# Report

*for*

# Next Generation 9-1-1 Planning

*submitted to*

## North Dakota Association of Counties and North Dakota 9-1-1 Association

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Kimball

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# 1. EXECUTIVE SUMMARY

L. Robert Kimball & Associates, Inc. (Kimball) is pleased to provide the North Dakota Association of Counties (NDACo) and the North Dakota 9-1-1 Association (ND9-1-1) with its report on Next Generation 9-1-1 (NG9-1-1) planning.

The intent of this project is for Kimball to assist NDACo and ND9-1-1 in preparing a document describing an NG9-1-1 strategy, define the budgetary costs and determine the implementation schedule for the strategy.

This high-level document is a master plan for 9-1-1 for North Dakota. This report covers the three primary tasks associated with the project plan.

- Task 1 - Assessment/evaluation
- Task 2 - Network design
- Task 3 - Master plan

## 1.1 INTRODUCTION

NG9-1-1 is a concept that has real life deployments today. NG9-1-1 is best described as a robust system of systems that allows the public to use any device to request help or send information to the appropriate public safety agency.

NG9-1-1 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 currently exists. The current 9-1-1 systems in North Dakota and throughout the nation are over 30 years old and are generally recognized as being limited both technically and functionally.

Various national agencies and organizations have developed their visions of this new system. Building on the work of the National Emergency Number Association (NENA), the Network Reliability and Interoperability Council (NRIC) (an advisory group to the Federal Communications Commission (FCC)), and the U.S. Department of Transportation (US DOT) NG9-1-1 Initiative, the NG9-1-1 concept envisions a systematic transition to a new system. The new system accommodates 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 North Dakota and its public safety answering points (PSAPs), implementation of and transition to NG9-1-1 may have far-reaching impacts such as:

- Call handling processes and procedures.
- Personnel issues.
  - Staffing with new skills (dispatchers and technology support staff).
  - Training on new systems.

- New and expanded data sources.
- Calls including audio, video, and telematics that can enable new sources of information for decisions about handling calls and dispatching and coordination of resources.
- Methods of transferring and coordinating information among PSAPs, emergency operations centers, and other public safety entities beyond that currently provided for the public switched telephone network.
- Greater interconnectivity among local PSAPs, regional, state, and national agencies for coordination of emergency responses.

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

While this is a conceptual technology, it is in use today in many areas of the country in various forms. There are many vendors that have various types of systems that can provide most of the functions of an NG9-1-1 system.

## 1.2 METHODOLOGY

To perform this feasibility study, Kimball gathered data in a variety of ways, including face-to-face meetings, telephone interviews, e-mail exchanges, and research on the internet. Kimball developed survey forms and spreadsheets to facilitate gathering the raw data from the various sources. Basic information gathered for each PSAP provided insight as to the current 9-1-1 system in North Dakota.

Additional follow up telephone calls, and e-mail correspondences with NDACo gained additional information on the 9-1-1 infrastructure in the state. Information on the voice network as well as database services was obtained.

Kimball used recognized best 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 NG9-1-1 system.

## 1.3 FINDINGS–CURRENT SYSTEM

There are 23 PSAPs that serve North Dakota including one that is located in South Dakota. These PSAPs use a variety of different 9-1-1 answering equipment called Customer Premise Equipment (CPE). PSAP CPE is specialized telephone answering equipment that permits the request for and display of a caller's phone number and the location of wire line phones and wireless phones as well as performing other specialized public safety related functions. The age of this CPE ranges from being installed in 1997 to the most recent, installed in 2008. Most PSAP CPE configurations are stand-alone with all equipment located at the PSAP. There are two PSAPs that operate as remote workstations off of the CPE switching equipment at another PSAP. Most of the PSAP CPE is reported by the vendors to be upgradable to make it IP compliant, but all require some type of upgrade to support IP communications.

Two Qwest-owned selective routers serve the majority of the PSAPs. The Qwest selective routers deliver most wire line and all wireless calls. There are several PSAPs that are served by direct trunks from the wire line central offices and do not have the benefits of selective routing. All of the selective routers to PSAP trunks are: Centralize Automatic Message Accounting (CAMA) type trunks. These trunks are traditional analog 9-1-1 trunks and provide a reliable connection to deliver 9-1-1 calls, but are limited in their capabilities to handle digital technologies. Qwest has installed router-to-router trunks between the two selective routers, enabling PSAPs to transfer fully enhanced 9-1-1 calls (both voice and associated location data) across the network where necessary.

Qwest/Intrado provides centralized wireless and Voice over Internet Protocol (VoIP) automatic location identification (ALI) database for all of the PSAPs and wire line ALI for many of the PSAPs. Some of the PSAPs have standalone ALI databases for wire line that they maintain on site.

The wireless 9-1-1 project lead by the NDACo has been very successful in delivering wireless Enhanced 9-1-1 (E9-1-1) calls to the PSAPs in the state so that all wireless callers have E9-1-1 service. This is a great accomplishment when looking at the fact that not all states have fully deployed wireless E9-1-1 in accordance with the FCC guidelines first published in 1996.

The systems in place today are working well. These systems were developed using the best available technology at the time they were developed. Newer technologies are being developed today that benefit the 9-1-1 system into the future.

## 1.4 PRELIMINARY DESIGN

The conceptual design for North Dakota is based on the NENA and US DOT Emergency Services IP Network (ESInet) design. The diagram below illustrates the system design. It includes redundant data centers for providing the NG9-1-1 services and data storage, and PSAP connectivity. This design also includes connection to the legacy 9-1-1 system. A full size diagram is included in Appendix A.

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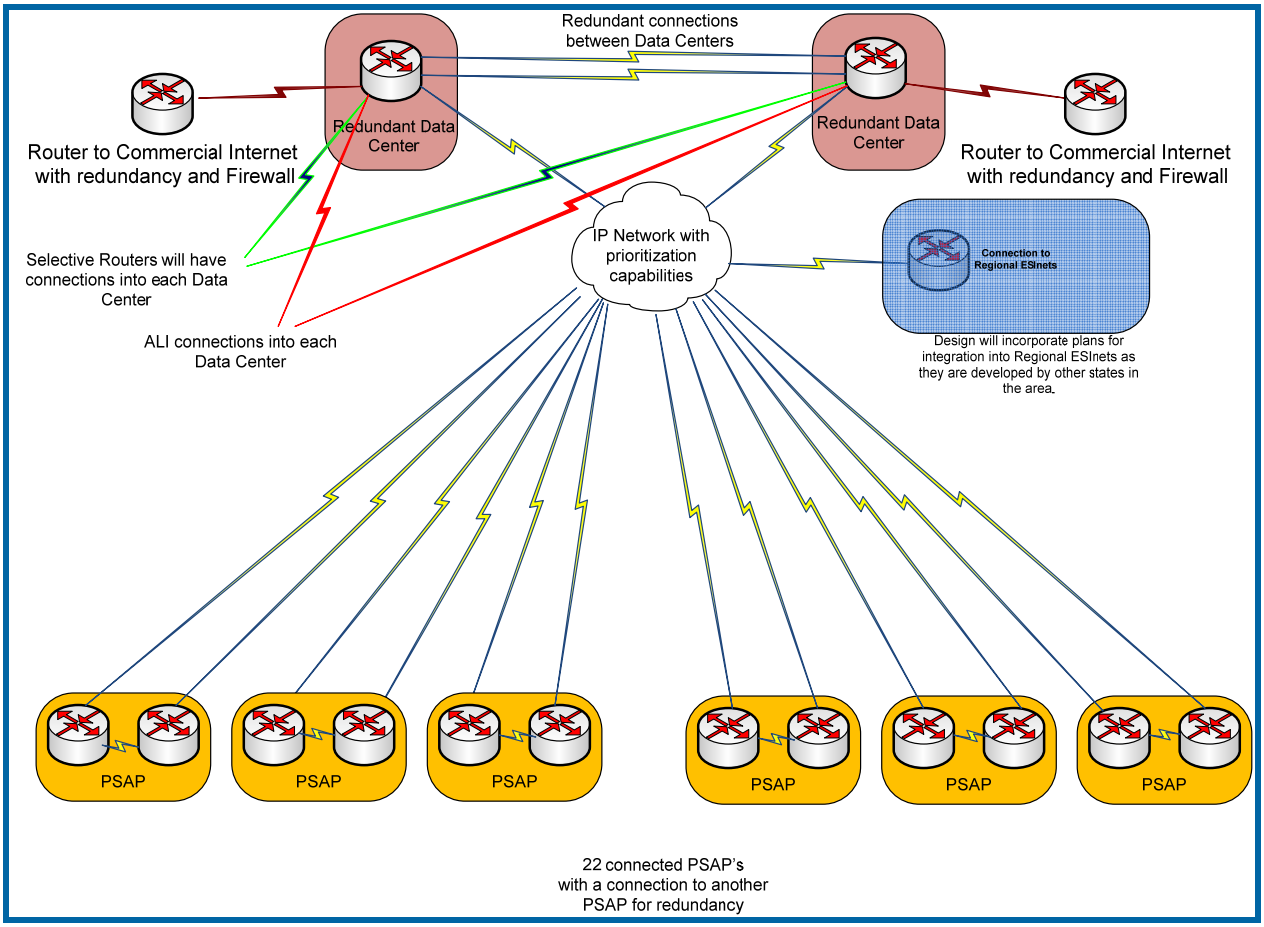



This design uses two geographically diverse datacenters to provide the NG9-1-1 services such as:

- Border control function
- Emergency services routing function
- Location validation function
- Legacy gateway

These datacenters provide the functions traditionally performed by the controllers at each PSAP, as well as more advanced functions of NG9-1-1. This can reduce the equipment needed at the PSAP. This may also reduce the number of 9-1-1 trunks needed by combining them at a central location.

