.1 Overview *44*
5.4.2 Timeline *46*
5.4.3 Cost Projections *49*
5.5 USE A TRANSPORT SERVICE PROVIDER 49
5.5.1 Overview *49*
5.5.2 Timeline *50*
5.5.3 Cost Projections *53*
5.6 POTENTIAL ISSUES 55
5.6.1 Alternate Implementation Plan *56*

6. RECOMMENDED SOLUTION 60

6.1 OVERVIEW 60
6.2 TIMELINE 60
6.3 COST PROJECTIONS 64
6.3.1 PSAP Annual Costs *64*
6.3.2 PSAP One Time Costs *64*
6.3.3 ENSB Annual Costs *65*
6.3.4 ENSB One Time Costs *65*

APPENDIX A 66

APPENDIX B 67

APPENDIX C 68

APPENDIX D 69

APPENDIX E 70

1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

L. Robert Kimball & Associates, Inc. (Kimball) is pleased to provide the state of Maryland Emergency Number Systems Board (ENSB or the Board) with its report on Next Generation 9-1-1 Recommendations.

On May 30, 2006, the state of Maryland requested a vendor to perform several tasks in a Task Order Request for Proposals (TORFP). This TORFP identified specific tasks to be completed. These tasks were developed from several major goals of the Maryland ENSB. In response to this TORFP, Kimball responded with a proposal to complete these tasks and was awarded the contract on July 31, 2006.

The ENSB, on behalf of the state of Maryland, desires to systematically explore and plan for implementation and integration of Next Generation 9-1-1 (NG9-1-1) technologies. "Next Generation 9-1-1" is commonly viewed as an interconnected, IP-based hierarchy of local, regional, state, and national networks that would enable a more robust interconnectivity and functionality for emergency communications applications than what currently exists. The current 9-1-1 systems in Maryland and throughout the nation are over thirty years old and are generally recognized as being limited both technically and functionally.

Building on the work of the National Emergency Number Association (NENA) and the Network Reliability and Interoperability Council (NRIC), an advisory group to the FCC, the NG9-1-1 concept envisions a systematic transition to a new system. The new system will accommodate a flexible services infrastructure where existing and new emergency communications applications of all types can be implemented without requiring major overhauls to existing network service providing elements. For Maryland and its PSAPs, implementation of and transition to NG9-1-1 may have far-reaching impacts such as:

- Handling calls and providing accurate location information from new devices requiring changes in call processing and procedures
- Delivering new and expanded data sources with calls including audio, video, and telemetrics that can enable new sources of information for decisions about handling calls and dispatching and coordination of resources
- Providing new and faster methods of transferring and coordinating information among PSAPs, emergency operations centers, and other public safety entities beyond that currently provided for in the public switched telephone network, which most 9-1-1 capabilities typically rely upon
- Far greater interconnectivity among local PSAPs, regional, state, and national agencies for coordination of emergency responses involving multiple agencies and various levels of public and private participation

Various national agencies and organizations have developed their visions of this new system. These groups range from the National Emergency Number Association (NENA) to the U.S. Department of Transportation (USDOT).

There is a great deal of work still going on, and will continue for some time. The central theme throughout all of the major visions of the next generation is an internet protocol (IP)-enabled network that can share voice, video, and data. This network is envisioned to be a dedicated, secure, public safety system.

1.2 METHODOLOGY

To perform this feasibility study, Kimball used a variety of ways to gather data, including face-to-face meetings, telephone, e-mail, and research on the internet. Kimball developed survey forms and spreadsheets to facilitate gathering the raw data from the various sources.

Site visits to each of the 24 primary Public Safety Answering Points (PSAPs) in the State were performed in September 2006. Basic information gathered at each PSAP provided insight as to the current 9-1-1 system.

Additional questionnaires, follow up telephone calls, and e-mail correspondences with Verizon Communications gained additional information on the 9-1-1 infrastructure in the State. Information on the voice network as well as database services was obtained. This information was consolidated into a web-based data collection tool. This web tool provided the means for each member of the team, regardless of his or her location, to have real-time access for the purposes of data entry and review.

Kimball used common practices in the telecommunications field, as well as documents and statements from national organizations such as NENA, APCO and USDOT to develop recommendations for the State regarding this IP-enabled network. Information obtained during data collection came from a variety of sources, and it occasionally conflicted. This fact required us to make judgment calls based on our experience and knowledge. Kimball reviewed and verified data when possible.

Potential issues that could become a serious roadblock to implementation were identified to the extent possible.

1.3 FINDINGS

The state of Maryland 9-1-1 system is a very robust system and is positioned to handle the current needs of the residents and visitors to the State. Several new technologies are coming into use today that may reduce that readiness over time.

The 24 primary PSAPs in the State are connected to one of the four sets of Verizon Communications' dual selective routers for 9-1-1 service, and a set of mirrored Automatic Location Identification (ALI) databases. These systems provide the PSAPs with diverse and redundant routing of the 9-1-1 caller's voice and location information.

Plant Equipment, Inc. manufactures most of the PSAP Customer Premises Equipment (CPE) used to answer calls to 9-1-1 in Maryland. Verizon Communications leases a little less than half of this equipment to the PSAPs. In addition, the majority of the PSAPs use a mapping system from Plant Equipment, Inc. called Orion.

Kimball also found there were several alternative networks in the area. These networks consist of state microwave systems, state fiber networks, and third-party systems. Each of the systems could be investigated as possible networks that can provide capacity, but a detailed network traffic analysis would be needed for each network.

1.4 IMPLEMENTATION OPTIONS

There are several solutions, timelines, methodologies and pricing structures to consider in planning for an IP-based 9-1-1 network. Listed below are examples of various options that are capable of routing wireless, wireline and VoIP traffic to PSAPs, some of which may be offered through RFP responses.

- Do Nothing
- Turn Key Solution
- Transport Network
- Private Network

There are also three major network options.

- Use Existing State Infrastructure
- Use Leased Fiber and Circuits
- Use a Transport Service Provider

1.5 RECOMMENDED SOLUTION

The state of Maryland should build out an IP-enabled network as the first step toward Next Generation 9-1-1. This network does not use the internet, but uses the same communications protocol on a secured private network similar to what major companies use today. This network will position the state to use the future technologies that will be developed to address the needs of today and the future.

The envisioned IP-enabled network has three basic parts:

- Connection to the current 9-1-1 infrastructure
- The backbone that carries the traffic around the state
- Connections to the PSAPs

The first issue that needs to be address is the funding mechanism. Kimball recommends the existing funding mechanism be increased to cover the following new annual recurring costs:

PSAP Funding - $9,995,712 annually
ENSB Funding - $2,679,152 annually

Additional one time costs for each groups are:

PSAP One Time Costs - $517,200
ENSB One Time Costs - $776,046

In order for the State to get the best solution that is cost effective, Kimball recommends the state release a Request for Information or Request for Proposal (RFI/RFP). This RFI/RFP will allow various providers to present their best solution to provide this service and will introduce some competition to possibly limit costs.

2. NEXT GENERATION 9-1-1

NG9-1-1 is a term frequently used today. This term is not an established set of standards, but is a conceptual vision of the future. Often this term is used to define a vision of where 9-1-1 is going, or at least moving towards, according to various groups. If we look at these visions, there are a few themes that are consistent, and these are where effort should be focused. To better understand this subject, Kimball will review some of the issues and groups with a stake in this vision.

The computer industry developed a method to send voice from computers to other computers using a technology called Voice over Internet Protocol (VOIP). The term "internet" in this title does not mean it has to use the internet, as we know it. Internet Protocol (IP) is really a group of protocols used by computers. This protocol is a standard that can be used to integrate various types of equipment. It is important to understand that an IP network uses these protocols. This network does not have to use the internet.

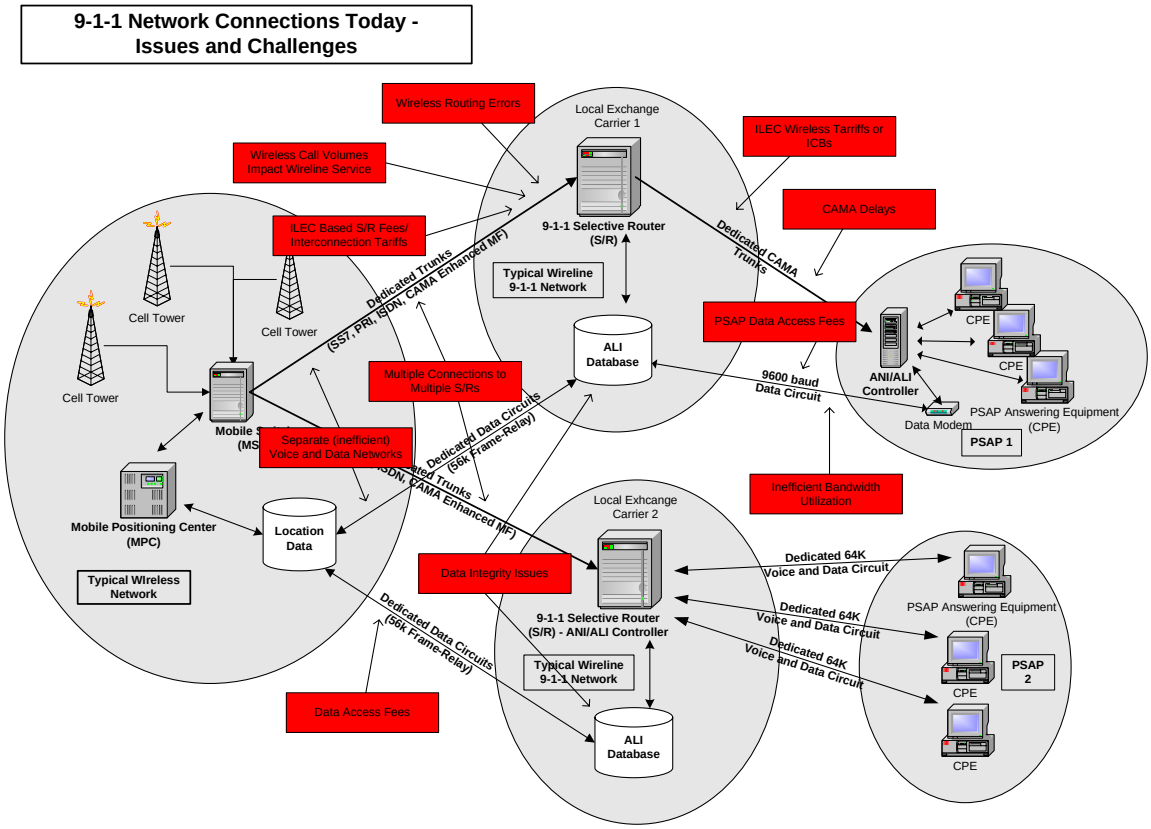
This technology is not restricted to the internet, but reflects the use of a protocol developed for the internet, namely IP. As this technology became more mature and more widespread, various groups looked at what this meant for 9-1-1 and public safety. For the purpose of this discussion, Kimball will only look at these new technologies for delivery of 9-1-1 calls to the PSAP within the 9-1-1 infrastructure, not callers using VOIP. Callers using VOIP are being sent to the existing 9-1-1 infrastructure today.

The National Emergency Number Association (NENA) started several workgroups that developed a future path plan for 9-1-1 PSAPs and networks. This plan looked at the various sources of information that can be used and how it can be utilized in the PSAP. The objectives of the future path plan are:

> *Any 9-1-1 call originator, voice or text, must be able to access the nation's 9-1-1 systems and have their call delivered to the appropriate answering point, with caller location identification.*
>
> *The answering point must receive and be able to manage the data, and be able to transfer the 9-1-1 call to a variety of emergency service points, and those entities must have access to the call information for call and incident handling.*
>
> *In present and future applications of all technologies used for 9-1-1 call and data delivery, maintain the same level or improve on the reliability and service characteristics inherent in past 9-1-1 systems design.*

They have also developed a set of standards for interim steps to get VOIP calls to the PSAP. This is a process that takes VOIP calls into the existing 9-1-1 system. This system is older and was technologically behind in the last major new technology change (wireless 9-1-1). In Dale Hatfield's report to the FCC titled "A Report on Technical and Operational Issues Impacting the Provision of Wireless Enhanced 9-1-1 Services," he stated:

"Third, one over-arching issue that immediately emerged in my inquiry is that the existing wireline E9-1-1 infrastructure, while generally reliable, is seriously antiquated. Indeed, it turns out that the existing wireline E9-1-1 infrastructure is built upon not only an outdated technology, but also one that was originally designed for an entirely different purpose. It is an analog technology in an overwhelmingly digital world. Yet it is a critical building block in the implementation of wireless E9-1-1."



The Emergency Services Interconnection Forum (ESIF) is a group formed by the Alliance for Telecommunications Industry Solutions (ATIS) and NENA to develop standards and work through the technical issues of wireless 9-1-1. ATIS is an American National Standard Institute (ANSI) approved organization. This allows them to establish national standards that can be adopted by the industry. This group continues to fine-tune the processes and standards to deliver wireless 9-1-1 calls but has recently begun subcommittees to examine the issues of IP and VOIP technologies in the telecommunications industry.

It is important to note that the concept of an IP-enabled next generation network is supported at the federal level. In fact, the IP-enabled network is the second initiative involving 9-1-1 in which the U.S. Department of Transportation has taken an interest. The first was Phase II wireless where "encouragement" was communicated from the federal level for a nationwide roll out of location technology to be employed to help locate wireless 9-1-1 callers.

USDOT has begun an initiative to examine the "Next Generation 9-1-1." The USDOT vision is:

> *The Next Generation 9-1-1 initiative aims to enable any communications device used nationwide to connect with the 9-1-1 system. The current 9-1-1 system is built on decades-old technology and cannot receive data from the text, data, image, and video devices increasingly common in personal communications and critical in many safety and medical applications. This initiative will involve a fundamental reexamination of the technological approach to 9-1-1 used today.*

One of the goals of the initiative is to *"encourage an open architecture, interoperable inter-network of all emergency organizations."* There are many different ways 9-1-1 calls are delivered throughout the United States. Each Local Exchange Carrier (LEC) has one or more ALI formats. There are varying types of circuits, varying speeds, varying costs, and varying types of equipment used to handle calls. The switches used in networks come in various versions; some with limited capability, some with massive capability, some are analog, some are digital. One of the initiative's goals will be to encourage standards so there is parity of service. Vendors of proprietary equipment and software will be encouraged to develop open architecture systems that can be used nationwide and in conjunction with other vendors' equipment or software. One of the main constraints of implementing an IP-enabled system is overcoming all the varying technologies and incompatibilities that exist.

> *"The 9-1-1 system is, and will remain, primarily a local government and communications industry responsibility. But this local focus has resulted, in the past, in fragmenting the 9-1-1 system capabilities and limiting the ability to develop and invest in new technologies. The intent of USDOT is to promote the vision for the next generation 9-1-1 system and provide leadership and resources to work with the public and private 9-1-1 stakeholders to lay out the path to achieve a vision of a nationally interoperable emergency services internet work."*
>
> *"USDOT's core vision for an IP-enabled network is that this new inter-network will provide the foundation for public emergency services in an increasingly mobile and technologically diverse society and ultimately enable enhanced 9-1-1 calls from most types of communication devices."*

The last two paragraphs make it known that *"The 9-1-1 system is, and will remain, primarily a local government and communications industry responsibility."* It is too early in the process to determine if federal funding will be made available to support local or state governments in the implementation of an IP-enabled network solution. USDOT is engaged in establishing a vision and assisting in creating a foundation with open architecture standards for which all IP-enabled systems at a local level can be designed.

The U.S. Department of Transportation, Federal Highway Administration has undertaken this initiative to explore the concept and benefits of an IP-enabled system if such a system were to be made available nationwide. As of this writing, the USDOT is in the final stages of selecting a vendor to assist in the exploration and proof-of-concept of an IP-enabled system. At this point in time, it does not appear that the DOT intends or plans to build out a nationwide IP network for routing 9-1-1 calls, nor do they plan to provide funding to jurisdictions that may be planning such a system locally.

The following are excerpts directly from the USDOT Concept of Operations document describing the initiative currently underway:

> *"The purpose of this document is to provide a preliminary Concept of Operations for the Next Generation (Next Gen 9-1-1) system (or "system of systems"). The U.S. Department of Transportation (DOT) understands that access to emergency services provided by 9-1-1 in today's world of evolving technology will ultimately occur within a broader array of interconnected networks comprehensively supporting emergency services, from public access to those services, to the delivery and facilitation of the services themselves. More specifically, DOT views an IP-enabled network as expanding and improving the capabilities of Public Safety Answering Points (PSAPs) through new inter-networking technologies. The Next Generation 9-1-1 initiative is a DOT research and development project to define the system architecture and develop a transition plan that considers responsibilities, costs, schedule, and benefits for deploying IP-based emergency services across the Nation."*
>
> *"The primary goal of the IP-enabled system is to save lives, health, and property by improving emergency services access and response in the United States. The state of the IP-enabled system also has a major effect on transportation security, mobility, and efficiency.*
>
> *The NG9-1-1 system objectives that will lead to this goal include:*
> - *Enable E9-1-1 calls from any networked communication device.*
> - *Enable geographic-independent call access, transfer, and backup among PSAPs and between PSAPs and other authorized emergency organizations.*
> - *Encourage an open architecture, interoperable inter-network of all emergency organizations.*
> - *Reduce emergency services capital, operating, and maintenance costs"*

The U.S. Department of Homeland Security has also looked at the issue of interoperability for communications between local, state and federal agencies. These communications systems are directed at voice and data. As a part of their direction in Presidential Homeland Security Directive 8 (HPSD-8), they have begun the development of standards for those communications systems.

These systems are designed in a set of networks that are based on the level of communication they handle. A short-term "incident system" would connect to a long-term "extended area network" (EAN). An EAN is *a local system linked with county, regional, state, and national systems. This network can be both wired and wireless, depending on the type of infrastructure deployed in the area (i.e., microwave point-to-point, fiber, etc.).* Future networks could be of a nature that they can be used as an extended area network.

While the future is not fully clear, the common theme of all of the popular visions of this future has an IP network in the vision. This network is envisioned to be a dedicated, secure, public safety IP network to allow data to be shared between all agencies and levels of government.

Using these visions in conjunction with the goals of the state of Maryland allows a system to be developed to maximize the value, and minimize costs.

The time required to develop and build these large-scale networks, will allow the state of Maryland to begin to prepare for the future using the available technology today. By developing an IP-enabled network, the backbone will be in place. When the industry completes developing the standards and vendors complete building the equipment, the state will be in the position to take full advantage of these technologies.

An *IP-enabled network* is an advanced network in which the delivery of E9-1-1 calls are routed directly to the appropriate PSAP via a managed, uniform, dedicated, statewide digital network utilizing standardized components and IP technology. The 9-1-1 traffic is typically carried through a medium of fiber optic network(s).

Faster call routing is possible because the *IP-enabled network* solutions use fewer connection points, newer networking technologies, and a variety of protocols. Also, digital circuits such as SS7 and ISDN decrease call set up time and allow for more information to be passed through the network.

An *IP-enabled network* supports and parallels the direction in which the public safety industry is heading and provides a solid technical foundation for PSAPs of the future. Most public safety industry leaders, both on the PSAP and vendor sides, agree that 9-1-1 is moving toward IP-enabled networks similar in concept to the local area networks (LANs) found in most offices today. It is generally accepted by most in the industry that the amount of data sent to PSAPs today is considerably less than the amount that will be sent to PSAPs in the future. While it is difficult to predict the future, services such as On-Star, telematics, Automatic Crash Notification (ACN), Geographic Information Systems (GIS) data, and several types of telemetry offer good examples of the increased data flow that is likely and could be easily supported by an appropriately sized *IP-enabled network* solution.

There are currently seven *IP-enabled network* projects of various levels in progress or implemented in the country. They are:

- Rhode Island – 1 PSAP
- The MARC (Kansas City area) – 47 PSAPs
- Allegheny County, PA (Pittsburgh area) – 1 PSAP
- MESB (Minneapolis/St. Paul) – 25 PSAPs
- Washington, D.C. – 1 PSAP
- Indiana – 167 PSAPs
- Vermont – 10 PSAPs

Most of these systems are using the funding available from wireless to implement the system. Several of these systems are a wireless call routing solution. This allows the wireless carriers to connect to fewer locations to deliver calls.

There are three other states in the process of determining the feasibility or assessing the possibility of implementing an *IP-enabled network* system. They are:

- Tennessee
- Delaware
- Missouri

Benefits of an IP-enabled network

In the implementations mentioned above, definite and substantial benefits have been realized by the operating agencies. The most cited benefits are:

- Faster emergency response times
- Reduced call-set time
- Improved quality of service
- Efficient use of resources
- Prepare PSAPs for future technologies
- Increased reliability and disaster recovery of the delivery network
- Clearer demarcations of responsibility and accountability
- Reduced potential points of failure in the network
- The ability to transfer 9-1-1 calls statewide
- The ability for PSAPs to exchange incident data
- Local Access and Transport Area (LATA) boundaries, wire centers, and rate centers do not restrict area of service
- Improved accessibility and increased compatibility to ensure all have access to the emergency response system, including those with disabilities
- Service parity for all 9-1-1 callers
- Enables interoperability
- Expandable to include other jurisdictions or entities, such as other states

3. METHODOLOGY

In this section, the methodology used to generate the report is outlined. This involves several methods, and each section is discussed independently.

The Kimball team launched the project with a kick-off meeting between members of the Board and Kimball staff. The purpose of this meeting was to review the goals of the Board and to review Kimball's proposed project plan and timeline, and to discuss the methods, processes, and tools that would be used to collect information, analyze it, and prepare the reports.

Data gathering occurred in a variety of ways, including face-to-face meetings, telephone, e-mail, and the internet. Kimball used the internet to obtain census information. Kimball developed survey forms and spreadsheets to facilitate gathering the raw data from the various sources.

Kimball consolidated all data into a web-based data tool. This web tool provided the means for each member of the team, regardless of his or her location, to have real-time access for the purposes of data entry and review.

Since the information obtained during the 9-1-1 infrastructure assessment project came from a variety of sources, it occasionally conflicted. This fact required us to make judgment calls based on our experience and knowledge.

Kimball reviewed and verified all data to the extent possible. Kimball has presented much of this data in the aggregate in order to preserve the confidentiality of information about the PSAPs' and LECs' systems and customers. Kimball's sources and processes are outlined below.

3.1 CURRENT INFRASTRUCTURE

3.1.1 PSAPs

All 24 PSAPs were visited by a team from Kimball over a two-week period. This took place beginning on Monday, September 11, 2006, and concluded on Monday, September 25, 2006. The decision to visit in person versus other means of collection was chosen so that the data could be obtained within a timely and consistent basis, a snap shot in time of the current technology in place and contact information. A synopsis of this data is included in Appendix A.

Items gathered included: general PSAP information, PSAP contact numbers, physical and mailing addresses, contact information from the 9-1-1 coordinator, Master Street Address Guide (MSAG), and GIS contacts, if so applicable.

Information related to the phone company providing 9-1-1 service to the PSAP such as, number and type of trunks they are currently receiving calls on and location of selective routers providing service. Procedures regarding PSAP evacuation where the calls get routed and how that is accomplished were discussed with these PSAPs. Information on the ALI database was collected. Information, such as database locations and the ALI format they are receiving, was collected.

PSAP equipment including Customer Premises Equipment (CPE), mapping, Computer Aided Dispatching (CAD), logging recorder, master clock, and radio consoles data was collected. Technology questions included make, model, and version as well as whether they own the equipment or lease the equipment, who is maintaining the equipment for them, and if they were looking at any procurement/replacement of the equipment.

Secondary PSAP information gathered was of not only who are their secondary PSAPs, but also how they transferred calls (one button transfer versus ten-digit speed dial) and the type of information transferred (voice only, voice and data). IP connectivity was the last item to be covered. That requested information centered on connection to any of the secondary PSAPs or any other IP connectivity currently in use in the PSAP such as a county or local intranet.

3.1.2 Infrastructure

Kimball had frequent communications with the dominant LEC, Verizon, to request information about their 9-1-1 network infrastructures.

Kimball developed a 9-1-1 network infrastructure form to request primary and secondary contact information, selective router name, location, and specific 9-1-1 tandem switch (selective router) information. The specific selective router information included the switch type, the date installed, the last upgrade date, the version of software being used, an enhanced feature list, PSAPs serviced, 9-1-1 call volume, and whether the switches were mated or paired to another. In addition, Kimball requested the interconnection information to another switch if it applied. One other key item requested was a list of all the wireless and VoIP carriers and providers connected to each selective router.

An ALI database form was designed to gather specific information regarding ALI database location, ALI database make and model, the date installed and upgraded, and the PSAPs served. Additionally, Kimball requested the types of interfaces the database has available for the PSAPs such as ASCI, IP, XML and whether the database has E2, PAM, or IP capabilities to connect to other database service providers.

3.2 NEXT GENERATION NETWORK

Kimball used common practices in the telecommunications field, as well as documents and statements from national organizations such as NENA, APCO and USDOT. The Kimball team also applied its internal knowledge and expertise gained as a result of working on similar projects for other states. Most importantly, however, was the task of ensuring that our analysis was done in the context of the Maryland state 9-1-1 coordinator's vision for the future.

As a result of assisting other states with similar projects, Kimball has a deep understanding of the issues that Maryland is likely to encounter as it proceeds to implement a statewide IP-enabled network for use with enhanced 9-1-1. The potential for these issues to become a serious roadblock to implementation cannot be underestimated. Therefore, our methods, of necessity, included an assessment of issues that could become roadblocks.

These operational and technical issues may arise at the State level and the PSAP level. To help assist the Board, a discussion of potential issues and possible solutions to these issues will be discussed in this report.

Kimball attempted to identify additional resources that the State could use to provide a statewide IP-enabled network. Various methods of delivering this service were also examined.

The result is an outline of a migration path that would enable the Board to turn its vision into reality – to the benefit of all its citizens. A strategic plan to develop a statewide IP-enabled network is the goal of this project.

Some of the terminology used in this report is new to the 9-1-1 field. These terms are needed to understand the function of the devices used. Two of these devices are IP routers and gateways.

IP **routers** send their traffic based on a high level of intelligence inside themselves. This intelligence allows them to consider the network as a whole. How they route (also called routing considerations) might include destination address, packet priority level, least-cost route, minimum route delay, minimum route distance, route congestion level, and community of interest. Routers constantly monitor the conditions of the network, as a whole, in order to dynamically adapt to changes in network conditions. These are not the same as the **selective routers** currently used by the 9-1-1 system.

