Report

on

The Feasibility of a Next Gen 9-1-1 Solution

submitted to

State of Tennessee
Emergency Communications Board

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Architects and Engineers

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1. EXECUTIVE OVERVIEW

1.1 EXECUTIVE SUMMARY

1.1.1 Background

The state of Tennessee Emergency Communications Board (ECB) has recognized that the potential exists for a faster and more efficient 9-1-1 system capable of faster emergency response times and improved emergency service to the citizens of Tennessee in the routing and delivery of E9-1-1 calls throughout the State. To that end, the ECB has commissioned a feasibility study to investigate the possibility of implementing a new state of the art E9-1-1 delivery network, known conceptually as a *Next Generation 9-1-1* (*Next Gen 9-1-1*) Network solution. Throughout this document we will refer to a "wireline network", a "wireless network" and when appropriate "the network" to include both wireline and wireless networks. Additionally, we will refer "9-1-1 calls" to mean wireless, wireline, and VoIP calls.

The ECB has commissioned L. Robert Kimball & Associates, Inc. (Kimball) to conduct this investigation, and present its findings and recommendations to the ECB in the form of this report.

L. Robert Kimball & Associates is a global leader in the design and implementation of new E9-1-1 and IP enabled (IP) E9-1-1 systems for local and state jurisdictions across the United States. Kimball's hands-on experience in 9-1-1 network design, hardware integration, mapping technologies, and systems installation translates into a unique capability to provide an expert and global perspective to the findings of this study.

This is an exciting time in Public Safety. A paradigm shift is taking place which has the potential to fundamentally change the way 9-1-1 calls are delivered, processed and dispatched. The public safety industry as a whole is taking a critical look at the concept of *Next Gen 9-1-1*, and much of the industry on both the public and private sides are undertaking the preliminary work required to move public safety forward to meet the technology challenges of tomorrow. Tennessee stands as one of the few state level programs with the foresight and vision required to prepare and plan today for the 9-1-1 of tomorrow.

This report and the findings presented herein are in keeping with the vision and leadership of the ECB and will explore all aspects of *Next Gen 9-1-1* in Tennessee, the alternatives, the technologies, the current environment, as well as issues that might derail or sidetrack any effort to move forward. The saying goes "well begun is half done" the ECB has taken a step down the road to the future of 9-1-1. The results of this study will provide the necessary data and information for the ECB to make informed decisions and lead the way forward to improve public safety in Tennessee.

1.1.2 Goals and Objectives of this Feasibility Study

An undertaking such as this should not commence without clearly defining the purpose and intent. The ECB has established the following as the purpose for undertaking this study.

1. Improve public safety for the citizens of and visitors to the state of Tennessee

2. Equalize service across the State, increasing functionality and capabilities for all Public Safety Answering Points (PSAPs)

3. Improve call transfer functionality across jurisdictions, including LATA boundaries

4. Improve communications between PSAPs

5. Facilitate transfer of GIS data across jurisdictional boundaries

6. Prepare PSAPs for future 9-1-1 technologies (telematics, VoIP, ACN)

7. Provide a cost effective means of PSAP backup and fail over (call rerouting)

8. Improve reliability and redundancy in the 9-1-1 delivery network

9. Transition E9-1-1 related network costs from ECDs to the ECB

10. Facilitate a cooperative project initiative involving all stakeholders and other potential partners in Tennessee

1.1.3 Points for Feasibility

While the current 9-1-1 technology in place today is without a doubt a success story in and of itself, wireless and IP-based communications technologies have forced the existing system to try to accommodate highly mobile, dynamic communications modes whose technological make up directly oppose the structure of the current 9-1-1 system. The 9-1-1 systems in place today were designed to support a single telephone company providing service to a fixed wireline telephone. These systems are being asked to accommodate more by incorporating new telephony technologies from a host of competitive local exchange carriers (CLECs), wireless carriers, and internet service providers. It is commonly accepted that the current 9-1-1 networks in place today are living on borrowed time. The new communications landscape presents both opportunities and challenges for the 9-1-1 systems of tomorrow. Opportunities include new location-based capabilities to provide instant, accurate position information and incorporate new media (e.g., video and imagery) into the system. Challenges include developing standardized interfaces and delivering information to the PSAPs with varying levels of technical capability.

The current E9-1-1 networks in Tennessee consists of point-to-point, analog technologies, in-band signaling, and low-speed data transmissions that are both costly and outdated. New high-speed fiber optic networks employing digital signaling technologies have surpassed the current network technology developed in the 1960s.

The opportunity exists to adopt a solution that will route wireline, wireless, and VoIP calls in a standardized manner directly through a common open architecture network. A network of this type will allow E9-1-1 callers to be directly connected to the PSAP and provides for faster delivery of critical call data to the PSAP. It is possible for the existing 9-1-1 delivery network to remain in place and operational until the new digital network is built, tested, and deployed.

A *Next Gen 9-1-1* solution using a high-speed digital network has been shown to improve call set-up times. Frequently, if someone dials "9-1-1" from a cell phone, there is a noticeable delay between dialing the three digits, pressing the send button, and hearing the phone ring. In addition, there is a delay between the caller dialing 9-1-1 and the information presenting itself to the PSAP. During our interviews, several 9-1-1 directors commented that the call set-up time under the current system is often very lengthy and lends to the inability of receiving Phase II information (latitude/longitude) when caller information is delivered to the PSAP. In order to receive the Phase II data a re-bid needs to be performed by the call taker to allow the network time to deliver the information.

A *Next Gen 9-1-1* solution provides a solid technical foundation for the future. Most public safety industry leaders on both the PSAP and vendor sides agree that the technical direction of 9-1-1 in the future is towards an IP enabled open architecture digital delivery network. Voice over IP and digital signaling technologies coupled with the expected increase in the volume of data and information that will be sent to PSAPs in the future are driving the migration and development of industry standards and the technologies required to support this type of delivery. A *Next Gen 9-1-1* delivery network will position the Tennessee PSAP community well for whatever technology changes occur in the future.

Due to the LEC selective routers not having inter-connectivity PSAPs may not be able to transfer a caller's data (call back number, or ANI, and cell tower address/location, or ALI) to another PSAP if that PSAP's calls are routed via a different selective router. With a *Next Gen 9-1-1* solution, ANI and ALI information could be transferred from one PSAP to another Statewide. If neighboring states were to embrace inter-connectivity, state to state transfers would be possible.

A *Next Gen 9-1-1* solution also has the potential for increasing accountability. Some 9-1-1 centers do not possess call-tracking software which allows them to track the number of 9-1-1 calls over a given period of time. Having this information centrally collected and maintained provides significant insight into the impact of E9-1-1 calls on PSAPs, and provides answers to questions about 9-1-1 calls or the 9-1-1 system. This is not to say that the LECs are unresponsive or are not accountable. The LECs have a long-standing history in 9-1-1 and many 9-1-1 directors look to their LEC for answers and expertise with respect to their 9-1-1 systems and 9-1-1 technology; these contributions cannot be overlooked or ignored. However, tracking information and subsequent reports, analysis, and findings is much easier and more thorough when data absent from existing technology can be captured with newer technologies and will be made available to all PSAPs on the network.

Wireless carriers pay the LECs specific recurring and nonrecurring charges associated with connecting to each selective router. It is probable their monthly recurring costs will decrease thereby reducing the amount of reimbursements paid by the ECB. Because Tennessee is a full cost recovery state, the ECB would realize those cost savings. For any new carriers, it is possible that their initial connection charges could be less (than under the current system).

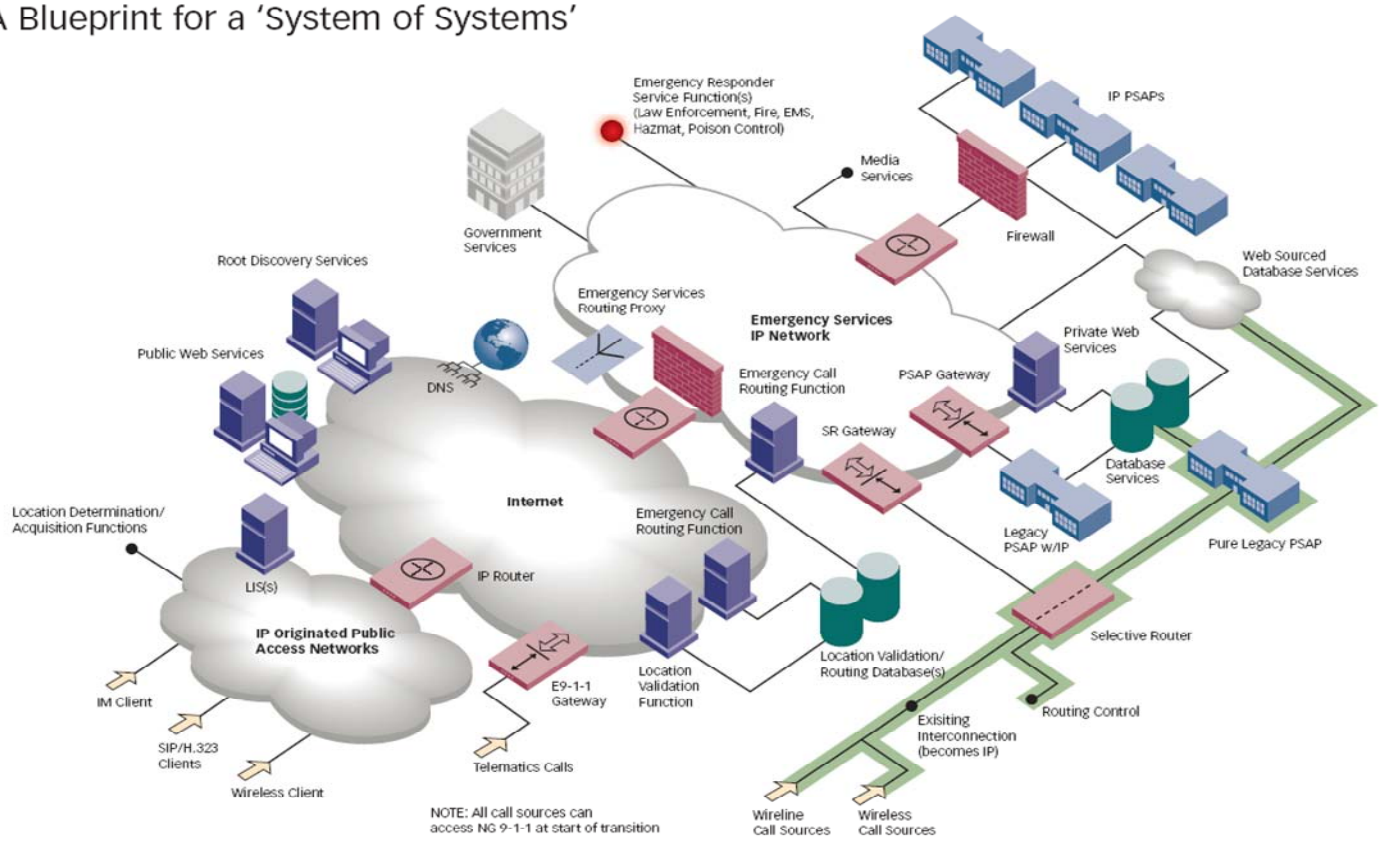
In the state of Indiana, an actual reduction in the wireless surcharge amount was realized as a result of their *Next Gen 9-1-1* implementation. Indiana was able to reduce the monthly surcharge from $.65 to $.50 and still pay for the monthly operating costs of the new system. Indiana was also able to reduce the overall circuits required of the wireless carriers to interconnect from a

minimum of 6 to 1 and in some cases 15 to 1 (1 new circuit replaced 15 old circuits) which provided an overall cost savings to the wireless carriers.