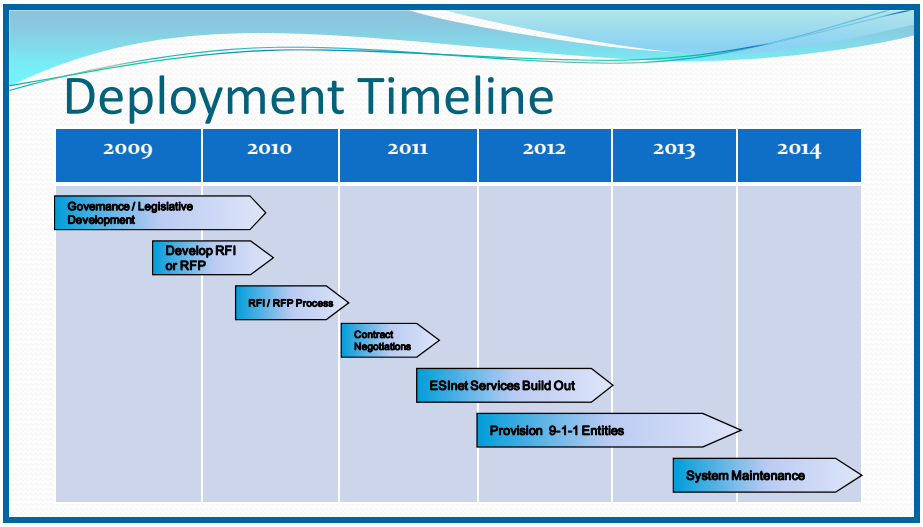
The system design covers the needed connectivity to the PSAPs, data centers, and call origination systems. Each location has two connections for reliability. In the case of the PSAPs they use a connection to the core, and a second connection to a neighboring PSAP. This design describes the major components of an IP Transport such as:

- Bandwidth
- Network management
- Service levels

## 1.5 PLANNING RECOMMENDATIONS

This plan looked at a six-year deployment effort. Many of these steps have some overlap, but, in general, the first two years would be used to develop the internal structure and defining the functionality needed to properly provide service to the residents and visitors to the state of North Dakota. NENA has indicated that they expect the first fully functional NG9-1-1 system is deployed in the fourth quarter of 2009. NENA and other organizations are working to complete the needed standards to reach that goal. Using this time to develop the systems needed, positions North Dakota will need to make use of these standards when completed.

The next three years would be for deployment of the final solution, and one year of annual maintenance for reference. This time frame is not firm, but gives a good overview of the process that should be followed to deploy these systems.




The costs associated with the deployment of the conceptual design are:

- One-time costs
- Recurring costs
- Professional services

These costs are budgetary and based on the full NG9-1-1 conceptual design. The actual costs may be reduced through developing more detailed functional requirements and competitive procurement processes.

The funding of the NG9-1-1 may be able to be reduced through the use of the federal 9-1-1 grant funding that is scheduled to be released in 2009. North Dakota is listed to get at least $500,000 in 50 percent matching funds from the National 9-1-1 Coordination Office. This match can be monetary or in-kind services. The final rules are yet to be published, but the Notice of Proposed Rule Making (NPRM) was published on October 3, 2008.[1]

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[1] Federal Register, Proposed Rules, October 3, 2008, Volume 73, Number 193, pp. 57567-57580.

# 2. INTRODUCTION

NG9-1-1 is a term frequently used today. This term is not a fully 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. To better understand this subject, Kimball reviews 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. IP is really a group of protocols used by computers. These protocols are a standard that can be used to integrate various types of equipment.

This technology is not restricted to the internet, but reflects the use of a protocol suite developed for the internet. 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 only looks at these new technologies for delivery of 9-1-1 calls to the PSAP within the 9-1-1 infrastructure, not callers using VoIP for their telephone service. Callers using VoIP on private phone systems and through phone service provided by internet service providers are being sent to the existing 9-1-1 infrastructure today.

NENA started several working groups 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.*

NENA has developed a set of standards for interim steps to deliver VoIP calls to the PSAP, and have other standards in development for completing NG9-1-1.

The current technology used by the 9-1-1 system is outdated and was technologically behind during the last major new technology change (wireless 9-1-1). In Dale Hatfield's report to the FCC in 2002 titled "A Report on Technical and Operational Issues Impacting the Provision of Wireless Enhanced 9-1-1 Services," he stated:

> *". . . one over-arching issue that immediately emerged in my inquiry is that the existing wire line E9-1-1 infrastructure, while generally reliable, is seriously antiquated. Indeed, it turns out that the existing wire line 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."*

Other organizations that are involved in the development of standards for this NG9-1-1 system include:

- Network Reliability and Interoperability Council (NRIC), an advisory group to the FCC.
- The Emergency Services Interconnection Forum (ESIF) - a group formed by the Alliance for Telecommunications Industry Solutions (ATIS) and NENA.
- Internet Engineering Task Force (IETF).

It is important to note that the concept of a NG9-1-1 network is supported at the federal level. In fact, the IP-enabled network was the second initiative involving 9-1-1 in which the USDOT has taken an interest.

The US DOT has begun an initiative to examine NG9-1-1. 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 telephone company called a 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 is to encourage standards so there is parity of service. Vendors of proprietary equipment and software are encouraged to develop open architecture systems that can be used nationwide and in conjunction with other vendors' equipment or software. The US DOT has stated:

*"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 US DOT 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."*[2]

The first sentence makes it known that "The 9-1-1 system is, and remains, primarily a local government and communications industry responsibility." US DOT 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.

Using these visions, in conjunction with the goals of the state of North Dakota for a NG9-1-1 system, allows a plan to be developed to maximize the value and minimize costs. The time required to develop and build these large-scale networks allows the state of North Dakota to begin to prepare for the future using the available technology today.

[2] US DOT Preliminary Concept of Operations document for the NG9-1-1 Initiative.

An ESInet is an advanced network in which the delivery of 9-1-1 calls are routed directly to the appropriate PSAP via a managed, uniform, dedicated, statewide digital network utilizing standardized components and IP technology.

An ESInet supports 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 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 is sent to PSAPs in the future. While it is difficult to predict the future, services such as telematics, (Automatic Crash Notification (ACN)), Geographic Information Systems (GIS) data, and several types of data offer good examples of the increased data flow that is likely and could be easily supported by an appropriately sized NG9-1-1 system solution.

While this is future technology, it is not far off in the future. NENA has announced that they expect the first NG9-1-1 system will be operational by the fourth quarter of 2009. There are several projects in place today that are using these same technologies to deliver 9-1-1 calls using IP transport, and several vendors have products available today that claim to provide most of the functionality of NG9-1-1.

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# 3. METHODOLOGY

To prepare this report, Kimball gathered information about the current 9-1-1 system in the state of North Dakota. Kimball then developed a preliminary design and recommendations using the data gathered and current national recommendations for NG9-1-1 established by industry leaders along with Kimball's expertise in the field. Kimball used recognized best practices in the telecommunications field, as well as documents and statements from national organizations such as NENA, APCO and US DOT to develop recommendations for the state regarding this NG9-1-1 system. Information obtained during data collection came from a variety of sources and it occasionally conflicted. This required us to make judgment calls based on our experience and knowledge. Kimball reviewed and verified data when possible.

## 3.1 FINDINGS - CURRENT SYSTEM

The NDACo, as a part of their ongoing wireless 9-1-1 program, provided the primary source of data on the PSAPs and 9-1-1 system in the state.

Kimball used following methods to gather data:

- Face-to-face meetings
- Telephone interviews
- E-mail exchanges
- Document review
- Research on the internet

## 3.2 PRELIMINARY DESIGN AND RECOMMENDATIONS

Kimball used recognized best practices in the telecommunications field, as well as standards, documents, and statements from national organizations such as NENA, APCO, NRIC and US DOT to develop recommendations for the state regarding this IP-enabled network plan. Potential issues that could become roadblocks to implementation and some requirements are identified in this document, to the extent possible.

This basic information was combined with the experience and knowledge of the Kimball staff from several other similar projects and work with the standards developing organizations. This experience and knowledge allows Kimball to understand the trends in the industry and apply those trends for the benefit of the state of North Dakota.

Costs were based on current values no calculation of inflation was included. These costs also did not include staffing costs for additional training or staff.

# 4. FINDINGS - CURRENT SYSTEM

The first task was to complete an assessment of the current infrastructure. This assessment assisted in the development of the conceptual design and planning recommendations.

## 4.1 PSAP

There are 23 PSAPs that serve North Dakota, 22 PSAPs in North Dakota, and one in South Dakota. A mixture of PSAP CPE equipment is installed and in service. The age of the equipment ranges from the oldest being installed in 1997 to the most recent being installed in 2008. Most PSAP CPE configurations are standalone with only two being remotes functioning as secondary PSAPs. There are five PSAP CPE equipment manufacturers represented in North Dakota, with Zetron having eight sites, Positron six sites, and PlantCML five PSAP sites each, rounding out the top three (see Table A.)