A **gateway** is a device that connects networks using different communications protocols so that information can be passed from one to the other. A gateway both transfers information and converts it to a form compatible with the protocols used by the receiving network.

The envisioned network has basically three sections as shown in the diagrams with each network option. The three sections are:

- PSAP Connectivity
- Backbone
- Carrier connectivity

3.2.1 PSAP Connectivity

Assuming the new statewide IP-enabled network is using different protocols than the last mile connectivity, a gateway may need to be required at the point where the call is moved to the PSAP network. An example of this would be if the network backbone was an Asynchronous Transfer Mode (ATM) network, but the PSAP was using an Ethernet network locally. A gateway would allow these two networks to be connected.

The PSAP connectivity to the new statewide IP-enabled network could be implemented through several providers and combination of providers throughout the State. Some considerations would be the LECs, facility-based Competitive Local Exchange Carriers (CLECs), large transport providers such as Level 3, and state alliance co-ops delivering transport in geographic areas. This PSAP network build-out would need to be designed in a redundant environment.

For example, rings could connect one network location to PSAP #1, then PSAP #1 would connect to PSAP #2, then PSAP #2 would connect to PSAP #3, then PSAP #3 would connect back to another network location, completing the ring. Another solution would be to have multiple diverse circuits into each PSAP.

The nature of the IP-enabled network will move traffic in the direction of the most efficient available route. Therefore, should a single circuit fail, an alternate circuit to the PSAP would be available. This design would provide the PSAPs with additional survivability. Smaller routers would need to be installed at the PSAP to receive the IP traffic from the network node.

3.2.2 Backbone

This is the main network infrastructure of this network. This is shown as the cloud on the diagrams in Appendix D. Several network providers will be discussed later in this report.

Regardless of the network used, there are certain recommendations the Kimball team will make regarding functionality. This network should provide redundancy to all points of presence on the network. To use this network for the provisioning of 9-1-1 traffic there is a need to have additional redundancies that a traditional computer network may not have. When choosing a vendor to engineer and provide this network, the selected vendor should have public safety and, in particular, 9-1-1 experience.

This critical infrastructure needs 24x7 monitoring of this network. This network should have monitoring, maintenance, repair, and upgrade/replacement agreements in place. These agreements are commonly referred to as Service Level Agreements (SLAs). These agreements should outline minimal repair times, on-site spare equipment, replacement schedule, and detailed reporting of network usage. Care should be taken as to the type of monitoring being provided. A system of paging people from the network equipment is not recommended.

Again, a proper network study would need to be conducted to identify the proper bandwidth for the network backbone; this bandwidth must support all devices that are connected to the network, including the PSAPs. A cursory look at this indicates that a bandwidth of approximately DS-3 should be examined. This bandwidth should be configured with Quality of Service (QoS) to prioritize the voice traffic on the network.

In a data communications network QoS refers to the ability of a network to provide better service to selected network traffic over various underlying technologies including Frame Relay, Asynchronous Transfer Mode (ATM), Ethernet and 802.1 networks, SONET, and IP-routed networks. QoS is assigned as classifications which define the per data packet characteristics desired by the customer. Each classification is defined to assure the customer with an observable, measurable, and reliable communications path through a network. QoS allows for leverage existing network bandwidth more fully, protecting mission-critical applications, and ensuring the quality of delay-sensitive traffic such as VoIP and streaming media.

In particular, QoS features provide better and more predictable network service by:

- Supporting dedicated bandwidth
- Improving loss characteristics
- Avoiding and managing network congestion
- Shaping network traffic
- Setting traffic priorities across the network

Customers can assign QoS measures per connection, per application, or per traffic type. Generally, QoS is used to provide a guarantee that a certain type of connection will always be available, un-congested, and reliable enough to deliver information to the destination.

Once a customer selects the desired QoS, a SLA is executed between the customer and network provider. This contractual agreement provides for the specific guarantees of a network/protocol to give guaranteed performance, throughput, and latency based on mutually agreed measures.

QoS generally provides techniques for protection of the following

- **dropped packets** - the routers might fail to deliver (drop) some packets if they arrive when their buffers are already full. Some, none, or all of the packets might be dropped, depending on the state of the network, and it is impossible to determine what will happen in advance. The receiving application must ask for this information to be retransmitted, possibly causing severe delays in the overall transmission.
- **delay** - it might take a long time for a packet to reach its destination, because it gets held up in long queues, or takes a less direct route to avoid congestion. Alternatively, it might follow a fast, direct route. Thus, delay is very unpredictable.
- **jitter** - packets from source will reach the destination with different delays. This variation in delay is known as jitter and can seriously affect the quality of streaming audio and/or video.
- **out-of-order delivery** - when a collection of related packets is routed through the internet, different packets may take different routes, each resulting in a different delay. The result is that the packets arrive in a different order to the one with which they were sent. This problem necessitates special additional protocols responsible for rearranging out-of-order packets to an isochronous state once they reach their destination. This is especially important for video and VoIP streams where quality is dramatically impacted by either latency or lack of packet order.
- **error** - sometimes packets are misdirected, or combined together, or corrupted, while en route. The receiver has to detect this and, just as if the packet was dropped, ask the sender to repeat itself.

QoS is defined into common terms such as Gold, Silver, and Bronze. Bronze service class can be thought of as Best Effort, or no classification at all. Silver classification commonly contains differentiated services, while Gold defines guaranteed services as shown in the table below.

Best Effort (BRONZE)	Best-effort service (Bronze) is basic connectivity with no guarantees. This is best characterized by FIFO queues, which have no differentiation between flows
Differentiated (SILVER)	Some traffic is treated better than the rest (faster handling, more average bandwidth, and lower average loss rate). This is a statistical preference, not a hard and fast guarantee.
Guaranteed (GOLD)	This is an absolute reservation of network resources for specific traffic.

This bandwidth should be protected should other users use this network. Prioritizing the use of 9-1-1 is recommended.

Within a QoS-enabled network, traffic can be prioritized to ensure delivery. By instituting prioritization rules, the network can "reserve" the available bandwidth for specific traffic requirements. This type of traffic segmentation can better utilize network connections. In addition, placing a priority measure on traffic can assure a customer that a certain type of communication will get to its destination.

Traffic priority is often defined in terms such as Real-Time, Variable, and Basic. In short, prioritization is a ranking system that ensures the mission critical traffic will be the first to reserve the access available.

Priority is normally broken into types during the implementation of the QoS umbrella. For example, Voice would require a constant amount of bandwidth to maintain consistency across the network. It can be essentially thought of as "circuit emulation" across a packet network. Typical Voice traffic cannot afford any delay, or network related congestion, and must arrive in the order it was sent. Video must have a large amount of bandwidth but can handle a small amount of delay, congestion, and can be re-assembled at the destination. Basic priority is normal network traffic or internet access.

TRAFFIC TYPE	EXAMPLE	REQUIRED BANDWIDTH	DELAY	LATENCY
Constant Rate (REAL-TIME)	Voice	Minimal	Low	None
Variable Rate (VARIABLE)	Video	Guaranteed	Variable	Low
Available Rate (BASIC)	Internet (data)	Not Guaranteed	Widely Variable	High

What this means to the customer is that when Real-Time traffic arrives at the network, it gets handled and delivered first. Real-Time priority ensures that delivery will occur regardless of any

other traffic interference. If the network is congested, Real-Time will still be the first-deliver priority of the router.

3.2.3 Carrier Connectivity

There are eight selective routers in the state of Maryland. Verizon owns these selective routers. The new statewide IP-enabled network will require redundant connectivity to these selective routers to transport 9-1-1 calls to the PSAPs.

Several items will need to be accomplished to accommodate this requirement. For example, establishing cost and ordering processes, bandwidth allocation studies, define connectivity requirements, i.e., port and port charges. This will require negotiations with the LECs and will take time. It is critical that these negotiations start early in the project to accommodate timelines and maintain proper project implementation schedules.

An option to this would be for the State to install its own selective routers and ALI databases. Similar projects have been successful in other states and regions.

A proper network study would need to be conducted to identify the proper bandwidth for each device that will connect to the network backbone. The actual bandwidth should take into account the current needs and the future growth of the network.

The delivery of the 9-1-1 trunks to the new statewide IP-enabled network will typically be in a Centralized Automatic Messaging Accounting (CAMA) format until the selective routers are upgraded or replaced by Verizon. Kimball, for the purposes of this assessment, will assume a CAMA delivery during the initial implementation.

A gateway is the first point of connection to the new statewide network. Used in this location on the network, the gateway would convert CAMA to the native protocol in use in the network. Once this is accomplished, the new statewide network is in receipt of the call, and it is transported to the designated PSAP.

From a technical standpoint, this gateway could be physically located in the LEC central office or on the new statewide network node location. Ultimately, this gateway will be eliminated as the selective routers are upgraded to send calls out in an IP format.

The ALI databases will also need to connect to this network. The mirrored databases will require single circuit connectivity to the network.

Again, a proper network study would need to be conducted to identify the proper bandwidth for each device that will connect to the network backbone. This bandwidth will also be dependent on the method used to deliver the data.

3.3 USE EXISTING STATE INFRASTRUCTURE

3.3.1 Overview

During the data collection process, Kimball asked the various PSAPs of their knowledge of infrastructure in place. In addition, Kimball conducted extensive interviews with the Maryland Institute for Emergency Medical Services System (MIEMSS), and the Maryland State Police (MSP).

Information from these sources was used to develop the options listed for the existing State infrastructure.

3.3.2 Timeline

Based on the overall goal of the Board, the available resources, and the future network plan, a timeline was developed. Each step of the process of the plan is outlined in a fashion that allows for the development of milestones.

These milestones will be stand-alone points where the Board can adjust the process if needed, without losing the benefit of the work that has been completed. This will allow the most flexibility to complete the project.

3.3.3 Cost Projections

As a result of the future network plan, costs associated with the plan were developed. These costs are budgetary in nature, and often are based on assumptions. These assumptions will be listed with the costs in the “Findings” and “Recommendations” sections of this report.

3.4 USE LEASED FIBER AND CIRCUITS

3.4.1 Overview

Kimball used various internet resources, experience from other similar projects, and existing relationships to identify available resources in Maryland. These resources provided limited information on their networks. They were willing to develop network engineering for a fee.

These resources were explained as available options.

3.4.2 Timeline

Based on the overall goal of the Board, the available resources, and the future network plan, a timeline was developed. Each step of the process of the plan is outlined in a fashion that allows for the development of milestones.

These milestones will be stand-alone points where the Board can adjust the process, if needed, without losing the benefit of the work that has been completed. This will allow the most flexibility to complete the project.

3.4.3 Cost Projections

As a result of the future network plan, costs associated with the plan were developed. These costs are budgetary in nature, and often are based on assumptions. These assumptions will be listed with the costs in the "Findings" and "Recommendations" sections of this report.

3.5 USE A TRANSPORT SERVICE PROVIDER

3.5.1 Overview

Based on experience from similar projects, Kimball developed a network plan of using a transport service provider to provide the network connectivity to the various points needed. This network was based on diverse redundant connections to each PSAP and connectivity to each selective router and ALI database.

3.5.2 Timeline

Based on the overall goal of the Board, the available resources, and the future network plan, a timeline was developed. Each step of the process of the plan is outlined in a fashion that allows for the development of milestones.

These milestones will be stand-alone points where the Board can adjust the process, if needed, without losing the benefit of the work that has been completed. This will allow the most flexibility to complete the project.

3.5.3 Cost Projections

As a result of the future network plan, costs associated with the plan were developed. These costs are budgetary in nature, and are based on information provided by Verizon.

4. FINDINGS

This information is presented without interpretation or analysis. Due to the nature of this as a planning document, not all sections will have findings, as they are future plans, not current findings.

4.1 CURRENT INFRASTRUCTURE

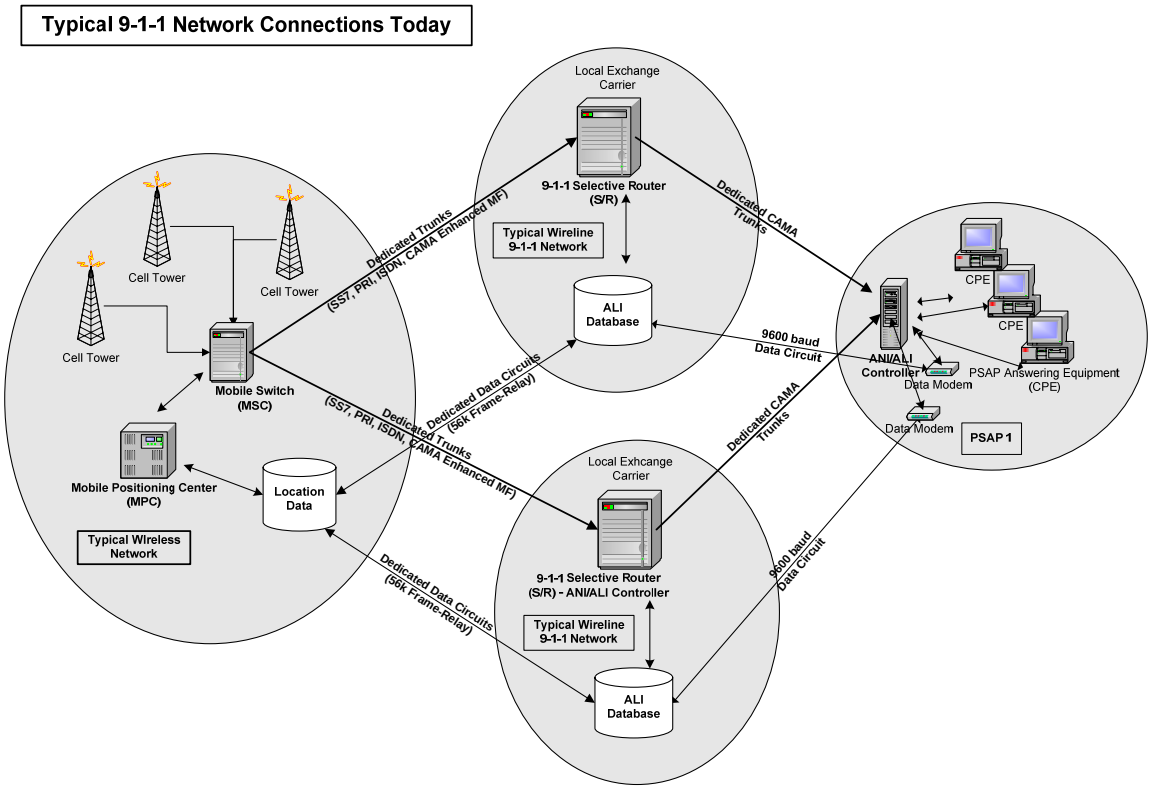
4.1.1 PSAPs

As is the case throughout the country, the PSAPs in Maryland exist and are created based on local needs and desires. Service is provided at the municipal and county level in conjunction with the serving LEC. All 24 counties have 9-1-1 service. There are 24 primary PSAPs and 72 secondary PSAPs. Of these secondary PSAPs, 23 are run by the MSP.

All 24 PSAPs are currently receiving wireless Phase II information. However, only a few of the secondary PSAPs receive any of the data information, and even fewer have the capability of rebidding for data once the caller is transferred to them.

Most primary PSAPs indicated that they transfer calls to their secondaries over the Public Telephone system. This method does not allow for the transfer of ALI information to the secondary. Several primary PSAPs indicated they had the ability to fax the ALI information to the secondary PSAP, but this would not allow the secondary to rebid wireless ALI.

Each PSAP has, on average, three secondary PSAPs to which they send calls. In most cases, the MSP is one of those secondary PSAPs.



A PSAP or 9-1-1 system with enhanced 9-1-1 service must have equipment with specialized functionality. This equipment is generally referred to as 9-1-1 CPE. In most cases, CPE is purchased or leased from the manufacturers or from the LEC. This equipment provides, at a minimum, for the display of the caller or subscriber's name, physical location, call back number, and the police, fire, and emergency medical services that serve the caller's location.

It is generally agreed that 9-1-1 CPE has a lifecycle of seven years. However, because of the rapid development of new communications technologies and services, CPE lifecycles may be shorter in the future.

About 42 percent of the PSAP CPE is owned by LECs and leased to the PSAPs. Verizon is responsible for the vast majority of leased equipment. About 58 percent of the equipment is owned by the PSAPs.

Plant Equipment manufactures the overriding majority of the PSAP's CPE equipment. Only three PSAPs currently are using another telephony vendor and of that, two are looking at replacement/procurement to occur in 2007, and the last remaining PSAP is ready to award a contract for a Siemens' IP phone solution.

The majority are utilizing the Plant Equipment's Orion Mapping solution, with a few doing call plotting on their CAD system instead.

CAD equipment seemed to be the most varied among the PSAPs with a spectrum of one county not operating a CAD system, a few operating a DOS solution CAD system and the majority are Windows-based solutions. A few of the PSAPs either are currently in negotiations for or are looking at procuring a new CAD system in the immediate future.

The majority of PSAPs use Mercom Audiolog as their logging recorder; a few uses NICE equipment; and a couple utilizes CVDS.

The two radio consoles used most by the PSAPs were Motorola Gold Elite or MA/COM Mystro.

Evacuation procedures for the most part are handled by the PSAPs directly with switches located either at the primary PSAP or at their back-up PSAP locations.

Noteworthy is the back-up system that Talbot, Caroline, and Queen Anne counties use. They have created a regional approach, with all being connected on a network. All three have the ability to handle the other two's calls; Talbot and Queen Anne are arranged with full capabilities of not only phone but radio and CAD as well.

4.1.2 Infrastructure

Verizon provides all 9-1-1 service in Maryland to all primary PSAPs and several secondary PSAPs. Verizon, likewise, provides ALI database services. Verizon is also the primary provider of maintenance of the PSAP's CPE equipment.

Verizon has four sets of dual selective routers throughout the state. Each LATA has a pair of selective routers to provide service to the PSAPs in that LATA. Each PSAP then connects to two selective routers of the pair providing service to their area.

Verizon has two mirrored ALI databases. These databases are in geographically diverse locations. These ALI databases are located at Fairland, Maryland and Freehold, New Jersey and are connected across the SS7 network. Each PSAP has connections to both ALI databases for diversity and redundancy. All PSAPs are receiving their data in the Maryland State NENA Format 2.1.

4.1.3 Maryland ENSB

The funding mechanism used by the Board is focused on reimbursing counties for the "cost of enhancing a 9-1-1 system." These costs have traditionally been training and capital costs of equipment. This funding mechanism was established by the Maryland Legislature to assist with the delivery of 9-1-1 service to the state of Maryland.

4.2 NEXT GENERATION NETWORK

There is no Next Generation network in place in Maryland today. There are a few IP networks in place. These networks will be described in later sections.

4.3 USE EXISTING STATE INFRASTRUCTURE

As a start to the process of developing a next generation 9-1-1 network, the state should look to identify all the existing systems currently within the state. The following are the systems that the Kimball team was able to identify in the state. Not all of these may be appropriate for use in the system, but during the design process, additional information should be gathered from these systems.

4.3.1 Microwave Systems

In addition to some local systems managed by a few counties in the State, Kimball has identified four large microwave systems in the state of Maryland. They are:

- The Public Safety Network
- Network Maryland
- Maryland Public Television Network
- The Sailor Network

The Public Safety Network is a 28 T-1 system with some 130 hops, with more hops on the way.

The Network Maryland system is on the eastern shore with a three DS-3 capacity.

The Maryland Public Television Network is up but not fully deployed at this time.

The Sailor Network is in place connecting all the libraries in the state together and, when completed, will connect to all the county seats.

All of these systems were designed all or in part by the staff at the MIEMSS.

4.3.2 Fiber Optic Facilities

Kimball has identified several fiber routes in the state of Maryland, much of which is managed and installed by Maryland Department of Transportation (MDOT). There are four fibers available for use to the Public Safety Infrastructure Technical Committee.

Some of the fiber routes identified run from Baltimore I-83 and Route 40 West, I-95 to Elkton, I-97 to Baybridge, and Route 50 to Route 301 to Virginia. It is our understanding that many more routes are planned by MDOT for construction. The intrastate systems in the state of Maryland could prove to be an asset for the PSAP community in the future.

4.3.3 Network Plans

In interviews with the MSP and MIEMSS, they indicated several of these systems would be used for projects that are currently underway. One of these projects is the Statewide Radio system that is being implemented. This new radio system will make use of the Fiber network as well as the microwave networks.

The MSP also indicated that they had plans to migrate several systems they have to these networks. MSP currently has several leased T-1 circuits they would like to replace with these existing networks.

A detailed network assessment of current usage and future plans will need to be conducted on these networks.

4.4 USE LEASED FIBER AND CIRCUITS

Various providers are able to provide fiber connectivity for a next generation network. The state of Maryland has four large companies with fiber optics networks located in the right of ways primarily on the interstate systems in Maryland. These companies are:

- Abovenet
- Looking Glass
- Level 3
- Fiberlight

Please see Appendix C for a route map. Note: Fiberlight is not represented on the route map.

4.5 USE A TRANSPORT SERVICE PROVIDER

Various providers can be contacted to provision the next generation network. Each option may have several possible providers. Caution must be used to ensure that the provider's solution will meet the rigorous requirements of a 9-1-1 system, and a standard computer network is not proposed.

The Board has the option to use one or several of these providers to establish and maintain the network.

<u>Third Party Providers</u>
The network can use third party networks and providers. These providers can be commercial or public entities that have invested in the infrastructure needed, and have additional bandwidth to lease or use.

The state has several CLECs. These companies are certified to provide local exchange telephone services in the state. These companies are actively offering services to the public.

If these carriers are facilities based, they may be considered as a candidate for providing backbone or partial backbone networks to facilitate 9-1-1 services. These companies offer other services such as last mile connectivity, point-to-point circuits, and possibly ATM and MultiProtocol Label Switching (MPLS).

Current 9-1-1 Service Provider

The current 9-1-1 provider, Verizon, has the established relationships with the PSAPs and network capabilities to provide the network. Verizon is the dominant LEC throughout the state of Maryland. For that reason, Verizon is able to cover all of the locations required with network access. The Verizon network is designed to allow for the "triple play" convergence (voice, video and data).

In early 2006, Verizon completed a merger with MCI launching Verizon Business. Verizon Business combines the strengths of MCI's IP platform (formerly UUNET) with Verizon's access network. The result is a deep blend of services and a wide range of product options. This unmatched full service approach allows Verizon to remain the leader throughout the territory.

Cable Company Fiber Optic Network Transport

Throughout the state of Maryland, cable providers have been enhancing their networks to provide converged voice, video, and data on a single network. Many of these networks are sufficiently designed to support IP-enabled services. Network configurations also connect to the dominant LEC and can provide access to the public telephone system.

Cable TV (CATV) providers mainly design their networks using dense wave division multiplexing (DWDM) or coarse wave division multiplexing (CWDM). CWDM and DWDM are typically designed much like a Synchronous Optical NETwork (SONET). Primary and secondary paths are used to "protect" the network in the event of a failure or outage. Within the wave division multiplexing, services are provisioned across a passive optical network (PON).

In the state of Maryland, the coverage from CATV providers is somewhat sporadic. While CATV is a very functional and well-designed solution, gaps in coverage area limit the effectiveness for specific customer applications. There may be areas where CATV could supplement services from other network providers but for the state of Maryland CATV transport is not recommended as a primary network provider.

All of the above options should be considered as candidates to deliver a uniform, standardized, IP-enabled 9-1-1 network in the state of Maryland.

5. IMPLEMENTATION OPTIONS

There are several solutions, timelines, methodologies, and pricing structures to consider in planning for an IP-based 9-1-1 network. Listed below are examples of various options that are capable of routing wireless, wireline and VoIP traffic to PSAPs, some of which may be offered through RFP responses.

- Do Nothing
- Turn Key Solution
- Transport Network
- Private Network

The Board has the option to select one or several of these options. As explained in the Methodology section, there are several parts of the network. As an example, the carrier connectivity could be a transport network provided by the 9-1-1 service provider Verizon, and the backbone from a third party provider. The basic options are below.

Do nothing. Doing nothing is a consideration. Maintaining the status quo is certainly an option the Board could consider. Doing nothing incurs no additional expenses to the current costs of providing 9-1-1 service in the state. Doing nothing results in no changes in the way business is conducted. There is nothing new to learn, and there is nothing that needs to be considered. Doing nothing has no impact fiscally or operationally to the current system.

Doing nothing, however, fits the adage of nothing ventured, nothing gained. The goals of the Board will not be achieved. The benefits of a Next Gen 9-1-1 system will not be realized. The PSAPs of the State will be limited in technologies that are available and the State itself cannot claim to be in tune to meeting public expectations. A recent article in a public safety magazine sums it best. The title of the articles was “Migrate or Stagnate.”

Turn Key Solution. Another design option to consider is one in which a single vendor offers a “turn key” solution. “Turn key,” meaning the one vendor will serve as the system provider in its entirety, wholly and conclusively. There will be no coordinating by the Board or staff. Turn key vendors offer a one-stop shop for all things that make up the system, to include design, engineering, procurement, provisioning, installation, testing, and operation. Additionally, a turn key vendor provides for the necessary databases, system monitoring, and maintenance.

Turn key vendors solutions are often the choice of entities seeking system wide coordination, project management, and technical consulting. The benefits include minimal staff resources for system oversight. The staffs’ primary engagement is participating in monthly status meetings with the vendor. The status meetings cover everything from billing, to issue resolution, to maintenance, to discussing statistical reports and system performance. This model approach requires the least participation of staff due to the fact the vendor takes care of everything under a negotiated contract for services. If staff desire is to have a “hands-off” approach, this offering will likely be attractive.

The disadvantage to a turn key system would be pricing. Because you are paying for someone to take on all responsibilities from migration to maintenance, the price tag may be higher than other solutions listed below.

Transport Network. Transport network is a solution option where the customer (in this case the State Board and staff) may take on the responsibility to provide or contract certain elements of the system and have other elements provided by one or more other vendors. This is sort of a semi-turn key system. Examples of this model would be where the Board agrees to purchase the required equipment and arranges for the placement and installation of the components. The Board could additionally obtain the services of a database vendor, a maintenance vendor, and a vendor to provide for monitoring, troubleshooting and repair. The Board may choose to provide for everything necessary except the network or transport medium.