1.1.4 *Next Gen 9-1-1* Explained

What is NG 9-1-1

The Future of 9-1-1 and Emergency Communications
A Blueprint for a 'System of Systems'



Next Gen 9-1-1 is a concept 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 Internet Protocol (IP) technology. The 9-1-1 traffic is typically carried through a medium of fiber optic network(s).

Faster call routing is possible because *Next Gen 9-1-1* solutions use fewer connection points, newer networking technologies and a variety of Internet protocols. Also, digital circuits such as SS7 and ISDN decrease call set up time and allows for more information to be passed through the network.

Next Gen 9-1-1 also generally entails a simplified network design with fewer failure points and streamlined, centralized 24x7 monitoring.

Next Gen 9-1-1 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 being sent to PSAPs today is considerably less than the amount that will be sent to PSAPs in the future. While it's 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 a *Next Gen 9-1-1* solution.

There are currently 7 *Next Gen 9-1-1* projects 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 DC – 1 PSAP
- Indiana – 167 PSAPs
- Vermont – 19 PSAPs

There are three other states in the process of determining the feasibility of implementing a *Next Gen 9-1-1* system. They are:

- Missouri
- Delaware
- Maryland

1.1.5 Benefits of *Next Gen 9-1-1*

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

1. Faster emergency response times
2. Reduced call-set time
3. Improved quality of service
4. Efficient use of resources
5. Prepare PSAPs for future technologies

6. Increased reliability and disaster recovery of the delivery network

7. Clearer demarcations of responsibility and accountability

8. Reduced potential points of failure in the network

9. The ability to transfer of 9-1-1 calls Statewide

10. The ability for PSAPs to exchange incident data

11. LATA boundaries, wire centers, and rate centers do not restrict area of service

12. Improved accessibility and increased compatibility to ensure all have access to the emergency response system, including those with disabilities

13. Service Parity for all 9-1-1 callers

14. Enables interoperability

15. Expandable to include other jurisdictions or entities, such as other states

1.1.6 Summary of Findings

Kimball has conducted an extensive investigation that is described in detail in the report sections that follow. This effort commenced in April 2006 and concluded in September 2006 at a meeting of the ECB in Nashville, Tennessee.

An undertaking of this magnitude requires extensive research, investigation, discussion, and fact finding. After performing numerous interviews and discussions with key stakeholders of the Tennessee 9-1-1 community, local exchange carriers, wireless carriers, various vendors of fiber optic cabling, data transport and telephony equipment. Kimball submits the following findings and recommendations to the ECB:

The PSAP community is strongly supportive of a *Next Gen 9-1-1* solution.

The Tennessee PSAP community strongly supports the implementation of a more efficient and robust 9-1-1 network in Tennessee. In numerous interviews with a variety of PSAP directors across the state this concept was met with a great deal of optimism and enthusiasm. Concerns were raised as to operational impacts and costs. These concerns must be addressed by the ECB in a manner that is satisfactory to the PSAP community as a whole. The overall consensus is that this will be a positive change and that this project has the definite potential to improve PSAP capabilities, improve service and overall improve public safety for the citizens of Tennessee. There is also a strong appreciation in the Tennessee PSAP community for the vision and leadership of the ECB in beginning to prepare and plan for *Next Gen 9-1-1*.

The wireless carrier community is supportive of a *Next Gen 9-1-1* solution.

Wireless carriers are required to connect to each selective router in order to deliver a 9-1-1 call to a PSAP. In Tennessee there are 7 selective routers. Wireless carriers must purchase, paying an installation fee and monthly recurring fees, an appropriate number of trunks from the local LEC to connect their wireless switches to the 9-1-1 network. These fees can be as much as several thousand dollars per month. An IP network could reduce the number of selective router connections from seven to two, resulting in saving wireless carriers a significant amount of money over a period of time. As such, wireless carriers support the concept of *Next Gen 9-1-1*.

Cingular Wireless

Cingular has acknowledged there are benefits from this solution that would minimize the amount of network components, reduce overall costs, reduce deployment time, reduce call set-up times, and should minimize the number of network failures. It is understood that if the number of networks a call must interface with and traverse could be minimized, it would make the data delivery more efficient and minimize delays to the PSAPs due to faster routing, it would also increase reliability.

Verizon Wireless

Verizon Wireless has indicated that they currently have 4 MSCs with trunks to 4 BellSouth selective routers. It was stated that to maintain this type of trunk arrangement is very costly for Verizon Wireless, and a solution such as *Next Gen 9-1-1* would be very beneficial to them.

The Local Exchange Carriers in Tennessee are generally supportive of a *Next Gen 9-1-1* concept.

The reality of an IP enabled network to deliver 9-1-1 traffic to the PSAPs is widely favored by the LECs across the country. To that end, almost all major LECs have announced their own plans to migrate their transmission infrastructures to IP based routing and delivery. Most recognize and acknowledge the need for IP networks to accommodate current 9-1-1 call traffic and to prepare for 9-1-1 traffic from future technologies. This is generally true for the LECs in Tennessee. Depending on which division is engaged for a sale of network elements determines the support of this concept. There exists the perception that a migration from the traditional LEC service offering to an independently managed network will result in significant loss of revenue by the LEC. This is not necessarily true. The LEC may very well propose the IP solution that best fits the needs of the State of Tennessee.

2. EXISTING SYSTEM FINDINGS OF FACT

2.1 GENERAL SUMMARY

2.1.1 General Findings

1. There are 163 PSAPs which receive or can receive wireline, wireless and VoIP 9-1-1 calls from a network perspective. These PSAPs are located within a total of 100 Emergency Communication Districts (ECD).

2. Appendix 1 (map) depicts the 9-1-1 environment as it exists today in Tennessee. The map provides the following information:

   a. The diverse locations of 7 selective routers
   b. The diverse service areas of each LEC
   c. The locations of 163 PSAPs
   d. LATA boundaries

2.1.2 Landline/Wireline Findings

1. The current landline 9-1-1 infrastructure in place in Tennessee is a typical, circuit switched, analog environment, employed by multiple service providers utilizing multiple selective routers to deliver 9-1-1 calls to primary PSAPs throughout the state. A caller dials 9-1-1 from a telephone which routes to a local end office. The call is then connected to the serving selective router whereby the ANI of the calling party is matched to a data base which provides the routing ESN. The ESN identifies the trunks/circuits to send the call through to the appropriate PSAP. When the call arrives at the PSAP ANI is used by the ALI controller to query the ALI database. The ALI database returns the correct ALI record identifying the address of the caller and other pertinent information to the call taker at the PSAP.

2. There are three LECs providing 9-1-1 service in Tennessee. They are:

   a. BellSouth
   b. Embarq
   c. Citizens

   (Reference Appendix 5 for a breakdown of counties served by each LEC.)

3. Every wireline, wireless, and VoIP 9-1-1 call is transported over a network owned and operated by one of these 3 companies.

4. BellSouth provides 9-1-1 service through 5 selective routers. BellSouth utilizes Intrado for maintenance of the wireline ALI data base.

5. Embarq provides 9-1-1 service through 1 selective router. Embarq utilizes HBF for maintenance of the wireline ALI database.

6. Citizens Telco provides 9-1-1 service through 1 selective router. Citizens Telco does not provide for database maintenance or ALI hosting. Each ECD or PSAP served by the Citizens Telco router relies on premise-based ALI.

7. 115 CLECs certified by the State of Tennessee were identified. CLEC companies sell access to the public switched telephone network, or other last mile network connections, in competition with a local exchange carrier. CLECs are typically facilities based and may not offer service to the entire state. CLECs may be instrumental in providing cost effective last mile connectivity to a transport network.

8. Four Inter Xchange Carrier (IXC) providers were identified as providing such services in the State. These companies are the long distance providers and carry telephony traffic across LATA boundaries. The four companies are:

   a. AT&T Communications
   b. MCI Telecommunications
   c. Sprint Communications
   d. US Carrier Telecom, LLC

   (Note: Due to mergers and acquisitions the above IXCs names may have changed. The changes have not been reflected on the certifications in the State of Tennessee.)

9. Intrado and TCS are third party vendors for the provisioning and maintenance of wireless ALI records and VoIP records.

10. There are 8 LATAs in the State (see Appendix 1).

11. Preliminary analysis shows that there are over 50 trunks in place to connect wireless carriers to the 7 selective routers.

12. Preliminary analysis shows that there are over 650 CAMA trunks in place connecting the selective routers to the 163 PSAPs.

2.1.3 Wireless Findings

1. The wireless 9-1-1 caller, upon dialing 9-1-1 and pressing the send button on a wireless handset, initiates a call setup through the wireless network. The call is delivered to the Mobile Switching Center (MSC) from the site/sector that is handling the call. The MSC captures the Mobile Directory Number (MDN) also known as the Call Back Number (CBN) along with the Emergency Service Routing Key (ESRK). Utilizing Non Call Path Associated Signaling (NCAS), the voice is connected from the MSC to the selective router and delivered to the PSAP through existing 9-1-1 trunks. The ESRK is delivered to a national wireless ALI data base vendor via SS7 circuits. The national wireless ALI data base vendor sends dynamic data (date, time, call back number, carrier ID, etc) to a static record which resides in the LEC ALI host. The ALI query returns the wireless ALI information which is displayed at the PSAP.

2. In a Phase 2 deployed network all of the above takes place with the addition of the following: Simultaneous to populating the static record with dynamic ALI information a Positioning Determining Entity (PDE) is calculating the location of the caller. The PDE provides the callers position in latitude and longitude coordinates. The coordinates are delivered to the wireless ALI database vendor who in turn populates the static record with the location coordinates. The wireless ALI is displayed to the call taker at the PSAP.