**Table A**

| | PSAP Locations | PSAP Controller | | Install Date | Serve as Secondary PSAP |
|---|---|---|---|---|---|
| | | Brands | Host or Remote | | |
| 1 | Devils Lake | Zetron | | 2005 | |
| 2 | Dickinson | Zetron | | 1999 | |
| 3 | Jamestown | Zetron | | 1999 | |
| 4 | Hillsboro | Zetron | | 2002 | |
| 5 | Washburn | Zetron | | 2005 | |
| 6 | Cavalier | Zetron | | 2002 | |
| 7 | Stanley | Zetron | | 2002 | |
| 8 | State Radio Bismarck | Zetron | | 2005 | |
| 9 | Fargo | Positron | | 2003 | |
| 10 | Mandan | Positron | | 2004 | |
| 11 | Grand Forks | Positron | | 2004 | |
| 12 | Williams | Positron | | 2002 | |
| 13 | Grafton | Positron | | 1996 | |
| 14 | Valley City | Positron | | 2003 | |
| 15 | Bottineau | PlantCML | Remote | 2005 | yes |
| 16 | Langdon | PlantCML | Host | 2008 | |
| 17 | Rugby | PlantCML | Remote | | yes |
| 18 | Bismarck | PlantCML | | 2003 | |
| 19 | Wahpeton | PlantCML | | 1997 | |
| 20 | Minot | PlantCML | | 2008 | |
| 21 | Stanton | Proctor | | 1997 | |
| 22 | Watford City | Proctor | | 1999 | |
| 23 | Mobridge, SD | Plant/CML | | 2008 | |

Most of the PSAP CPE is reported by the vendors to be upgradable to make it IP capable. With most equipment being over two years old, it all requires some type of upgrade to IP. The costs associated with upgrading and the age of the equipment should be evaluated in relationship to the final NG9-1-1 solution of the state to assure that the right financial and technological decision is being made on a case-by-case basis. One type of system that was manufactured by Proctor and is installed at two PSAPs is manufacture-discontinued and should be considered for replacement. Table A shows the manufacture and the date of install. Normally, the workstations for any PC-type workstation system should be considered for replacement at around five years of service. This should also be a consideration when deciding on upgrading versus replacement.

IP-enabled CPE allows for direct connection to an IP network but might not make the PSAP completely NG9-1-1 capable. Many of the NG9-1-1 features and requirements are still being developed and tested and manufacturers have not designed some of these into their systems at this time. Evaluation of each manufacturer's upgrades to make them IP enabled must be completed to determine if the upgrade accomplishes the goal of being NG9-1-1 capable. In some cases, replacement of the system might be the most economical solution.

## 4.2 INFRASTRUCTURE

Two Qwest-owned selective routers, one in Fargo (5E) and the other in Bismarck (DMS-100), serve the majority of the PSAPs. The Qwest selective routers deliver most wire line and all wireless calls. There are several PSAPs that are served by direct trunks from the wire line central offices and do not have the benefits of selective routing. All of the PSAP trunk lines are Centralized Automatic Message Accounting (CAMA)-type trunks delivering analog voice and Automatic Number Identification (ANI). Some PSAPs receive both wire line and wireless calls on the same trunks while others have separate trunks for each. Qwest has installed router-to-router trunks between their selective routers, enabling PSAPs to transfer fully-enhanced 9-1-1 calls across the network where necessary. NDACo has indicated that all end office trunks that terminate on Qwest's selective routers use Signaling System 7 (SS7) signaling and the end offices that are direct trunked to an on-site ANI/ALI controller use CAMA type trunks (See Table B.)

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## Table B

| PSAP Location | Wireless Tandem | Wireless Database | Landline Tandem | Landline Database | Local Telephone (PSAP) | 9-1-1 Trunks | ALI LINKS |
|---|---|---|---|---|---|---|---|
| Fargo | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado | Qwest | Three Land Two Wrls | Two Intrado |
| Bismarck | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Qwest/ Intrado | Qwest | Five Combined | Two Intrado |
| Grand Forks | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado | Qwest | Three Combined | Two Intrado |
| Bismarck State Radio SE | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado-Local SALI | Qwest | Three Land Two Wrls | Two Intrado |
| Bismarck State Radio SW | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Qwest/ Intrado-Local SALI | Qwest | Three Land Two Wrls | Two Intrado |
| Minot | Bismarck-Qwest | Qwest/ Intrado | Local Trunks | Local-SALI | Souris River Telephone | Two Wireless | Two Intrado |
| Bottineau | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Qwest/ Intrado-Local SALI | Turtle Mountain Comm. | Two Combined | |
| Langdon | Fargo-Qwest | Qwest/ Intrado | Local Trunks | Local-SALI | United Telephone | Two Wireless | Two Intrado |
| Rugby | Fargo-Qwest | Qwest/ Intrado | Local Trunks | Local-SALI | North Dakota Tele. Co. | Through Langdon | |
| Devils Lake | Fargo-Qwest | Qwest/ Intrado | Local Trunks | Local-SALI | North Dakota Tele. Co. | Two Wireless | Two Intrado |
| Dickinson | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Qwest/ Intrado | Qwest | Three Combined | Two Intrado |
| Mandan | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Qwest/ Intrado | Qwest | Three Combined | Two Intrado |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Jamestown | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado | Qwest | Three Combined | Two Intrado |
| Williston | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Qwest/ Intrado | Nemont Telephone | Three Combined | Two Intrado |
| Wahpeton | Fargo-Qwest | Qwest/ Intrado | Abercrombi | Local-SALI (IES) | Red River Rural Telephone | Two Land Two Wrls | Two IES/Intrad |
| Grafton | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado | Qwest | Three Combined | Two Intrado |
| Valley City | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado | Qwest | Two Combined | Two Intrado |
| Stanton | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Local-SALI | West River Telephone | Two Combined | Two Intrado |
| Hillsboro | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Local-SALI | Qwest | Two Combined | Two Intrado |
| Washburn | Bismarck-Qwest | Qwest/ Intrado | Bismarck-Qwest | Local-SALI | West River Telephone | Two Combined | Two Intrado |
| Cavalier | Fargo-Qwest | Qwest/ Intrado | Fargo-Qwest | Qwest/ Intrado | Polar Communicati ons | Two Combined | Two Intrado |
| Stanley | Bismarck-Qwest | Qwest/ Intrado | Local Trunks | Qwest/ Intrado | Midstate Tele. Co. | Two Wireless | Two Intrado |
| Watford City | Bismarck-Qwest | Qwest/Intra do | Bismarck-Qwest | Qwest/ Intrado | Reservation Tele Coop | Two Combined | Two Intrado |
| Mobridge, SD | Sioux Falls - Qwest | Qwest/Intra do | Sioux Falls - Qwest | Qwest/ Intrado | West River Telephone | Three Combined | Two Intrado |

## 4.3 DATA SERVICES

Qwest/Intrado provides the centralized wireless and VoIP ALI database for all of the PSAPs, and the wire line ALI database for many of the PSAPs. Some of the PSAPs have standalone on-site databases. These standalone databases are updated by the local jurisdictions utilizing telephone company data provided by the participating telephone companies. Selective routers are updated utilizing data from the Intrado ALI database.

Today, CAMA trunks serve all PSAPs whether it is from a selective router or an end office. These CAMA-type trunks do not support the more enhanced features of NG9-1-1. In a migration plan, with being NG9-1-1 capable as the end result, CAMA can be considered and could be utilized during the transition. CAMA can be supported on an IP network, utilizing gateways at each end to convert between IP and analog CAMA. These are called legacy gateways.

As stated above, the end office trunks that terminate on Qwest's selective routers are currently SS7 signaling. Today, SS7 is the most efficient and fastest method for delivering E9-1-1 traffic to a traditional TDM-type selective router and is supported by most, if not all, end offices, whether it is a landline, wireless or VoIP carrier. Having all SS7 trunks from the end offices to the selective routers is today's best choice that most carriers can support.

In the event of a delay of the deployment of NG9-1-1, those PSAPs that are supported by direct end office trunks with no connection to a selective router utilizing CAMA trunks should consider connecting to one of the legacy selective routers. These PSAPs also have stand alone ALI systems which means they only have access to ALI records that reside solely in their jurisdictions. As seen in Table B, there are 11 PSAPs that have standalone ALI systems. A standalone ALI system normally has a major limitation - only the PSAP that houses the system can view the ALI information. The ALI information cannot be shared with another PSAP in the event of a transferred 9-1-1 call or a misrouted call to another PSAP.

Without a connection to a selective router and a shared ALI database, these PSAPs lack the ability to transfer wire line enhanced 9-1-1 calls to a neighboring PSAP. All wireless calls are routed through a selective router for the PSAPs and data can be transferred to another PSAP. This arrangement allows for ALI data to also be shared between any PSAPs for calls that are routed to them through one of the Qwest selective routers or transferred to another PSAP that is served by one of the Qwest selective routers. Another major deficiency in direct trunking is the inability to automatically reroute 9-1-1 calls to a designated alternate PSAP in the event of a network or PSAP outage.

A critical data source in the NG9-1-1 environment is GIS. These databases hold the key for the advanced routing of the calls to the correct PSAPs and response agencies. Currently each PSAP develops their own map data. There is a project to develop a statewide map and GIS database. As that project is developed, NG9-1-1 needs should be included in the final project plans and the types of data that are developed and stored in this statewide GIS.

NDACo provided Kimball manufacturer data on current mapping and CAD systems that are deployed across North Dakota. All PSAPs that answer Phase II wireless calls have a mapping system in place while only seven have a CAD system (see Table C.)