The transport medium is under separate contract with a data transport provider that has an existing network in place and may have other types of traffic currently on the network. A transport network provides for the required bandwidth the customer needs to move traffic from point A to point B. An example of a transport network might be a telephone company that has digital network in place and uses this network to transport data for a number of customers, such as banks, stock trading, utility companies, etc. Due to the large capacity of the network and the number and type of existing customers, utilization of bandwidth might be a great deal less than the network is capable. In this case, the network provider may offer the unused and available bandwidth as an option to transport 9-1-1 calls and data.

Using this example, the Board may find it prudent to contract for use of this network but take on the responsibility of connectivity by the PSAPs in the State through other means and utilize still other means for maintenance and support.

This scenario may or may not require the purchase of selective routers. If the chosen data transport vendor is a LEC or facilities-based CLEC, the routers may already be in place, leaving only the necessity for connectivity and to provision circuits from the PSAP to the network and other providers having a serving selective router.

In most cases, these companies all use an optical technology to increase bandwidth over existing backbones. These networks can transmit IP, ATM, and Ethernet data. These networks typically handle bit-rates between 100 MBPS and 2.5 GBPS. Some technologies used in these networks allow for up to an OC-192 to be transmitted over the same fiber optic strand.

The advantage of this type of system would be a network does not have to be provided for or built by multiple vendors nor is it necessary to design or engineer a new network. A network is already in place and operating. The PSAPs just need to be connected by installing the necessary connectivity components, which may include CPE upgrades or replacement.

A disadvantage to this type of system may include security concerns because other traffic may share the transport medium. Additionally, it will require several such smaller networks to make a statewide network. There may be concerns from one or more of the smaller transport providers to connect to other providers; again, security being the main concern.

Private Network. The Board has the option of provisioning a private network. This system would require the identification of various fiber optic cable (dark fiber) sources. Separate, long-term contracts could be negotiated for the number of strands necessary to support the traffic through multiple fiber cable sources. A series of fiber rings would be provisioned with connectivity from ring to ring until the entire state is covered and access is established to all PSAPs. The same needs as listed in the above networks would remain. There would still remain selective routers to purchase as well as various types of connectivity cards, PSAP upgrades, and circuits.

The advantage of this type system is it is custom built to serve a client's special needs. It is scalable and can grow, as client's needs increase. It can be built to be totally secure and dedicated for specific private traffic.

The disadvantages of this system are the requirements of many contracts with multiple vendors. The client would likely be responsible for each element of the system. For everything a turn key system is, a private network is just the opposite. If staff is available to administer contracts, manage projects, and provide implementation oversight for the network, then the impact is lessened. If staff resources are at issue, this is not a logical choice.

There are companies that lease dark fiber. Route maps for some of these networks can be found in Appendix C.

5.1 CURRENT INFRASTRUCTURE

5.1.1 PSAPs

5.1.1.1 Customer Premise Equipment

PSAP CPE is a subject open to many interpretations. Most CPE vendors have a product that they advertise as a next generation system. The capability of each system needs to be evaluated closely. Many of these systems have limited IP capabilities, or have future plans to add IP capabilities to the equipment. The term "capable" does not always mean that the function is available in a particular installed system.

For this report, Kimball examined the CPE currently in use at the PSAPs, and examined their capabilities to use the envisioned IP network. Using the network is defined as having the ability to directly connect to the IP network to receive 9-1-1 calls.

The telephone CPE that is currently in use at the PSAPs in Maryland is not capable of receiving calls from an IP network at this time. This equipment falls into several categories.

Vendor	Model	Sites	Counties
Plant/CML	Vesta Pallas	9	Caroline, Carroll, Cecil, Dorchester, Garrett, Kent, Talbot, Washington, Wicomico
Plant/CML	M-1	5	Anne Arundel, Charles, Harford, Montgomery, Prince Georges
Plant/CML	Vesta	5	Frederick, Queen Annes, Somerset, St Marys, Worcester
Plant/CML	DMS (Nortel)	2	Baltimore City, Howard
CML	ECS1000	1	Calvert
Siemens		1	Baltimore County
Motorola		1	Allegany

5.1.1.1.1 Vesta Pallas/M-1

The overall majority of equipment is Plant/CML equipment. The first group of equipment is the Vesta M-1 and Vesta Pallas models. There are 14 Primary PSAPs in Maryland using this equipment:

- Anne Arundel
- Caroline
- Carroll
- Cecil
- Charles
- Dorchester
- Garrett
- Harford
- Kent
- Montgomery
- Prince George's
- Talbot
- Washington
- Wicomico
- Ocean City (Back Up)

This equipment does not have the capability at this time to connect to an IP network for the delivery of calls. There are three options to connect this current CPE to the envisioned IP network. One of these options must be done to connect to the IP Network. Upgrade or replacement will need to be completed before the PSAP will be able to fully benefit from the new network.

Upgrade existing equipment. In a presentation to the Maryland PSAP community on October 30, 2006, representatives from Plant/CML stated that the equipment would be capable in

the future with the installation of new modules. There was no estimation of when these new modules would be available.

Install a gateway. A gateway will convert the IP connection to a CAMA trunk line to connect into the existing CPE. This will cost approximately $21,000 for each PSAP, with the exception of Anne Arundel, Montgomery, and Prince George, which have more 9-1-1 trunks, and they will cost approximately $25,000 for each PSAP.

Replace CPE. The last option would be to replace the CPE with equipment that can connect to the IP Network. This equipment is fairly new on the market, and there are at least three systems with this ability that Kimball is aware of. Manufacturers are updating their product line frequently, and this number will be growing. This would cost approximately $50,000 to $70,000 per position depending on the options chosen.

5.1.1.1.2 Vesta DMS

The next group of CPE in use at the PSAPs is a Plant/CML Vesta DMS. There are two PSAPs in Maryland using this equipment:

- Baltimore City
- Howard

This equipment is a central office based CPE. This means that the connection to an IP network, must be coordinated through Verizon.

Upgrade existing equipment. In a presentation to the Maryland PSAP community on October 30, 2006, representatives from Plant/CML stated that the equipment would be capable in the future with the installation of new modules. There was no estimation of when these new modules would be available.

Replace CPE. The last option would be to replace the CPE with equipment that can connect to the IP Network. This equipment is fairly new on the market, and there are at least three systems with this ability that Kimball is aware of. Manufacturers are updating their product line frequently, and this number will be growing. This would cost approximately $50,000 to $70,000 per position depending on the options chosen.

5.1.1.1.3 Vesta

The third group of CPE is the PSAPs with a Plant/CML Vesta. There are five primary PSAPs in Maryland using this equipment.

- Frederick
- Queen Anne
- St. Mary
- Somerset
- Worcester
- Annapolis (Back Up)

This has a computer telephone integrated (CTI) workstation, but an analog phone switch. The Vesta workstations should be able to function on an IP network the same as the above section, but

the phone switch would need to be replaced with a switch capable of connecting to the IP Network.

There are three options to connect these PSAPs to the envisioned IP network.

Upgrade existing equipment. In a presentation to the Maryland PSAP community on October 30, 2006, representatives from Plant/CML stated that the equipment would be capable in the future with the installation of new modules. There was no estimation of when these new modules would be available.

Install a gateway. A gateway will convert the IP connection to a CAMA trunk line to connect into the existing CPE. This will cost approximately $21,000 for each PSAP.

Replace CPE. The last option would be to replace the CPE with equipment that can connect to the IP Network. This equipment is fairly new on the market, and there are at least three systems with this ability that Kimball is aware. Manufacturers are updating their product line frequently, and this number will be growing. This would cost approximately $50,000 to $70,000 per position, depending on the options chosen.

5.1.1.1.4 Other

Calvert County has an ECS-1000 from Plant/CML. This is a high end phone switch that has been used as a selective router in other locations. This type of switch is in use in several of the current IP-enabled networks today. The Calvert County ECS-1000 will require some upgrades to connect to the IP network. These upgrades will cost approximately $60,000

Allegany County has a Motorola Centralink CPE. This is an older phone system and is not upgradeable to receive calls from an IP Network. This system will need to be replaced when its life cycle ends. As a short-term solution, a gateway can be installed to convert the IP to CAMA trunks. This will cost approximately $21,000. Then when the CPE is due to be replaced, a newer IP-enabled system can be installed. In the data collection process the PSAP stated that they plan to replace this CPE.

Baltimore County has recently received approval by the Board for funding to upgrade their current CPE. During the funding process, the question of the ability to operate on a new IP network was discussed. The process of contract negotiations is still ongoing but is to include this function. This new system should be prepared to connect to the envisioned IP network when installed.

The PSAP community has raised the issue of the secondary PSAP's ability to receive ALI information. Addressing this issue is both a financial and local authority question. The recommendation of Kimball is to continue to work towards a solution that is a benefit to the public, the PSAPs, and the Board. The Next Generation network may open additional opportunities to solve this.

5.1.1.2 Back Up PSAPs

During the data collection process, the PSAPs surveyed presented conflicting information as to the back-up PSAPs they used. Several have arrangements with another PSAP and others use a secondary PSAP. Still others have a back-up PSAP in another location that is standing by.

The Board should establish rules for back up PSAPs. These PSAPs should have equipment to connect to the IP network and process calls for service. This should be located in a geographically remote location from the primary PSAP. The Board may wish to encourage these back-up sites be a staffed location to reduce the time that calls are not answered.

Once a definitive list of back-up PSAPs is established, the costs to connect them to a network can be established. In general, this will cost $50,000 to $70,000 per workstation of CPE needed and connection charges of $1,500 a month. Annapolis and Ocean City, which Kimball has information on, are addressed above.

5.1.1.3 Secondary PSAPs

Secondary PSAPs should be connected to the statewide network once the build out is complete and all primary PSAPs are connected. Each secondary PSAP should have a connection to the network using an IP connection. The options for this are listed in the "Network Options" section.

To accomplish this, Kimball recommends each primary PSAP develop connectivity to their secondary PSAPs. This will allow for better local control, and flexibility. The primary PSAP would also be able to provide workstations off their CPE to transfer calls. The cost of this for the 49 secondary PSAPs that do not belong to MSP is about $4,900,000. This is based on two workstations at $50,000 for each of the 49 secondary PSAPs.

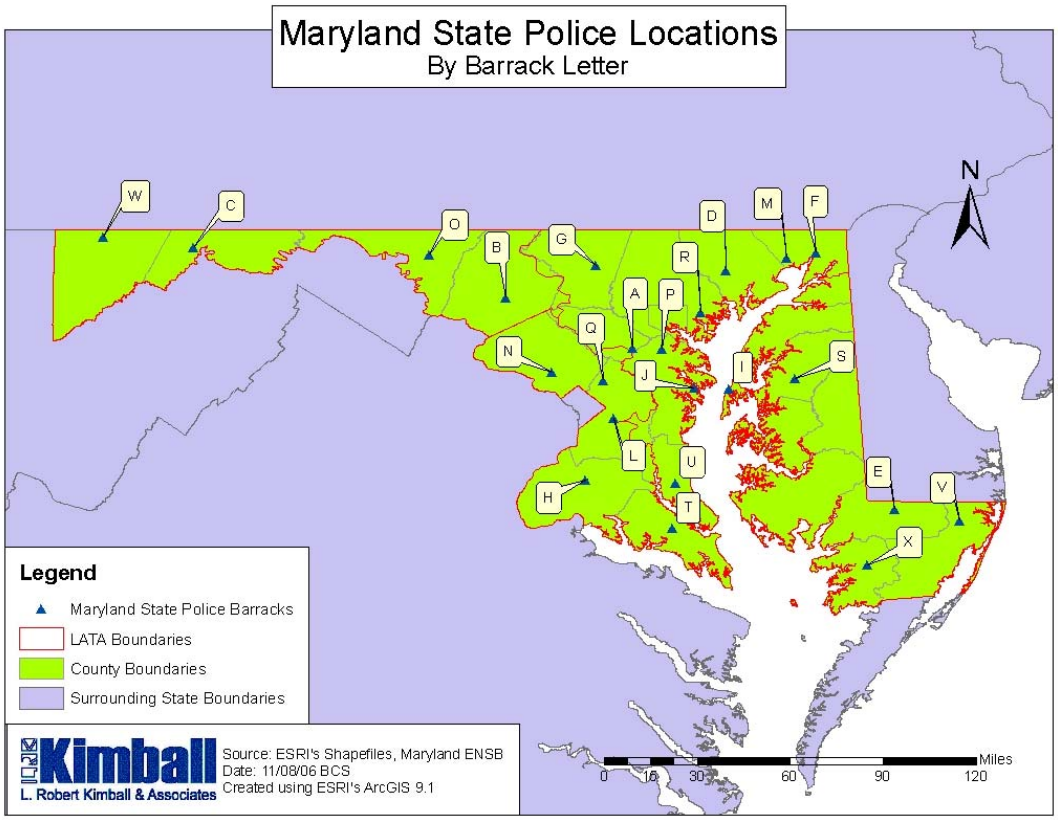
5.1.1.4 State Agencies (MSP, DNR)

In addition, the MSP should examine the possibility of putting at least two 9-1-1 CPEs (ANI/ALI Controller - back room equipment) into operation. They can then run remote workstations to each state agency answering point in the state. This will allow access to the 9-1-1 system to the State agencies, and may also provide some other benefits such as interconnectivity between agencies, sharing of telephone assets, and emergency back up capabilities for these agencies.

Additionally, the possibility of installing four CPEs may be considered for diversity. The installation of a 9-1-1 CPE in each area serviced by a Verizon selective router pair will allow them to receive calls from the primary PSAP with Automatic Number Identification (ANI) and ALI information directly. This will also allow them to rebid ALI information on wireless Phase II calls.

From these CPE systems, any state agency like the MSP, Department of Natural Resources (DNR), and others will be able to connect to the 9-1-1 system with a remote workstation.

Implementation of four CPE systems in place with two workstations at each MSP dispatch center will cost approximately $2,000,000 for CPE and equipment and $1,500 per month for each location.



5.1.2 Infrastructure

5.1.2.1 Selective Routers

Kimball recommends that selective router and ALI database locations be reviewed by the State in relationship to potential natural and man-made hazards. This may have been done as a part of homeland security assessments in the past. The 9-1-1 infrastructure is critical infrastructure to the public safety in Maryland, and should be protected as such. Appendix B has a map of potential natural hazards in the area.

Verizon has not reported the selective routers capabilities. These should be upgraded to allow them to connect directly to the statewide network with native IP. The cost of this would need to be negotiated with Verizon.

Until the selective routers can be upgraded, they can be connected to the statewide network using a gateway to convert the CAMA signaling to IP. To accomplish this, a gateway or several would need to be installed.

Each selective router should be connected to the network. Because these are already using a mated router solution, they would not require diverse and redundant connections to the network for each location. Due to the traffic load for each selective router, the bandwidth requirements for each will be high. A detailed traffic study should be performed, but this connection can start with a DS3 level connection as a baseline.

5.1.2.2 ALI Databases

The current ALI databases are mirrored databases so they can function independently if needed. They would require a single connection to the statewide network. A detailed traffic study should be performed, but this connection can start with a DS1 level connection as a baseline.

These databases capabilities have not been fully reported by Verizon. They have stated that the ALI databases are currently IP capable.

This would be a good use for the network in the early phases of implementation. Using the network for ALI would eliminate the need for each PSAP to have two dedicated data circuits to receive ALI.

5.2 NEXT GENERATION NETWORK

Maryland has a robust 9-1-1 network today. Next Generation 9-1-1 is the next technology coming to the PSAPs. The Board has identified that this is the direction it wants to go. To fully implement NG9-1-1 the Board needs to develop a clear vision and goals. These will guide the entire implementation process.

5.2.1 Vision and Goals

The Boards vision statement:

> *The Emergency Number Systems Board is dedicated to ensuring Maryland's 9-1-1 system remains robust and responsive to the public-safety needs of our citizens and visitors. The Board is committed to providing fiscally responsive funding to maintain a technological advanced 9-1-1 system staffed with appropriately trained emergency operators providing access to emergency services. Through a partnership with the 9-1-1 community, the Board will provide leadership and guidance for Maryland to be recognized nationally for excellence in providing 9-1-1 service*

This vision provides direction and continuity to the board. A project vision statement is needed to present a global picture of how the Board would like to see the Next Generation 9-1-1 technologies be developed and used to accomplish the goals of the Board in keeping with their existing vision.

This vision is a global picture of what the Board wants to accomplish with this specific 9-1-1 project. An example of a vision statement would be:

> *The Maryland ENSB seeks to deliver calls for help with the associated data to the appropriate PSAP regardless of the method used by the public to place that call. To accomplish this, the Board will coordinate a statewide network to connect all PSAPs in the state, and support the purchase of equipment to connect to this network within the limits of its statutory authority.*

From this vision, goals can be established. Examples of some goals are:

- Implement a statewide IP network that connects each PSAP in the state
- Establish CPE equipment standards for connection to the statewide network
- Connect the existing selective routers and ALI databases to the statewide network
- Deliver 9-1-1 calls with ANI and ALI over the statewide network
- Support the upgrade of the statewide network as new standards and technologies are developed

The major questions that the Board should decide are:

- Do we want to proceed with a Next Generation 9-1-1 system?
- Do we want to deliver 9-1-1 calls over the envisioned network?
- Do we share this network with other agencies for other purposes?
- Do we want to route ALI over the network?
- Do we want to own or lease the network?
- Do we manage or contract for management of the network?

5.2.2 Proposal Process

The backbone of a Next Generation 9-1-1 system is an IP network. There are various types of systems and mediums that are used to provide these networks. In this report, Kimball has identified some of the available options to provide the network for the NG9-1-1 system. In order to provide the best solution for the Board, Kimball recommends the Board use a proposal process to get input from more providers.

This process involves having a RFI or a RFP published. Various entities that have these capabilities would propose their best solution to meet the goals and specifications listed in this report and the RFI or RFP.

This process will allow those entities that may have unique solutions or better pricing to present its ideas so that the Board can make enhancements to their goals.

5.2.3 Solution Providers

In the findings section, we list several available solution providers. The Next Generation 9-1-1 system opens up the opportunity to use providers other than the traditional telephone providers. This makes the available pool of possible vendors much larger.

There are companies that will provide just the medium such as fiber or wire, and companies that provide just the network connectivity or maintenance. The Board has the option of using one or several of these providers to provide transport and maintenance.

5.3 USE EXISTING STATE INFRASTRUCTURE

5.3.1 Overview

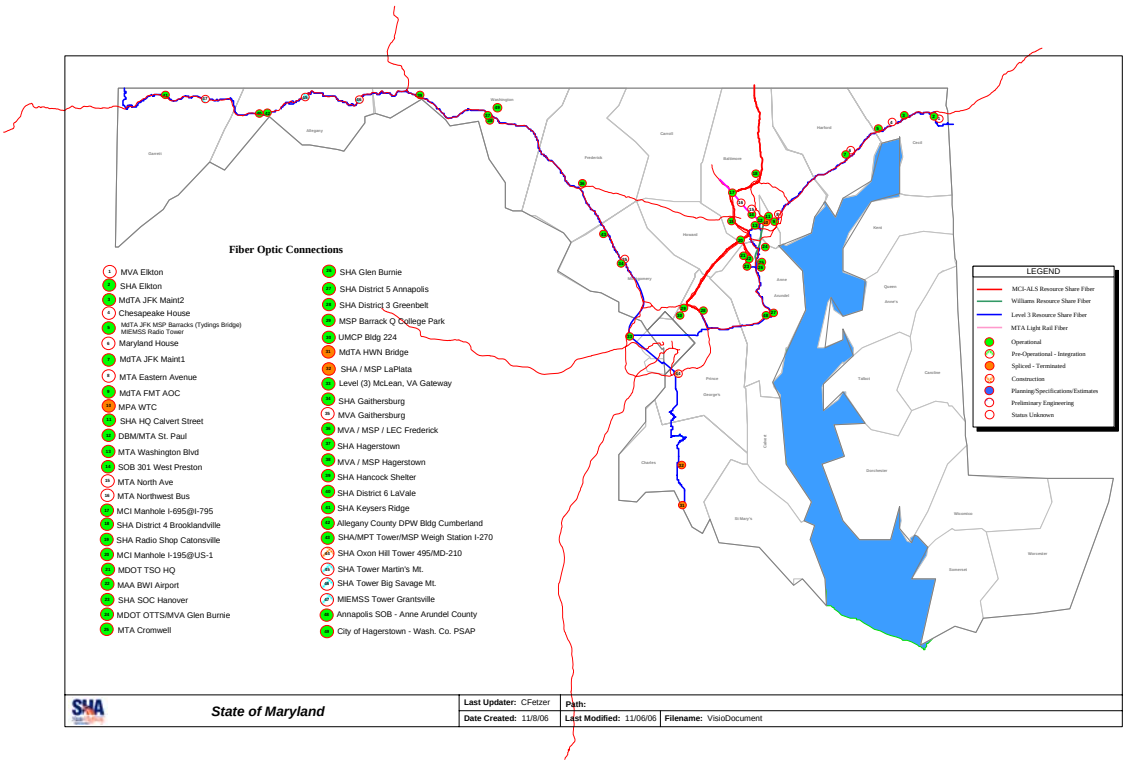
The state of Maryland's new 9-1-1 network can be built using two major state assets. One is the MDOT fiber network managed by the State Highway Administration (SHA). Currently there is several hundred miles of fiber optic cable in the highway right of ways in the state. Through agreements with MCI-ALS, Williams Communications, Level 3 and MTA Light Rail Fiber a network is in place. The majority of this fiber network has not been lit. There is, however, one segment in the northwestern part of the state that has been lit and is being utilized for one of the existing radio network services connectivity. This is a shared network and will be used to connect offices and tower sites throughout Maryland. The counties with fiber facilities are:

- Garrett
- Allegany
- Washington
- Frederick
- Montgomery
- Baltimore
- Cecil
- Harford
- Anne Arundel
- Prince George's
- Charles
- Howard
- Baltimore City

The counties without fiber facilities are:

- Carroll
- Kent
- Queen Anne's
- Talbot
- Caroline
- Dorchester
- Calvert
- St. Mary's
- Somerset
- Wicomico
- Worcester

Please find drawing of MDOT fiber optic network below:

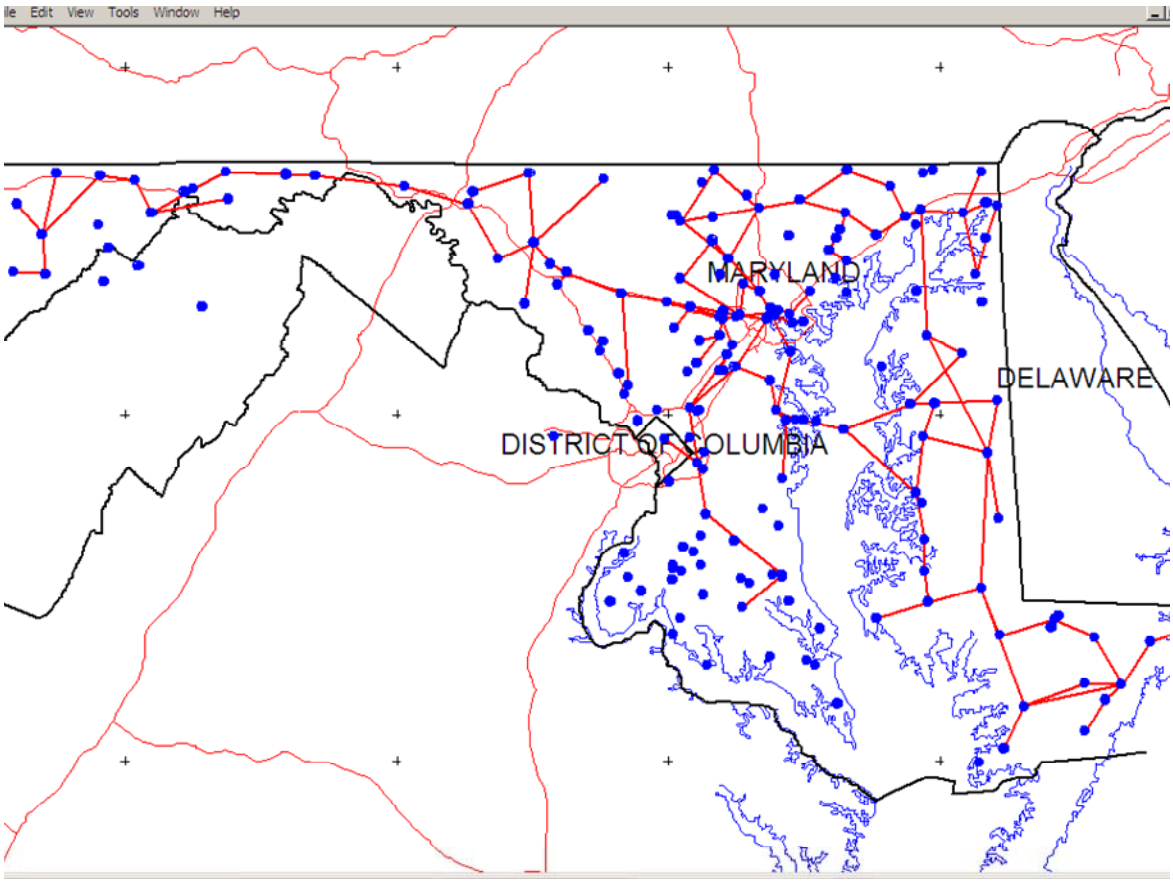


The Maryland DOT network has four shared purposes. Connectivity for "Network Maryland," MDOT Enterprise Network including the Interstate System Cameras, Resource Sharing – used for leasing revenue to pay for the network, and four dedicated strands of fiber are included for Public Safety services. These four strands could be used in a shared environment for the delivery of 9-1-1 calls. The only PSAP known at this time to have direct access with this fiber network is Baltimore City.