3. There are 14 wireless carriers providing service in Tennessee. There are many resellers and distributors of wireless services and plans operating in the state. The companies listed below own their own networks, are connected to a selective router in the State of Tennessee and are routing 9-1-1 traffic through a selective router.

Advantage (Dekalb Co-Op)	Alltel	American
Cingular	ClearTalk	Crickett
Horizon	Nextel	T-Mobile
Tritel/SunCom (Now Cingular)	Triton/SunCom (Now Cingular)	Sprint PCS
US Cellular	Verizon Wireless	

Reference Appendix 4 for a breakdown of counties served by wireless carriers.

2.1.4 VoIP Findings

1. The following VoIP providers were identified as providing service and having connectivity or are in the process of connecting to a selective router serving the ECDs in the State of Tennessee. The specific Counties each provider offers service in could not be determined.

Charter	Time Warner	Comcast
Vonage	AT&T CallVantage	Level 3

2. VoIP delivery in the State of Tennessee has two call flow methods depending on which method the VSP has chosen.

   a. One method is to deliver voice only through the PSTN to a 10 digit number at the PSAP. There are no E9-1-1 features associated with this method.
   b. The second method is where a VSP has established connectivity to the selective router. This method will route a call much like a typical wireline 9-1-1 call. There are occasions where some VSPs provide ALI information for their caller subscribers and some VSPs do not.

2.1.5 Alternative Network Findings

1. A total of 15 companies were identified as having fiber available for use through a negotiated use agreement. These agreements are commonly used in the industry and are referred to as an Indefeasible Right to Use (IRU) contracts. These contacts are typically long term agreements, 15 to 25 years in length. The agreements cover but are not limited to; identification of the specific fiber strands being leased, location of the fiber segments,

maintenance procedures, service levels, outage escalation procedures and guarantees. The cost of an IRU is typically negotiable. Some items that affect the costs are the number of fiber strands in use, the amount of fiber available in the route, the degree of service level provided, the distance or length of the segment and competition. The IRU typically will not include any type of equipment on the network. The following companies were identified as having available fiber in the State of Tennessee.

Level 3	Tellico	TDS Telecom
Century Tel	Qwest	SSB KDL Network
Cornersville	Frontier	WestTN
NCTC Fiber	Ardmore Telephone TN Fiber Network	Bledsoe Telephone Cooperative, Inc.
TVA	AT&T Longlines	Global Crossing

All of the above companies provided a route map of their available fiber in Tennessee. (See Appendix 2)

2. The following 21 Counties were found not to have fiber optic facilities available for long term wholesale lease by the companies mentioned above. However it would be possible to connect to an IP network via local circuits from the PSAPs in these counties to a node on the network.

Hardeman	Campbell	McNairy
Chester	Claiborn	Marshal
Hancock	Houston	Sevier
Stewart	Cocke	Meigs
Unicoi	Overton	Jackson
Carter	Pickett	Johnson
Fentress	Scott	Morgan

2.2 TECHNICAL SUMMARY

The following section provides a technical discussion of the various technologies present in the 9-1-1 network today in Tennessee and gives an overview of the technical issues and solutions provided by a *Next Gen 9-1-1* solution.

2.2.1 Wireless

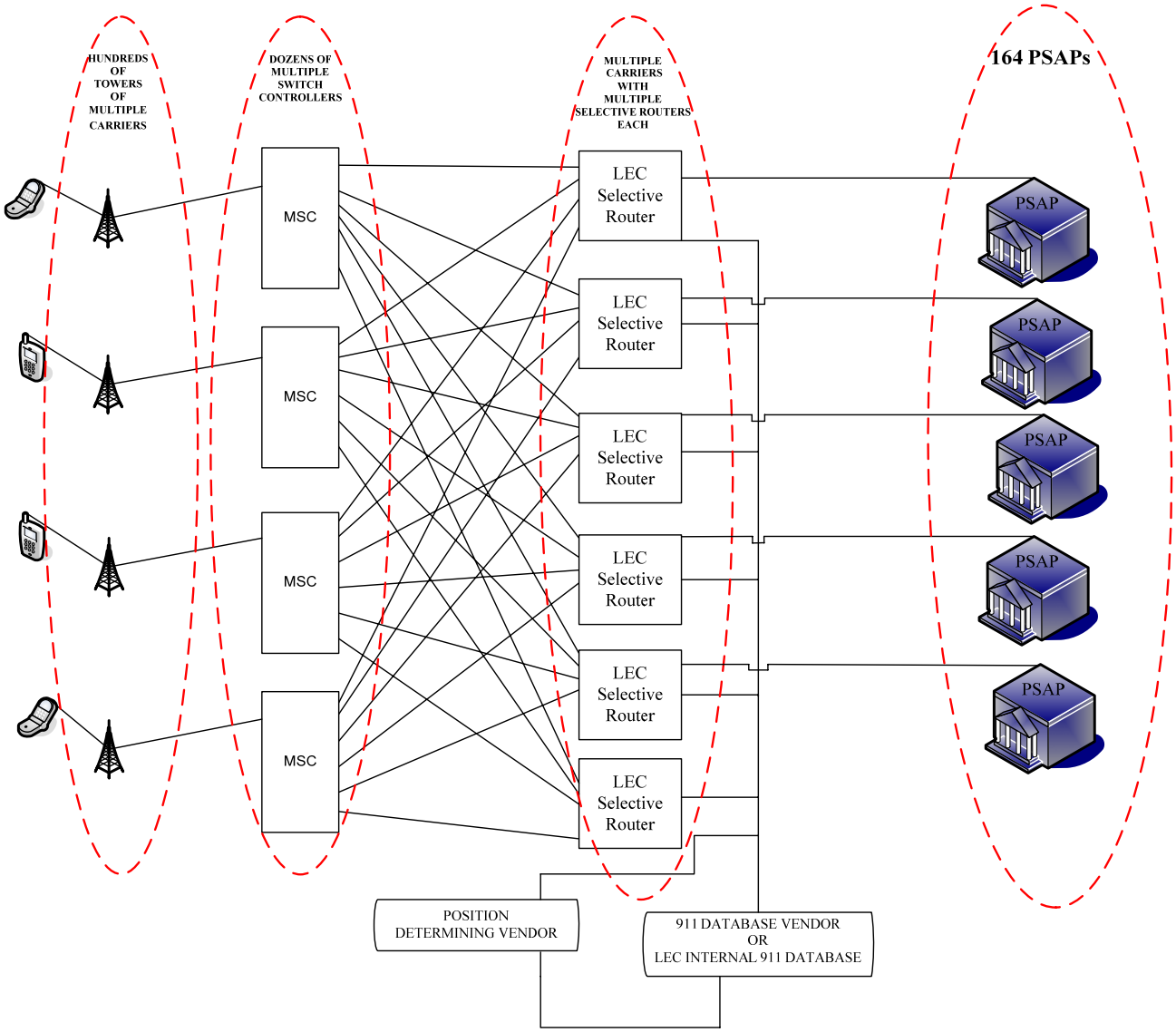


Figure 1 - Wireless Network Diagram

2.2.1.1 FCC Docket Number 94-102

In 1996, the FCC released Docket 94-102, or the *E9-1-1 First Report and Order*, and mandated wireless E9-1-1 service. In this Order, the FCC mandated that wireless E9-1-1 service was to be achieved in two Phases, I and II. Under Phase I, wireless carriers are required to provide a requesting PSAP with the address of the cell tower receiving the wireless E9-1-1 call and the caller's call-back number. Phase I location technology consists of addressing cellular towers and providing a gross location or radio propagation area from where the wireless telephone call originated. Phase I information is used to determine which PSAP to route the call to based on the tower location or antenna pattern direction. This is the method by which all wireless E9-1-1 calls are routed to a PSAP today.

Under Phase II, wireless carriers are required to provide a requesting PSAP with the caller's location via longitude and latitude (X, Y) in accordance with specific accuracy requirements as well as the call-back number wireless carriers are required to select a specific location determining technology used to derive Phase II data, which is either handset-based or network-based. A rebid (mid-call update) can be performed to update the caller's location if the caller is mobile. Since the original report and order, wireless carriers have requested and received waivers concerning the final deadline to implement Phase II service.

To provide for the processing of wireless E9-1-1 calls for wireless subscribers, several events need to occur:

1. The caller must be located, either by the network, handset, or a combination of these technologies

2. The cell sector or geographic location of the site must be determined

3. The caller's voice has to be presented or routed to the appropriate PSAP

4. The caller's telephone number must be presented or routed to the appropriate PSAP

5. The caller's location must be presented or routed to the appropriate PSAP

6. The PSAP must have the proper equipment to receive and use the above data

Over the past several years each wireless carrier has adopted a specific location technology and the focus now is on delivering the call and the information to the appropriate PSAP. Getting Phase II data to the PSAP over the current 9-1-1 network has been identified as an issue. Delivering wireless E9-1-1 data often requires a more robust network that provides for the speed and data capacity to properly deliver the call (voice) and location data to the appropriate PSAP without having to perform a rebid. Advanced digital networks were not envisioned when the FCC mandated wireless E9-1-1 service. Although the current 9-1-1 network has served the wireline industry well for over 30 years, the networks need to be upgraded to accommodate the data demands of wireless E9-1-1, VoIP and public safety technologies of the future.