**Table C**

| PSAP Location | Mapping | CAD |
|---|---|---|
| Bismarck | GeoTechGrp | Sunguard HTE |
| Bottineau | Seatol | |
| Cavalier | Bullberry | |
| Devils Lake | Seatol | |
| Dickinson | Bullberry | Archonix |
| Fargo | Positron | Bidding on New |
| Grafton | Bullberry | |
| Grand Forks | AccuGlobe | CISCO |
| Hillsboro | Seatol | |
| Jamestown | Bullberry | CIS |
| Langdon | Seatol | |
| Mandan | Bullberry | Archonix |
| Minot | Bullberry | New World |
| Rugby | Seatol | |
| Stanley | Bullberry | |
| Stanton | Seatol | |
| State Radio Bismarck | Bullberry | |
| Valley City | Bullberry | |
| Wahpeton | Bullberry | CIS |
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# 5. PRELIMINARY DESIGN

NENA defines an ESInet as "an IP-based inter-network (network of networks) shared by all agencies which may be involved in any emergency." Interconnection to hierarchical ESInets that exist in other states requires interconnection to the ESInet being planned for North Dakota. The ability to share public safety information between states is in the public's best interest. Some PSAPs receive calls from neighboring communities across state lines. It is essential to have the ability to transfer calls to the correct responding agency.

Transfer of voice information using the Session Initiation Protocol (SIP) has already been defined as a standard for voice communications between ESInets. Data standards for location information associated with the call have also been defined.

The goals and objectives of the North Dakota ESInet are to provide a faster and more efficient transport system for the exchange of data and delivery of 9-1-1 call information between all state 9-1-1 entities. The network infrastructure should be redundant and provide interoperability via NG9-1-1 applications while supporting legacy features for all PSAPs in the state.

Upgrading to a NG9-1-1 network eliminates several problems that exist in today's environment. Currently some of North Dakota's PSAPs are provisioned with direct trunks and are not serviced through a selective router. All ALI information is provided either by a standalone system or through a carrier, depending on location of PSAP and the call type. While the calls may be transferred between PSAPs, the associated emergency call information may be lost in the transfer. The fully implemented NG9-1-1 system allows all emergency calls to be transferred between PSAPs with the associated emergency call data and define the call type.

The conceptual design is based on several basic strategies. The network should be implemented using a phased-in approach. The network infrastructure should be installed first and thoroughly tested. The NG9-1-1 applications should then be transitioned in gradually. Network-to-network integration needs to be included in the transition plan since some 9-1-1 entities in other states are also planning their own regional ESInet. The ESInet architecture allows access to and transport of data throughout the state. Integration of current shared databases such as mapping data can be designed into the architecture to expedite data exchanges. Detailed descriptions of an IP-enabled network and interfaces are described in the NENA document 08-002, NENA Functional and Interface Standards for Next Generation 9-1-1 Version 1.0 (i3) and the U.S. Department of Transportation Next Generation 9-1-1 System Initiative.

The communications network transport speeds are determined by the vendor and sized appropriately to handle all proposed applications and a 100 percent growth factor. As described in NENA 08-002, packet prioritization must be available in the network. This prioritization is used to make sure that the voice is delivered to the end location quickly. Several IP-transport methodologies could be incorporated to meet the specifications. Multi-protocol Label Switching (MPLS) is one of these technologies. There are, however, several other technologies available in the state that meets the specifications for an ESInet.

Several service levels must be met for a public safety ESInet. Scheduled down time for maintenance is not acceptable and may not be considered in a public safety network. The infrastructure must also be robust and provide redundancy. A single point of failure shall not cause a network outage. A conceptual

network design is attached as Appendix B of this document. The network provider should comply with and be familiar with applicable NG9-1-1 recommended technical standards and documents from the organizations listed, and track new standards that are under development.

- National Emergency Number Association (NENA)
- US Department of Transportation NG9-1-1 Initiative
- Network Reliability and Interoperability Council (NRIC)
- Internet Engineering Task Force (IETF)
- Emergency Services Interconnection Forum (ESIF)

The NG9-1-1 system for North Dakota should include:

- IP transport
- NG9-1-1 services
- Call termination functions

## 5.1 IP TRANSPORT

The IP transport provides the method that carries the calls from the call origination to the PSAP. This is similar to the CAMA trunks that are in use today, but IP allows for more diverse types of data and diversity in routing of that data that CAMA trunks do not provide. The key elements of IP transport are:

- Bandwidth
- Network management
- Service levels

### 5.1.1 Bandwidth

Bandwidth is dependent on many things in the NG9-1-1 network. The numbers of PSAPs, busy hour calls, types and number of data sources, etc., all have an impact. The procurement process should develop this more specifically. For this project, it was assumed that the bandwidth would be DS-1 (1.54 Mbps) to each PSAP and 100 Mbps at the core of the network.

### 5.1.2 Network Management

North Dakota requires a fully-managed architecture to meet public safety best practices. Recommended service levels are outlined in this document. North Dakota relies on this network for public safety, consequently, network outages and poor network performance directly affects the ability of first responders to react to an emergency situation. The monitoring of the network and associated reporting must encompass these areas:

- **Performance Management** - Performance management measures the variables that affect network performance. The state of North Dakota requires a reactive performance monitoring system with user-defined thresholds that meet the service levels defined. Network performance reports describing corrective action when thresholds are not met should be required on a monthly basis.
- **Configuration Management** - Configuration management monitors the ESInet system configuration. Changes in configuration can cause network outage situations and poor network performance. The configuration management process should store copies of the various hardware and software configurations in place and track network-affecting changes.
- **Configuration Restoration** - If changes adversely impact public safety grade standards, then the provider must initiate immediate corrective action and restore the previous working configurations.
- **Fault Management** - Fault management detects, logs, and notifies the state of North Dakota of ESInet problems. If the failure immediately corrects itself, notification is not required, but the event should be logged and reported.
- **Root Cause Analysis (RCA)** - For major outages, the network provider should provide the state of North Dakota with a RCA within five business days; and for minor outages provides an RCA upon request.
- **Security Management** - Security management must control access to network resources according to public safety network security guidelines to prevent sabotage (intentionally or unintentionally) and compromise sensitive information. Security management must use public safety network security standards to monitor users logging into the network resources and refuse access to those who enter inappropriate access codes. The ESInet should support standard security policies that may include the use of anti-virus software, Virtual Local Area Networks (VLANs), Virtual Private Networks (VPNs), and secure sockets layer protocols.
- **Physical Security** - Network hardware and software must reside in a secure area that complies with industry standard physical security policies. The network provider must grant to the state of North Dakota or their authorized representatives 24/7 escorted physical access to the secure area.
- **Internet Firewall Management** - Firewalls supporting internet remote access to the state of North Dakota ESInet must provide protection from hostile intrusion. The firewall design should incorporate the following features:
    - Stateful intrusion detection
    - VPN support for remote users
    - Network Address Translation (NAT) routing for integration into the inside network
    - DES, 3DES, or 256-bit AES encryption
    - Logging, analysis, and reporting firewall activity
    - Real-time notification of serious attacks and intrusions
    - DMZ support
    - SPI to stop Denial of Service (DoS) attacks

- **Hardware Maintenance** - Hardware components used in the network require 24/7 hardware maintenance. Available spares should be identified for each location and component.
- **Preventative Maintenance** - The provider should include preventative maintenance activities that are included as part of a maintenance contract. This should address how preventative maintenance is handled, as well as the frequency of preventative maintenance activities. The provider should use support logs to drive the development of solutions to recurring issues and follow industry best practices.
- **Scheduled Maintenance** - Scheduled maintenance, including upgrades to the system, must be coordinated in advance with the state of North Dakota and conducted in a manner that does not interrupt operations at more than two remote or one-core location locations simultaneously. The network provider should make all attempts to assure that a remote location and its designated back up are not affected at the same time.

### 5.1.3 Service Levels

The state of North Dakota must have the flexibility to respond to new communication technologies and to maintain different Quality of Service (QoS) schemes to accommodate all current and future forms of emergency requests. The future forms may include, but are not limited to, the following:

- Short Message Service (SMS) messaging
- Instant messaging (IM)
- Text messaging
- Satellite personal locator beacons
- Future development in TTY/TDD type devices
- Video and image
- Automatic crash notification

While it is not possible to design a system that anticipates every possibility, North Dakota requires a system architecture that is modular and based on open standards. To accomplish this, service levels should be defined with the vendor that provides the IP transport network.

This section identifies the service level criteria that North Dakota should have. These service criteria are not typical of the general telecommunications industry but they are required for public safety communications.

The network provider should provide various monthly network management reports for Fault Management, Performance Management, Configuration Management, and Security Management. The Service Level Agreements (SLA) should address the following:

- **Core Backbone Availability** – The core backbone network infrastructure of the North Dakota ESInet shall have a minimum monthly network availability factor of 99.999 percent based on a 30-day month. The network availability factor must be calculated for the entire core backbone network infrastructure and not on a per-circuit basis.