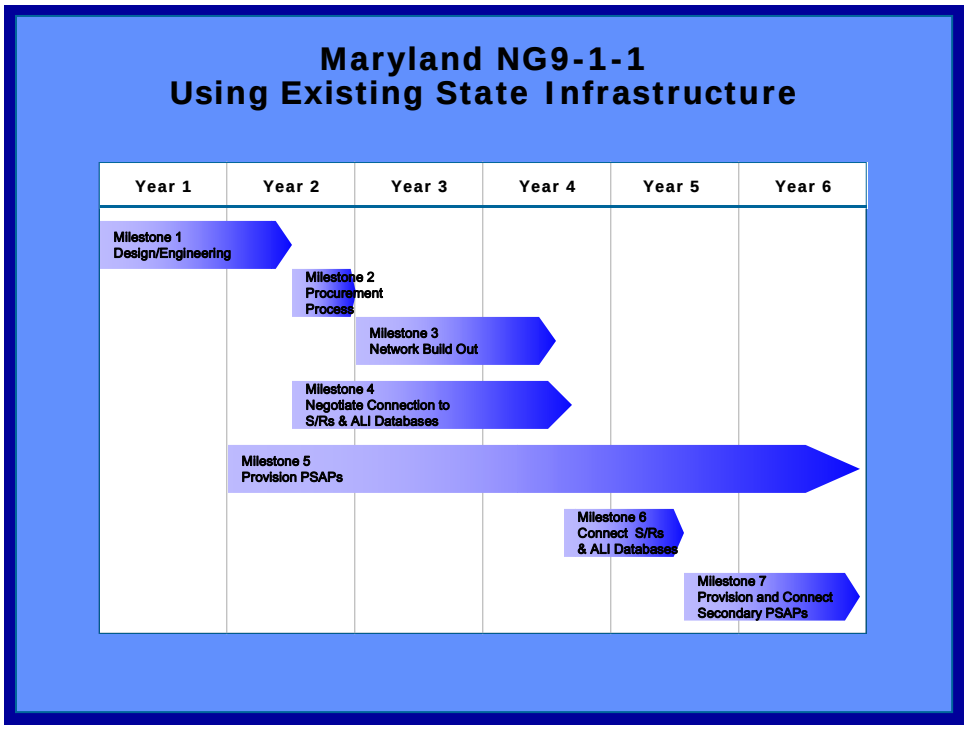
The existing fiber optic network either has 49 connection points in place today or planned. Should these connection points be suitable for co-location of equipment they could serve as a point for the connection to the LECs and the PSAPs. The installation of circuits at the desired and required bandwidth from the LECs' tandems would serve as the delivery of traffic to the bandwidth available on the shared Public Safety strands.

One method to gain access to the PSAPs is to use the second asset the State currently has in operation. That is the Public Safety Intranet (PSI). Kimball appreciates the cooperation from MIEMSS regarding the description and access procedures of the PSI network found in Appendix E.

Please find the Public Safety Intranet network map below:



5.3.2 Timeline



Milestone 1 – 12 to 18 Months
Design and Engineering

The first step to implementing this solution would be to engage MIEMSS in the design and engineering of the system. The systems have detailed requirements and standards to be met to operate on these systems. See Appendix E for the procedures for the Public Safety Network.

Milestone 2 – 3 to 6 Months
Procurement Process

As defined above, the systems have detailed requirements for equipment. These devices are available on state contract, so the procurement process will be streamlined.

Milestone 3 – 12 to 24 Months
Network Build Out

This milestone is the building out of the network that provides access to all users and providers. The network, or specifically the transport medium, is most likely digital and IP-enabled. The network receives the benefits of redundancy; and the speed of moving traffic is greatly increased. The network is now ready to accommodate new technologies, growth, and provide for interoperability, including the delivery of 9-1-1 calls to the PSAPs at a later date. This stage of implementation provides a good infrastructure to begin routing 9-1-1 traffic.

Simultaneously during this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment and funding mechanisms for capitol costs should be established.

Milestone 4 –Up to 2 Years
Negotiate connection to LEC Infrastructure

During this milestone, the State should begin the process of negotiating with Verizon. The system will need connectivity to selective routers and ALI databases. A request for engineering and required bandwidth analyses should be started at this time. Actual completion of ordering, provisioning, and installation of connectivity to the selective routers would need to be completed in a timely manner in Milestone 6.

The provisioning of the 9-1-1 infrastructure to a Next Generation network will take time and cooperation with all of the parties involved in the network. To help facilitate this, Kimball encourages the Board begin the negotiations process early with Verizon.

These negotiations will help explain the expectations of the Board, and the work required to accomplish the goals of the project. This will also allow the providers to understand the goals and to identify issues early in the process to allow adjustments to the network. By understanding the goals of the Board and the limitations of the providers, a better solution will be produced.

Milestone 5 – Recurring up to 7 Years
Provision the Primary PSAPs to be IP-enabled.

Simultaneously during all phases of this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment should be established.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to IP-enabled CPE. After the PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

Milestone 6 – 6 to 12 Months
Connect to each of the LEC's selective routers and ALI databases.

This action will enable all 9-1-1 traffic to flow from the selective routers through the statewide IP-enabled network, terminating at the appropriate PSAP. The benefits of the IP network are realized. Now the traffic is digital from end to end. At this stage is when massive amounts of data can be moved across the network from PSAP to PSAP. Data applications can be introduced into the 9-1-1 system such as GIS map data, imagery, video, e-mail, instant messaging, and other similar data files. The speed of moving data from point A to point B is fully realized. Statewide transfers of voice and data are possible as well as all the other benefits of an IP-enabled network solution that have been previously mentioned.

At the completion of this stage is also where telematics, On-Star, ACN, and other real-time information sources can be introduced into the system. At this stage is also the opportunity to work with other public safety agencies and discuss sharing bandwidth (interoperability). Emergency management agencies, police agencies, fire departments, sheriffs, and homeland security agencies can participate and utilize the network for a variety of overlapping needs.

Examples are sharing images such as mug shots, maps, building plans, fire hydrant locations, and a host of various types of pictures, drawings, and images. The PSAP can send information directly to a mobile data terminal in a police car or a fire truck. A dedicated private e-mail system can be put in place between agencies. Video can be shared across participating agencies. Instant text messaging and many other forms of communicating with one another and across agencies are other possibilities. Interoperability between agencies is one of the more attractive features of an IP network.

Milestone 7 – Up to 18 Months
Provision the secondary PSAPs to be IP-enabled and connect them to the network.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to IP-enabled CPE. After the secondary PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

Secondary PSAPs equipment standards should be examined. While secondary PSAPs may not require complete 9-1-1 systems, the network design may support stand-alone workstations connected to the network. If this is not supported, the State should examine the use of workstations served off of the primary PSAPs.

Due to the nature of this network, geographic distances are not a factor. Secondary PSAPs could be hosted off of another PSAP anywhere in the state. One option would be to use the regional back up centers as the host, and then the equipment would be in place in an emergency.

5.3.3 Cost Projections

To estimate the exact equipment needed for this network would require site surveys of each of the co-location points and site surveys of the PSAPs. It is possible the co-location facility have state owned router already in place and therefore an additional router may not be required.

The equipment required for such a network would encompass but not be limited to the following gear:

Description	Quantity	Cost
Cisco 7206 Router	5	$250,000
T-1 Cards	10	$50,000
Cisco 3845 Router	30	$660,000
SM SFP card	40	$120,000
WIC cards	120	$120,000
	Total	**$1,200,000**

This cost is only an estimate for equipment charges and would need to be verified and confirmed through a design and engineering process.

There can be several costs involved in the preparation of an RFI or RFP. The major cost would be to prepare the document. Should a consulting firm be used to prepare these documents, this should cost approximately $150,000.

In addition, there may be additional cost to a state procurement agency, for review and publication of the document in compliance with state procurement rules.

The costs associated with procurement support also fall into several areas. Procurement support is assisting with the pre-bid meetings, answering proposal questions, and evaluating responses. If a consultant firm is used to assist in these procurement procedures, the cost is approximately $100,000. There may be additional cost for copying, postage, and facilities to hold meetings for the procurement meetings.

There will be limited, one-time costs with this network if the Board chooses to use a third party vendor. If the Board works with existing networks within the State, there will be equipment needed, but each case will be dependent on the network used.

Should the Board request project management support, this would cost about $500,000.

5.4 USE LEASED FIBER AND CIRCUITS

5.4.1 Overview

Another option for the Board to consider is the use of independent fiber optic networks in the state of Maryland. Some providers of fiber optics allow for the lease of “dark” fiber. This means that fiber can be leased without the necessary equipment to deliver telecommunication services. Dark fiber is an option, but additional cost would be involved in “lighting” or creating a network.

Typically, the fiber is leased through an agreement called an Indefeasible Right to Use (IRU) agreement. These agreements are long term in nature and may be 15 year to 30 or more years in term length. IRUs are made to stay in place without change and legal negotiation must take place for each and every element of the agreement. Some of the very specific requirements and mechanisms are (but not limited to); description of segment being leased, count of the fiber, binder color, number of strands, length of the segment, maintenance requirements, etc. An IRU is

typically a wholesale agreement and is usually unique with regard to pricing. Some IRUs might charge by the mile and others by the segment. In addition to these costs, the need for co-location is necessary to install equipment to light and define transport. It is not an uncommon requirement for co-location facilities be place every 60 miles along a segment.

The state of Maryland has four large companies with fiber optics networks located in the right of ways primarily on the Interstate Systems in Maryland. These companies are:

- Abovenet
- Looking Glass
- Level 3
- Fiberlight

Please see Appendix C for a route map. Note: Fiberlight is not represented on the route map.

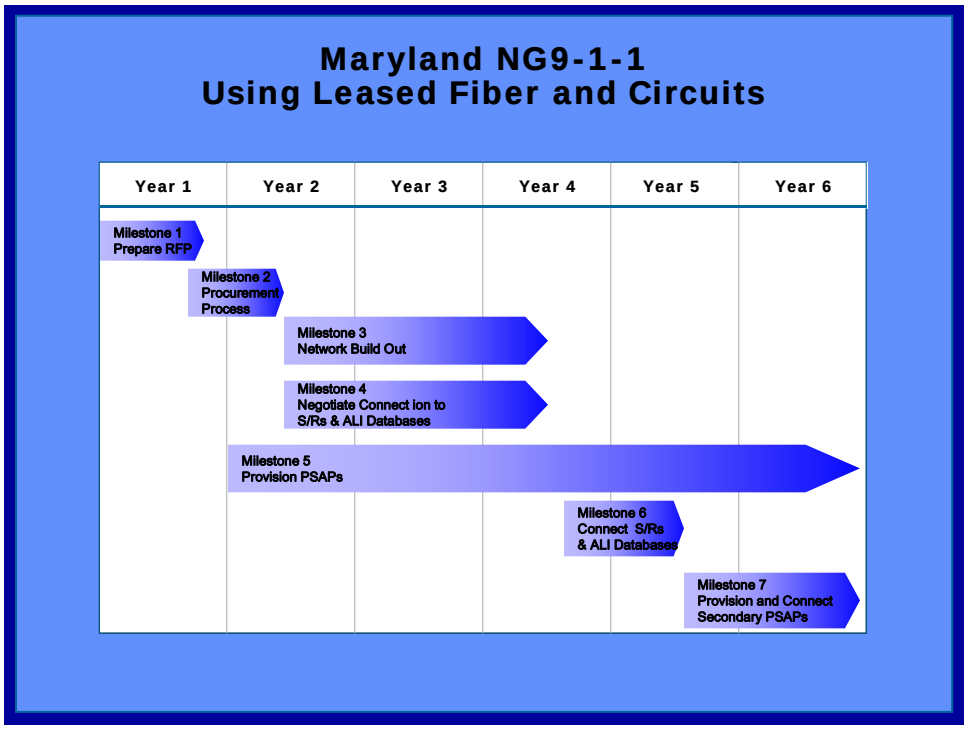
Other than the listed Fiber Optic Network providers in the state, the gas companies, power/utility companies, railroad companies, and cable television companies might also have available fiber optic facilities in the state. The fact is, any company with access to the right of ways in the state of Maryland may have fiber optic facilities available for long-term, wholesale lease.

These companies have managed to parallel each to some degree and partner with others to facilitate the routes they have. One example is the partnership that one or two of them have made with the state of Maryland and the MDOT. For access to the right of way, the companies would provide fiber in certain routes. This is, in fact, where some of the existing fiber that is now available for use by the state has come from.

The Board has the option to lease dark fiber from anyone or all of these three companies.

With much of the state having four strands of fiber dedicated to public safety, to establish an IRU with one of the above mentioned companies is not recommended. However, this is an option to consider during a network design phase, should the need arise where a fiber optic segment is needed to complete a ring or establish connectivity in a critical area, or a specific segment may be needed to complete a desired path.

5.4.2 Timeline



Milestone 1 – 6 to 9 Months
Prepare a Request for Proposals (RFP)

The process of deploying a Next Generation network has many possible solutions. Most of the various options will work with proper provisioning. To allow the State to benefit from the best pricing and allow available vendors in the area the flexibility to explain the options that they can provide, Kimball recommends the State prepare a RFP.

The RFP process will allow several vendors, or even groups of vendors, to provide their solutions to provision the Next Generation network. This can result in new and unique solutions to be considered.

Milestone 2 – 3 to 6 Months
Procurement Process - Release the RFP, review the responses, and negotiate the contract

The procurement process involves several steps. Once the RFP is released, there is usually a meeting to review the RFP with interested parties. At this meeting, and during subsequent meetings and correspondence, there are questions that arise from the RFP. Answering these questions to allow all parties to have the same information is important.

Once the responses are returned, the reviewing of each response against the RFP requirements is done. This could entail a scoring process of yes or no, or a rating based on percentage.

Once the final selection is made, the contract is then negotiated. This process can be drawn out, and all items required in the RFP, and items presented in the response that the State wishes to use, need to be included in the contract.

Milestone 3 – 12 to 24 Months
Network Build Out

This milestone is the building out of the network that provides access to all users and providers. The network, or specifically the transport medium, is most likely digital and IP-enabled. The network receives the benefits of redundancy; and the speed of moving traffic is greatly increased. The network is now ready to accommodate new technologies, growth, and provide for interoperability, including the delivery of 9-1-1 calls to the PSAPs at a later date. This stage of implementation provides a good infrastructure to begin routing 9-1-1 traffic.

Simultaneously during this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment and funding mechanisms for capitol costs should be established.

Milestone 4 –Up to 2 Years
Negotiate Connection to LEC Infrastructure

During this milestone, the State should begin the process of negotiating with Verizon. The system will need connectivity to selective routers and ALI databases. A request for engineering and required bandwidth analyses should be started at this time. Actual completion of ordering, provisioning, and installation of connectivity to the selective routers would need to be completed in a timely manner in Milestone 6.

The provisioning of the 9-1-1 infrastructure to a Next Generation network will take time and cooperation with all of the parties involved in the network. To help facilitate this, Kimball encourages the Board begin the negotiations process early with Verizon.

These negotiations will help explain the expectations of the Board, and the work required to accomplish the goals of the project. This will also allow the providers to understand the goals, and to identify issues early in the process to allow adjustments to the network. By understanding the goals of the Board and the limitations of the providers, a better solution will be produced.

Milestone 5 – Recurring up to 7 Years
Provision the Primary PSAPs to be IP-Enabled.

Simultaneously during all phases of this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment should be established.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to

IP-enabled CPE. After the PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

During Milestone 5, the negotiations required to connect to the LECs selective routers should continue.

Milestone 6 – 6 to 12 Months
Connect to each of the LEC's selective routers and ALI databases.

This action will enable all 9-1-1 traffic to flow from the selective routers through the statewide IP-enabled network, terminating at the appropriate PSAP. The benefits of the IP network are realized. Now the traffic is digital from end to end. At this stage is when massive amounts of data can be moved across the network from PSAP to PSAP. Data applications can be introduced into the 9-1-1 system such as GIS map data, imagery, video, e-mail, instant messaging, and other similar data files. The speed of moving data from point A to Point B is fully realized. Statewide transfers of voice and data are possible as well as all the other benefits of an IP-enabled network solution that have been previously mentioned.

At the completion of this stage is also where telematics, On-Star, ACN, and other real-time information sources can be introduced into the system. At this stage is also the opportunity to work with other public safety agencies and discuss sharing bandwidth (interoperability). Emergency management agencies, police agencies, fire departments, sheriffs, and homeland security agencies can participate and utilize the network for a variety of overlapping needs.

Examples are sharing images such as mug shots, maps, building plans, fire hydrant locations, and a host of various types of pictures, drawings, and images. The PSAP can send information directly to a mobile data terminal in a police car or a fire truck. A dedicated private e-mail system can be put in place between agencies. Video can be shared across participating agencies. Instant text messaging and many other forms of communicating with one another and across agencies are other possibilities. Interoperability between agencies is one of the more attractive features of an IP network.

Milestone 7 – Up to 18 Months
Provision the secondary PSAPs to be IP-enabled and connect them to the network.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to IP-enabled CPE. After the secondary PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

Secondary PSAPs equipment standards should be examined. While secondary PSAPs may not require complete 9-1-1 systems, the network design may support stand-alone workstations connected to the network. If this is not supported, the State should examine the use of workstations served off of the primary PSAPs.

Due to the nature of this network, geographic distances are not a factor. Secondary PSAPs could be hosted off of another PSAP anywhere in the state. One option would be to use the regional back-up centers as the host, and then the equipment would be in place in an emergency.

5.4.3 Cost Projections

The cost of Independent fiber is unknown and is typically unique to the proprietary IRUs that are established.

There can be several costs involved in the preparation of an RFI or RFP. The major cost would be to prepare the document. Should a consulting firm be used to prepare these documents, this should cost approximately $150,000.

In addition, there may be additional cost to a state procurement agency, for review and publication of the document in compliance with state procurement rules.

The costs associated with procurement support also fall into several areas. Procurement support is assisting with the pre-bid meetings, answering proposal questions, and evaluating responses. If a consultant firm is used to assist in these procurement procedures, the cost is approximately $100,000. There may be additional cost for copying, postage, and facilities to hold meetings for the procurement meetings.

There will be limited, one-time costs with this network if the Board chooses to use a third party vendor. If the Board works with existing networks within the State, there will be equipment needed, but each case will be dependent on the network used.

Should the Board request project management support, this would cost about $500,000.

5.5 USE A TRANSPORT SERVICE PROVIDER

5.5.1 Overview

A transport service provider can be a one-stop shop for this network. These providers can often provide the network as well as the required monitoring. There are many of these providers, and this also allows for the opportunity to have competition to possibly reduce prices.

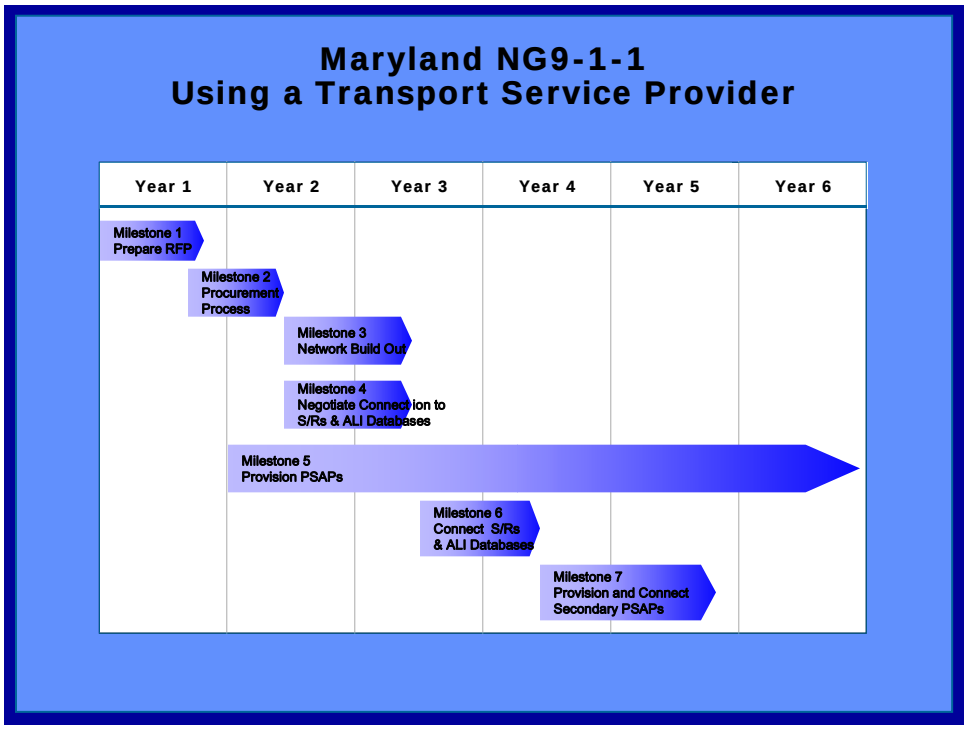
The Board could also use more then one provider to provide various parts of the network and maintenance. The network can be one of several network types. Several types of networks are described in Appendix D.

For the purpose of this report, several stipulations were made. The first is that each primary PSAP would connect to the network with two diverse circuits. This provides protection of the circuits to the PSAP.

Secondly, the selective routers are paired so only one circuit for each would be needed. The ALI databases are the same. Being mirrored databases, a single circuit is all that is needed.

One of the major advantages of this type of solution is they are often quicker to establish. Much of the backbone is in place prior to starting the project in most cases.

5.5.2 Timeline



Milestone 1 – 6 to 9 Months
Develop a Request for Proposal (RFP)

The process of deploying a Next Generation network has many possible solutions. Most of the various options will work with proper provisioning. To allow the State to benefit from the best pricing and allow available vendors in the area the flexibility to explain the options that they can provide, Kimball recommends the State prepare a RFP.

The RFP process will allow several vendors, or even groups of vendors, to provide their solutions to provision the Next Generation network. This can result in new and unique solutions to be considered.

Milestone 2 – 3 to 6 Months
Procurement Process - Release the RFP, review the responses, and negotiate the contract.

The procurement process involves several steps. Once the RFI is released, there is usually a meeting to review the RFI with interested parties. At this meeting, and during subsequent meetings and correspondence, there are questions that arise from the RFI. Answering these questions to allow all parties to have the same information is important.

Once the responses are returned, the reviewing of each response against the RFI requirements is done. This could entail a scoring process of yes or no, or a rating based on percentage.

Once the final selection is made, the contract is then negotiated. This process can be drawn out, and all items required in the RFI, and items presented in the response that the State wishes to use, need to be included in the contract.

Milestone 3 – 6 to 12 Months
Network Build Out

This milestone is the building out of the network that provides access to all users and providers. The network, or specifically the transport medium, is most likely digital and IP-enabled. The network receives the benefits of redundancy; and the speed of moving traffic is greatly increased. The network is now ready to accommodate new technologies, growth, and provide for interoperability, including the delivery of 9-1-1 calls to the PSAPs at a later date. This stage of implementation provides a good infrastructure to begin routing 9-1-1 traffic.

Simultaneously during this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment and funding mechanisms for capitol costs should be established.

Milestone 4 –Up to 2 Years
Negotiate Connection to LEC Infrastructure

During this milestone, the State should begin the process of negotiating with Verizon should they not be selected as the vendor. The system will need connectivity to selective routers and ALI databases. A request for engineering and required bandwidth analyses should be started at this time. Actual completion of ordering, provisioning, and installation of connectivity to the selective routers would need to be completed in a timely manner in Milestone 6.

The provisioning of the 9-1-1 infrastructure to a Next Generation network will take time and cooperation with all of the parties involved in the network. To help facilitate this, Kimball encourages the Board begin the negotiations process early with Verizon.

These negotiations will help explain the expectations of the Board, and the work required to accomplish the goals of the project. This will also allow the providers to understand the goals and to identify issues early in the process to allow adjustments to the network. By understanding the goals of the Board and the limitations of the providers, a better solution will be produced.

Milestone 5 – Recurring up to 7 Years
Provision the Primary PSAPs to be IP-Enabled.

Simultaneously during all phases of this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment should be established.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to

IP-enabled CPE. After the PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

During Milestone 5, the negotiations required to connect to the LECs selective routers should continue.

Milestone 6 – 6 to 12 Months
Connect to each of the LEC's selective routers and ALI databases.

This action will enable all 9-1-1 traffic to flow from the selective routers through the statewide IP-enabled network, terminating at the appropriate PSAP. The benefits of the IP network are realized. Now the traffic is digital from end to end. At this stage is when massive amounts of data can be moved across the network from PSAP to PSAP. Data applications can be introduced into the 9-1-1 system such as GIS map data, imagery, video, e-mail, instant messaging, and other similar data files. The speed of moving data from point A to Point B is fully realized. Statewide transfers of voice and data are possible as well as all the other benefits of an IP-enabled network solution that have been previously mentioned.

At the completion of this stage is also where telematics, On-Star, ACN, and other real-time information sources can be introduced into the system. At this stage is also the opportunity to work with other public safety agencies and discuss sharing bandwidth (interoperability). Emergency management agencies, police agencies, fire departments, sheriffs, and homeland security agencies can participate and utilize the network for a variety of overlapping needs.

Examples are sharing images such as mug shots, maps, building plans, fire hydrant locations, and a host of various types of pictures, drawings, and images. The PSAP can send information directly to a mobile data terminal in a police car or a fire truck. A dedicated private e-mail system can be put in place between agencies. Video can be shared across participating agencies. Instant text messaging and many other forms of communicating with one another and across agencies are other possibilities. Interoperability between agencies is one of the more attractive features of an IP network.

Milestone 7 – Up to 18 Months
Provision the secondary PSAPs to be IP-enabled and connect them to the network.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to IP-enabled CPE. After the secondary PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

Secondary PSAPs equipment standards should be examined. While secondary PSAPs may not require complete 9-1-1 systems, the network design may support stand-alone workstations connected to the network. If this is not supported, the State should examine the use of workstations served off the primary PSAPs.

Due to the nature of this network, geographic distances are not a factor. Secondary PSAPs could be hosted off another PSAP anywhere in the state. One option would be to use the regional back-up centers as the host, and then the equipment would be in place in an emergency.

5.5.3 Cost Projections

There can be several costs involved in the preparation of an RFI or RFP. The major cost would be to prepare the document. Should a consulting firm be used to prepare these documents, this should cost approximately $150,000.

In addition, there may be additional cost to a state procurement agency, for review and publication of the document in compliance with state procurement rules.

The costs associated with procurement support also fall into several areas. Procurement support is assisting with the pre-bid meetings, answering proposal questions, and evaluating responses. If a consultant firm is used to assist in these procurement procedures, the cost is approximately $100,000. There may be additional cost for copying, postage, and facilities to hold meetings for the procurement meetings.

There will be limited, one-time costs with this network if the Board chooses to use a third party vendor. If the Board works with existing networks within the State, there will be equipment needed, but each case will be dependent on the network used.