2.2.2 Wireline

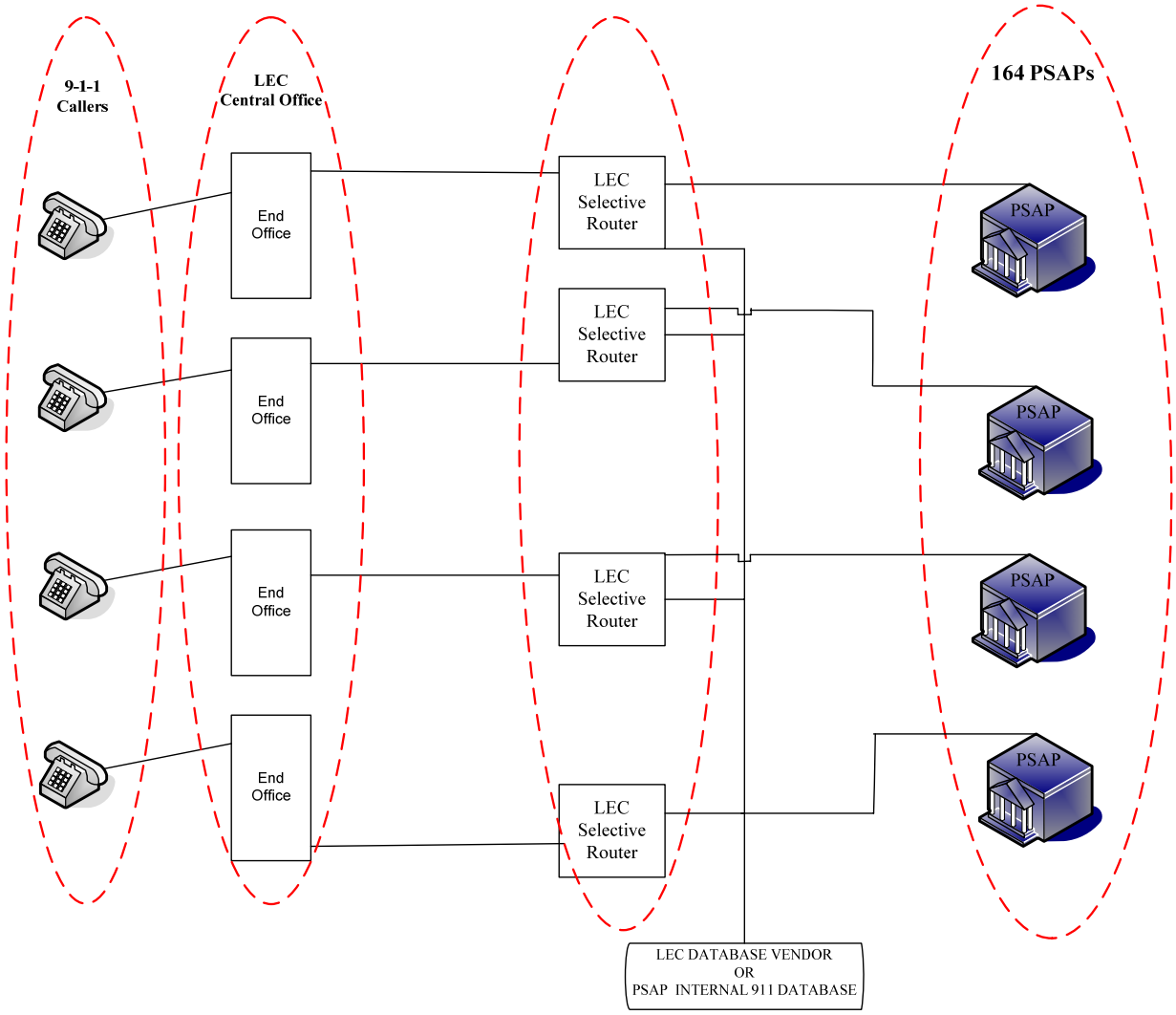


Figure 2 - Wireline Network Diagram

The current 9-1-1 wireline telephone network technology was designed in the 1960s using a signaling system known as Centralized Automatic Message Accounting (CAMA). This technology was originally designed to provide the calling party's telephone number for use in long distance toll calls and to ensure proper billing. By using this signaling system, PSAPs were able to receive the calling party's telephone number (ANI) and the long-distance telephone provider (at the time AT&T) did not have to invent something specifically for 9-1-1. The CAMA signaling system allows for eight digits of information to be presented with the telephone call at the PSAP. An example of this data would be (1-555-5555), where the first digit identifies an area code, and the last 7 digits provide the telephone number.

The 9-1-1 network has remained basically unchanged to this day, and as such, relies on outdated analog technology to deliver vital information to the PSAP. With respect to wireless E9-1-1, there is no way for all of the wireless information that gets generated during a wireless E9-1-1 call to be passed through the CAMA signaling system to the PSAP. There have been many attempts to modify this analog signaling technology to accommodate the wireless telephone information; however, either long call set-up times occur, or multiple networks need to be established to provide this information to the PSAP.

2.2.3 Voice over Internet Protocol (VoIP)

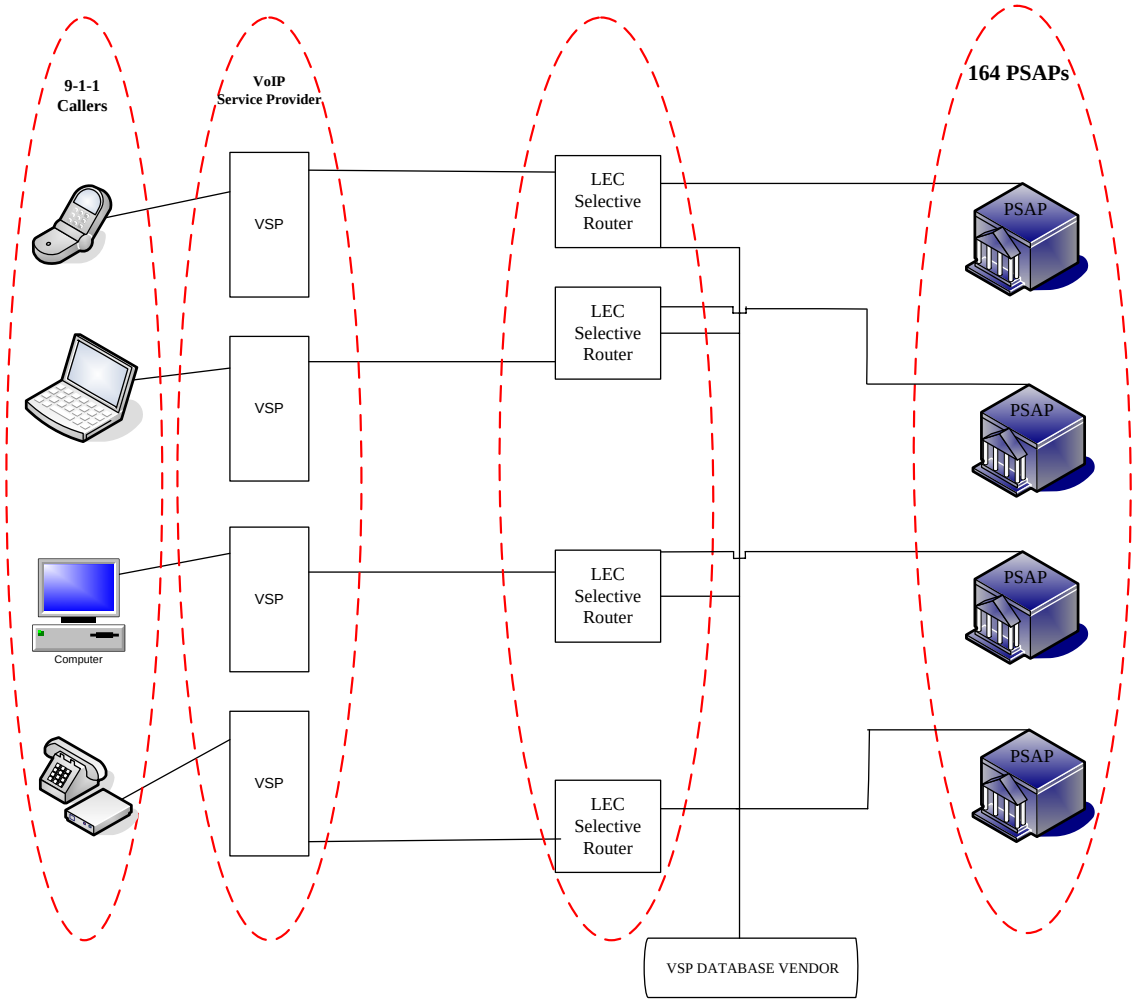


Figure 3 - Voice over IP Network Diagram

VoIP is the use of internet protocol for transmitting voice communications. VoIP allows you to make telephone calls using an Internet connection instead of a regular telephone line. Some VoIP services may allow you only to call other people using the same service, while others may allow

you to call any telephone number including local, long distance, mobile, and international numbers.

VoIP converts the voice signal from a telephone (audio) into a digital signal that travels over the Internet. You can make a VoIP call from a computer, a special VoIP phone, or a traditional phone using an adapter. In addition, new wireless "hot spots" in public locations such as airports, parks, cafes, and some metropolitan areas that allow you to connect to the Internet may enable you to use VoIP service wirelessly. VoIP service providers such as Vonage, Level 3 and AT&T Advantage along with VoIP cable companies such as Bright House, Charter, Cox, and Time Warner connect to the LEC's selective routers to deliver 9-1-1 calls to the PSAP.

Some features such as location information may not be available from the VoIP 9-1-1 caller. This is especially true for the nomadic caller.

3. *NEXT GEN 9-1-1* CONSIDERATIONS

3.1 FEDERAL SUPPORT

It is important to note that the concept of *Next Gen 9-1-1* is supported at the federal level. In fact *Next Gen 9-1-1* is the second initiative involving 9-1-1 the Department of Transportation has taken an interest in. 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. The Enhance 9-1-1 act was passed by congress to provide federal assistance to jurisdictions to help in establishing nationwide Phase II wireless. That legislation mandates that a position similar to a national 9-1-1 director be created to provide coordination for a nationwide wireless 9-1-1 initiative. Unfortunately, the funding required to initiate the program as called for in the law has not been allocated.

The U.S. Department of Transportation, Federal Highway Administration has undertaken an initiative to explore the concept and benefits of a *Next Gen 9-1-1* system if such a system were to be made available nationwide. As of this writing, the DOT is in the final stages of selecting a vendor to assist in the exploration and proof-of-concept of a *Next Gen 9-1-1* 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 DOT 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 *Next Gen 9-1-1* as expanding and improving the capabilities of Public Safety Answering Points (PSAPs) through new internetworking 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 Next Gen 9-1-1 System is to save lives, health and property by improving emergency services access and response in the United States. The state of the Next Gen 9-1-1 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 internetwork of all emergency organizations.

Reduce emergency services capital, operating, and maintenance costs,"

One of the goals of the initiative is noteworthy. *"Encourage an open architecture, interoperable internetwork of all emergency organizations."* There are many different ways 9-1-1 calls are delivered throughout the U.S. Each 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 vendor's equipment or software. One of the main constraints of implementing a *Next Gen 9-1-1* 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 internetwork."

"USDOT's core vision for Next Gen 9-1-1 is that this new internetwork 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 assume that federal funding is now or ever will be made available to assist local or state governments in implementing a *Next Gen 9-1-1* solution. DOT is engaged in establishing a vision and assisting in creating a foundation with open architecture standards that all *Next Gen 9-1-1* systems at a local level can be designed to.

3.2 SYSTEM DESIGN VARIABLES

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 solutions' options that are capable of routing wireless, wireline and VoIP traffic to PSAPs, some of which may be offered through RFP responses.

1. Do nothing. Doing nothing is a consideration. Maintaining the status quo is certainly an option the ECB 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 ECB 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."