- **Remote Location to Core Backbone Availability** - That part of the network infrastructure consisting of Wide Area Network (WAN) circuit connections and the edge devices managed by the network provider as part of the availability requirement shall have a minimum monthly network availability factor of 99.999 percent based on a 30-day month.
- **Future Connectivity** - The network provider should include in the network design, the capability to support future redundant and diverse connections from the remote locations to the host locations. Design should accommodate connectivity to support T1, microwave, Synchronous Optical Network (SONET), point-to-multipoint, or other diverse infrastructure solutions deemed necessary by the state of North Dakota.
- **Average Jitter Measurement** - Jitter is a measurement of the delay variations in the transport of the packets in a network. A reading should be taken every five minutes, 12 samples per hour. The samples, minus any five-minute samples where the average bandwidth utilization is >= 80 percent or minus any samples that where otherwise unavailable, is then averaged together for the daily measurement.
  - Edge Device to Network Access Point (NAP)-average jitter is =< 15 ms
  - Average Jitter Measurement, NAP–to-NAP-average jitter is =< 2 ms
- **Average Hourly Packet Loss** - A reading should be taken every five minutes, 12 samples per hour. The samples, minus any five-minute samples where the average bandwidth utilization is > = 80 percent or minus any samples that where otherwise unavailable, is then averaged together for the daily measurement.
  - NAP to NAP average hourly packet loss is =< .5 percent
  - Hourly average round-trip response time delay, edge device to the first hop in the core should be =< 20 ms
  - Average hourly round trip latency, remote location to host location is =< 125 ms
  - Average hourly round trip latency, NAP to NAP is =< 10 ms
- **Hourly Average Bandwidth Utilization** - The average hourly inbound bandwidth utilization and the hourly average outbound bandwidth utilization: =< 80 percent average bandwidth utilization per 24-hour day per calendar month. In the event this 80 percent hourly average bandwidth utilization factor is exceeded for a given location, the network provider must determine and recommend corrective action.
- **Critical Problem Identification and Resolution** – Identification of a critical problem shall result in an immediate action such as maintenance ticket opened, work log entry within ten minutes, subsequent entries into work log within 30 minutes, first critical notification to the state of North Dakota within 30 minutes, and subsequent critical notifications every hour until the problem is fixed. Critical problems should be resolved in two hours or less.
- **Minor Problem Identification and Resolution** – Identification of a minor problem should result in an immediate action such as maintenance ticket opened, work log generated within 30 minutes and subsequent entries logged within four hours. Minor problems should be fixed within 12 hours or less.
- **Installing and Testing New or Upgraded ESInet Connectivity** – All equipment should be maintained and replaced as needed. Installing, testing, and configuring new or upgraded host or remote location's core network connection should take place in 30 calendar days or less, with the

exception of a remote location's unavailability. Prior notice to the state of North Dakota should be made for all new equipment and upgrades.

- **Configuration Management Services–Major** - Any configuration management issue that isolates a critical network component, a host, or a remote location is considered to be "major" and requires immediate corrective action and notification to the state of North Dakota. The network provider gives the state of North Dakota a final RCA within five business days.
- **Configuration Management Services–Minor** - The network provider must respond to "minor" issues within two hours or less. The network provider must place a courtesy call to the state of North Dakota on-call personnel and provide periodic status reports until the configuration issue is resolved. The network provider must provide the state of North Dakota a final root cause analysis (RCA) upon request.
- **Configuration Management Services–Proactive** - The network provider must notify the state of North Dakota three business days in advance of changes in remote access configuration services that affect the ESInet.

Adherence to industry accepted guidelines and best practices provides many advantages including protection from obsolescence, improved supportability, reduced costs, and improved interoperability.

Several nationwide carriers, the Dakota Carrier Network and North Dakota StageNet, are possible vendors to use for the IP transport of the ESInet. Public safety networks require strict adherence to service level guarantees and the coordination between vendors far exceeds that required in other communication networks. A vendor should not clear a trouble ticket simply because they have verified it is not on their equipment. All vendors must cooperate until a full resolution is accomplished. Testing between vendors also must be coordinated.

Service levels for network performance must be established and management parameters of the network must be defined. Management must encompass security, configuration, fault and performance.

The selection of an ESInet backbone carrier does not only include adherence to service levels, but also adherence to public safety policies and practices.

## 5.2 NG9-1-1 SERVICES

The network is a transport mechanism for the NG9-1-1 system. The NG9-1-1 services provide the functionality for the system. These services are subject to change as new services are developed and added to the ESInet. The minimum functional elements that should apply in the North Dakota ESInet include:

- Border control
- Emergency call routing function
- Location validation function
- Legacy gateway

These elements and functions only address the minimum requirements in a broad-based manner for an ESInet. The solution must support commonly used IP-based telecommunications, messaging, image, and video protocols in order to maintain interoperability with IP applications. Other services may be needed for new technologies as they are deployed on the ESInet.

### 5.2.1 Border Control Function

The border control function provides several services. These services include but are not limited to:

- Interconnection to other systems (informational and operational)
- Security

Border control functions interconnecting with other ESInet requires equipment and standards be implemented. Security of an independent ESInet needs to be maintained while interoperability for information transfer is available. Interfaces should be scalable to accommodate interconnections with other ESInet's across state lines or across the country. Security policies should be established initially, and interconnecting agencies have to adhere to these polices which should be based on NENA standards, local regulations, and industry best practices.

Security between the ESInets is required with firewalls and a public key infrastructure to maintain identities of entities allowed access to information. Internally, in each ESInet encryption design, technologies may be implemented between interconnected agencies to keep data secure. When attaching to external ESInets and other agencies, an authorization matrix must be developed to maintain data confidentiality. Interconnection between state agencies has a different set of security criteria than agencies outside the state boundaries. A different logical interface is recommended. Global policies on the equipment vary between in-state agencies and out-of-state agencies. Both configurations could also supply redundancy from a logical and physical perspective.

North Dakota's ESInet design is based on the interconnection of all PSAPs in the state. Since ESInets are IP-based, such interconnections allow any agency to communicate with any other agency or service on any of the interconnected ESInets. The IP-enabled PSAP is a PSAP that is capable of receiving IP-based signaling and media for delivery of emergency calls and for originating calls.

### 5.2.2 Emergency Call Routing Function

The Emergency Call Routing Function (ECRF) is one of the major functions that make NG9-1-1 different from the current systems. The ECRF is an advanced system for routing calls for service to the best location to handle the call. This also involves several other systems outside of the ECRF for data.

An Emergency Service Routing Proxy (ESRP) performs call routing. There may be several of these within the network to properly deliver calls to the proper location and for redundancy. The ESRP makes use of the location information stored in the Location to Service Translation (LoST) database to determine the route to the proper PSAPs.

This also involves a new function called policy-based routing function. This uses policies of the destination PSAP, and the ESInet owner to route calls. This routing can be based on the PSAP state (in-

service, busy, etc.), congestion state, time of day, or most other new data information that is provided with the call for service. This function can also use supportive information such as crash information to make routing decisions.

### 5.2.3 Location Validation Function

The Location Validation Function replaces several systems in use today such as the master street address guide. This is basically a geographic information system with various sets of data related to the provision of 9-1-1 service in the area. This information can be used to route calls by the ESRP or to verify data to the service providers. The function must be able to look up information based on geographic or civic information provided directly by the call origination network.

The major component of this function is the LoST database. The LoST database stores location information in a GIS format and is used to translate a location, both geographic and civic, to the proper response agency and PSAP.

### 5.2.4 Legacy Gateway

The Legacy Gateway is not a part of the NG9-1-1 system, but is included in the architecture of the NG9-1-1 system with the realization that the legacy systems will remain in place for some time to come. The legacy gateway is used to take a legacy system such as the traditional phone system and convert it to a format that can be used by the NG9-1-1 system. Over time, fewer of the traditional systems remain and the need for this diminishes.

The legacy gateway may allow for the reduction of the number of 9-1-1 trunks and ALI links that are needed. Many PSAPs use two 9-1-1 trunks as a minimum. This is to provide for diversity. A true calculation of the needed trunking may be much less, but the PSAP still needs to have two trunks. By combining these trunks to a data center the number of trunks can be reduced, and still allow the PSAP to function.

## 5.3 CALL TERMINATION FUNCTION

The call termination function provides the equipment and functions that the 9-1-1 call taker uses to receive calls for service from the public. This equipment can be as simple as a workstation to as complex as an Automatic Call Distribution (ACD) system and local databases. The call termination functions can be hardware installed in the PSAP or a managed service model. This function replaces the traditional PSAP controller hardware. The traditional PSAP hardware was used to retrieve the location information about a call. The NG9-1-1 system sends the location with the call, eliminating the need to retrieve it at the PSAP.

Call termination can include:

- Remote location ACD incorporating transfer and call bridge capabilities
- Business rules database
- Call record database

- Supplemental data access
- Remote location workstations

## 5.4 DATA SERVICES

Centralized data services are key in creating an effective and efficient NG-9-1-1 system. Developing a centralized GIS mapping system on an NG9-1-1 network increases the quality and consistency of data at the PSAPs. Updates and maintenance can be done more efficiently and less costly. The increased capacity of the new network would allow quick and efficient transfer of mapping, CAD, and CPE call data.

Mapping, applications, and data traditionally reside at each PSAP to minimize network bandwidth requirements. Several technologies currently available allow centralized network based map data to be accessed without creating significant network bandwidth use. Mirrored copies could be stored locally at the PSAPs or applications can be designed to minimize network utilization. As North Dakota migrates to a NG-9-1-1 network, more of the applications may be network centric. Management and monitoring of bandwidth is essential in the design.

## 5.5 POTENTIAL SHARED INFRASTRUCTURE

Using shared infrastructure with common carriers and private networks is acceptable in a public safety network if criteria providing network security and bandwidth allocation as specified in the service levels are maintained.

Developing bandwidth segmentation including network addressing space and quality of service must be maintained. Several of the current network providers under contract with state of North Dakota already adhere to these practices.

