Minnesota - ARMER and 9-1-1 Funding Study

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Executive Summary

For over three decades, local and state leaders in Minnesota public safety have taken a comprehensive end-to-end view of the emergency response continuum. This view required a thorough evaluation of the systems and networks used to receive an emergency distress call from residents, tourists or emergency responders through the execution of emergency response activities.

The Minnesota public safety emergency communications system, broadly stated to include all of the communications systems and elements, Allied Radio Matrix for Emergency Response (ARMER) and Next Generation 9-1-1 (NG9-1-1) and the future broadband system, (including voice, data, video and text), are technically modern systems highly integrated and interdependent for the effective delivery of emergency services. These systems are critical to every public safety organization in the state and the people they serve.

The technologies and design characteristics that allow for the functionality of the ARMER and NG9-1-1 systems used in Minnesota, and by similar systems across the country, are finely tuned systems developed by vendors based on real-world operational needs from emergency response disasters and lessons learned over the last 30 years.

Because of these technological developments, these systems are significantly different from their predecessors. Beyond the major differences of cost and feature functionality there is a paradigm shift in the maintenance and life cycle expectations for these systems. In order for Minnesota's emergency response systems to perform to their full capability, firmware or operating system improvements must occasionally occur just as is the case with other technologies, such as computers and smart phones.

The occurrences of these improvements are more frequent than that of legacy systems. Radio systems and 9-1-1 call answering systems of the past had a hardware life cycle of approximately 20 years, but the current software driven systems have an annual or biennial software update and hardware revisions of three to 10 years based on the piece of equipment. The constant evolution is not full system replacements and in the case of ARMER represent a fraction of the total system capital cost, but are still important for full system functionality.

The oversight of the ARMER system plan and construction, and more recently coordination with the NG9-1-1 system, is managed by the Statewide Emergency Communications Board (SECB). The SECB is a 21-member board codified in Minnesota law and balanced with seven state members, seven local metro members and seven local

rural members from multiple disciplines. In support of the SECB are Regional Radio Boards developed with the focus of ensuring a bottom up communications pathway for local communications systems users. An organizational chart of Minnesota's nationally recognized governance structure can be found in Attachment J.

At the request of the SECB, the State engaged Federal Engineering (***FE***) to provide a high-level assessment of the current state of the systems, maintenance provisions and funding strategies (current and available) to determine the best road to sustainability of the ARMER and NG9-1-1 system, including systematic maintenance, update and refresh well into the future.

The Statewide Emergency Communications Board's (SECB) objectives for this project are to:

- Assess the current and future operating and upgrade costs of the ARMER system
- Assess the current and future costs of completing the NG9-1-1 project and future operation and maintenance costs
- Assess the current and potential future revenue sources for existing public safety emergency communication projects and obligations.
- Examine whether the current revenue source is adequate to support the long-term needs of public safety emergency communications
- Outline funding obligations necessary to retire the 9-1-1 Revenue Bonds that funded the construction of the ARMER backbone
- Outline potential long-term funding strategies and alternatives
- Assessment of alternatives and recommendations

In addition the SECB requested that ***FE*** provide the State with options to take a more in-depth view of any of the study areas.

ARMER Overview

The state of Minnesota ARMER radio system is one of the largest, if not the largest standards-based shared statewide land mobile radio network in the nation, based on the geographic area served, along with the number of tower sites, dispatch centers and mobile/portable radios active on the system.

It is estimated that over 87% of the public safety agencies within the state now utilize the ARMER system for day-to-day mission critical voice radio communications. This includes State of Minnesota, city, county, federal, medical, transportation and other types of agencies. There are a total of nearly 82,000 mobile and portable radios currently allocated for use on the system by the agencies in Minnesota.

The first phases were implemented in the Twin Cities Metropolitan Area. The system expanded to the St. Cloud and Rochester areas, the central and western areas of the state, and ultimately throughout the remainder of the state. At this time, the P25 digital trunked 800 MHz ARMER system consists of 310 towers, six regional controllers and over a thousand base stations. ARMER is 95% complete and 76 of the 87 counties in the state have migrated radio operations to the new system, with excellent results as the ARMER system provides for the highest level of interoperable communications.

To date, the total investment by the State for infrastructure, not including funding spent by local city and county agencies, is $240 million.