2. 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.

3. Transport Network. Transport network is a solution option where the customer (in this case the State ECB 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 ECB agrees to purchase the required equipment and arranges for the placement and installation of the components. The ECB could additionally obtain the services of a database vendor, a maintenance vendor and a vendor to provide for monitoring, troubleshooting and repair. The ECB 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 of. 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 ECB 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.

There are several transport companies capable of delivering a network to all the counties in the State of Tennessee. These companies are as follows.

a. BellSouth Emerging Technologies
b. TNII
c. IRIS
d. Level 3
e. Intrado

With the exception of Level 3, these companies manage their own fiber optic networks. They do not lease dark fiber. 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. These networks are in place and can reach all of ECD in the State of Tennessee.

Route maps for the TNII network and the IRIS network found in Appendix 1.

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 state-wide 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.

4. 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.

3.3 IMPLEMENTATION VARIABLES

Coinciding with solution options are implementation options. The ECB will be able to proceed with a *Next Gen 9-1-1* implementation at a pace that is suitable and fundable to meet the needs of the Board and staff.

Of particular importance in this section is the fact that at the conclusion of any one of the benchmarks, the State has the option of stopping for whatever the reason before moving on to the next stage. For example, if after completing Benchmark 1 it became necessary to halt the implementation until such time as sufficient revenue was generated in the wireless fund to pay anticipated non-recurring fees for stage 2, the State could simply stop for a while, realizing the benefits listed for stage 1. At such time as the fund was replenished to pay for stage 2 costs, the implementation could continue. The State will control the pace at which the implementation progresses. These various stages of implementation lend particularly useful in controlling revenue and expenses and budgeting for continued migration. Below are listed 5 stages of implementation benchmarks that can be realized.

Benchmark 1 - consists of building out a network that provides access to all PSAPs. All PSAPs have connectivity to the network but have not been upgraded to be IP capable. The network, or specifically the transport medium, is all digital and IP enabled, and IP enabled routers have been provisioned in the network. Under this scenario all of the traffic on the network is digital until it gets to the PSAP. By being all digital, the network receives the benefits. Call set-up times are improved. The amount of circuits have been reduced, the number of selective routers have been reduced, connection points have been minimized, redundancy is in place, and the speed of moving traffic is greatly increased. Call delivery to the PSAPs has greatly improved. The network is now ready to accommodate new technologies, growth, and provide for interoperability. The PSAPs at this point will not see any great benefit other than call set-up times have improved, and Phase II wireless data is more common without having to perform a rebid. This stage of implementation is a good infrastructure to begin routing wireless and VoIP calls.

Benchmark 2 - comprises upgrading the PSAPs to be IP enabled. These tasks involve either adding new peripheral equipment such as line cards, digital-to-analog converters and other similar equipment, or changing out the CPE from legacy equipment to IP enabled CPE. After the PSAPs have been upgraded, the real benefits of the IP network are realized. No longer does the digital signal have to be converted to analog at the PSAP. 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 a *Next Gen 9-1-1* 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.

Benchmark 3 - involves the option of moving the wireline 9-1-1 traffic off the LEC provided system onto the new IP system. At this stage the LECs are literally disconnected from PSAPs and their services (9-1-1 service offering) are no longer required. The State at this point is self reliant and providing the full host of 9-1-1 delivery that includes selective routing of wireless, wireline, and VoIP calls and is engaged in ALI database maintenance and hosting. These services are now being provided through contract negotiated vendors.

Benchmark 4 - is the final point where moving the ALI database could be considered. If the plan is for a statewide ALI database to be incorporated into the network, now would be the most appropriate time. All of the elements are in place to make that a reality.

Benchmark 5 - could be considered maintenance or operational mode wherein the normal course of action is maintaining the system for 24x7 operation, implementing quality control procedures, and monitoring performance.

The diagram below gives a general time line for the benchmarks discussed above.

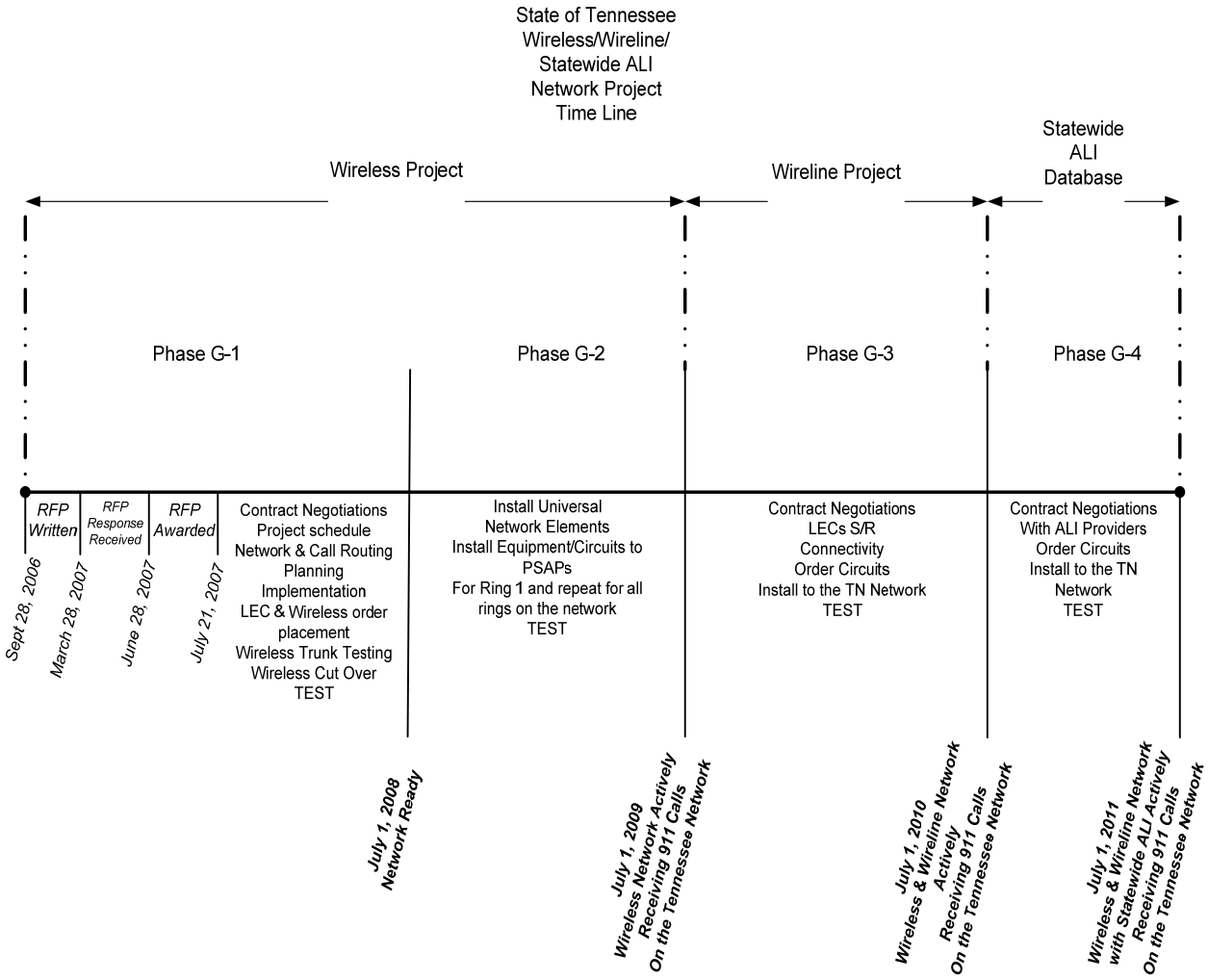


Figure 4 - Potential Project Timeline

3.4 COST CONSIDERATIONS

A system of this size will require up-front capital expenditures and resources. Actual costs will not be known until an in-depth design process is undertaken and implementation details are worked through.

Cost considerations can be broken into four general areas, each of which is explored in detail below.

3.4.1 Network Equipment Costs

Up front equipment costs could result in a 'sticker shock' effect when a final design is performed and the total costs associated with the effort is disclosed. The initial equipment costs will comprise the majority of costs for a *Next Gen 9-1-1* solution.

A typical installation of a *Next Gen 9-1-1* solution may entail the following.

- Selective routers for routing calls
- Provisioning of routers
- Shelves for expansion
- UPS
- Line cards
- Power supplies
- Codex equipment
- ALI database servers for providing location information
- Digital access cross connect systems (DACCS)
- Upgrades to PSAP equipment
- Potential upgrades to LEC equipment
- Selective router facility costs
- Dedicated circuits and cabling
- Installation and configuration costs

Additional factors that could impact equipment costs would be dependent on the actual network design of the system, physical location of the selective routers, and specific makes and models of the equipment required.

3.4.2 Voice Circuit (Trunk Costs)

The current network in Tennessee has wireless carriers purchasing dedicated voice circuits (trunks) which connect their networks to seven selective router locations across the State. A *Next Gen 9-1-1* solution has the potential to reduce these costs by reducing the number of selective routers the carriers must connect to. One design would result in the reduction from 7 selective routers to 2.

There will, however, be trunk costs incurred to replace these existing connections, and for an interim period, both types of connections need to be operational and will contribute to costs, until a *Next Gen 9-1-1* network were tested and implemented.

3.4.3 Data Circuit Costs

The delivery of location information as it relates to wireless E9-1-1 is critical. The whole purpose of FCC Docket Number 94-102 is to ultimately provide location information for a wireless E9-1-1 call similar to what is provided for a wireline E9-1-1 call. This critical location information for a wireless E9-1-1 call is primarily provided by two companies, Intrado and TCS, commonly referred to as third-party data providers.

The delivery of E9-1-1 data varies throughout Tennessee. There are LEC owned databases with third-party connectivity that provide wireless and wireline location information along with a 9-1-1 call. There are PSAP owned onsite databases which require connectivity to a wireless database vendor. To receive wireless location information each of these PSAPs must provision connectivity to a national wireless database provider. This connectivity will incur additional network cost.

The connections to these databases varies as well and is dependent on who the serving LEC is or the particular solution implemented by the PSAP. An additional factor for consideration is that it is possible for wireless E9-1-1 data to be delivered over other third-party networks during the wireless E9-1-1 call process. An agreement negotiated by the ECB could provide that Intrado and TCS establish network connectivity between each other and provide the capability to deliver wireless call data to all Tennessee PSAPs over common facilities, regardless of which provider a PSAP has connection to or which wireless carrier is providing the data.

This is known as ALI steering whereby a request is 'steered' from one ALI database system to another in order to retrieve the correct information. If a location is processing wireless E9-1-1 calls today, then ALI steering is taking place; reconfigurations would be necessary and an essential item addressed in any response to an ECB issued RFP.