Several state agencies have contracts in place that may be used to provide network services for the North Dakota ESInet. These in-place network contracts do not require a RFP and allow any state agency to purchase services. These contracts have pricing schedules and set service levels associated with them. Current contracts should be reviewed to determine if the service levels meet public safety network requirements. Shared backbone infrastructure must also have sufficient bandwidth and management in place to assure required service levels are met.

## 5.6 TRANSITION AND DEPLOYMENT ISSUES

Plans for statewide ESInet do not take away the autonomy of the local PSAPs. The flexibility of the IP network impacts operations for day-to-day events and extraordinary situations. The infrastructure design allows for local information control and access while storing the data and services in core locations. The flexibility of an IP network allows for the development of contingency plans for all major and minor events.

While the benefits are undeniable, there are challenges the state would have to address. Through work with other states, Kimball has a keen understanding of the issues that North Dakota is likely to encounter as it proceeds to implement a statewide IP-enabled network supporting NG9-1-1 applications.

Local exchange telephone carriers support the NG9-1-1 initiatives but may be reluctant to change their internal support systems because a business driver for such an initiative may not exist yet. Several of the databases currently residing with the carriers may require access from the ESInet to support NG9-1-1 applications. Standards to interconnect with these databases are established and are operational in other areas of the country. The carriers may require legislative influence to change their internal procedures and allow interconnection to these databases. They currently have no reason to change their procedures from a business perspective.

Standards are still evolving for NG9-1-1 applications. Guidelines are well established but, as with all technologies, standards are evolving. The NG9-1-1 applications service providers have to be committed to supporting the NG9-1-1 standards as they evolve.

Projects of this size and complexity require proper oversight to be successful. Kimball recommends development of a detailed transition plan to include:

- Implementation management
- Technical consulting
- Project management

In the event of a delay of the deployment of NG9-1-1, those PSAPs that are supported by direct end office trunks with no connection to a selective router, utilizing CAMA trunks, should consider connecting to one of the legacy selective routers. These PSAPs also have stand alone ALI systems which means they only have access to ALI records that reside solely in their jurisdictions. As seen in Table B, there are 11 PSAPs that have standalone ALI systems. A standalone ALI system can usually only send the ALI information to the PSAP that houses the system and cannot be shared with another PSAP in the event of a 9-1-1 call transferred to another PSAP.

We are confident that North Dakota public safety stakeholders, who understand the importance of moving forward, not only help PSAPs improve their ability to handle everyday emergencies, but also assure that information can be instantly shared across jurisdictions in the event of an extraordinary emergency.

After connecting to the statewide ESInet, agencies may need to make changes at the operational level:

- PSAP personnel require additional trainings to handle the new types of information that an IP-enabled network may deliver to them and the new applications that make this possible.
- PSAPs do not only improve their ability to handle everyday emergencies, but also assure that information can be instantly shared across jurisdictions in the event of an extraordinary emergency, whether it is a natural disaster or a man made one.
- Some 9-1-1 entities may have newer types of equipment that will require different skill sets than they have today. This may result in additional staff or retraining of existing staff.

## 5.7 COSTING

The vendor selected will determine the final costing. For budgetary costing, several assumptions were compiled from the survey data collected. There are 22 PSAPS in the state and 64 trunks for an average of 2.78 trunks per PSAP currently. Round up to three and add expansion of 100 percent uses six trunks per PSAP for budgetary design.

Network bandwidth requirements are directly dependent on applications being supported and the requirements set forth by the applications providers. Network costing is dependent on those factors.

The applications supplied by a vendor are a substantial portion of the cost involved in the design. Coordination of the applications and network services are critical in the operation of this network. Strict parameters must be adhered to assuring coordination of services.

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# 6. PLANNING RECOMMENDATIONS

There are several areas that North Dakota should look at carefully when deploying a NG9-1-1 system. These areas can be important to the success of the deployment.

## 6.1 STATEWIDE COORDINATION

Experience in deploying 9-1-1 initiatives across the county has revealed one fundamental lesson—states with central coordination deploy 9-1-1 enhancements faster than those that do not. This is clearly shown in the deployment of wireless 9-1-1 in North Dakota. The successful wireless deployment in North Dakota also shows another important point related to coordination. This is needed, but it does not require regulatory authority to accomplish a great deal of success.

The NDACo has a history of coordinating with the counties for the delivery of information technology services as well. The NDACo can help to provide the coordination of NG9-1-1. Most of the PSAPs are county or city run agencies; the league of cities can also provide coordination with the municipal agencies, and work cooperatively with NDACo to develop the plans needed to deploy NG9-1-1 in North Dakota.

The notice of proposed rule-making for the 9-1-1 grant funding that is released in 2009 by the National 9-1-1 Coordination Office has indicated that the grants are disbursed through a state coordinator appointed by the governor.

This has worked well in the deployment of traditional and wireless 9-1-1. The NG9-1-1 environment also requires a certain level of governance to be successful. This is demonstrated in the fact that there are several options available and coordination of a central ESInet to provide for interoperability across the state and between states is critical.

## 6.2 GOVERNANCE

Governance plays a major role in the NG9-1-1 environment. The NG9-1-1 architecture involves a network-of-networks topology. Each of these networks should have policies in place to assure interoperability. These policies can include:

- Connection requirements by call delivery providers
- Data management
- Data maintenance
- Data access
- Interconnection requirements
- PSAP or regional ESInet interconnection requirements

Governance is necessary to develop policies and procedures for the statewide system. All users are required to adhere to these policies and procedures. These policies should be developed with the input of the user community and providers. They require updating over time, and there should be some method of enforcing these policies and procedures.

One model that may work well is a committee or council similar in nature to the statewide interoperability committee. The Department of Homeland Security document titled "Creating a Charter for a Multi-Agency Communication Interoperability Committee: Template and Questions to Consider" is a good reference to begin this process.

This structure makes use of a group of stakeholders to develop the policy for the benefit of all the groups represented. When forming a committee it is best to look at getting a good representation of the stakeholder, but keep the size of the committee limited to 15 or less to keep things progressing. The selection of these representatives is also important. Each representative must want to be on the committee and be willing to work towards the greater good of the state's residents and visitors.

Governance can be contractual or regulatory. The usual reaction is to pass a law to provide governance, but there are other ways of providing governance. Using Memorandums of Understanding (MOUs) and contracts can be effective also. Developing policies for the NG9-1-1 system and then using the contracts of the users to enforce those policies may be faster than the legislative process. In addition, contracts with the call origination networks eliminate the need for regulatory actions such as tariffs. One last advantage is that contracts are easier to adjust as needed. This allows a more flexible system that can adjust quicker to the changing environment.

There are disadvantages to the use of contractual governance. The major disadvantage is that this may result in some entities not using the system. The use of contracts is voluntary whereas regulations are requirements. This can lead to an incomplete system, or more than one system with interconnection issues.

The NDACo's use of MOUs and relationship to assist the local governments with the wireless 9-1-1 project, and the ongoing information technology support services that they provide to local governments, are examples of a successful use of contractual over regulatory methods.

## 6.3 LEGISLATIVE AND REGULATORY ISSUES

This report did not undertake a review of the legislative and regulatory environment in North Dakota. The state should examine the following areas to address with legislative, regulatory, or executive action as may be appropriate within the State's constitutional authority and needs of the state:

- **Coordination** - Appoint a statewide coordinator and outline the authority of that position in line with the requirements of the 9-1-1 grant program guidelines.
- **Governance** - After investigating and choosing a governance model, formalize this and appoint members.
- **Funding** - Develop funding streams to provide service to the public at a standard level statewide.

- **Delivery of calls to NG9-1-1 system** - Examine the tariffs and regulations on the provisioning of 9-1-1. Change or add language to reflect newer technologies and to enable competition.
- **Liability protection for providers** - Look at the liability protections afforded to 9-1-1 providers, and possibly extend this protection to the new service providers
- **Establish rules** - Grant the governance entity, statewide coordinator, or other entity the authority to promulgate rules in the following areas:
  - Ability to select method of call delivery from the origination networks
  - Fee structure and rules
  - Interconnection requirements

## 6.4 DEPLOYMENT MODELS

One of the advantages of the NG9-1-1 concept is that it uses open standards and interfaces. This has resulted in a situation where there are many ways to provide the needed functionality to achieve or at least prepare for true NG9-1-1. The major methods are:

- IP enabled network
- ESInet
- Centralized equipment
- Managed services

### 6.4.1 IP Enabled Network

An IP-enabled network is what many of the early adopters have put into place today. This simply provides the IP transport of the calls to the PSAP. It does not provide most of the NG9-1-1 services and advanced features that are NG9-1-1. These networks were often deployed early in the process before many of the NG9-1-1 standards were developed. These networks can be used as the NG9-1-1 services are added to the network to provide NG9-1-1 functions.

### 6.4.2 ESInet

An emergency services IP network follows the NENA standards for an i3 network. These standards are still being finalized, but all of the basic functions have been defined. This is a system of network and services working in concert to process any device type in a standard format. This is the most complete design and the reigning entity can control the services that are connected to this network.