Should the Board request project management support, this would cost about $500,000.

Verizon offered a network platform consisting of an ATM backbone with ATM based T-1 connectivity to each PSAP, the eight tandems, and their ALISA database. This infrastructure would support data communications across the ATM core network.

Verizon proposed ATM solution does not include measures for QoS. One feature of QoS is to allow for traffic prioritization across the network. This will allow for voice grade circuits to have Real Time access to the available bandwidth to ensure consistent voice transmission across IP-based networks. With its network, Verizon would allow the Committed Access Rate (CAR) to drive a measure of QoS for Voice traffic over ATM. While similar to VoIP, Verizon stated that Voice over ATM can be delivered today to the tandems.

A T-1 or DS-3 access will terminate on a Smart Jack off whatever facility is available at the PSAP. Verizon also recommended that a T-1 could be connected over copper or a litespan if one exists at the site. In the case of a DS-3, a litespan or similar device would already exist and the circuits could be wired directly to the litespan itself.

Any CPE required to terminate to the existing LAN is not included in the quote and would be an additional Non Recurring Charge (NRC) to the PSAP. A common Cisco device such as a 2811 or 2851 could be installed if needed. These cost approximately $20,000 each. The Verizon ATM network can support both copper and fiber, limiting the necessity for fiber availability throughout the State.

The circuit costs are shown in the table below. In this cost estimation each site would have two ATM-based circuits from the Verizon network. A charge for disaster recovery is also included.

PSAP	DS1s Recommended	Estimated Cost One Time Fee	Estimated Cost Yearly
Allegany Co. Emerg. Mgmt. & Civil Def. Agency	1	$400.00	$91,992.00
Anne Arundel Co. Police Dept.	3	$1,200.00	$247,896.00
Baltimore County	2	$800.00	$156,624.00
Baltimore City Police Dept., Comm. Div.	4	$1,600.00	$311,328.00
Calvert Co. Dept. of Pub. Safety & Srv.	1	$400.00	$94,632.00
Caroline Co. Dept. Emergency Mgt.	1	$400.00	$91,272.00
Carroll Co. Emergency Service	1	$400.00	$85,032.00
Cecil Co. Emerg. Mgmt. & Civil Def. Ag.	1	$400.00	$87,912.00
Charles Co. 9-1-1 Comm. Center	1	$400.00	$84,792.00
Dorchester Co. 9-1-1Emergency Services	1	$400.00	$89,832.00
Frederick Co. Emerg. Operation Ctr.	1	$400.00	$78,792.00
Garrett Co. Emerg Operations Ctr.	1	$400.00	$101,592.00
Harford Co. Emerg. Operations	1	$400.00	$83,352.00
Howard Co. Emerg. Comm. Ctr.	2	$800.00	$164,784.00
Kent Co. Emergency Mgt.	1	$400.00	$98,232.00
Montgomery Co. Police Comm. Ctr.	2	$800.00	$156,624.00
Prince George's Co. Emerg. Comm. Ctr.	2	$800.00	$165,264.00
Queen Anne's Emerg. Services	1	$400.00	$95,352.00
Somerset Dept. of Emerg. Services	1	$400.00	$85,032.00
St. Mary's Co. Emerg. Mgt.	1	$400.00	$88,872.00
Talbot Co. Emerg. Mgt. Agency	1	$400.00	$84,312.00
Washington Co. Fire & Rescue Comm.	1	$400.00	$85,032.00
Wicomico Co. Emergency Services Div.	1	$400.00	$78,792.00
Worcester Co. 9-1-1 Center	1	$400.00	$85,512.00
TOTAL		**$13,200.00**	**$2,792,856.00**

Multiple DS-1 or T-1 circuits should be combined. Connectivity should be purchased in bandwidth rather then T-1 circuits. Rather than three different T-1 paths, a single 4 Mbps connection could be purchased. Verizon is known to offer these services and so do other providers.

Selective routers and ALI databases would also need to have ATM-based connectivity. Cost for the selective router and ALI database connectivity was not provided and are estimated from the

information presented by Verizon. Bandwidth to these tandems was estimated from the trunk information for each tandem.

Tandem Location	Bandwidth Recommended	Estimated One time Costs	Estimated Annual Costs
Cumberland, MD	2 T-1	1,658.00	$98,232.00
Ellicott City, MD	11 T-1 (DS-3)	3,504.00	$233,508.00
Rockville, MD	5 T-1	4,145.00	$236,580.00
Salisbury, MD	4 T-1	3,316.00	$179,664.00
Hyattsville, MD	5 T-1	4,145.00	$236,580.00
Chestertown, MD	4 T-1	3,316.00	$179,664.00
Pikesville, MD	11 T-1 (DS-3)	3,504.00	$233,508.00
Keyser, WV	2 T-1	1,658.00	$98,232.00
	TOTAL	**$25,246.00**	**$1,495,968.00**

Database Location	Bandwidth Recommended	Estimated One time Costs	Estimated Annual Costs
Fairland, MD	T-1	$400.00	$101,592.00
Freehold, NJ	T-1	$400.00	$101,592.00
	TOTAL	**$800.00**	**$203,184.00**

5.6 POTENTIAL ISSUES

Operational and technical issues may arise at the State level and the PSAP level. The State may have to provide for operational oversight of the system, including maintenance, something it does not have to do at present. To the extent that LECs continue to have a role in the provisioning of certain functions, such as ALI database and selective routing, there will be coordination issues to negotiate and integrate into operational practices.

If LECs do not continue to have a role in one or the other of these functions, then the State will have to organize itself to assume those responsibilities. PSAP personnel may require additional training to handle the new types of information that an IP-enabled network could deliver to them and the new functionality that it could make possible.

Connecting the selective routers to the IP-enabled network may be an issue with some carriers. Traditional tariffs and telephone company rules have included language that allows a LEC to limit equipment that is connected to their network. This was put in place in the past to prevent damage to the network. These rules may create problems in implementing the IP-enabled network.

The capabilities of these selective routers are also an issue. These selective routers can be enabled to transport their calls out in an IP format. This will reduce the need for additional gateways in the network. This should be discussed with the LECs early in the process.

Like the selective routers, ALI database connectivity may become an issue. The carriers that maintain them may not allow them to be connected to the IP-enabled network. In addition, the ALI databases may require new software or equipment to allow it to be connected to the network.

The assessment found that several PSAPs in Maryland lease their CPE. A detailed review of the lease agreements for the PSAP CPE should be performed. Some lease agreements have been used in the past to prevent the equipment from being connected to networks that are not provided by the leasing company.

Often systems expect to save money by using an IP-enabled network for 9-1-1. This can be the case, but sometimes it is not. This may result in costs shifting from one area to another.

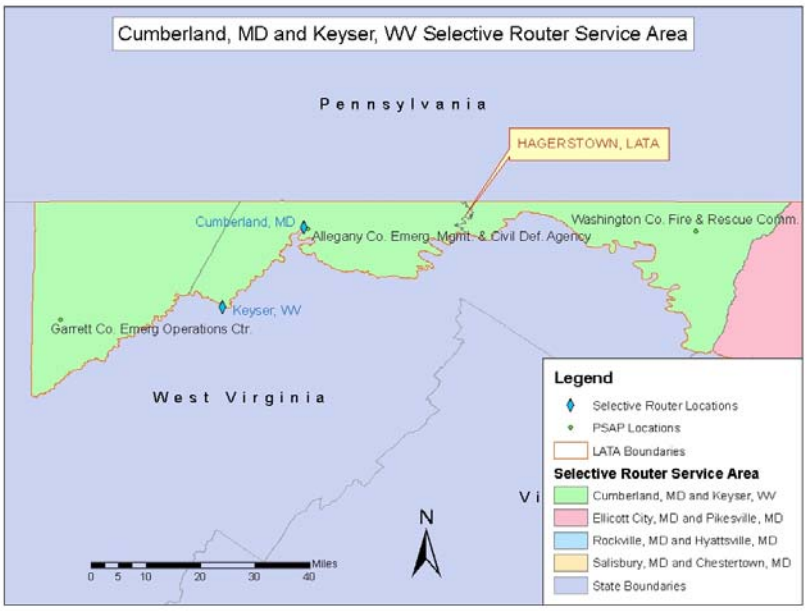
Many, if not all, of these issues can be mitigated with negotiations with the various LECs. Most issues can be resolved with an agreement outside of the existing tariffs. Negotiations with the LECs should start as early as possible.

Once the issues of getting the 9-1-1 calls onto the network, and connectivity to the PSAP have been solved, the PSAP still needs to be able to accept these formats. PSAP equipment must be upgraded over time. There are ways to use the existing equipment, but this should be a short-term solution.

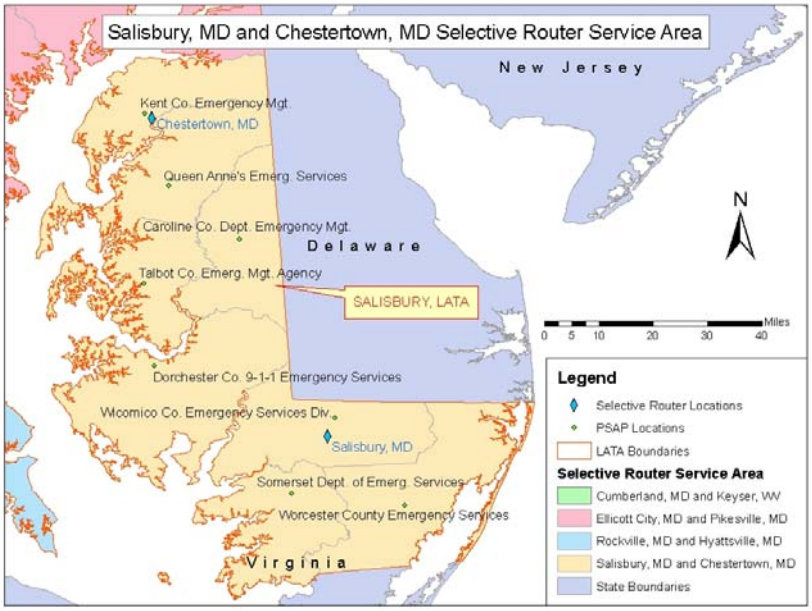
5.6.1 Alternate Implementation Plan

An alternative schedule to the State would be to use the milestones described above but segment them into regions. An example would be to connect all PSAPs connected to a mated selective router pair then connect those selective routers. Once that is completed, repeat the process for another selective router pair.

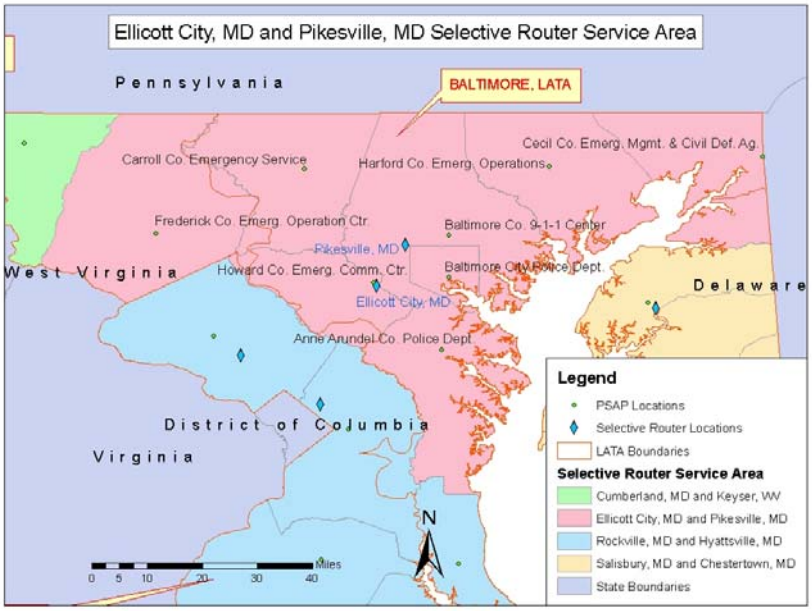
The recommend solution would be to begin in the northwest corner of the state. This is the smallest region in the state. This would connect three PSAPs and two selective routers to the network.


Cumberland, MD and Keyser, WV Selective Router Service Area
Pennsylvania
HAGERSTOWN, LATA
Cumberland, MD
Allegany Co. Emerg. Mgmt. & Civil Def. Agency
Washington Co. Fire & Rescue Comm.
Keyser, WV
Garrett Co. Emerg Operations Ctr.
West Virginia
Legend
Selective Router Locations
PSAP Locations
LATA Boundaries
Selective Router Service Area
Cumberland, MD and Keyser, WV
Ellicott City, MD and Pikesville, MD
Rockville, MD and Hyattsville, MD
Salisbury, MD and Chestertown, MD
State Boundaries
N
Miles
0 5 10 20 30 40

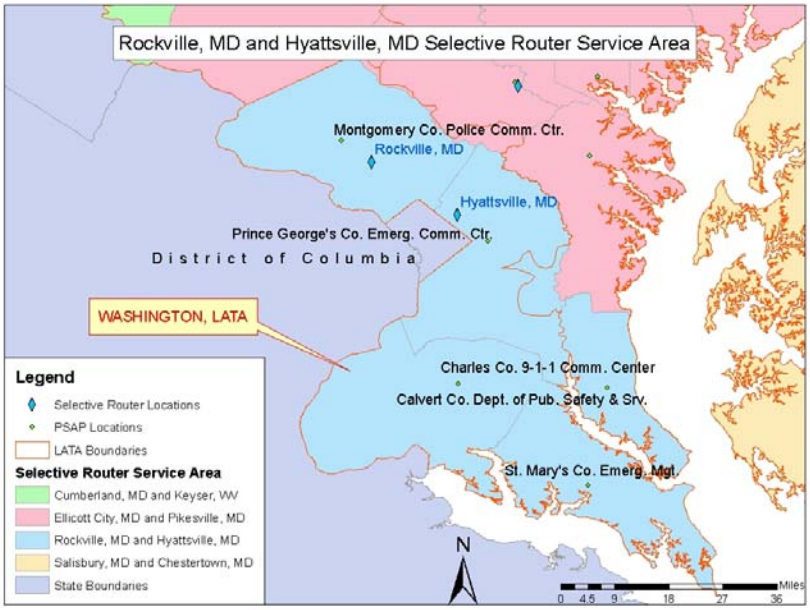
The next group to be connected would be the Eastern Shore. This would connect eight more PSAPs and two more selective routers.



The next group to be connected would be the Baltimore area. This would connect eight more PSAPs and two more selective routers.



The last group to be connected would be the District of Columbia area. This would connect the last five PSAPs and two more selective routers.



6. RECOMMENDED SOLUTION

6.1 OVERVIEW

The state of Maryland should build out an IP-enabled network as the first step toward Next Generation 9-1-1. This network does not use the internet, but uses the same communications protocol on a secured private network similar to what major companies use today. This network will position the state to use the future technologies that will be developed to address the needs of today and the future.

The first issue to be addressed is the funding of this network, and future equipment. This funding should be based on the estimates listed below.

Kimball recommends a combination of these various options; a transport service provider in combination with the existing state infrastructure. The existing state infrastructure is a very robust system, but more agencies are using it and the availability of bandwidth is not known. This is in addition to microwave connectivity being susceptible to nature. The state infrastructure is a good system, but should not be used as the sole system.

A RFP should be developed to request potential vendors present their plan to accomplish the following:

- Provide engineering and specifications on their network proposal
- Provide redundant connectivity to each primary and secondary PSAP in the State
- Provide diverse routing for the connectivity to each primary and secondary PSAP.
- Provide defense in depth security to the entire network including at the PSAPs
- Provide a dedicated rate for the primary PSAPs to use to create local networks for their secondary PSAPs
- Provide detailed plan for maintenance and copies of service level agreements
- Connect into the State public safety network

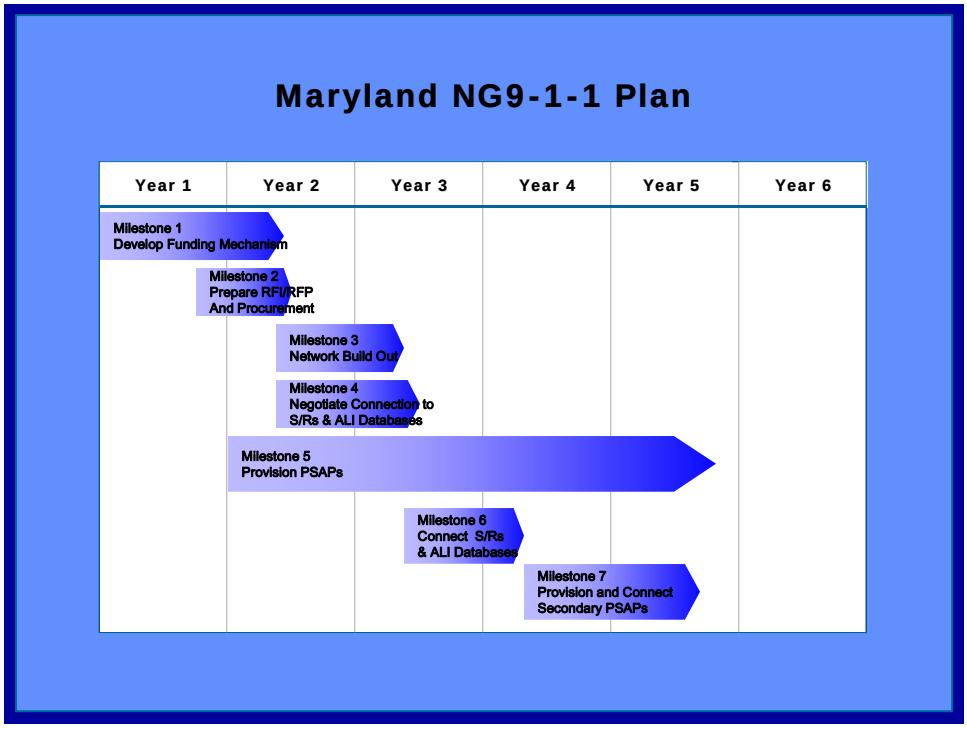
6.2 TIMELINE

As a result of the fact that many of the IP standards for these 9-1-1 systems are still in development, the state has some lead time to use in developing their systems. This time can be spent to prepare the infrastructure as well as the PSAPs to take full advantage of these functionalities when it is completed.

Coinciding with options of network and providers listed above are implementation options. The state of Maryland will be able to proceed with an IP-enabled network implementation at a pace that is suitable and fundable to meet the needs of the State. It is Kimball's recommendation that the new statewide IP-enabled 9-1-1 network be built-out in phases or milestones.

Of particular importance in this section is the fact that at the conclusion of any one of the milestones, the State has the option of adjusting the implementation for whatever the reason before moving on to the next milestone.

The State will control the pace at which the implementation progresses. These various milestones of implementation lend particularly useful in controlling revenue and expenses and budgeting for continued migration.



Milestone 1 – 12 to 18 Months
Develop a Funding Mechanism

Prepare information to change the legislative funding mechanism to provide the Board and the counties cost recovery for the additional cost for a Next Generation network.

Milestone 2 – 6 to 9 Months
Develop a Request for Information (RFI) or Request for Proposal (RFP)

The process of deploying a Next Generation network has many possible solutions. Most of the various options will work with proper provisioning. To allow the State to benefit from the best pricing and allow available vendors in the area the flexibility to explain the options that they can provide, Kimball recommends the State prepare an RFI/RFP.

The RFI/RFP process will allow several vendors, or even groups of vendors, to provide their solutions to provision the Next Generation network. This can result in new and unique solutions to be considered.

Milestone 3 – 3 to 9 Months
Procurement Process - Release the RFI/RFP, review the responses, and negotiate the contract.

The procurement process involves several steps. Once the RFI/RFP is released, there is usually a meeting to review the RFI/RFP with interested parties. At this meeting, and during subsequent meetings and correspondence, there are questions that arise from the RFI/RFP. Answering these questions to allow all parties to have the same information is important.

Once the responses are returned, the reviewing of each response against the RFI/RFP requirements is done. This could entail a scoring process of yes or no, or a rating based on percentage.

Once the final selection is made, the contract is then negotiated. This process can be drawn out, and all items required in the RFI/RFP, and items presented in the response that the State wishes to use, need to be included in the contract.

Milestone 4 – 12 to 24 Months
Build Out the Network

This milestone is the building out of the network that provides access to all users and providers. The network, or specifically the transport medium, is most likely digital and IP-enabled. The network receives the benefits of redundancy; and the speed of moving traffic is greatly increased. The network is now ready to accommodate new technologies, growth, and provide for interoperability, including the delivery of 9-1-1 calls to the PSAPs at a later date. This stage of implementation provides a good infrastructure to begin routing 9-1-1 traffic.

This build out should follow the Alternate Implementation Plan outlined in section 5.6.1. This will allow a structured and functional implementation.

Simultaneously during this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment and funding mechanisms for capitol costs should be established.

Milestone 5 – Recurring up to 7 Years
Provision the Primary PSAPs to be IP-Enabled.

Simultaneously during all phases of this network build-out, the upgrade process to the PSAP CPE should be encouraged. By upgrading the PSAP CPE to IP-capable equipment, the PSAP would not require a conversion to analog from an IP network. Standards for equipment should be established.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to IP-enabled CPE. After the PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

During Milestone 5, the negotiations required to connect to the LECs selective routers should continue.

Milestone 6 – 6 to 12 Months
Connect to each of the LEC's selective routers and ALI databases.

During this milestone the State should begin the process of negotiating with Verizon should they not be selected as the vendor. The system will need connectivity to selective routers and ALI databases. A request for engineering and required bandwidth analyses should be started at this time. Actual completion of ordering, provisioning, and installation of connectivity to the selective routers would need to be completed in a timely manner in Milestone 6.

This action will enable all 9-1-1 traffic to flow from the selective routers through the statewide IP-enabled network, terminating at the appropriate PSAP. The benefits of the IP network are realized. Now the traffic is digital from end to end. At this stage is when massive amounts of data can be moved across the network from PSAP to PSAP. Data applications can be introduced into the 9-1-1 system such as GIS map data, imagery, video, e-mail, instant messaging, and other similar data files. The speed of moving data from point A to Point B is fully realized. Statewide transfers of voice and data are possible as well as all the other benefits of an IP-enabled network solution that have been previously mentioned.

At the completion of this stage is also where telematics, On-Star, ACN, and other real-time information sources can be introduced into the system. At this stage is also the opportunity to work with other public safety agencies and discuss sharing bandwidth (interoperability). Emergency management agencies, police agencies, fire departments, sheriffs, and homeland security agencies can participate and utilize the network for a variety of overlapping needs.

Examples are sharing images such as mug shots, maps, building plans, fire hydrant locations, and a host of various types of pictures, drawings, and images. The PSAP can send information directly to a mobile data terminal in a police car or a fire truck. A dedicated private e-mail system can be put in place between agencies. Video can be shared across participating agencies. Instant text messaging and many other forms of communicating with one another and across agencies are other possibilities. Interoperability between agencies is one of the more attractive features of an IP network.

Milestone 7 – Up to 18 Months
Provision the secondary PSAPs to be IP-enabled and connect them to the network.

These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters, or other similar equipment, or changing out the CPE from legacy equipment to IP-enabled CPE. After the secondary PSAPs have been provisioned, the connectivity to the statewide IP-enabled network should be implemented.

Secondary PSAPs equipment standards should be examined. While secondary PSAPs may not require complete 9-1-1 systems, the network design may support stand-alone workstations connected to the network. If this is not supported, the State should examine the use of workstations served off of the primary PSAPs.

Due to the nature of this network, geographic distances are not a factor. Secondary PSAPs could be hosted off of another PSAP anywhere in the state. One option would be to use the regional back-up centers as the host, and then the equipment would be in place in an emergency.

6.3 COST PROJECTIONS

During the process of developing the funding mechanism, Kimball recommends the following be taken into consideration while setting the new funding level. This would be a new funding need annually on a statewide basis.

6.3.1 PSAP Annual Costs

Based on the cost projections in the Transport Service provider section, the PSAP funding should be increased for the following:

ITEM	COST
Primary PSAP Connectivity	$2,792,856
Back Up PSAP Connectivity	$2,792,856
Connectivity to Secondary PSAPs	$4,410,000
TOTAL	**$9,995,712**

Cost for the back-up center assumes the same level of service and costs as the primary PSAP.

Cost for the secondary PSAPs is based on $90,000 per year for 49 secondary PSAPs. This does not include the MSP.

6.3.2 PSAP One Time Costs

ITEM	COST
Connection Charges to Network	$ 13,200
Gateway for CPE Connections	$504,000
TOTAL	**$517,200**

The cost above for gateways is a worst-case issue. The preferred method to connect the PSAP CPE to the network would be to upgrade the CPE. Should this not be completed, the gateways will allow the functionality to remain for the PSAP.

6.3.3 ENSB Annual Costs

ITEM	COST
Selective Router Connectivity	$1,495,968
ALI Database Connectivity	$ 203,184
Workstations for Secondary PSAPs	$ 980,000
TOTAL	**$2,679,152**

Workstations costs are based on two workstations per secondary PSAP for a total of $4,900,000, then split over five years.

6.3.4 ENSB One Time Costs

ITEM	COST
RFI/RFP Development	$150,000
Procurement Support	$100,000
Project Management	$500,000
Connection Charges for S/R and ALI	$ 26,046
TOTAL	**$776,046**

RFI/RFP Development and Procurement Support costs include the following:

- Developing the requested document
- Presenting the document at a pre-submittal meeting
- Answering questions throughout the request phase
- Assisting in the review of received proposals
- Evaluating the submissions for technical relevance
- Assisting the Board during the selection process

The Project Management costs are an estimate of providing project management to oversee the development of a Next Generation network. This is a highly recommended option regardless of the vendor selected. Oversight by a Project Manager not from the vendor will help to reduce delays and help to ensure the resulting network is what was envisioned. This Project Management could be an outside consultant or a new employee hired.

The connectivity charges are to connect the existing selective routers and ALI databases to the new network.

APPENDIX A

PSAP Data Sheets

The information contained on these data sheets is information presented to the data collection team by the PSAP representative. This information was compared to information from Verizon regarding CPE type and trunk line counts. US Census data was used to identify the population counts.