The cost of operating and maintaining a radio system of this magnitude and complexity is considerable for system owners, as the tower sites, radio transmitting and receiving equipment, microwave radios, network control systems, Public Safety Answering Point (PSAP) consoles, and mobile/portable radio equipment require ongoing support, including both repair and preventative services. For the backbone equipment provided by the state, these services are currently provided by the state of Minnesota's Department of Transportation (MnDOT) Office of Statewide Radio Communications technology staff. In addition, MnDOT has entered into a parts contract with Motorola Solutions[1], the primary provider of the system's equipment, and a two year System Upgrade Agreement (SUA).The SUA provides for:

- One on site dedicated field service technician
- Technical Support Services (calls to factory engineers)
- System Software Subscription Agreement
- Subscriber Software Subscription Agreement
- Hardware changes (not hardware platform changes, such as Gold Elite or STR3000) such as new desktop computers for the dispatch consoles

[1] Motorola Solutions is referred to as Motorola for the remainder of the document.

- System software installation costs.

The State spends approximately $11.5 million annually on the maintenance of the ARMER system. These maintenance costs are only for the MnDOT owned portion of the ARMER backbone and do not include any local system owner ARMER enhancements for subscriber or console maintenance. Local system owners can be cities, counties, private EMS organizations and even state agencies, such as the Department of Corrections. While an exact figure for annual local system owners maintenance costs has yet to be determined, without question, it is in the millions of dollars annually.

The SECB is planning an ARMER platform upgrade in May 2016 with the adoption of Motorola Solutions software release 7.15. As a result, older Gold Elite PSAP consoles, now over 11 years old, will require replacement since the vendor will not support them in software release 7.15. Another major component, the STR3000 800 MHz base station, will also need to be replaced before the next major system software release 7.19 in 2019 or 2020. The replacement of these legacy base stations is required because they will no longer be compatible with the rest of the system. This change affects both locally owned ARMER backbone infrastructure as well as the State owned ARMER infrastructure. ***FE*** notes that the SECB could opt to forgo the 7.15 and all platform upgrades, but a discussion about the impacts to current and pending ARMER users would need to occur at the SECB as well as a discussion on what new system features and functions the users would forgo without the software upgrades.

State owned ARMER backbone equipment is funded through the 9-1-1 Special Revenue Account (9-1-1 SRA). Local city and county system owners operate equipment on the system funded with local funds and there are state agencies who own and operate ARMER equipment through their biennial general fund (and Trunked Highway fund) appropriation.

An emerging challenge is keeping the state owned and locally owned components of the ARMER system operating at maximum capability to meet the long-term needs of users when state and local agencies are on very different budgeting cycles. The shared ARMER platform does not allow for some legacy components of the system to be updated while others remain idle. All end of life components, regardless if they are locally owned or state owned, must be updated at the same time or coverage, capacity or service outages will occur.

NG9-1-1 Overview

Minnesota has made tremendous progress to become a leader in implementing landline and wireless Enhanced 9-1-1 service (E9-1-1) statewide. All 87 Minnesota counties

provide E9-1-1 (selectively routed 9-1-1 calls providing PSAPs with callback phone numbers and accurate location information) for landline telephones, Phase II E9-1-1 for mobile/wireless telephones, VoIP and prepaid wireless customers. Despite these advances in the level of 9-1-1 service, communication technologies are rapidly transitioning to IP networks and are advancing in ways that the existing analog 9-1-1 network cannot accommodate.

Nationally, the telecommunication industry and public safety agencies are trying to catch up to the change in user's expectations with the transition to an IP enabled Next Generation 9-1-1 network deployment of (NG9-1-1). Although details of many of the features and functions of the NG9-1-1 network are still being developed, the transition from an analog network to the basic IP network upon which NG9-1-1 features and functions will be implemented is well developed. Minnesota's implementation of NG9-1-1 has proceeded as follows:

- Phase 1 – Implementing seamless interoperability between ten selective routers used in the state by installing the core of the Emergency Services Internet Protocol network (ESInet)--two IP selective routers, between the legacy selective routers. This allows for the transfer of 9-1-1 calls between all Minnesota PSAP's with phone number and location information included. This Phase of the NG9-1-1 system migration was completed by the State in September 2010.

- Phase 2 – Providing for the transitioning and testing of two PSAPs (one rural, one metro) from analog circuits to IP circuits connecting them to the ESInet was completed in March 2013.

- Phase 3 – Providing for the transition of the remaining state PSAPs to the ESInet and IP selective routers enabling PSAPs access to the functions and features of the NG9-1-1 network. This Phase is nearing completion with 99 of 104 PSAPs migrated to the new IP network backbone as of December 31, 2013. The remaining five PSAPs will migrate in the first quarter of 2014.