### 6.4.3 Centralized Equipment

Many regional systems are looking at using centralized equipment to deliver the calls. This option involves using a large device that would normally be placed at each PSAP, and provide workstations only at the PSAP. This may save some funds with the reduction of back room equipment, but may not provide

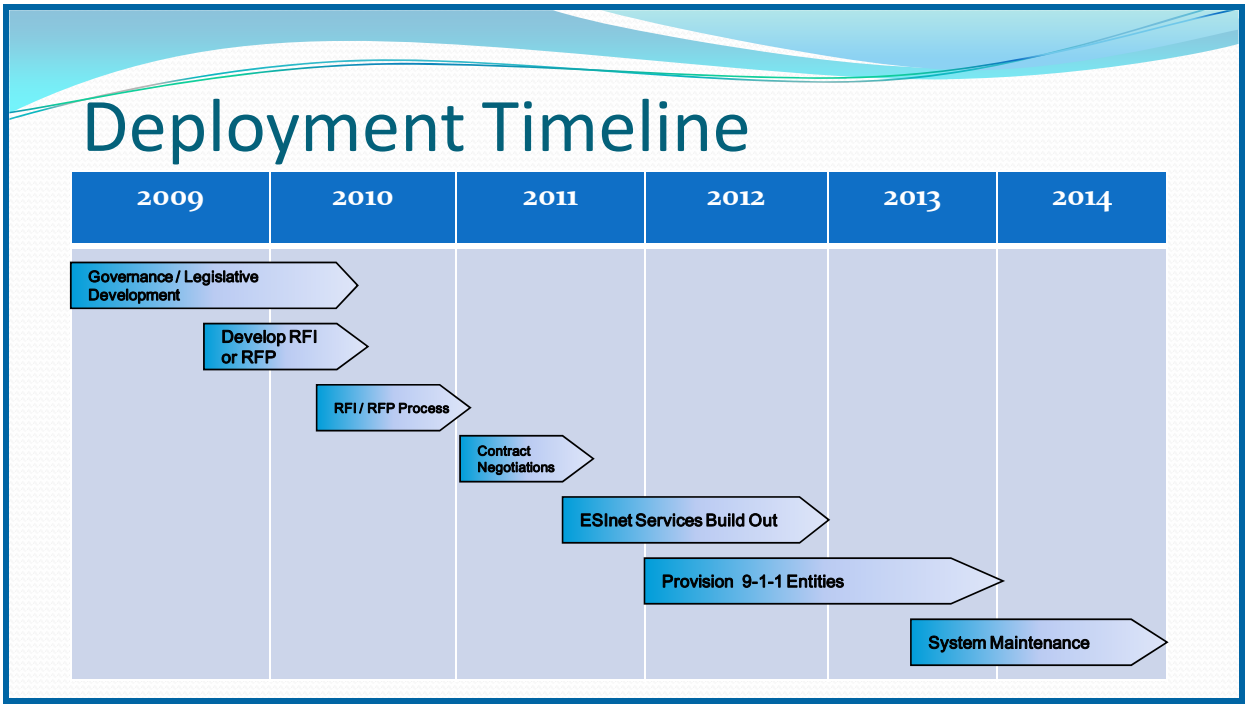
full NG9-1-1 functions depending on the equipment selected. This equipment must still be connected to the call origination providers. This equipment should support all connection types expected in an NG9-1-1 environment, and be able to transport these calls in a standard format.

### 6.4.4 Managed Services

Lastly, there are vendors who offer a managed service. This service uses the vendor's equipment to complete the interconnection and NG9-1-1 functions, and the PSAPs have workstations with which they handle the calls. This option is low on initial costs, but high on recurring costs. This also requires stringent service level agreements that include the control of the entities that can connect to the system.

## 6.5 TIME LINE

The following time line would position the state of North Dakota well for NG9-1-1 systems. This timeline can be adjusted as needed to provide the best solution for the state. Each time segment phase is described below. The time line takes into account the legislative cycle of North Dakota and the development of the NG9-1-1 standards.




### 6.5.1 Governance/Legislative Development Phase

During this phase, the state should develop a governance structure and assign a statewide coordination point. This begins the process of developing the specific needs of the 9-1-1 entities within the state. This is an important step in the process, as there needs to be input from the 9-1-1 entities as to the specific

functions of the new system they require. This also allows for the integration of the various 9-1-1 entities that may have worked independently in the past to begin to work in a coordinated environment.

The coordination with the various stakeholders allows time to educate the 9-1-1 stakeholders on NG9-1-1. This education assists to develop the functional requirements of the various processes that are needed to deploy this technology. By gathering information from all of the stakeholders up front, some issues during deployment can be eliminated.

Also during this phase, there needs to be a review and possible update of the legislative and regulatory environment. The management, funding, and maintenance of the NG9-1-1 system needs to be reviewed. In addition, there may be a need to address issues related to call initiation. For example, there may be new devices that users want to connect to the statewide ESInet. Rules have to be developed for these devices that include, among other things, the same level of liability protection as traditional 9-1-1 calls are afforded.

### 6.5.2 Develop RFI/RFP Phase

A great deal of the information acquired in the governance/legislative development phase is used to develop a procurement process. In this phase, a more detailed requirements list is developed to be included in a procurement document.

This process can use a Request for Information (RFI) to gather more information. The information gained from the RFI assists the state to make further decisions as to the specific solution that is best for the state.

If there is a clear direction based on the detailed requirements, a Request for Proposal (RFP) can be developed. This should contain the specific functional requirements needed for the NG9-1-1 system to include the statewide ESInet and the call termination equipment at the PSAPs.

### 6.5.3 RFI/RFP Phase

The RFI/RFP phase includes publishing the RFI and/or RFP, review of the responses, and the selection of the final vendor. This can be scheduled for just before the 2011 legislative session. This allows for accurate pricing and a clear solution to be deployed for the state.

### 6.5.4 Contract Negotiation Phase

The procurement phase includes the RFI or RFP review, the selection of the final vendor, and contract negotiation. This negotiation should include a detailed review of the contract and service level agreements, all parts lists, and the services associated with the system.

### 6.5.5 ESInet Services Build-out Phase

The build-out phase is when the vendor begins to build the network and NG9-1-1 services on the core network and data centers. This includes detailed testing of all components and the system as a whole. These tests should be developed based on the functional requirements developed during the procurement.

### 6.5.6 Provision 9-1-1 Entities Phase

At the completion of the ESInet build-out and testing, the PSAPs can then be connected. Each component of the PSAP systems and the interconnectivity to the ESInet must be tested, as well as the system as a whole, before going live.

### 6.5.7 System Maintenance Phase

At the completion of all PSAPs being connected to the ESInet, the maintenance phase begins. This phase includes the network, network services and all recurring costs to the vendors. This includes maintenance agreements to repair problems and update systems. The maintenance agreements should also provide preventative maintenance and monitoring of the systems to correct issues before they get to the level of a major outage.

## 6.6 COSTS

Based on the conceptual design, Kimball prepared budgetary costs for the NG9-1-1 system. These costs are budgetary in nature, and reflect the system being owned by the state. These prices can be reduced through the use of shared infrastructure and competitive procurement. The pricing of other models is not included as these models are usually proprietary to the vendor.

The pricing is broken down as follows:

- Non-recurring cost
- Recurring costs
- Professional services

Non-recurring costs are those paid one time for equipment, installation or software. These costs are outlined in Appendix B. The cost of replacement of equipment is not included in this budgetary cost as that should not need to occur in the time frame discussed.

Recurring costs are the monthly or yearly costs to provide the maintenance of the various equipment, software and connectivity. There is not an inflation rate associated with these costs.

Professional services include the professional assistance to develop final functional requirements of the NG9-1-1 system based on the cooperative efforts of all agencies. It also includes this assistance in the development of procurement documents, contract negotiation, and project oversight of the project.

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| | Year 2009 | Year 2010 | Year 2011 | Year 2012 | Year 2013 | Year 2014 |
|---|---|---|---|---|---|---|
| **Non-recurring Equipment Costs** | $0 | $0 | $5,200,000 | $6,775,000 | $1,575,000 | $0 |
| **Recurring Service Costs** | $0 | $0 | $1,377,600 | $4,364,400 | $4,364,400 | $4,364,400 |
| **Professional Services** | $184,880 | $101,179 | $209,006 | $114,475 | $57,238 | $0 |
| **TOTAL** | **$184,880** | **$101,179** | **$6,786,606** | **$11,253,875** | **$5,996,638** | **$4,364,400** |

An important factor in the cost of the NG9-1-1 network to be considered is the 9-1-1 grant funds that are available in 2009 from the National 9-1-1 Coordination Office. The notice of proposed rule-making was published in the Federal Register on October 3, 2008. This grant makes available at least $500,000 in funds that must be matched as a 50/50 grant with state or local funds or in-kind matching. This amount may increase as it is based on all states applying for and receiving their funds. Not all states may be eligible to apply for these funds, as the grant requires the applying states to:

- Have a statewide coordinator appointed by the governor
- Have a state 9-1-1 plan with specific items covered
- Provide a project budget and a supplemental budget for reallocated funds
- Certify that the state meets the conditions of the grant to include the use of 9-1-1 funds

The State should apply for these funds when they become available, and also submit a supplemental project budget for additional funds that may become available. The funds that are received from this grant must be spent by September 30, 2012. This would be in line with the planed timeline.