Allegany Co. Emerg. Mgmt. & Civil Def. Agency

Cumberland MD

Population Served: 73,639

Director

Name:	Jay Robert Dick
Title:	
Phone:	(301) 777-5908
Fax:	(301) 777-8196

CPE Equipment

Manufacturer:	Motorola
Model:	Centralink
Version:	
Interface to PBX:	

CAD Equipment

Manufacturer:	Logistics
Model:	First Call

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	Logisys
Model:	
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Maryland State Police Frostburg PD
Secondary Connectivity:	Work in progress
Other IP Connectivity:	Part of the wireless band via the County with contact to all County offices

Call Volume

Wireline / Percentage:	32,036 / 67.00%
Wireless / Percentage:	15,779 / 33.00%
Call Volume Total:	47,815

Trunk Lines

Wireline:	6
Wireline Trunk Type:	
Wireline Trunk Overflow:	Goes to Garrett County
Wireless:	2
Wireless Trunk Type:	
Wireless Trunk Overflow:	Fast Busy
Notes:	Average 131 calls a day with 1/3 wireless
PSAP Evac. Routing:	Garrett Co PSAP
PSAP Evac. Procedure:	Switch at PSAPs

Operator Positions

Combined:	6
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Cumberland, MD
Tandem B Location:	Keyser, WV
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Anne Arundel Co. Police Dept.

Millersville MD

Population Served: 510,878

Director

Name:	Susan Greentree
Title:	Management Asst. I
Phone:	(410) 222-8601
Fax:	(410) 222-8695

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta M-1
Version:	25.40B
Interface to PBX:	PBX

CAD Equipment

Manufacturer:	GEAC
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	MapStar
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Annapolis Police Dept. MD State Police Naval Academy DNR Glen Burnie?/Annapolis
Secondary Connectivity:	MD State Police, Annapolis PD and Glen Burnie-one button transfers. Others are 10-digit speed dials. Annapolis PD receives ANI/ALI.
Other IP Connectivity:	Fire Communications-Shared system-radio, CAD and CPE (across the street). Back-up Center 7480 Baltimore/Annapolis Blvd. Glen Burnie, MD 21061 Shared with Howard, Anne Arundel and Annapolis City. They are connected via Fiber to the Back-up.

Call Volume

Wireline / Percentage:	192,000 / 48.00%
Wireless / Percentage:	208,000 / 52.00%
Call Volume Total:	400,000

Trunk Lines

Wireline:	28 police 12 fire
Wireline Trunk Type:	tandem end office trunks
Wireline Trunk Overflow:	que
Wireless:	
Wireless Trunk Type:	
Wireless Trunk Overflow:	que
Notes:	PSAP Reports 400,000 Total typically month to month wireless is 51-53%.
PSAP Evac. Routing:	either to fire dispatch or Annapolis City PD
PSAP Evac. Procedure:	Switches at PSAPs

Operator Positions

Combined:	9
Calltaker Only:	8
Dispatch Only:	6
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Baltimore City Police Dept., Comm. Div.

Baltimore MD

Population Served: 635,815

Director

Name:	Lt. Scott Roper
Title:	
Phone:	(410) 396-2450
Fax:	(410) 396-2289

CPE Equipment

Manufacturer:	Plant
Model:	Vesta DMS
Version:	
Interface to PBX:	

CAD Equipment

Manufacturer:	Tiburon
Model:	Stratus

Mapping & Radio

Type:	Stand alone
Manufacturer:	Plant
Model:	Orion
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	City Fire Maryland Transport Police Dept
Secondary Connectivity:	Phone line City Fire on ACD Switch
Other IP Connectivity:	

Call Volume

Wireline / Percentage:	840,000 / 60.00%
Wireless / Percentage:	560,000 / 40.00%
Call Volume Total:	1,400,000

Trunk Lines

Wireline:	60
Wireline Trunk Type:	T-1
Wireline Trunk Overflow:	Que
Wireless:	14
Wireless Trunk Type:	T-1
Wireless Trunk Overflow:	Que
Notes:	1.4 Million calls 40% estimated are cellular
PSAP Evac. Routing:	City Fire Dispatch
PSAP Evac. Procedure:	Switch at the PSAP

Operator Positions

Combined:	52
Calltaker Only:	
Dispatch Only:	
Notes:	14 are training positions that can be made live

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Baltimore County

Towson MD

Population Served: 786,113

Director

Name:	Marie Whisonant
Title:	PSAP Director
Phone:	410-307-2002
Fax:	410-307-2039

CPE Equipment

Manufacturer:	Siemens
Model:	
Version:	
Interface to PBX:	Yes

CAD Equipment

Manufacturer:	Internal
Model:	

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	Micro Data
Model:	E9-1-1 GIS
Radio Console:	Motorola - Centracom II

Secondary PSAPs

PSAP List:	Baltimore County Sheriff MDSP - Golden Ring, Pikesville MDSP - Westminster, Bellaire Towson University Social Security UMBC
Secondary Connectivity:	None
Other IP Connectivity:	County LAN to Sheriff Connectivity to the back up center is in progress

Call Volume

Wireline / Percentage:	276,120 / 44.11%
Wireless / Percentage:	349,800 / 55.89%
Call Volume Total:	625,920

Trunk Lines

Wireline:	20
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	
Wireless:	8
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	
Notes:	
PSAP Evac. Routing:	Gilroy Regional Site
PSAP Evac. Procedure:	Switch at the Center

Operator Positions

Combined:	11
Calltaker Only:	28
Dispatch Only:	17
Notes:	11 Fire Dispatch Combined 17 Police Dispatch only

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicot City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Calvert Co. Dept. of Pub. Safety & Srv.

Prince Frederick MD

Population Served: 87,925

Director

Name:	Ms. Jackie Vaughan
Title:	Divsion Chief
Phone:	(410) 535-3491
Fax:	(410) 414-3782

CPE Equipment

Manufacturer:	CML
Model:	ECS 1000
Version:	5.0
Interface to PBX:	No

CAD Equipment

Manufacturer:	Cysco PS
Model:	

Mapping & Radio

Type:	CAD -Standalone
Manufacturer:	GTG
Model:	
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Maryland State Police Sheriff's Dept
Secondary Connectivity:	One button transfers - phone lines for all non-emergency calls
Other IP Connectivity:	County Intranet

Call Volume

Wireline / Percentage:	25,200 / 50.00%
Wireless / Percentage:	25,200 / 50.00%
Call Volume Total:	50,400

Trunk Lines

Wireline:	8
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	4
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	4200 monthly - 50,400 Annually 50% wireless
PSAP Evac. Routing:	Back-Up Center
PSAP Evac. Procedure:	Switch at Back-Up Ctr

Operator Positions

Combined:	12
Calltaker Only:	
Dispatch Only:	
Notes:	Admin Positions are designed for call taker positions as well

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Rockville, MD
Tandem B Location:	Hyattsville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Caroline Co. Dept. Emergency Mgt.

Denton MD

Population Served: 31,822

Director

Name:	Mr. Bryan Ebling
Title:	
Phone:	(410) 479-2622
Fax:	(410) 479-4200

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	3.6
Interface to PBX:	No

CAD Equipment

Manufacturer:	New World Systems
Model:	AEGIS

Mapping & Radio

Type:	CPE & CAD Integrated
Manufacturer:	Plant / New World Systems
Model:	Map Star / Geo Based
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Maryland State Police - Easton
Secondary Connectivity:	direct telephone connection
	Queen Anne and Talbot connectivity
Other IP Connectivity:	Internet and WAN available at County

Call Volume

Wireline / Percentage:	9,519 / 61.66%
Wireless / Percentage:	5,918 / 38.34%
Call Volume Total:	15,437

Trunk Lines

Wireline:	4
Wireline Trunk Type:	
Wireline Trunk Overflow:	Fast Busy
Wireless:	2
Wireless Trunk Type:	
Wireless Trunk Overflow:	Fast Busy
Notes:	PSAP reports about 45 % of calls are Cellular
PSAP Evac. Routing:	Talbot County
PSAP Evac. Procedure:	Switches at Kent & Wicimico

Operator Positions

Combined:	7
Calltaker Only:	
Dispatch Only:	
Notes:	1 is used for Training Primarily but can be placed into operations

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Carroll Co. Emergency Service

Westminister MD

Population Served: 168,541

Director

Name:	Mr. Randolph Waesche
Title:	PSAP Manager
Phone:	(410) 386-2260
Fax:	(410) 848-3794

CPE Equipment

Manufacturer:	Plant
Model:	Vesta Pallas
Version:	2.6
Interface to PBX:	

CAD Equipment

Manufacturer:	PSSI
Model:	

Mapping & Radio

Type:	Stand Alone
Manufacturer:	
Model:	Map Star
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Maryland State Police Westminister Police Dept
Secondary Connectivity:	Phone Line only - Copper wire to Maryland State police, Fiber line to Westminister PD
Other IP Connectivity:	None

Call Volume

Wireline / Percentage:	27,688 / 50.00%
Wireless / Percentage:	27,687 / 50.00%
Call Volume Total:	55,375

Trunk Lines

Wireline:	6
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	4
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	2005 Call Volume Total 55,375 with 50% being wireless
PSAP Evac. Routing:	Westminister FD
PSAP Evac. Procedure:	10 Digit Transfer

Operator Positions

Combined:	10
Calltaker Only:	
Dispatch Only:	
Notes:	6 Staffed 2 Overflow 2 Training

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Cecil Co. Emerg. Mgmt. & Civil Def. Ag.

Elkton MD

Population Served: 97,796

Director

Name:	Mr. Frank W. Muller
Title:	Director
Phone:	(410) 392-2014
Fax:	(410) 398-0536

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	3.6
Interface to PBX:	

CAD Equipment

Manufacturer:	PSSI
Model:	

Mapping & Radio

Type:	CPE & CAD Integrated
Manufacturer:	Plant / PSSI
Model:	Map Star
Radio Console:	MA/COM Mystro

Secondary PSAPs

PSAP List:	Elkton PD Sheriff's Office - Co located in building Maryland State Police
Secondary Connectivity:	None
Other IP Connectivity:	None

Call Volume

Wireline / Percentage:	53,292 / 66.45%
Wireless / Percentage:	26,910 / 33.55%
Call Volume Total:	80,202

Trunk Lines

Wireline:	4
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	4
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	2005 Call Volume 53,292 is an estimation because the PSAP equipment could not provide call volume data in 2005. The wireless call volume is based on '06 data from January 1 through November 17, 2006.
PSAP Evac. Routing:	Courthouse Back Up Center
PSAP Evac. Procedure:	Switch at PSAP

Operator Positions

Combined:	10
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Charles Co. 9-1-1 Comm. Center

LaPlata MD

Population Served: 138,822

Director

Name:	Mr. Tony Rose
Title:	Chief
Phone:	(301) 609-3550
Fax:	(301) 609-3557

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta M-1
Version:	2.2
Interface to PBX:	None

CAD Equipment

Manufacturer:	Keystone
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Orion
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Back-Up Ctr No other Secondary's (Handle all the call and then notify MSP, unless the caller specifically request to talk to Maryland State Police)
Secondary Connectivity:	Fiber and Microwave to Back-up Ctr (CAD redunancy servers located at Back-Up, live time sync)
Other IP Connectivity:	All County & School District phones are VoIP except the PSAP. 2 Computers in PSAP have access to County Intranet, 4 positions to internet and 2 Sheriff's system.

Call Volume

Wireline / Percentage:	129,384 / 81.71%
Wireless / Percentage:	28,955 / 18.29%
Call Volume Total:	158,339

Trunk Lines

Wireline:	5
Wireline Trunk Type:	
Wireline Trunk Overflow:	Que
Wireless:	3
Wireless Trunk Type:	
Wireless Trunk Overflow:	Que
Notes:	VoIP 105
PSAP Evac. Routing:	Back Up PSAP
PSAP Evac. Procedure:	Switches at Both PSAP's

Operator Positions

Combined:	12
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Rockville, MD
Tandem B Location:	Hyattsville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Dorchester Co. 9-1-1Emergency Services

Cambridge MD

Population Served: 31,401

Director

Name:	Mr. Vernon Hurley
Title:	Director
Phone:	(410) 221-0203
Fax:	410-901-2529

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	
Interface to PBX:	Within building

CAD Equipment

Manufacturer:	PSSI
Model:	

Mapping & Radio

Type:	CPE & CAD Integrated
Manufacturer:	Plant
Model:	Map Star
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Cambridge Police Dept Maryland State Police Dept of Natural Resources Police USCG
	1 button transfer for all
Secondary Connectivity:	Phone line only
Other IP Connectivity:	County Intranet via Comcast 2nd cable internet available within building.

Call Volume

Wireline / Percentage:	10,071 / 53.57%
Wireless / Percentage:	8,729 / 46.43%
Call Volume Total:	18,800

Trunk Lines

Wireline:	4
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Overflows to Cambridge PD
Wireless:	2
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Overflows to 410-228-2222
Notes:	For 2005 we had 8729 cell phone 911 calls and 10071 landline 911 calls.
PSAP Evac. Routing:	Cambridge PD
PSAP Evac. Procedure:	Verizon to make switch

Operator Positions

Combined:	7
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Frederick Co. Emerg. Operation Ctr.

Frederick MD

Population Served: 220,701

Director

Name:	Mr. Chip Jewell
Title:	Bureau Chief
Phone:	(301) 694-2072
Fax:	(301) 696-2967

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta
Version:	
Interface to PBX:	

CAD Equipment

Manufacturer:	Integraph
Model:	

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	Integraph
Model:	
Radio Console:	Motorola Centracom Gold Elite

Secondary PSAPs

PSAP List:	Frederick Police Dept Joint located with Maryland State Police
Secondary Connectivity:	County Intranet
Other IP Connectivity:	

Call Volume

Wireline / Percentage:	41,432 / 43.95%
Wireless / Percentage:	52,830 / 56.05%
Call Volume Total:	94,262

Trunk Lines

Wireline:	6
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	4
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	This is for the period of 11/15/05 thru 11/14/06 911 Wireless 52,830 911 Wire line 41,432 Other County Inbound 126,004 Other County Outbound 61,228
PSAP Evac. Routing:	Frederick Police Dept
PSAP Evac. Procedure:	Switches at Frederick PD and Back-up Center

Operator Positions

Combined:	14
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Garrett Co. Emerg Operations Ctr.

Oakland MD

Population Served: 29,909

Director

Name:	Mr. Jon Bradley Frantz
Title:	9-1-1 Coordinator
Phone:	(301) 334-7619
Fax:	(301) 334-8946

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	Firmware 2At
Interface to PBX:	County PBX

CAD Equipment

Manufacturer:	Plant/CML
Model:	CAD Star

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	Plant
Model:	
Radio Console:	Motorola Centracom Series II

Secondary PSAPs

PSAP List:	Sheriff's office MSP
Secondary Connectivity:	Internal IP through Courthouse only
Other IP Connectivity:	

Call Volume

Wireline / Percentage:	11,057 / 66.72%
Wireless / Percentage:	5,516 / 33.28%
Call Volume Total:	16,573

Trunk Lines

Wireline:	6 - 4 incoming ,2 Sheriff Transfer
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	2
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	6 Landline Trunks 4 are incoming 2 are transfer trunks to Sheriff's office
PSAP Evac. Routing:	Allegany County PSAP
PSAP Evac. Procedure:	Switch at either PSAP

Operator Positions

Combined:	5 * See Notes
Calltaker Only:	
Dispatch Only:	
Notes:	2 Call Taker/Dispatch 1 Overflow 1 Admin 1 Sheriff's Office

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Cumberland, MD
Tandem B Location:	Keyser, WV
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Harford Co. Emerg. Operations

Forrest Hill MD

Population Served: 239,259

Director

Name:	W. Mitchell Vocke
Title:	Director of Communications
Phone:	(410) 638-3401
Fax:	(410) 879-5091

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta M-1
Version:	2.2
Interface to PBX:	EOC phones interfaced

CAD Equipment

Manufacturer:	Cisco
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Orion
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Bel Air PD, Aberdeen PD, Hav de Grace PD, MD State Police for JFK Highway.
Secondary Connectivity:	Backup will have IP connectivity
Other IP Connectivity:	Intranet to County

Call Volume

Wireline / Percentage:	48,960 / 48.00%
Wireless / Percentage:	53,040 / 52.00%
Call Volume Total:	102,000

Trunk Lines

Wireline:	8
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	6
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	102,000 calls 54% wireless
PSAP Evac. Routing:	Cecil County
PSAP Evac. Procedure:	2 switches in EOC

Operator Positions

Combined:	15
Calltaker Only:	11
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Howard Co. Emerg. Comm. Ctr.

Ellicott City MD

Population Served: 269,457

Director

Name:	Lt. Glen Case
Title:	Communications Division Commander
Phone:	(410) 313-2303
Fax:	(410) 313-2212

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta DMS
Version:	
Interface to PBX:	Via DMS 1000

CAD Equipment

Manufacturer:	Integraph
Model:	

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	Integraph
Model:	
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	None-transfer Interstate calls to Maryland State Police
Secondary Connectivity:	None
Other IP Connectivity:	County Intranet-Closed Loop

Call Volume

Wireline / Percentage:	465,226 / 84.86%
Wireless / Percentage:	83,006 / 15.14%
Call Volume Total:	548,232

Trunk Lines

Wireline:	24
Wireline Trunk Type:	T-1
Wireline Trunk Overflow:	fast busy
Wireless:	2
Wireless Trunk Type:	T-1
Wireless Trunk Overflow:	fast busy
Notes:	DMS 1000 Centrex
PSAP Evac. Routing:	alternate PSAP
PSAP Evac. Procedure:	sign in at phones at the alternate PSAP

Operator Positions

Combined:	18
Calltaker Only:	9
Dispatch Only:	
Notes:	9 call taker-4 fire dispatch-5 training

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Ellicott City, MD
Tandem B Location:	Pikesville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Kent Co. Emergency Mgt.

Chestertown MD

Population Served: 19,899

Director

Name:	Mr. Gregg Bird
Title:	Director of Communications
Phone:	(410) 778-3758
Fax:	(410) 778-4601

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	2.6
Interface to PBX:	No

CAD Equipment

Manufacturer:	None
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Orion
Radio Console:	Moducom - Motorola Gold Elite

Secondary PSAPs

PSAP List:	Back-up at County Public Works facility Maryland State Police Barracks
Secondary Connectivity:	County in the process of upgrading to a County wide VoIP phone system
Other IP Connectivity:	

Call Volume

Wireline / Percentage:	6,061 / 58.46%
Wireless / Percentage:	4,306 / 41.54%
Call Volume Total:	10,367

Trunk Lines

Wireline:	4
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	2
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	VOIP calls=35. This data is based on calls from Janury 1-November 14, 2006. The PSAP does not have any available data for 2005.
PSAP Evac. Routing:	Queen Anne's
PSAP Evac. Procedure:	Switch at PSAP

Operator Positions

Combined:	4
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Montgomery Co. Police Comm. Ctr.

Gaithersburg MD

Population Served: 927,583

Director

Name:	Mr. Brian Melby
Title:	Director
Phone:	(240) 773-7032
Fax:	(240) 773-7030

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta M-1
Version:	
Interface to PBX:	County PBX

CAD Equipment

Manufacturer:	Northrup Gruman Terrace / PRC
Model:	

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	Gruman Terrace
Model:	
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Maryland State Police- Rockville Montgomery County Park Police Takoma Park Police Metro Transit Police County Sheriff County Fire/Rescue
Secondary Connectivity:	Speed dial numbers Takoma Park Police currently gets an automatic ALI Fax,Currently have quotes to put Takoma Park Police on Meridian System Primary/Back-Up Ctr common network Meridian/Nortel BETA site
Other IP Connectivity:	Phone system on an isolated LAN County Enterprise on a WAN Public Safety LAN which supports CAD

Call Volume

Wireline / Percentage:	222,000 / 45.98%
Wireless / Percentage:	260,809 / 54.02%
Call Volume Total:	482,809 + 1,160 (VoIP) = 483,969

Trunk Lines

Wireline:	20
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	10
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	Trunks are evenly split between Copper and Fiber 4 VoIP Trunks with a call volume of 1,160
PSAP Evac. Routing:	Back Up Center
PSAP Evac. Procedure:	Switches at PSAP's

Operator Positions

Combined:	2 Supervisor
Calltaker Only:	17
Dispatch Only:	10
Notes:	Fire Communications Set -up 8 Dual Consoles 1 Supervisor 5 in Training that can be made operational Total of 44 Call Taker positions

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Rockville, MD
Tandem B Location:	Hyattsville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Prince George's Co. Emerg. Comm. Ctr.

Landover MD

Population Served: 846,123

Director

Name:	Ms. Charlynn Flaherty
Title:	Director
Phone:	(301) 499-8090
Fax:	(301) 499-8034

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta M-1
Version:	61C
Interface to PBX:	Comcentrex

CAD Equipment

Manufacturer:	Tiburon
Model:	CAD 2000

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Orion MapStar
Radio Console:	MA/COM Mystro

Secondary PSAPs

PSAP List:	Bladensburg/ Mt. Rainer PD Hyattsville City PD Greenbelt PD Riverdale Park PD Laurel PD Andrews Air Force Base (Wireless only)
Secondary Connectivity:	Standard phone line to all No ANI/ALI Display - 10 digit speed dial to all
Other IP Connectivity:	County Intranet through Comcast MDT system through Verizon Wireless

Call Volume

Wireline / Percentage:	379,469 / 42.57%
Wireless / Percentage:	511,842 / 57.43%
Call Volume Total:	891,311

Trunk Lines

Wireline:	20
Wireline Trunk Type:	Analog DID
Wireline Trunk Overflow:	Fast Busy
Wireless:	10
Wireless Trunk Type:	Analog DID
Wireless Trunk Overflow:	Fast Busy
Notes:	
PSAP Evac. Routing:	Kent County
PSAP Evac. Procedure:	

Operator Positions

Combined:	49
Calltaker Only:	25
Dispatch Only:	24
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Rockville, MD
Tandem B Location:	Hyattsville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Queen Anne's Emerg. Services

Centreville MD

Population Served: 45,612

Director

Name:	Robert Blackiston
Title:	Chief of Communications
Phone:	(410) 758-4500
Fax:	(410) 758-2086

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta
Version:	
Interface to PBX:	No

CAD Equipment

Manufacturer:	PSSI
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Map Star
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Maryland State Police
Secondary Connectivity:	Talbot and Caroline Connectivity (Talbot and Queen Anne full capability to run each other's operation from either PSAP including phones, radios and CAD)
Other IP Connectivity:	County Intranet separate computer working on installation of 4.9 Public Safety Wireless Network

Call Volume

Wireline / Percentage:	23,000 / 69.70%
Wireless / Percentage:	10,000 / 30.30%
Call Volume Total:	33,000

Trunk Lines

Wireline:	8
Wireline Trunk Type:	
Wireline Trunk Overflow:	
Wireless:	2
Wireless Trunk Type:	
Wireless Trunk Overflow:	
Notes:	
PSAP Evac. Routing:	Talbot & Caroline
PSAP Evac. Procedure:	Switch at PSAP

Operator Positions

Combined:	6
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Somerset Dept. of Emerg. Services

Princess Anne MD

Population Served: 25,845

Director

Name:	Mr. Steven Marshall
Title:	Director
Phone:	410-651-0707
Fax:	(410) 651-3350

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta
Version:	
Interface to PBX:	Centrex

CAD Equipment

Manufacturer:	OSSI
Model:	

Mapping & Radio

Type:	CPE & CAD Integrated
Manufacturer:	Plant
Model:	MapStar / OSSI
Radio Console:	MA/COM Mystro

Secondary PSAPs

PSAP List:	Maryland State Police Princess Anne PD Christfield PD Sheriff's Dept
Secondary Connectivity:	all 1 button transfers
Other IP Connectivity:	County Intranet - which is part of Sailor's Network (State network)

Call Volume

Wireline / Percentage:	8,192 / 55.41%
Wireless / Percentage:	6,592 / 44.59%
Call Volume Total:	14,784

Trunk Lines

Wireline:	4
Wireline Trunk Type:	
Wireline Trunk Overflow:	Fast Busy
Wireless:	4
Wireless Trunk Type:	
Wireless Trunk Overflow:	Rolls over to 10 - Digit (1) then fast busy
Notes:	
PSAP Evac. Routing:	Somerset Road Dept (Back-Up Ctr) Worcester till up
PSAP Evac. Procedure:	Wicomico PSAP Switch

Operator Positions

Combined:	3
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

St. Mary's Co. Emerg. Mgt.

Leonardtown MD

Population Served: 96,518

Director

Name:	Ms. Shirley Copado
Title:	Communications Manager
Phone:	(301) 475-4200 X 2120
Fax:	(301) 475-4512

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta
Version:	2.2
Interface to PBX:	Centrex

CAD Equipment

Manufacturer:	HTE
Model:	LG Dispatch

Mapping & Radio

Type:	CAD Integrated
Manufacturer:	GTG
Model:	LG Dispatch
Radio Console:	MA/COM Mystro

Secondary PSAPs

PSAP List:	Maryland State Police - 1 Button transfer 1 button Transfers to surrounding Counties
Secondary Connectivity:	Phone line Only
Other IP Connectivity:	County Intranet

Call Volume

Wireline / Percentage:	158,276 / 93.07%
Wireless / Percentage:	11,784 / 6.93%
Call Volume Total:	170,060

Trunk Lines

Wireline:	4
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Fast Busy
Wireless:	2
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	170,060 Total
PSAP Evac. Routing:	Back Up Ctr
PSAP Evac. Procedure:	Switch @ Back up Ctr - Verizon to direct admin line

Operator Positions

Combined:	11
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Rockville, MD
Tandem B Location:	Hyattsville, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Talbot Co. Emerg. Mgt. Agency

Easton MD

Population Served: 35,683

Director

Name:	Mr. W. Edward Mullikin
Title:	
Phone:	(410) 770-8161
Fax:	(410) 770-8163

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	unknown
Interface to PBX:	no

CAD Equipment

Manufacturer:	PSSI
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Map Star
Radio Console:	Morotola Gold Elite

Secondary PSAPs

PSAP List:	Easton PD 1- button transfers Maryland State Police - I Barracks - 1 button transfers Dept of Natural Resources 1 button transfers
Secondary Connectivity:	Queen Anne and Caroline connectivity (Talbot and Queen Anne full capability to run each other's operation from either PSAP including phones, radios and CAD) Fiber line to Easton PD 2 consoles off Gold Elite system
Other IP Connectivity:	County Intranet

Call Volume

Wireline / Percentage:	11,449 / 54.30%
Wireless / Percentage:	9,634 / 45.70%
Call Volume Total:	21,083

Trunk Lines

Wireline:	4
Wireline Trunk Type:	
Wireline Trunk Overflow:	fast busy
Wireless:	4
Wireless Trunk Type:	
Wireless Trunk Overflow:	fast busy
Notes:	
PSAP Evac. Routing:	Queen Annes
PSAP Evac. Procedure:	switch at PSAP

Operator Positions

Combined:	7
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Washington Co. Fire & Rescue Comm.