To date, the state has been judicious in its approach for funding of the NG9-1-1 migration as each phase has been funded by the 9-1-1 fee deposited in the state 9-1-1 Special Revenue Account (SRA), but completion of the NG9-1-1 build out will be a continuous process with more phases and the continued replacement of existing infrastructure and equipment. This will require significant investment over the next 5 years. There will be additional costs at the local level to fund call answering equipment, upgrades necessary to deploy some of the new technology, as well as increased training costs to ensure 9-1-1 call takers are adequately prepared to deal with the calls from ever changing devices

used by the public. The state is projecting a modest increase in funding to PSAPs beginning in 2016 for NG9-1-1 equipment and training, but the actual impact to the 9-1-1 SRA and cost to the local PSAPs is speculative at this time.

Phase 4 of Minnesota's NG9-1-1 project will result in the migration of existing legacy telecommunications end office networks into the statewide ESInet. The legacy analog selective routers, which are the backbone of the existing 9-1-1 network, will be decommissioned. Similarly, future steps will require the replacement of existing PSAP equipment with IP equipment capable of implementing the functions and features of NG9-1-1 as they evolve.

It is anticipated that one of the first unique NG9-1-1 features to be implemented on Minnesota's NG9-1-1 network will be a preliminary version "Text-to-9-1-1" functionality. This functionality will enable the Minnesota's 9-1-1 network to process and properly route text messages for emergency services.

LTE Overview

Most readers of this report are aware of the development of LTE (Long Term Evolution) technology, which is expected to be the next generation of public safety communications. LTE is an IP-based high capacity cellular radio communications technology, that is being designed to provide public safety grade mission critical voice communications. It is anticipated that these future LTE voice and data networks will mirror, to a certain extent, the commercial cellular telephone and data networks, but will be dedicated to public safety usage.

At this time it is extremely difficult to predict when these next-generation mission critical "one-to-many" voice LTE systems will begin to develop and become available, and whether or not they will eventually replace the current 800 MHz trunked radio systems. It is expected that the first LTE systems will primarily provide high-capacity data services, a feature that is lacking in the current public safety radio systems. Most public safety agencies have embraced the use of wireless mobile air cards through commercial cellular service providers, which are available for a monthly fee of $25 to $50 per unit.

It is important to note that the ARMER system was first and foremost designed as a voice radio system, with the goal of providing highly reliable voice communications for the users of the system. It was not designed for the purpose of delivering data services to mobile and portable field units. While it is true that the near-term version upgrades of the Motorola ASTRO 25 systems will allow or provide low-speed data services over the control channel of the trunked radio system, this is not intended to be a substitute for true higher-speed

data applications on an LTE network. It will; however, provide data transport for interesting applications such as GPS location services and text messages.

In view of the current state of technological development, ***FE*** believes that the ARMER system, with ongoing updates and maintenance, will continue to serve the public safety agencies in Minnesota for many years to come. In short, the sustainment of ARMER allows Minnesota to wait for the next major technology shift in mission critical voice communications, which may occur with the planned development of the LTE based National Public Safety Broadband Network (NPSBN) being managed by FirstNet.

Report Findings

The 9-1-1 system has saved countless lives, but just the ability to dial 9-1-1 and have a call answered by a PSAP does not complete the emergency response continuum. State and local leaders have determined that both the 9-1-1 network and ARMER system are critical public safety systems that are interdependent and complementary to each other and that either by itself falls woefully short of providing comprehensive end-to-end emergency services.

As evidence of the critical nature of these services and systems, the state legislature instituted a specific 9-1-1 fee which is assessed on each subscriber line that has access to the 9-1-1 system. In most cases these fees are paid monthly by the customer and remitted by the telecommunications service provider for deposit into the 9-1-1 SRA account.

For many years, the 9-1-1 SRA funded only 9-1-1 telecommunication related activities, but as the concept for the statewide ARMER system gained momentum public safety leaders recommended and ultimately the legislature approved the building and maintenance costs of the ARMER system out of the 9-1-1 SRA. Today, ARMER system costs represent approximately half of the debits out of the 9-1-1 SRA, 30% of the debits support the 9-1-1 program costs and counties receive about 20% to pay for costs associated with running their 9-1-1 call answering centers. There is concern that the 9-1-1 fee and the 9-1-1 SRA account will be further diluted and unable to provide for its original core function of statewide 9-1-1 service.

The SRA has a fiscal year 2014 projected fund balance of approximately $8,033,000, which is slightly higher than the $5,000,000 fund balance floor established for cash flow on an account where fees collected on subscriber lines vary from month-to-month.

The following subsections summarize the tasks set by the SECB for this project.

Task 1 – Current and Long-Term Maintenance Costs for ARMER System

In performance of this task, ***FE*** reviewed ARMER cost elements and developed a comprehensive life cycle assessment of the ARMER system. These costs are the responsibility of both the state and local agencies, dependent on the ownership of the system equipment.