Connections from the third-party database providers could be established to a *Next Gen 9-1-1* network, with connections provisioned to each PSAP. There would be connection costs associated with connecting the third-party data providers to the *Next Gen 9-1-1* network.

3.4.4 Maintenance and Monitoring Costs

The maintenance and monitoring of a *Next Gen 9-1-1* network would have cost implications. Maintenance of a state-wide network would no longer be carried out by multiple companies performing multiple roles. Today, each player in the E9-1-1 network in Tennessee is responsible for a portion of the entire system. The LEC is responsible for the primary delivery network and its operation. The wireless carriers are responsible for their networks and their connections to the LEC network, and the third-party data providers are responsible for their connections into both the wireless and LEC networks.

The responsibility for maintaining and monitoring a state-wide network would fall to the ECB or its designee. The 24 x 7 monitoring and maintenance of this or any 9-1-1 system is critical and necessary. These functions do have costs associated with them. The actual costs for maintenance and monitoring would be determined by the ECB and could take on many forms.

3.5 SERVICE LEVEL CONSIDERATIONS

Implementing a *Next Gen 9-1-1* solution would introduce a different level and a different type of service for E9-1-1 than is experienced in today's PSAP environment in Tennessee. Consideration needs to be given to the implications and what impacts might occur due to the differing service levels. Service levels are, in a sense, a type of guarantee. Service levels affect the response and repair times to correct an issue. A service level agreement also defines the liability and cost of that liability for the event. The determination of various service levels is addressed through the

RFP phase. Varying service levels are offered with varying pricing. The cost of the agreement depends on the level of service being provided.

3.5.1 Data Delivery Times/Issues

As implied by the *Next Gen 9-1-1* solution, a more direct connection to the networks that ultimately provide information to the PSAP during a 9-1-1 call could entail faster data delivery times.

Other issues that manifest when something goes wrong with the data delivery are accountability and responsibility and are difficult to assign when problems occur. A lot of effort is spent determining who should be fixing what, and identifying what the problem is so that preventive measures can be put in place to keep it from happening again.

In the *Next Gen 9-1-1* model control, accountability, and responsibility are clearly defined, and the determination rests with the ECB or its designee. Problem identification and issue resolution become simplified, and the overall reliability of the delivery system increases.

3.5.2 Redundant Selective Routers

The *Next Gen 9-1-1* solution relies on two or more selective routers known as 'mated pair tandems.' This configuration provides for call load balancing between the selective routers, as well as failover and redundancy capabilities during times of outage or disaster.

Many of the PSAPs in the state of Tennessee are being served by one selective router. This particular configuration introduces a single point of failure into the 9-1-1 delivery system and could result in the inability of a citizen to reach 9-1-1 in an emergency.

The dual tandem configuration mitigates this potential single point of failure by having redundant connectivity between all network connections; if one segment fails, it would not impair the entire system.

3.5.3 Redundant ALI Databases

The *Next Gen 9-1-1* model may also provide for 2 databases for E9-1-1 location data. One is located at each switch. This configuration allows for complete redundancy and failover capability from each selective router and ALI database to the other.

If one database should fail, the other database would provide ALI service until the failed unit can be restored.

4. BARRIERS TO MIGRATION

4.1 PSAP CPE CONFIGURATIONS

The single most significant barrier to implementation, and one that presents the most significant challenge from a technical perspective, is the diverse and varied configurations of the 163 PSAPs in Tennessee. Configuration refers to the specific combination of LEC network connectivity, CPE, ANI/ALI controller and ALI databases, and the myriad of components required to establish connectivity to the network.

4.1.1 Leased CPE

In many of the PSAPs Kimball has visited, the 'owner' of the equipment was the LEC, not the PSAP. The LEC owns the network, the ANI/ALI controller, and the CPE equipment and also provides maintenance and support to these PSAPs under lease/service contract arrangements.

The LECs equipment may not have the necessary capacity for upgrades needed to facilitate a *Next Gen 9-1-1* solution and may not be able to accept or use the latest digital technologies. Each ANI/ALI controller for each PSAP must be evaluated to make certain that adequate expansion capabilities exist. This would include the capacity to add new cards, trunks, firmware, and software upgrades. It may also be necessary to actually replace (forklift upgrade) equipment that is unable to accommodate the requirements of a *Next Gen 9-1-1* solution.

4.1.2 LEC- Owned and Maintained ALI Databases

As discussed earlier, there are multiple ALI database configurations deployed in the PSAPs across Tennessee. These consist of LEC owned national databases and PSAP owned stand alone or premise-based ALI configurations.

Each of these configurations will need to be evaluated, and reconfiguration will likely be required in order to interface these multiple systems with a *Next Gen 9-1-1* network solution to retrieve E9-1-1 location data. This will require LEC involvement for those systems they either own or are contracted by the PSAPs to support and maintain.

4.2 LOCAL EXCHANGE CARRIERS

LECs in Tennessee are for profit-regulated utilities and as such operate under strict operating guidelines and regulations imposed at both the federal and state levels and also at the direction of their shareholders. The business of telephony and the facilities used to conduct the business of telephony have been the domain of these companies for decades, and 9-1-1 is a part of the telephony business. Each LEC plays a vital role in making 9-1-1 a reality in Tennessee and across the country today.

A number of factors are challenging the traditional role the LEC plays in 9-1-1 of the twenty-first century. Chief among these factors is the Telecommunications Act of 1996 which has changed the competitive environment telephone companies operate in. Wireless telephony and VoIP is

having an impact as well as the average consumer transitions from a landline telephone to a wireless or VoIP telephone.

The *Next Gen 9-1-1* model presents an additional challenge to the way LECs have conducted business with regard to 9-1-1. *Next Gen 9-1-1*, as a concept, removes the requirement for the LEC to deliver all voice and data related to a 9-1-1 call to a PSAP. It has the potential to relegate LECs to providing only the wireline 9-1-1 call and associated data to a system that is designed to handle multiple types of voice communications. This challenges the status quo and the traditional way things have been done in 9-1-1. *Next Gen 9-1-1* will require all parties to 'think outside the box' and keep the primary focus on providing the best service possible to the citizens of Tennessee.

In other jurisdictions, outside of Tennessee, where a *Next Gen 9-1-1* solution has been put into operation, a lack of cooperation from the LEC has been cited as one of the biggest barriers to implementation.

The stature Tennessee has achieved in the deployment of wireless E9-1-1 Phase I and II could not have been accomplished without the cooperation of the LECs in the State. The cooperation of the LEC community as a partner and stakeholder in the possible implementation of a *Next Gen 9-1-1* solution is critical and necessary.

Local exchange carriers, as mentioned previously, have long been the sole provider of 9-1-1 services in this country. Tennessee is no exception. BellSouth and Embarq (formerly Sprint) have provided 9-1-1 service to the PSAPs in Tennessee for many years. While discussion of intent and even the authorization of this feasibility study may appear to some to threaten that long standing relationship, the fact is LEC revenues may merely shift from one internal business unit to another within the structure of the LEC. While a shifting of paradigms may result within the 9-1-1 house, additional revenues will likely result within the wholesale and retail house. True, LEC revenues from the State may decrease, but the LEC will likely always be a provider of 9-1-1 call delivery in some fashion. They own the necessary switches, facilities, and infrastructure to complete calls even with a *Next Gen 9-1-1* system in place from another provider. The LEC will never cease to play a vital role in delivery of 9-1-1 calls to the PSAPs of the state of Tennessee.

Uncooperative LECs has been identified as being the 2nd most significant barrier of migration to an IP based 9-1-1 system. Resistance by a LEC to cooperate with an entity desiring to upgrade their public safety services because the status quo is being challenged is counter-productive to the essence of the technology. *Next Gen 9-1-1* is about saving lives and providing the best possible service technology can offer. *Next Gen 9-1-1* is about making available to the PSAPs features and benefits the LECs simply cannot provide through the traditional circuit-switched analog network. It is essential the LECs embrace this change and support the effort for the benefit of all.

4.2.1 Tariffs

It is not clear at this point in this feasibility study whether -- and what impact -- LATA and inter-LATA issues will have on a *Next Gen 9-1-1* solution. These issues will be addressed through the responses to a formal RFP.

At the same time, anecdotal evidence indicates that under the current situation, some wireless carriers pay significantly more in LEC charges than other carriers (serving the same area) due to the location of their MSC; the former incur mileage and distance charges to connect their switches to a selective router.

Any RFP response submitted to the ECB should contain a discussion of these issues and whether tariff-related and LATA charges will affect the final outcome.

Another issue that will likely surface at some point is one of the E9-1-1 tariff. The LECs "bundle" certain services into convenient "packages" of related service offerings, the idea being to remove the necessity and complication of requiring a customer to choose which few features of many offered they desire to purchase.

An example of bundling can be found on your home telephone bill where you receive a package of features such as caller ID, call transfer, three-party calling, and detailed billing, all for one low monthly fee added to your phone bill. If you have no use for the three-party calling feature, you will likely not be able to remove it because it is bundled with other offerings.

The E9-1-1 tariffs are quite similar. Features such as selective routing, ANI, ALI, forced disconnect, one-button transfer, database management, and summary billing are typically bundled into a pricing structure that is based on the number of 1,000 subscriber lines being provided 9-1-1 service. A county having 225,000 subscriber lines might receive a 9-1-1 telephone bill each month in the amount of $45,000. This is based on a fee structure of $200 per 1,000 subscriber lines ($200 x 225= $45,000).

Earlier in this document various implementation benchmarks were detailed. If, at the appropriate benchmark, the ECB decided to begin routing wireline calls across the new IP network but not (at this time) move ALI database services away from the LEC provider, full featured billing for wireline calls would continue. Billing for all E9-1-1 services that are tariff bundled would continue regardless of whether they are being provided or not. In this reference ALI database management continues to be provided by the serving LEC. As long as any one feature of the bundled offering is being utilized, the subscribing entity will pay for all because individual features cannot be unbundled and priced separately.

To escape the unfairness of this billing style, the ECB may find it necessary to engage the Public Service Commission or the FCC to intervene and require LECs to unbundle the E9-1-1 tariffs.

5. RECOMMENDATIONS AND CONCLUSIONS

Based on the findings of this report, Kimball recommends that a *Next Gen 9-1-*1 system is feasible for the state of Tennessee and further recommends that the ECB continue the necessary planning and preparation necessary to implement a *Next Gen 9-1-1* system for the state of Tennessee. Kimball recommends that the ECB issue a request for proposal (RFP) document to interested parties to determine a viable solution and define how a *Next Gen 9-1-1* network infrastructure could be implemented in the state of Tennessee, with the stated purpose of improving public safety, providing improved services and realizing technical and fiscal efficiencies. Kimball further finds the goals outlined in section 1.1.2 are achievable through a migration to an IP enabled E9-1-1 system.