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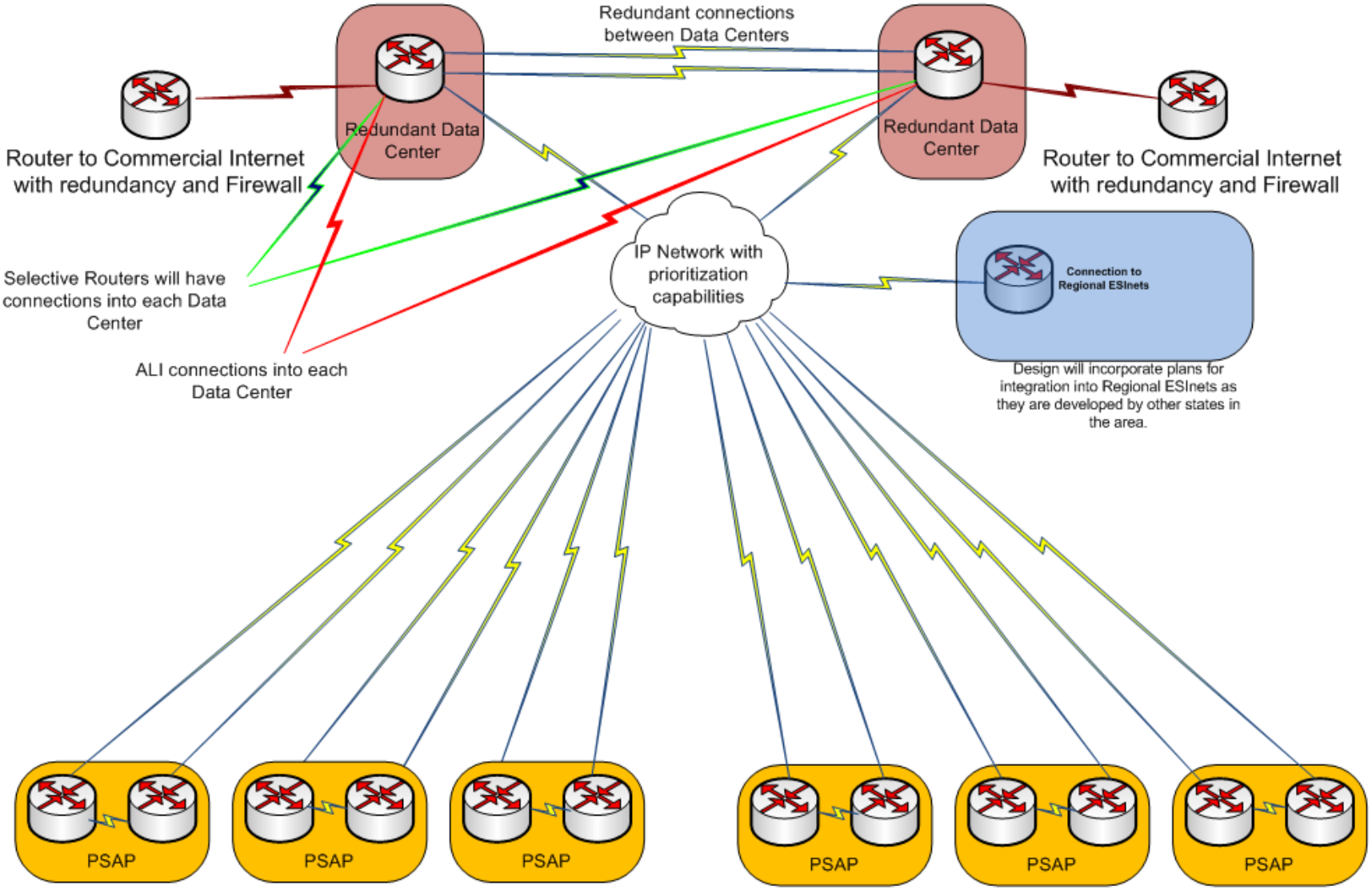
# APPENDICES

## APPENDIX A – CONCEPTUAL NETWORK DESIGN DIAGRAM

The diagram can be found on the following page.


Redundant connections between Data Centers
Redundant Data Center
Redundant Data Center
Router to Commercial Internet with redundancy and Firewall
Router to Commercial Internet with redundancy and Firewall
IP Network with prioritization capabilities
Selective Routers will have connections into each Data Center
ALI connections into each Data Center
Connection to Regional ESInets
Design will incorporate plans for integration into Regional ESInets as they are developed by other states in the area.
PSAP
PSAP
PSAP
PSAP
PSAP
PSAP
22 connected PSAP's with a connection to another PSAP for redundancy

## APPENDIX B – BUDGETARY COST WORKSHEETS

The worksheets can be found on the following pages.

| Border Gateway Functions Non-Recurring Costs | | | $0 | $450,000 | $450,000 | $0 | $0 |
|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **Call Access** | | | | | | | |
| **Border Control Equipment** | Equipment Installation/Configurat | 500,000/one time | | 250,000 | 250,000 | | |
| **IP Routing** | Redundant Routers | 2 @ 200000 | | 200,000 | 200,000 | | |

| Border Gateway Functions Recurring Costs | | | $0 | $206,400 | $412,800 | $412,800 | $412,800 |
|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **Call Access** | | | | | | | |
| **IP Routing** | DS-1 at $1100/month | 7 @ 1100 | | 46,200 | 92,400 | 92,400 | 92,400 |
| **CAMA Gateways** | Gateway to CAMA Trunks | 7 @ 1100 | | 46,200 | 92,400 | 92,400 | 92,400 |
| **ALI Circuits and Gateways** | Connection to 3 ALI Circuits | 3 @ 1000 | | 18,000 | 36,000 | 36,000 | 36,000 |
| **Commercial Internet Access** | DS-3 Connection to Internet | 7000/month | | 42,000 | 84,000 | 84,000 | 84,000 |
| **Firewall Capabilities** | Firewall Management | 1900/month | | 11,400 | 22,800 | 22,800 | 22,800 |
| **Data Center Hardware** | Rack space, power, etc. in two data centers | 2100/month | | 12,600 | 25,200 | 25,200 | 25,200 |
| **Border Control Maintenance** | System Monthly Maintenance Fee | 5000/month | | 30,000 | 60,000 | 60,000 | 60,000 |

| ESRP Functions Non-Recurring Costs | | | $0 | $4,750,000 | $4,750,000 | $0 | $0 |
|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **Call Routing** | | | | | | | |
| **Routing Servers** | Hardware | 2,500,000 | | 1,250,000 | 1,250,000 | | |
| **Routing Servers** | Software | 1,500,000 | | 750,000 | 750,000 | | |
| **Vendor Software** | | 3,500,000 | | 1,750,000 | 1,750,000 | | |
| **Vendor Services** | Professional Services/Installation | 2,000,000 | | 1,000,000 | 1,000,000 | | |

| ESRP Functions Recurring Costs | | | $0 | $1,171,200 | $2,342,400 | $2,342,400 | $2,342,400 |
|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **Call Routing** | | | | | | | |
| **Call Routing Infrastructure** | 6 Racks at two locations | 12 @ 2100 | | 151,200 | 302,400 | 302,400 | 302,400 |
| **Network Interconnection** | 2 OC-3 connections to Data Centers | 2 @ 10000 | | 120,000 | 240,000 | 240,000 | 240,000 |
| **Call Routing Vendor Software** | Software Licenses | 20,000/month | | 120,000 | 240,000 | 240,000 | 240,000 |
| **Call Routing Vendor Software** | Maintenance | 80,000/month | | 480,000 | 960,000 | 960,000 | 960,000 |
| **Call Routing Hardware** | Maintenance | 50,000/month | | 300,000 | 600,000 | 600,000 | 600,000 |

**Notes:** for budget planning used OC-3 pricing to interconnect two diverse data centers which the ESRP servers will be located in.
Other network services are available.

| PSAP Call Termination Functions Non-Recurring Costs | | | $0 | $0 | $1,575,000 | $1,575,000 | $0 |
|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **PSAP Workstations** | Workstation Hardware | $1,300,000 | | | $650,000 | $650,000 | |
| **PSAP Workstations** | Workstation Software | $950,000 | | | $475,000 | $475,000 | |
| **PSAP Workstations** | Installation/Professional Services | $900,000 | | | $450,000 | $450,000 | |

| PSAP Call Termination Functions Recurring Costs | | | $0 | $0 | $1,609,200 | $1,609,200 | $1,609,200 |
|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **NetTN DS-1 PSAP** | Connection to an estimated 23 individual PSAPs. One DS-1 each | 22 @ $1,100 | | | $290,400 | $290,400 | $290,400 |
| **DS-1 PSAP Redundancy** | These provide connectivity between neighboring PSAPs for redundancy. | 22 @ $1,100 | | | $290,400 | $290,400 | $290,400 |
| **End Site Router** | 24 Ports with POE | 22 @ $200 | | | $52,800 | $52,800 | $52,800 |
| **End Site Firewall** | Managed Firewall for each end site with 48 port switch | 22 @ $650 | | | $171,600 | $171,600 | $171,600 |
| **Site Maintenance** | Maintenance for network equipment and workstations at 22 sites | 67,000/month | | | $804,000 | $804,000 | $804,000 |

| Professional Services | | | $184,880 | $101,179 | $209,006 | $114,475 | $57,238 | $0 |
|---|---|---|---|---|---|---|---|---|
| **Item** | **Description** | **Assumptions** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** |
| **Planning** | Planning assistance to develop coordination and governance. Develop legislative language and final tranistion plan. | $184,880 | $184,880 | | | | | |
| **Procurement Support** | Development of Procurement documents, Evaluation of the Procurement responses, and contract negotiation. | $101,179 | | $101,179 | $151,769 | | | |
| **Implimentation Support** | Project management of the instalation, coordination and conflict resolution with various vendors, Teting and change management during the implimentation | $171,712 | | | $57,237 | $114,475 | $57,238 | |