Hagerstown MD

Population Served: 141,895

Director

Name:	Ms. Bardona Woods
Title:	Chief
Phone:	(240) 313-2906
Fax:	(240)-313-2901

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	2.60
Interface to PBX:	County Nortel 61C

CAD Equipment

Manufacturer:	Keystone Public Safety
Model:	

Mapping & Radio

Type:	CPE Intergrated
Manufacturer:	Orion
Model:	MapStar
Radio Console:	Motorola Centracom Series II

Secondary PSAPs

PSAP List:	Washington Co Sheriff's Dept Hagerstown Police Dept Maryland State Police
Secondary Connectivity:	CAD Data to Washington Co Sheriff's Dept and Hagerstown Police Dept - Closed system
Other IP Connectivity:	County Offices,

Call Volume

Wireline / Percentage:	75,225 / 65.69%
Wireless / Percentage:	39,298 / 34.31%
Call Volume Total:	114,523

Trunk Lines

Wireline:	4
Wireline Trunk Type:	CAMA
Wireline Trunk Overflow:	Sheriff's office - then fast busy
Wireless:	4
Wireless Trunk Type:	CAMA
Wireless Trunk Overflow:	Fast Busy
Notes:	
PSAP Evac. Routing:	Sheriff's Dept
PSAP Evac. Procedure:	Switch at Sheriff's PSAP

Operator Positions

Combined:	7
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Cumberland, MD
Tandem B Location:	Keyser, WV
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Wicomico Co. Emergency Services Div.

Salisbury MD

Population Served: 90,402

Director

Name:	Ms. Sandy Silvia
Title:	Director
Phone:	(410) 548-4921
Fax:	410-341-6031

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta Pallas
Version:	
Interface to PBX:	Centrex Lines Meshed

CAD Equipment

Manufacturer:	HTE
Model:	

Mapping & Radio

Type:	CPE Integrated
Manufacturer:	Plant
Model:	Map Star
Radio Console:	Motorola Gold Elite

Secondary PSAPs

PSAP List:	Sheriff's Office - also transfers to Fruitland PD Delmar PD Maryland State Police Salisbury City
Secondary Connectivity:	1 one transfers to all 3 Sheriff's office shares CAD 5 point phone special point to point Other Police agencies connected through radio console 800 MHz system
Other IP Connectivity:	County Intranet Additional Separate Internet access in PSAP

Call Volume

Wireline / Percentage:	65,082 / 55.00%
Wireless / Percentage:	53,248 / 45.00%
Call Volume Total:	118,330

Trunk Lines

Wireline:	6
Wireline Trunk Type:	
Wireline Trunk Overflow:	Que
Wireless:	2
Wireless Trunk Type:	
Wireless Trunk Overflow:	Que
Notes:	2005 Call Volume 118,330 45% Wireless
PSAP Evac. Routing:	Sheriff's Office
PSAP Evac. Procedure:	Switch in Worcester PSAP

Operator Positions

Combined:	4
Calltaker Only:	
Dispatch Only:	
Notes:	

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

Worcester Co. 9-1-1 Center

Snow Hill MD

Population Served: 48,750

Director

Name:	Ms. Teresa Owens
Title:	
Phone:	(410) 632-1311
Fax:	(410) 632-2141

CPE Equipment

Manufacturer:	Plant/CML
Model:	Vesta
Version:	2.2
Interface to PBX:	Centrex

CAD Equipment

Manufacturer:	OSSI
Model:	

Mapping & Radio

Type:	CPE & CAD Integrated
Manufacturer:	Plant
Model:	Map Star
Radio Console:	MA/COM C-3 Mystro

Secondary PSAPs

PSAP List:	Ocean City Maryland State Police- Berlin WICE Terminals(provide ALI/ANI only) at Pocomoke City, Berlin & Ocean Pines
Secondary Connectivity:	Ocean City T1 connection Rebid capable - currently running on Plant Vesta Pallas
Other IP Connectivity:	County Network only

Call Volume

Wireline / Percentage:	36,128 / 65.69%
Wireless / Percentage:	18,869 / 34.31%
Call Volume Total:	54,997

Trunk Lines

Wireline:	5 County / 5 Ocean City
Wireline Trunk Type:	
Wireline Trunk Overflow:	Fast Busy
Wireless:	4
Wireless Trunk Type:	
Wireless Trunk Overflow:	Fast Busy
Notes:	
PSAP Evac. Routing:	Ocean City
PSAP Evac. Procedure:	Switches at Kent & Wicomico Counties

Operator Positions

Combined:	6
Calltaker Only:	
Dispatch Only:	
Notes:	5 in PSAP 1 in EOC

Service Providers

9-1-1 Provider:	Verizon
Tandem A Location:	Salisbury, MD
Tandem B Location:	Chestertown, MD
ALI Provider:	Verizon
ALI Location 1:	Freehold, NJ
ALI Location 2:	Fairland, MD

APPENDIX B

Selective Router Data Sheets

The information presented on these sheets was the information provided by Verizon.

Verizon Selective Router

5500 BALTIMORE AV
HYATTSVILLE, MD 20781
VCOORD: 05603 HCOORD: 01577

CLLI Code:	HYVLMDHY1ED
Point Code:	246193030
Switch Make:	Nortel
Switch Model:	DMS100
Mated/Pair With:	RKVLMDRV1ED
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Calvert Co. Department of Public Safety Charles Co. 911 Communications Center Montgomery Co. Police Communications Center Prince Georges Co.Emergency Communications Center St Marys Co. Emergency Management
Enhanced 911 Features:	

Verizon Selective Router

490 FLEET ST
ROCKVILLE, MD 20850
VCOORD: 05601 HCOORD: 01621

CLLI Code:	RKVLMDRV1ED
Point Code:	246193096
Switch Make:	Nortel
Switch Model:	DMS 100
Mated/Pair With:	HYVLMDHY1ED
Date Installed/Upgraded:	
Trunks To:	ELLICOTT CITY, PIKESVILLE, KEYSER WV, AND CUMBERLAND
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Calvert Co. Department of Public Safety Charles Co. 911 Communications Center Montgomery Co. Police Communications Center Prince Georges Co.Emergency Communications Center St Marys Co. Emergency Management
Enhanced 911 Features:	

Verizon Selective Router

S MINERAL & CARSKAD
KEYSER, WV 26726
VCOORD: 05711 HCOORD: 01922

CLLI Code:	KYSRWVMR1ED
Point Code:	246203008
Switch Make:	Nortel
Switch Model:	DMS100
Mated/Pair With:	CMLDMDCM12T
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Allegany Co. Emergency Management & Civil Defense Agency Garrett Co. Emergency Operations Center Washington Co. Fire & Rescue
Enhanced 911 Features:	

Verizon Selective Router

128 E Church ST
Salisbury, MD 21875
V-05577 H-01316

CLLI Code:	SLBRMDSB12T
Point Code:	246202003
Switch Make:	Nortel
Switch Model:	DMS 100
Mated/Pair With:	CHRTMDCH12T
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Caroline Co. Department Emergency Management Dorchester County Kent Co. Emergency Management Queen Anne's Emergency Service Somerset County Talbot County Wicomico Co. Emergency Services Div. Worcester Co. 9-1-1 Center (Primary)
Enhanced 911 Features:	

Verizon Selective Router

3561 SAINT JOHNS LN
ELLICOTT CITY, MD 21043
VCOORD: 05535 HCOORD: 01601

CLLI Code:	ELCYMDEL12T
Point Code:	246192046
Switch Make:	Nortel
Switch Model:	DMS100
Mated/Pair With:	PIVLMDPK12T
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Anne Arundel Co. Police Dept Baltimore City Baltimore County Carroll Co. Emergency Service Cecil County Ferderick Co. Emergency Operations Center Harford County Howard Co. Communications Center
Enhanced 911 Features:	

Verizon Selective Router

400 REISTERSTOWN RD
PIKESVILLE, MD 21208
VCOORD: 05508 HCOORD: 01598

CLLI Code:	PIVLMDPK12T
Point Code:	246192064
Switch Make:	Nortel
Switch Model:	DMS100
Mated/Pair With:	ELCYMDEL12T
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Anne Arundel Co. Police Dept Baltimore City Baltimore County Carroll Co. Emergency Service Cecil County Ferderick Co. Emergency Operations Center Harford County Howard Co. Communications Center
Enhanced 911 Features:	

Verizon Selective Router

24 S CENTRE ST
CUMBERLAND, MD 21502
VCOORD: 05650 HCOORD: 01917

CLLI Code:	CMLDMDCM12T
Point Code:	246203007
Switch Make:	Nortel
Switch Model:	DMS100
Mated/Pair With:	KYSRWVMR1ED
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Allegany Co. Emergency Management & Civil Defense Agency Garrett Co. Emergency Operations Center Washington Co. Fire & Rescue
Enhanced 911 Features:	

Verizon Selective Router

119 WASHINGTON AVE
CHESTERTOWN, MD 21620
VCOORD: 05473 HCOORD: 01488

CLLI Code:	CHRTMDCH12T
Point Code:	246202006
Switch Make:	Nortel
Switch Model:	DMS100
Mated/Pair With:	SLBRMDSB12T
Date Installed/Upgraded:	
Trunks To:	
Selective Routing:	Yes
20 Digit ANI Capable:	Yes
PSAPs Served:	Caroline Co. Department Emergency Management Dorchester County Kent Co. Emergency Management Queen Anne's Emergency Service Somerset County Talbot County Wicomico Co. Emergency Services Div. Worcester Co. 9-1-1 Center (Primary)
Enhanced 911 Features:	

APPENDIX C

Map – Selective Router and ALI database locations with LATA Boundaries

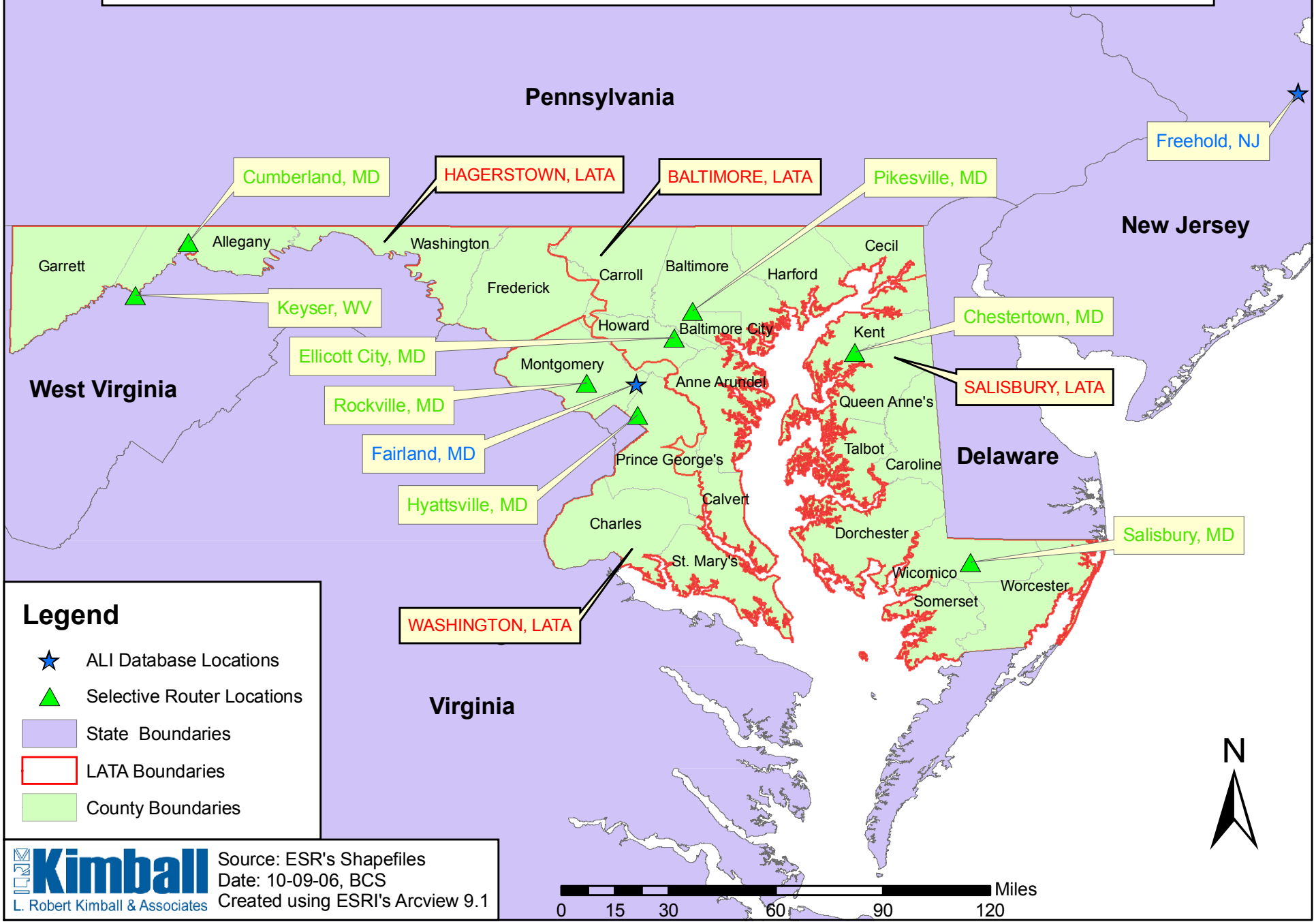
Map – Public Safety Answering Points

Map – Natural Hazards

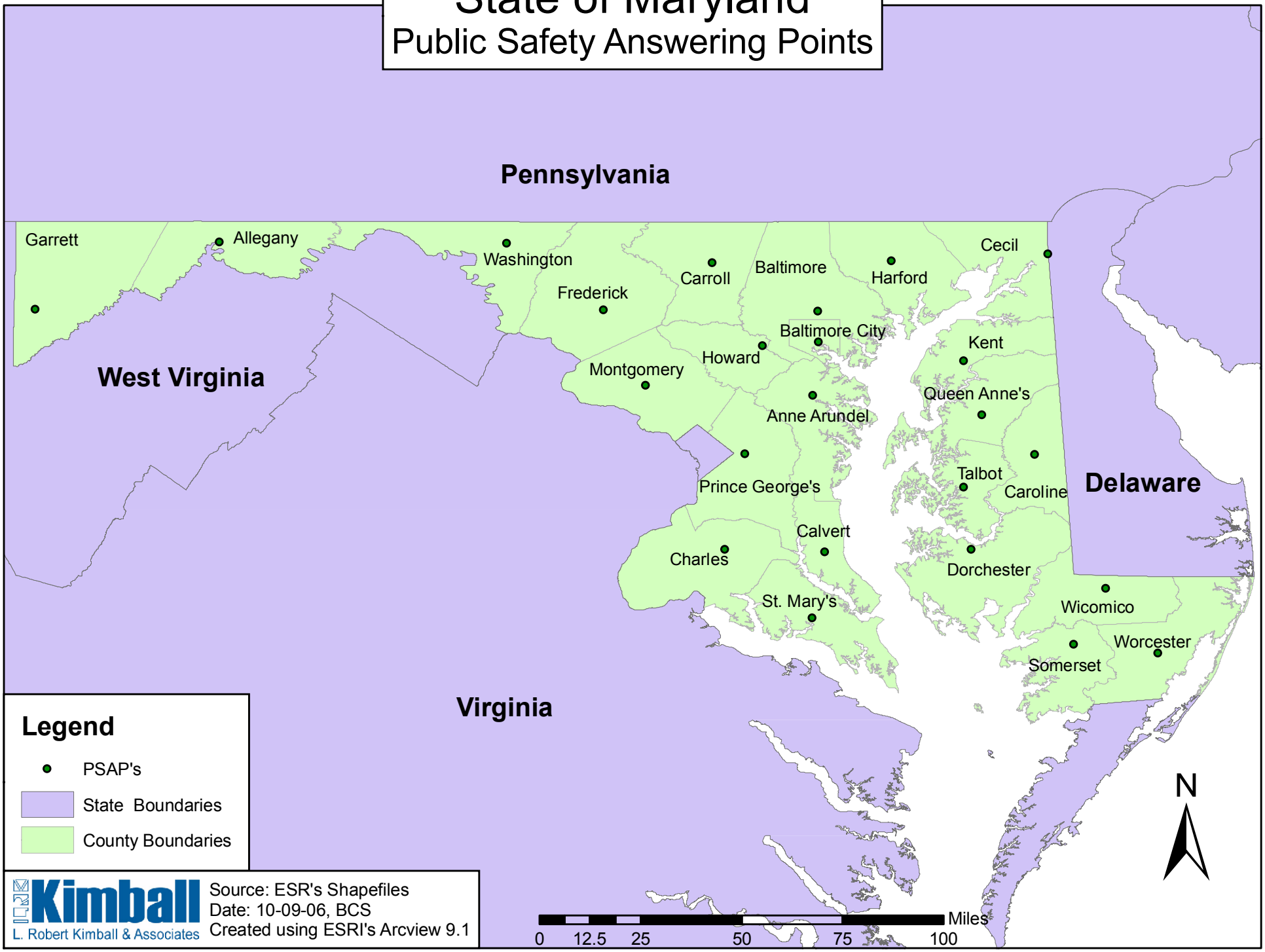
Map –Fiber Routes

State of Maryland

Selective Router and ALI Database Locations with LATA Boundaries



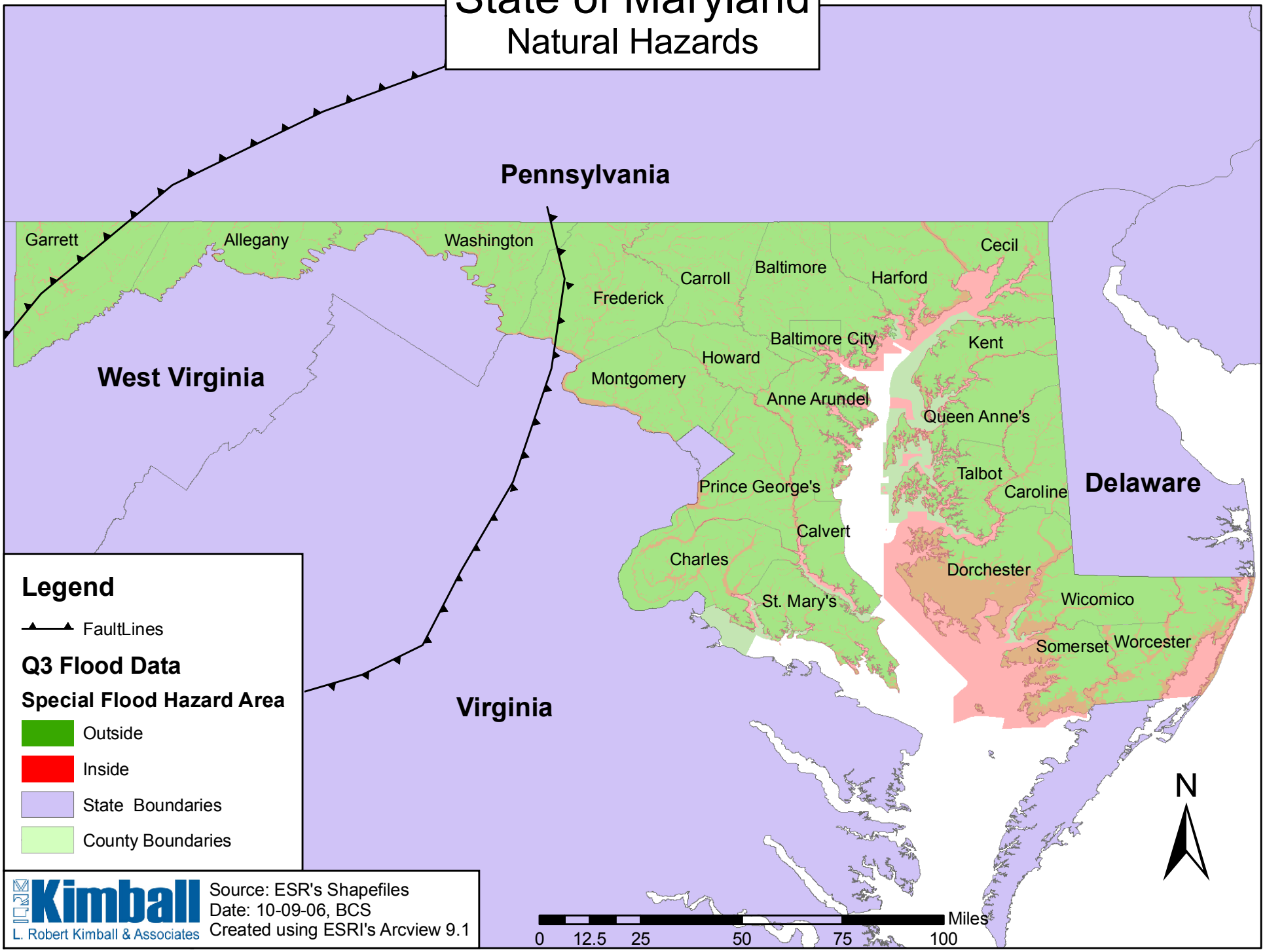
State of Maryland
Public Safety Answering Points



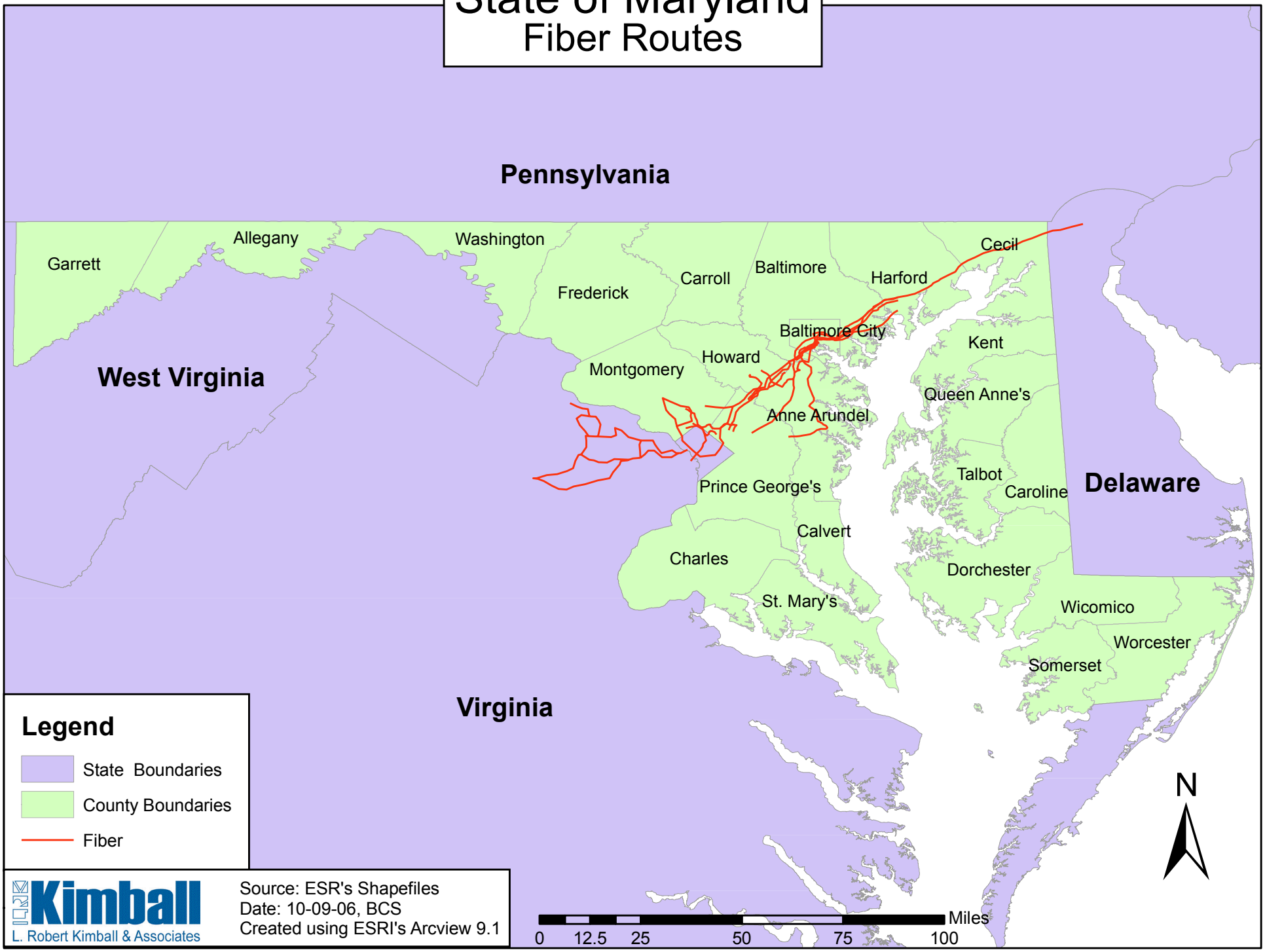
Kimball
L. Robert Kimball & Associates

Source: ESR's Shapefiles
Date: 10-09-06, BCS
Created using ESRI's Arcview 9.1

State of Maryland
Natural Hazards



State of Maryland
Fiber Routes



Kimball
L. Robert Kimball & Associates

Source: ESR's Shapefiles
Date: 10-09-06, BCS
Created using ESRI's Arcview 9.1

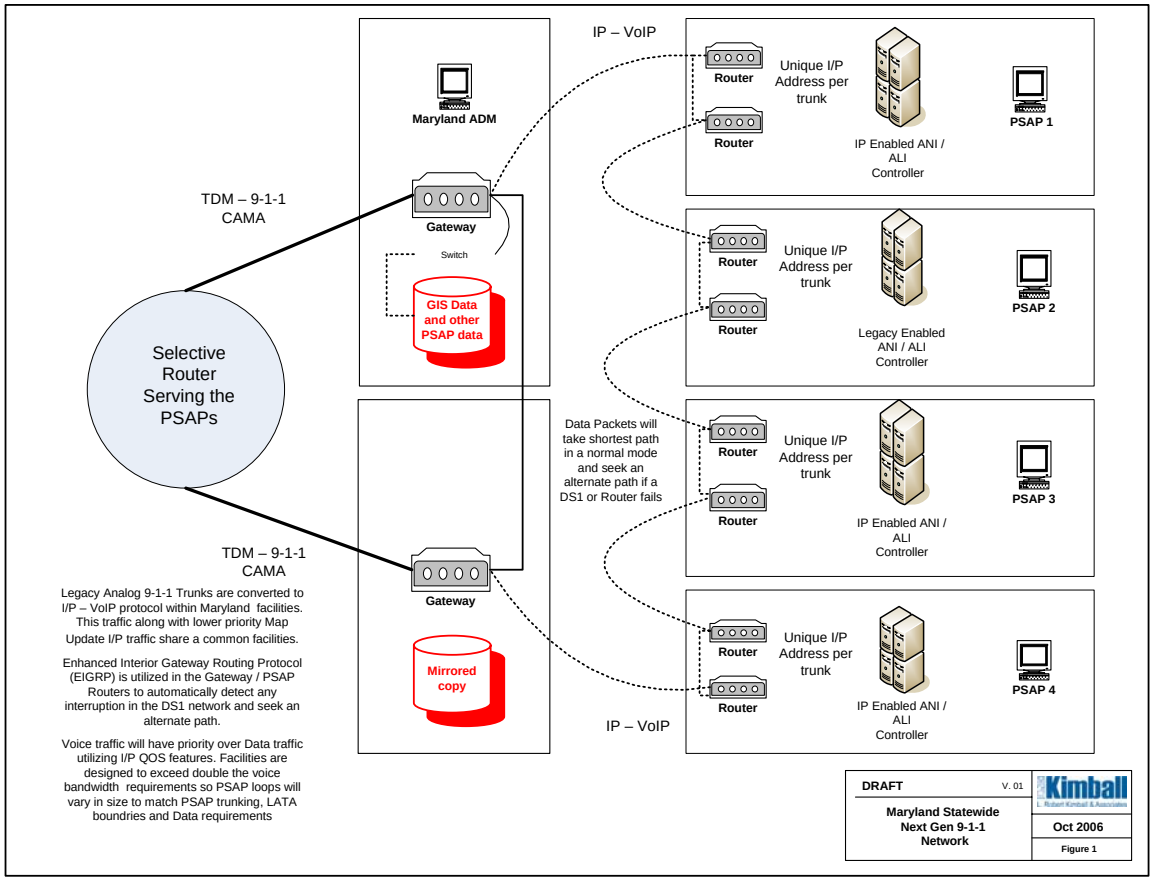
APPENDIX D

Network Type Descriptions

Network Options

The state of Maryland has several options of a network topology to provide the IP backbone to the PSAPs.