The RFP is an announcement of willingness to consider bids for the performance of a specified project or program component and a logical next step in the path towards *Next Gen 9-1-1*. Requests for proposals are often issued when seeking bids for a specified research project. An RFP is a document which solicits a particular solution offered by the respondents to the RFP. The respondent's cost to provide that solution is included in detail in the response. An RFP is announced to multiple companies that will be interested in procuring the project. This allows the ECB to evaluate the responses, compare the multiple solutions and costs. This evaluation process will aid the ECB in their decision-making process. Once a vendor's solution and price is accepted, the ECB would then award the selected vendor the contract to proceed with their solution.

Based on our findings and the information reported in this report, Tennessee is well positioned to move forward. The elements required to provide such a network are found to be available in Tennessee from a variety of sources. Because several solutions are available, an air of competition among RFP respondents and proposing vendors will result, ensuring the best price will be provided for the chosen solution.

Due to the fact the one best solution is not known at this time, the State will be provided with a menu of options to choose from. The ECB will need to determine at what pace they wish to proceed to achieve their goals (e.g., wireless only, wireless and wireline, statewide ALI database). This decision will likely be driven by costs. Kimball encourages the ECB to proceed through the RFP stage to more accurately determine the best course of action to employ to achieve the desired results.

5.1 ESTIMATED PRICING

Providing pricing via a feasibility study is outside the scope of the study. A feasibility study answers the question of "is it or is it not feasible to pursue this desire?" An RFP is a much better resource to address the "how much will it cost?" question. However, it is understood that the ECB cannot consider or approve any further action beyond this report without some idea of the fiscal impact of a *Next Gen 9-1-1* solution in the state of Tennessee. To address the fiscal impact and costs associated with a project such as this, it will be recommended an RFP be issued. Responses to the RFP will provide the necessary pricing and implementation timelines for the work to be performed as well as provide the options for implementation.

In the interim Kimball provides the following estimates for the benefit of the Board members to comprehend budgetary estimates for a 5 year period. The estimates provided below are based on a hypothetical solution but are in line with realistic a migration such as may be entertained by the State of Tennessee.

FY06-07

Non Recurring fees	estimated at between $2 to $4 million to establish connectivity
Recurring fees	estimated at between $50,000 to $100,000 as implementation progresses

FY07-08

Non Recurring fees	estimated at an additional $2 to $3 million ($4 to $7 million total) as more connectivity is established and build out occurs
Recurring fees	estimated to increase to between $100,000 to $150,000 as implementation occurs

FY08-09

Non Recurring fees	estimated at an additional $2 to $3 million ($6 to $10 million total) as wireless completes and wireline migration occurs
Recurring fees	estimated to increase to between $150,000 to $250,000 as implementation occurs

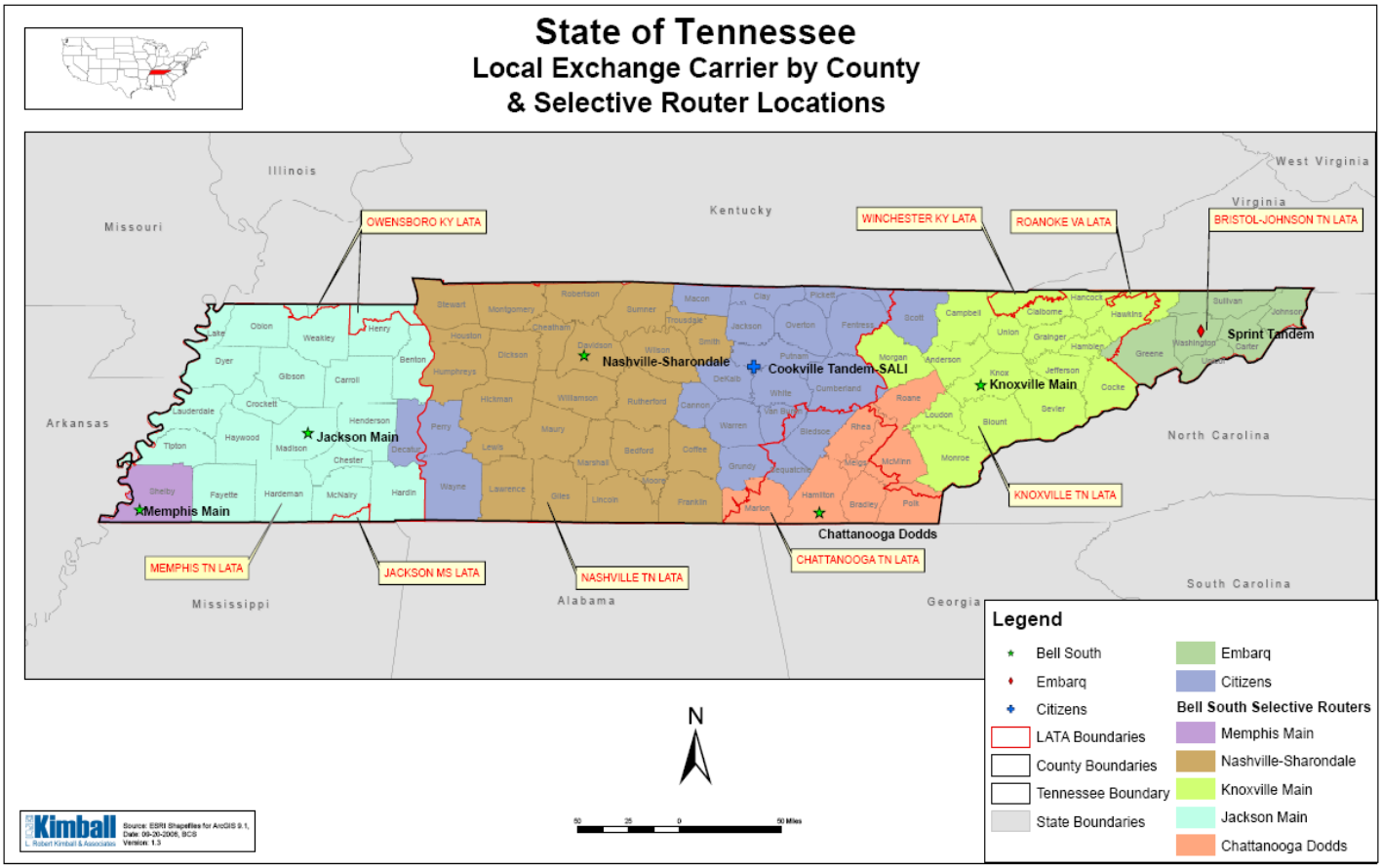
FY09-10

Non Recurring fees	estimated at an additional $1 to $2 million ($7 to $12 million total) as wireline completes and state wide ALI migration occurs
Recurring fees	estimated to increase to between $200,000 to $300,000 as implementation occurs

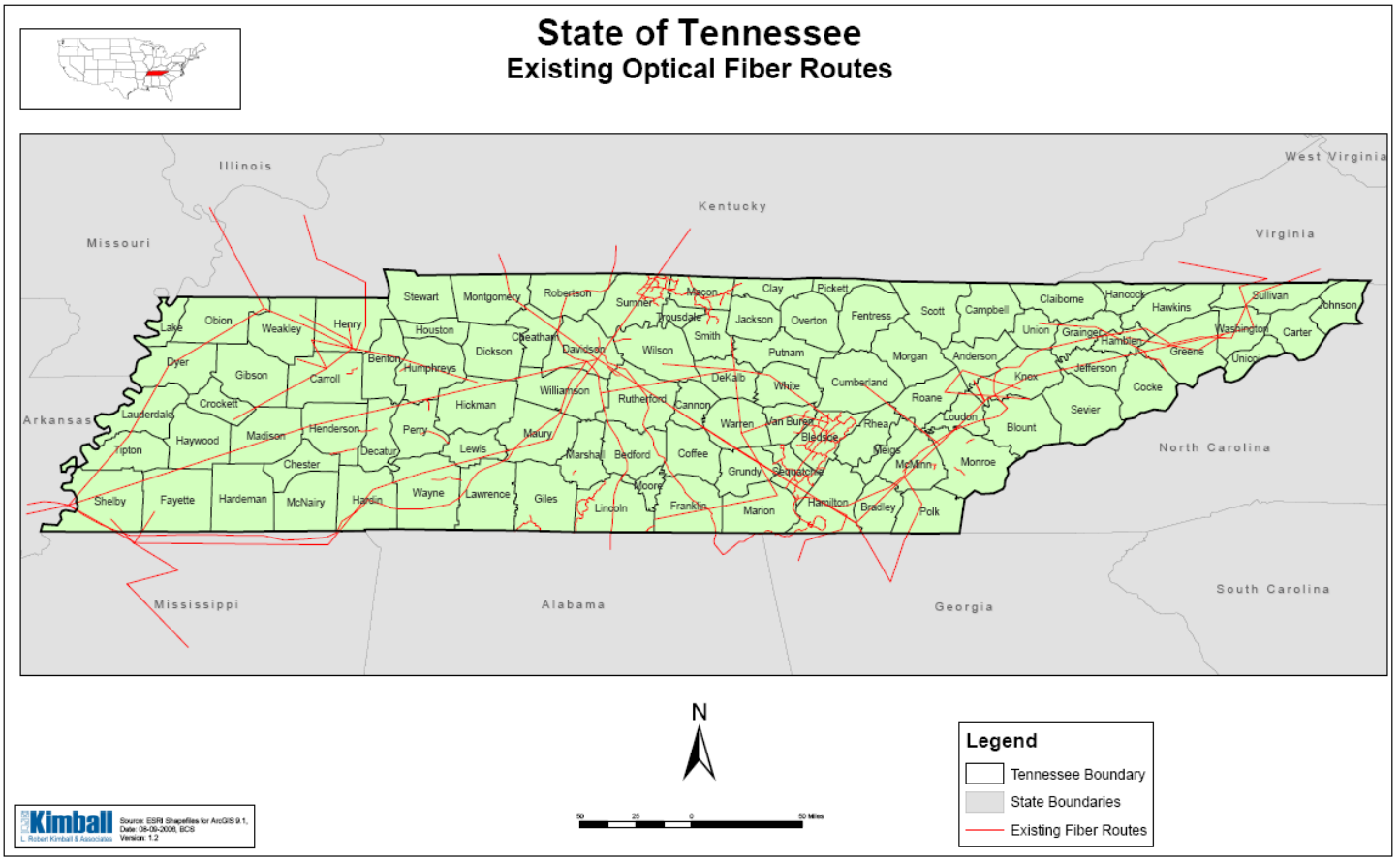
FY10-11

Non Recurring fees	estimated at an additional $1 to $3 million ($8 to $15 million total) as implementation completes
Recurring fees	estimated to increase to between $300,000 to $400,000 as daily operation, maintenance and monitoring of the system occurs

APPENDIX 1


State of Tennessee
Local Exchange Carrier by County
& Selective Router Locations
Illinois
Missouri
Kentucky
West Virginia
Virginia
North Carolina
South Carolina
Georgia
Alabama
Mississippi
Arkansas
OWENSBORO KY LATA
WINCHESTER KY LATA
ROANOKE VA LATA
BRISTOL-JOHNSON TN LATA
KNOXVILLE TN LATA
CHATTANOOGA TN LATA
NASHVILLE TN LATA
JACKSON MS LATA
MEMPHIS TN LATA
Nashville-Sharondale
Cookville Tandem-SALI
Knoxville Main
Sprint Tandem
Jackson Main
Memphis Main
Chattanooga Dodds
N
Legend
Bell South
Embarq
Citizens
LATA Boundaries
County Boundaries
Tennessee Boundary
State Boundaries
Embarq
Citizens
Bell South Selective Routers
Memphis Main
Nashville-Sharondale
Knoxville Main
Jackson Main
Chattanooga Dodds

APPENDIX 2


State of Tennessee
Existing Optical Fiber Routes
Illinois
Missouri
Kentucky
West Virginia
Virginia
Arkansas
Mississippi
Alabama
Georgia
South Carolina
North Carolina
Lake
Obion
Weakley
Henry
Stewart
Montgomery
Robertson
Sumner
Macon
Clay
Pickett
Fentress
Scott
Campbell
Claiborne
Hancock
Hawkins
Sullivan
Johnson
Carter
Washington
Greene
Unicoi
Jefferson
Cocke
Sevier
Blount
Knox
Union
Grainger
Hamblen
Anderson
Morgan
Roane
Loudon
Rhea
Meigs
McMinn
Monroe
Bledsoe
Sequatchie
Hamilton
Bradley
Polk
Marion
Franklin
Grundy
Coffee
Warren
Van Buren
White
Cumberland
DeKalb
Putnam
Smith
Jackson
Overton
Trousdale
Wilson
Davidson
Cheatham
Dickson
Houston
Humphreys
Benton
Carroll
Dyer
Gibson
Crockett
Lauderdale
Tipton
Haywood
Madison
Henderson
Chester
Decatur
Perry
Hickman
Williamson
Rutherford
Cannon
Maury
Lewis
Marshall
Bedford
Moore
Lincoln
Wayne
Lawrence
Giles
Hardin
McNairy
Hardeman
Fayette
Shelby
N
50 25 0 50 Miles
Legend
Tennessee Boundary
State Boundaries
Existing Fiber Routes

APPENDIX 3

Study Timeline

The following timeline gives an overview of the effort required of this investigation as well as the process and methodology followed by Kimball to provide the necessary components found in this report.

April 2006

- Project kickoff at Nashville
- Met and interviewed staff members
- Established goals of feasibility study
- Aligned expectations
- Established time line for report completion
- Discussed and established process and methodology
- Discussed the conceptual idea of *Next Gen 9-1-1*
- Discussed potential PSAP issues
- Discussed specific PSAP operational information
- Discussed potential wireless carrier issues
- Discussed specific wireless carrier operational information
- Discussed potential time lines and process

May 2006

- Brainstormed existing infrastructure potentials
- Gathered diagrams/graphics that reflected existing infrastructure
- Requested information from BellSouth, Citizens, Embarq
- Identified wireless carriers
- Identified CLECs
- Identified VoIP providers
- Researched potential fiber companies throughout the State
- Identified all PSAPs

June 2006

- Researched *Next Gen 9-1-1* implementations
- Discussed maintenance and operation issues
- Continued to gather data from all the carriers

July 2006

- Obtained the following data for each PSAP:
  - PSAP name
  - PSAP address
  - Primary or secondary
  - Primary contact information
  - Secondary contact information
  - Stand alone ALI system Y/N?
  - Serving LEC
  - Other telcos
  - 9-1-1 trunk quantity
  - 9-1-1 trunk type
  - Wireless trunk quantity
  - Selective router location
  - Non 9-1-1 trunk quantity
  - CPE type
  - Number of positions
  - Manual re-bid Y/N
  - Extended ALI Y/N
  - Type of mapping system
  - Type of CAD system
  - Type of logging recorder
  - Type of radio system
  - Type of console(s)
  - Type of instant recall recorder
  - Number of employees full time equivalent
  - Number of employees part time equivalent
  - Generator type
  - UPS Y/N
  - Phase 2 ready Y/N
  - EMS dispatch Y/N
  - EMS dispatch type
  - Percentage of wireless calls
  - EMD used
  - Number of certified EMD C/T
  - Medical Director
  - Records last updated

August 2006

- Met with ECB staff to discuss proposed report outline and rough draft, finalize timeline and delivery of report findings and recommendations
- Began developing feasibility study rough draft
- Continuing to receive support data
- Finalize mapping requirements

September2006

- Finalized report
- Developed presentation
- Presented final report to the ECB
- Presented findings to the ECB at fall meeting

Kimball would like to acknowledge and thank the following for their valuable input for the report:

- The Staff of the Emergency Communications Board
- Citizens
- Embarq
- Members of the State of Tennessee's Cooperative
- TVA
- Tennessee Telecommunications Association
- University of Tennessee
- University of Memphis
- The wireless carriers providing services in Tennessee
- INdigital Communications
- KDL
- Level 3
- IRIS
- AT&T
- Vonage
- Qwest, and
- Many others who contributed valuable information.

APPENDIX 4

Wireless Carriers by Counties Served

Alltel

Carter	Grainger	Greene
Hamblen	Hawkins	Johnson
Sullivan	Washington	Unicoi.

Horizon

Carter	Grainger	Greene
Hamblen	Hawkins	Jefferson
Johnson	Sullivan	Washington
Unicoi.		

Sprint PCS

Anderson	Bedford	Benton
Blount	Bradley	Campbell
Carter	Cheatham	Claiborne
Cocke	Coffee	Cumberland
Davidson	Decatur	Dickson
Fayette	Gibson	Giles
Grainger	Greene	Grundy
Hamblen	Hamilton	Hawkins
Haywood	Henderson	Hickman
Humphreys	Jefferson	Johnson
Knox	Lauderdale	Loudon
Madison	Marion	Marshall
Maury	McMinn	Monroe
Montgomery	Obion	Polk
Putnam	Rhea	Roane
Robertson	Rutherford	Sequatchie
Sevier	Shelby	Smith
Sullivan	Sumner	Tipton
Trousdale	Unicoi	Union
Washington	Williamson	Wilson

Verizon Wireless

Anderson	Bedford	Benton
Bledsoe	Blount	Bradley
Campbell	Cannon	Carroll
Carter	Cheatham	Chester
Claiborne	Clay	Cocke
Coffee	Crockett	Cumberland
Davidson	Decatur	Dekalb
Dickson	Dyer	Fayette

Fentress	Franklin	Gibson
Giles	Grainger	Greene
Grundy	Hamblen	Hamilton
Hancock	Hardeman	Hardin
Hawkins	Haywood	Henderson
Henry	Hickman	Houston
Humphreys	Jackson	Knox
Lake	Lauderdale	Lawrence
Lewis	Lincoln	Loudon
Macon	Madison	Marion
Marshall	Maury	McMinn
McNairy	Meigs	Monroe
Montgomery	Moore	Morgan
Obion	Overton	Perry
Pickett	Polk	Putnam
Rhea	Roane	Robertson
Rutherford	Scott	Sequatchie
Sevier	Shelby	Smith
Stewart	Sullivan	Sumner
Tipton Trousdale	Unicoi	Union
Van Buren	Warren	Washington
Wayne	Weakley	White Williamson
Wilson.		

Nextel

Anderson	Bedford	Benton
Blount	Bradley	Campbell
Carter	Cheatham	Claiborne
Cocke	Coffee	Cumberland
Davidson	Decatur	Dickson
Fayette	Gibson	Giles
Grainger	Greene	Grundy
Hamblen	Hamilton	Hawkins
Haywood	Henderson	Hickman
Humphreys	Jefferson	Johnson
Knox	Lauderdale	Loudon
Madison	Marion	Marshall
Maury	McMinn	Monroe
Montgomery	Obion	Polk
Putnam	Rhea	Roane
Robertson	Rutherford	Sequatchie
Sevier	Shelby	Smith
Sullivan	Sumner	Tipton
Trousdale	Unicoi	Union
Washington	Williamson	Wilson.

Cingular

All ECDs served by the LEC BellSouth. (No other information was provided with regard to coverage by ECD.)

Advantage

Smith	Dekalb Cannon	Warren
Grundy	Coffee	White Van Buren.

Crickett

Davidson	Wilson	Williamson
Rutherford	Maury	Dickson
Cheatham	Sumner	Robertson
Montgomery	Anderson	Blount
Jefferson	Knox	Loudon
Sevier	Shelby	Tipton
Fayette		

APPENDIX 5

Local Exchange Carriers and Counties Served

BellSouth

Anderson	Bedford	Benton
Blount	Bradley	Campbell
Carroll	Cheatham	Chester
Claiborne	Cocke	Coffee
Crockett	Davidson	Dickson
Dyer	Fayette	Franklin
Gibson	Giles	Grainger
Hamblen	Hamilton	Hancock
Hardeman	Hardin	Hawkins
Haywood	Henderson	Henry
Hickman	Houston	Humphreys
Jackson	Jefferson	Knox
Lake	Lauderdale	Lawrence
Lewis	Lincoln	Loudon
Madison	Marion	Marshall
Maury	McMinn	McNairy
Meigs	Monroe	Montgomery
Moore	Morgan	Obion
Polk	Rhea	Roane
Robertson	Rutherford	Sevier
Shelby	Smith	Stewart
Sumner	Tipton	Trousdale
Union	Weakley	Williamson
Wilson	Oakridge	LaFollette

Embarq

Carter	Greene	Sullivan
Johnson	Kingsport	Unicoi
Bristol	Washington	

Citizens/Frontier

Bledsoe	Cannon	Clay
Cumberland	De Kalb	Decatur
Fentress	Grundy	Jackson
Macon	Overton	Perry
Picket	Putnam	Scott
Sequatchie	Van Buren	Warren
Wayne	White	

L. Robert Kimball & Associates

L. Robert Kimball & Associates, Inc. and Affiliates
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