DS-1 Network Model 1



This is a fully redundant network. The backbone is likely to operate at a minimum DS-3 level on a (SONET) ring in the state of Maryland. The SONET ring is designed to function as a survivable network with more than adequate growth available to support future technologies.

Each PSAP has been located and evaluated for bandwidth requirements. Based on our calculations and experience, the PSAPs will require 80 Kbps per existing trunk for the delivery of voice services and 38.4 Kbps for data services. These estimates consider only the bandwidth required for supporting the 9-1-1 traffic. Additional bandwidth may be required to support the PSAP's workstations after an upgrade to their CPE.

Point-to-point DS-1 design can be thought of as a ring-type design. Connections are made from each PSAP to the next, creating point-to-point connections completely around the network. These connections are traditional Telco connections that can be used for various

services. The result is a ring made up of individual circuits that will provide a level of redundancy in the event of failure.

The DS-1 loops will be used as access to a router-based IP network configured over the ring. Each routing table will be populated with the information needed to traverse the network.

a. IP and EIGRP routing benefits
   IP transport relies on the transmission of packets. IP is connectionless in nature and requires the use of routers.

b. CODEC compression choices

c. Backbone bandwidth throughput

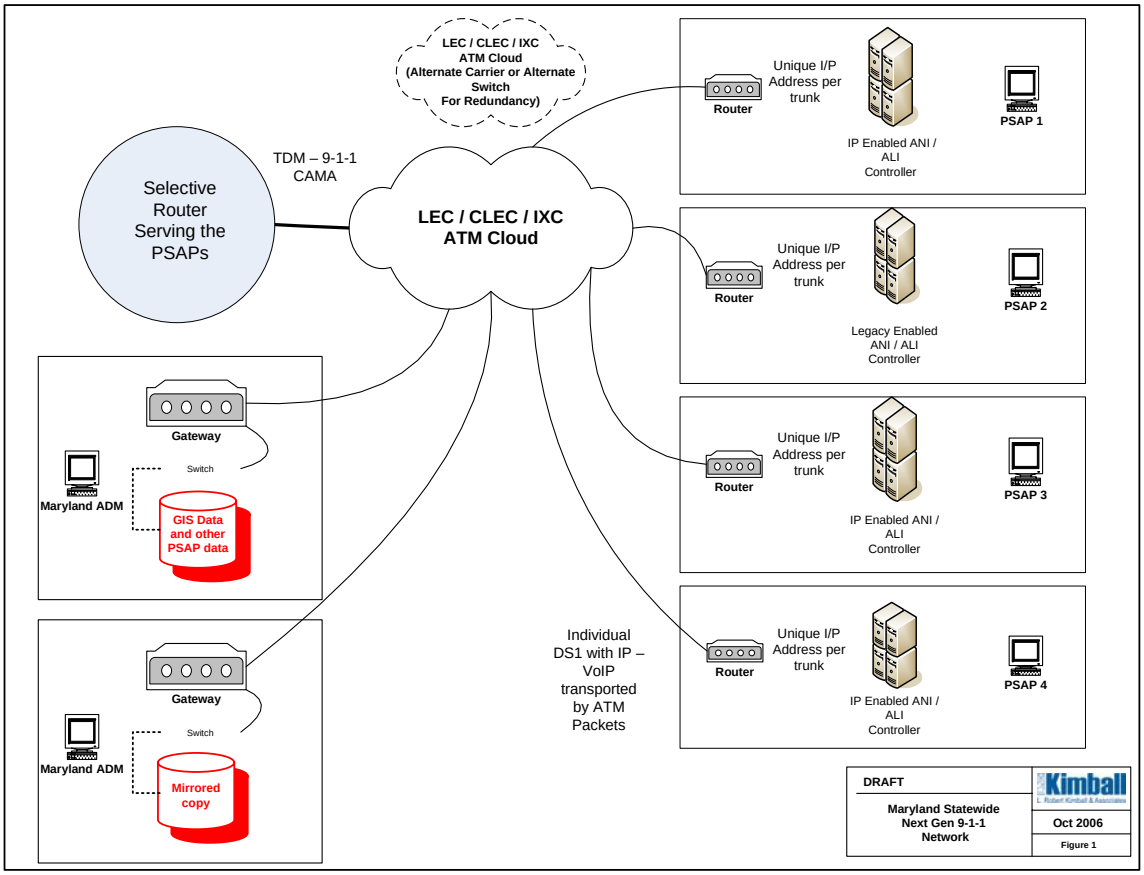
d. Supported by some LEC/CLECs and internal IT personnel

e. Remote map maintenance

f. Legacy CAMA and IP support

g. Redundancy, single points of failure

Asynchronous Transfer Mode (ATM) Network Model 2



An ATM network is a switched platform using physical telecommunications access as connection to the switches. ATM is “connection-oriented” which means that the physical connection to the switch must be operational for ATM to function. The

telecommunication access is typically Telco services such as DS-0 (56kbs), DS-1 (1.544Mbs) or some greater level of service. At its core, ATM was designed to bridge the service gap between data communications and traditional telecommunications across a protected, redundant network.

In an ATM network, virtual circuits (VCs) are mapped across the physical backbone to support the desired bandwidth. VCs can be either switched or permanent – but with ATM the most common is a permanent virtual circuit or PVC.

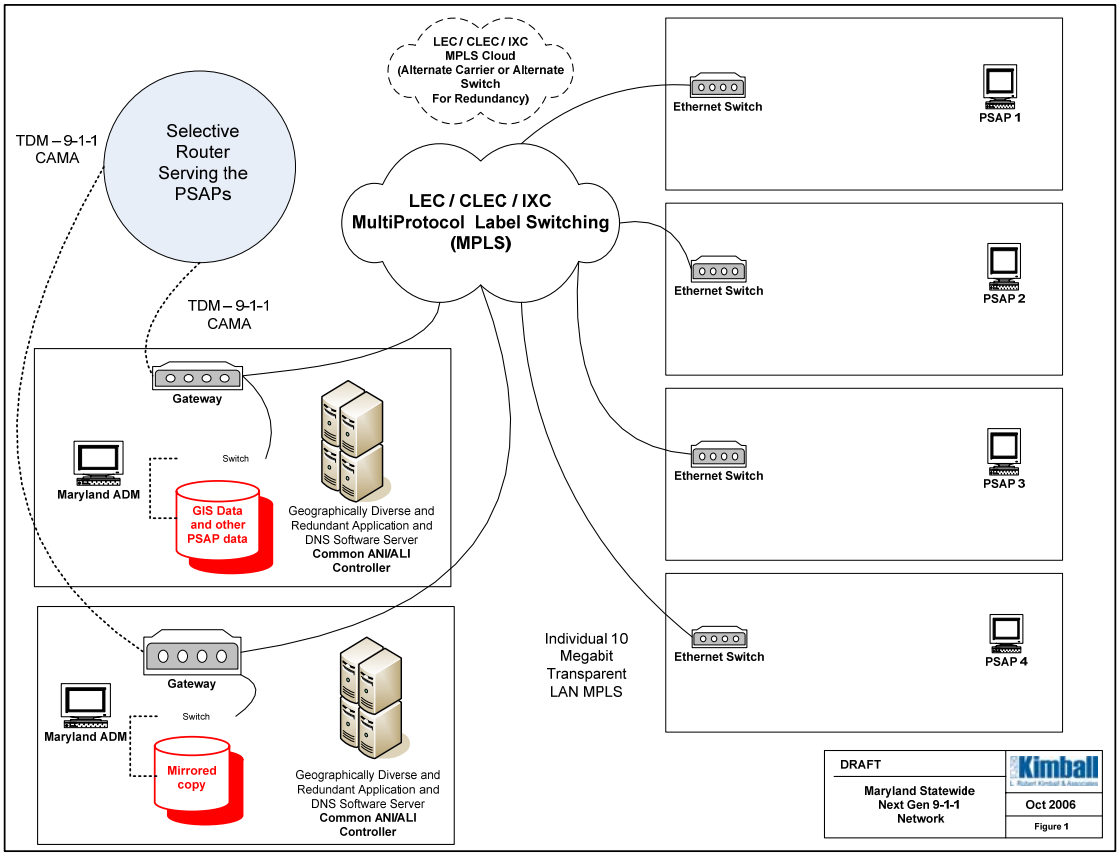
ATM also allows for Quality of Service (QoS) which can guarantee that traffic is delivered to the destination based on certain criteria.

In this context, ATM will be used at the core of the network with DS-1 connections to each PSAP and to the CAMA trunks. The PVCs must be configured within the ATM switch fabric to allow traffic delivery across the network. This design essentially creates the LAN that IP will ride. Next Gen 9-1-1 can operate over an ATM network quite nicely.

IP offers a level of security while preserving reliability. Since IP can re-route when congestion or links fail, traffic will still be able to get through. In this configuration, the ATM would be required to have switch diversity at the core. Backup ATM switches with redundant connections would allow the ATM network to survive a network outage.

The IP network would be using normal routing protocols to re-route IP packets in the event of network failure.

MultiProtocol Label Switching (MPLS) Network Model 3



MPLS is a data communications platform which emulates the features of a circuit-switched network over a packet-switched network. Because MPLS contains features of both circuit and packet networks, it is often thought of as “Layer 2.5” within the OSI model. While MPLS operates within routers, it can switch frames much like ethernet or frame. It can be used to carry many different kinds of traffic, including IP packets, as well as native ethernet, SONET, and frame relay.

While frame relay and ATM have specific attributes, MPLS offers another level of flexibility. MPLS is poised to replace these technologies in the marketplace, mostly because it is better aligned with current and future technology needs.

MPLS operates through utilizing labels that are attached to each packet. These labels allow for forwarding based on the label itself – rather than a lookup in an IP routing table. MPLS can forward packets faster, and generally reduce hop count since it does not directly view packet information.

1.1.1.1 Comparison of MPLS vs. IP

Since MPLS is not a typical Layer 3 routing protocol, it cannot be compared to IP as a separate entity. MPLS does work in conjunction with IP and IP's IGP routing protocols and allows added features such as traffic engineering, the ability to transport Layer 3 (IP)

VPNs with overlapping address spaces, and support for Layer 2 pseudo wires (with any transport over MPLS). MPLS relies on IGP routing protocols to construct its label forwarding table, and the scope of any IGP is usually restricted to a single carrier for stability and policy reasons.

1.1.1.2 Comparison of MPLS versus ATM

Both MPLS and ATM provide a connection-oriented service for transporting data across computer networks. In both technologies connections are signaled between endpoints, connection state is maintained at each node in the path, and encapsulation techniques are used to carry data across the connection.

MPLS is able to work with variable length packets while ATM transports fixed-length (53 byte) cells. Packets must be segmented, transported, and reassembled over an ATM network using an adaptation layer, which adds significant complexity and overhead to the data stream. MPLS, on the other hand, simply adds a label to the head of each packet and transmits it on the network.

Frame Relay

Frame Relay was designed to offer an efficient data transmission technique to allow bandwidth sharing across a network. Local Area Networks (LAN's) and Wide Area Networks (WAN's) can be integrated using Frame Relay protocols and techniques that allow bandwidth to be shared among distributed workstations. Frame Relay uses tools such as encapsulation and committed information rates (CIR) to forward (or relay) frames of data to one or many destinations from one or many end-points. These features are further defined below.

Frame relay is often used as a connection from a LAN to a service provider or a WAN. In Frame Relay a backbone WAN is built through a series of leased lines over T-1 (1.544Mbps) lines. Frame relay delivers frames of data at the data link layer (layer 2) of the Open Systems Interconnection (OSI) model rather than at the network layer (layer 3).

Frame Relay is an example of a packet-switched technology. Packet-switched networks enable workstations to dynamically share the physical network connection and the available bandwidth. The following two techniques are used in packet-switching technology:

- Variable-length packets
- Statistical multiplexing

Variable-length packets are used for more efficient and flexible data transfers. These packets are switched between the various segments in the network until the destination is reached.

Statistical multiplexing techniques control network access in a packet-switched network. The advantage of this technique is that it accommodates more flexibility and more efficient use of bandwidth. Most local area networks (LANs), are packet-switched networks.

Congestion techniques

Frame Relay uses congestion notification to avoid exhausting the available bandwidth. The congestion avoidance allows for QoS measures to be implemented allowing for a reliable communications platform. Within Frame Relay congestion control bits have been incorporated into the address field of the frame relay: Forward Explicit Congestion Notification (FECN) and Backwards Explicit Congestion Notification (BECN). The basic idea is to avoid data accumulation inside the network. The FECN bits can be set to a numerical value to indicate that congestion was experienced in the direction of the frame transmission, so it informs the destination that congestion has occurred. BECN effectively operates in the same fashion except it assigns the value to identify congestion in the direction opposite of the frame transmission, so it informs the sender that congestion has occurred.

Virtual circuits

Within Frame Relay - Two types of circuits exist: permanent virtual circuits (PVCs) which are used to form logical end-to-end links mapped over a physical network, and switched virtual circuits (SVCs). PVC's are analogous to the circuit-switching concepts of the public-switched telephone network (or PSTN), the global phone network we are most familiar with today. SVCs are most often considered harder to configure and maintain and are generally avoided without appropriate justification.

Virtual circuits provide a bidirectional communication path from one device to another and are uniquely identified by a data-link connection identifier (DLCI). A number of virtual circuits can be multiplexed into a single physical circuit for transmission across the network. This capability often can reduce the equipment and network complexity required to connect multiple devices.

Permanent Virtual Circuits

Permanent virtual circuits (PVCs) are permanently established connections that are used for frequent and consistent data transfers between devices across the Frame Relay network. Communication across a PVC does not require the call setup and termination states that are used with SVCs. One advantage of a PVC is that the transmission path is always available. No setup or reservation must be

made prior to data communication. PVCs always operate in one of the following two operational states:

- Data transfer—Data is transmitted between the devices over the virtual circuit.
- Idle—The connection between devices is active, but no data is transferred. Unlike SVCs, PVCs will not be terminated under any circumstances when in an idle state.

Switched Virtual Circuits

Switched virtual circuits (SVCs) are temporary connections used when sporadic data transfer between devices is needed. A SVC is generally constructed as a normal telephone call. A communication session across an SVC consists of the following four operational states:

•Call setup—The virtual circuit between two Frame Relay devices is established.

•Data transfer—Data is transmitted between the devices over the virtual circuit.

•Idle—The connection between devices is still active, but no data is transferred. If an SVC remains in an idle state for a defined period of time, the session willbe terminated.

•Call termination—The virtual circuit between devices is terminated.

After the virtual circuit is terminated, the devices must establish a new SVC if there is additional data to be exchanged.

Data Link Connection Identifiers

Datalink Connection Identifiers (or DLCIs) are numbers that identify the paths through the frame relay network. They are only locally significant, which means that when device-A sends data to device-B it will most-likely use a different DLCI than device-B would use to reply.

Committed Information Rate (CIR)

Frame relay connections are often given a Committed Information Rate (CIR) and an allowance of burstable bandwidth known as the Extended Information Rate (EIR). The provider guarantees that the connection will always support the CIR rate, and sometimes the EIR rate should there be adequate bandwidth. Frames that are sent in excess of the CIR are marked as "discard eligible" (DE) which means they can be dropped should congestion occur within the frame relay network. Frames sent in excess of the EIR are dropped immediately.

Frame relay was introduced to make more efficient use of existing physical resources. Telcos often sell frame relay to businesses looking for a cheaper alternative to dedicated lines while delivering a highly reliable data communications platform.

Frame Relay Network Implementation

A common private Frame Relay network implementation is to equip a T1 multiplexer with both Frame Relay and non-Frame Relay interfaces. Frame Relay traffic is forwarded out the Frame Relay interface and onto the data network. Non-Frame Relay traffic is forwarded to the appropriate application or service, such as a private branch exchange (PBX) for telephone service or to a video-teleconferencing application.

A typical Frame Relay network consists of a number of devices, such as routers, connected to remote ports on multiplexer equipment via traditional point-to-point services such as T1, fractional T1, or 56-Kb circuits. The majority of Frame Relay networks deployed today are provisioned by service providers that intend to offer transmission services to customers.

Public Carrier-Provided Networks

In public carrier-provided Frame Relay networks, the Frame Relay switching equipment is located in the central offices of a telecommunications carrier. Subscribers are charged based on their network use but are relieved from administering and maintaining the Frame Relay network equipment and service.

The majority of today's Frame Relay networks are public carrier-provided networks.

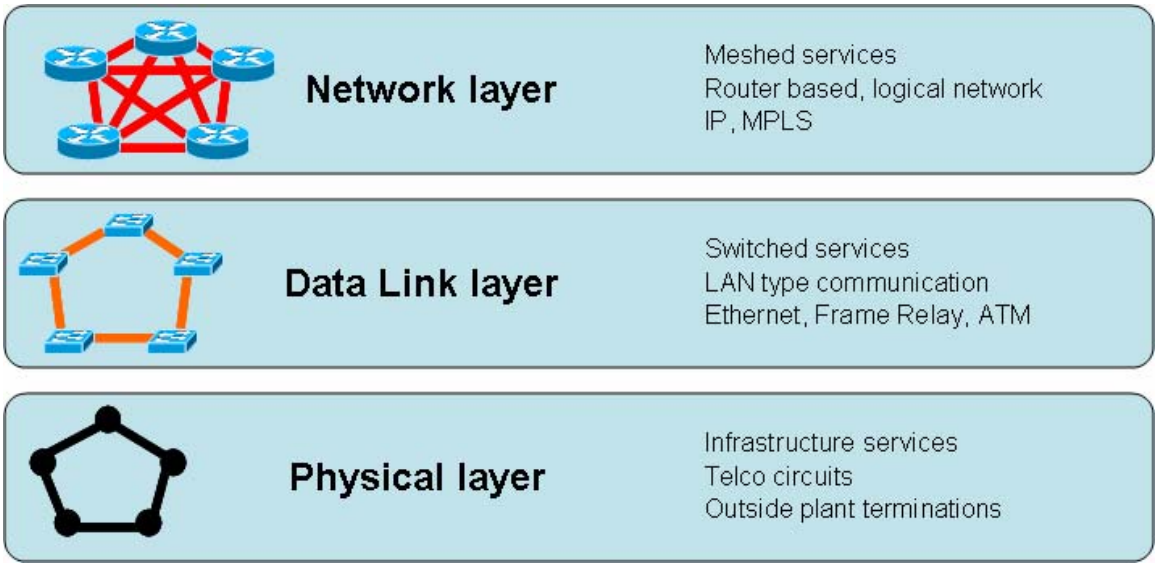
Private Enterprise Networks

More frequently, organizations worldwide are deploying private Frame Relay networks. In private Frame Relay networks, the administration and maintenance of the network are the responsibilities of the enterprise (a private company). All the equipment, including the switching equipment, is owned by the customer.

As of 2006 native IP-based networks have gradually begun to displace frame relay. With the advent of MPLS, VPN and dedicated broadband services such as cable modem and DSL, the end may loom for the frame relay protocol and encapsulation. There remain, however, many rural areas lacking DSL and cable modem services, and in such cases the least expensive type of "always-on" connection remains a 128-kilobit frame-relay line. Thus a retail chain, for instance, may use frame relay for connecting rural stores into their corporate WAN.

IP ENABLED NETWORK

Deploying an IP enabled network can provide a highly flexible, yet standards based platform for future growth. While IP remains the standard networking transport protocol, it is its ability to packetize communications that makes it indispensable. An IP network can be built upon a physical infrastructure to support voice, video, data and offer convergence across a standard network protocol. A key is the ability (as shown in the diagram below) of IP to build upon the lower communication layers.



The Physical layer connects the locations, be it Star, Hub and Spoke or even point to point. The Data Link layer (or Path) layer configured the end to end transmission path. Once the path is configured the Network layer allows for transparent connections to utilize the resources in the network. This is a *logical network* built to expand the physical capabilities and enhance the path. Logical networks can be configured on any type of physical connection, and can remain largely protocol independent. The only stipulation is that the Physical layer must exist for the Path to be created and a Path must exist for the logical network to address.

APPENDIX E

Maryland Public Safety Intranet
Standards, Policies, and Procedures

Maryland Public Safety Intranet
Standards, Policies, and Procedures

The purpose of the Maryland Public Safety Intranet initiative is to provide reliable, low-cost, broadband connectivity between Public Safety related state, county, and federal agencies to enable data and resource sharing. This infrastructure will serve as a means for business and communications continuance during times of crisis such as terrorist attack or natural disaster.

The boundary of this infrastructure backbone is to be the data and wireless communication equipment contained within the communication shelters and facilities as identified by the Statewide Communications Infrastructure Data Committee and the Statewide Communications Infrastructure Operations and Maintenance Committee. The boundary may be extended in certain circumstances by agreement of the committees. Additional non-backbone equipment may be housed in the communications shelters and facilities, but are not to be included in backbone maintenance considerations.

Standard Equipment

Backbone routers and switches are to be standardized to ensure compatibility of features and functionality with existing equipment. Specifications for new backbone data equipment are to be reviewed and approved by the Statewide Communications Infrastructure Data Committee.

Access points to the backbone, i.e., Wireless Bridges, should be standardized to ensure compatibility with current access points.

Routing Protocols

Backbone routers must be configured for IP and support the standard routing protocol, EIGRP.

Security

Due to the nature of shared network infrastructures, the security of data transmitted on this network cannot be guaranteed. It is highly recommended that any agency using this infrastructure for connectivity use firewalls that support IKE and IPSec VPN standards, and 168-bit 3DES or better data encryption.

Agencies connecting to the Maryland Public Safety Intranet are responsible for securing the network(s) or system(s) being connected. The Statewide Communications Infrastructure Data Committee reserves the right to disconnect any network or system that may compromise the integrity of the data infrastructure.

Maintenance

Unless otherwise agreed upon for specific sites, response will be next business day. The options for maintenance of the data equipment are as follows:

1. Manufacturer Support - Purchase support contract(s) from the equipment manufacturer.
2. In-House - Purchase 8x5xNBD support from the equipment manufacturer, maintain a supply of spares, and negotiate an MOU between maintenance partners for support of data equipment.
3. Out-Source - Put the support and maintenance out for bid.

Currently, maintenance is handled in a combination of options 2 and 3.

Procedures for gaining access to the Maryland Statewide Communications Data Infrastructure:

A completed Connectivity Request Form is submitted to the Maryland Statewide Communications Infrastructure Data Committee. The request is to include the location/address of the site to connect, bandwidth needs, systems to connect, the name, address, phone number, e-mail address of the contact person for the project, signed Terms and Conditions Agreement, and the desired implementation date. Also included should be a list of any equipment the requesting agency plans to connect to the data infrastructure, up to and including the firewall, for committee review.

The Statewide Communications Infrastructure Data Committee may request additional information regarding the security of the network(s) or system(s) to be connected. This information may consist of the agency's security policies and network diagrams including relevant IP addressing.

Requests will be reviewed within 30 days. During the review process, the Statewide Communications Infrastructure Data Committee will coordinate with the Statewide Communications Infrastructure Operations and Maintenance Committee to determine the feasibility of the project and bandwidth availability. If approved, the Data Committee will then sign, in agreement, for the project to move forward.

When the project is approved, the Statewide Communications Infrastructure Data Committee will respond to the requestor with the available bandwidth, nearest point of presence of wireless backbone, suggested methods of connecting, installation and availability date, and any cost or equipment issues. If the project is not approved, the Data Committee will respond with the reason and, if possible, suggestions for alternative means of connecting.

The Statewide Communications Infrastructure Data Committee will maintain a listing or database of points of presence for the review of participating agencies

The Public Safety Intranet Memorandum of Understanding (MOU) must be signed by partners in use of this microwave network.