Though the system is now nearing completion of the statewide infrastructure build out, and has recently received a significant system upgrade, there are core elements of the system that are now over 10 years old, which will require replacement within the next two years, and others that will require replacement near 2019. This includes Motorola CENTRACOM Gold Elite dispatch consoles, and STR3000 base stations, equipment which is owned by both the state of Minnesota as well as many of the local city and county agencies. Additionally, many of the mobile and portable radios being used by state, county and city agencies will require replacement now and in the future, based on the age of the equipment.

The table below provides a summary of the state and locally owned equipment requiring replacement including the Gold Elite consoles (7.15 release), STR3000 stations (7.19 release) and portable and mobile radios and their associated cost estimates. Cost estimates include installation and project management costs. The cost estimates are based on quantities of each of these system elements that were provided by MnDOT.

ARMER Equipment Replacement Summary

System Elements	*State of MN Agency Costs	Local Agency Costs	Total Costs
Gold Elite Dispatch Consoles	NA	$13,940,000	$13,940,000
STR3000 Base Stations	$2,814,000	$29,711,000	$32,525,000
Other System Equipment	$4,673,000	$1,894,000	$6,149,000
800 MHz Mobile and Portable Radios	$34,152,000	$213,466,000	$247,618,000
Totals	$41,639,000	$259,011,000	$300,232,000

*Costs primarily effect the Departments of Public Safety (including the division of the Minnesota State Patrol), Transportation, Corrections and Metropolitan Council and these state agencies do not receive 9-1-1 fee revenues for the ongoing maintenance, replacement or upgrades of ARMER equipment. This is of primary concern for an agency such as the Department of Corrections who has significant funding requirements to

maintain their local enhancements to the ARMER system for their network of institutions across the state. Corrections and other state agencies rely solely on general fund appropriations to cover their costs.

The replacement of portable and mobile radios is by far the most significant cost facing State and local system owners, but the replacement of these radios has been routinely budgeted for decades by state and local agencies. More clearly, the transition to ARMER has not changed the life expectancy or replacement cycle of portable and mobile units or dispatch consoles, base stations and other network equipment. What has changed is the requirement for all agencies, State and local, to make coordinated equipment purchases to allow for maximum operation with ARMER system platform upgrades.

While $300,232,000 in equipment replacement costs are projected, not all of these costs occur immediately. The table below outlines estimated costs in three specific years based on the methodology documented in Section 3.

ARMER Equipment Replacement Summary by Year

System Elements	2015	2019	2025	Total
Gold Elite Dispatch Consoles	$13,940,000	NA	NA	$13,940,000
STR3000 Base Stations	NA	$32,525,000	NA	$32,525,000
Other System Equipment	NA	$6,149,000	NA	$6,149,000
800 MHz Mobile and Portable Radios	$113,796,000	$62,320,000	$71,502,000	$247,618,000
Totals	$127,736,000	$100,994,000	$71,502,000	$300,232,000

Of chief concern to local system owners is the pending $13,940,000 in required console upgrades and the additional $38,674,000 in costs in 2019. While PSAP operators can use their distributed 9-1-1 fees for network equipment upgrades within the PSAP, radio system users (ARMER and non-ARMER) have limited funding options for OPEX and lifecycle replacement costs. Therefore, the funding options for local system owners are, the local tax base (including bonding), grants, and state appropriations. With grants dwindling and no precedent for state appropriations for locally owned equipment, the real funding option remains to be from the local tax base and there is concern that if funds cannot be generated to replace equipment as needed for a SECB required ARMER platform upgrade their day-to-day emergency communications system will be impacted with reduced coverage, capacity or entire system use.

For more system owner detail on this equipment and associated costs, refer to Sections 3.1.2, 3.2.2, and 3.2.7.

In completing this Task, ***FE*** also developed a year-by-year replacement schedule and estimated CAPEX and OPEX costs over 15 years. These costs can be reviewed in Attachment D.

The 15 year totals for ongoing capital outlay for the state (not including subscriber radios) is approximately $120,200,000 and the 15 year estimate for maintenance and operational costs is an additional $212,307,000.

In examining the data and interviewing the local system owners for this Task ***FE*** learned that the budgeting information for ARMER upgrades is not being provided quickly enough. As a result, ***FE*** would recommend the state press Motorola Solutions for specifics on platform changes and associated costs well in advance of implementation. Upon receipt of this information MnDOT should follow the major system change portion of ARMER Standard 1.8 and analyze the change and as quickly as possible get the change before the Operations and Technical Committee. This will allow the review and potential approval of system upgrades by the Statewide Emergency Communications Board (SECB) years before migration. A planned migration at least three years in advance, and preferably five years, will help state and local agencies to work with their elected officials on securing funding to maintain the ARMER system at its maximum capability. The SECB should also weigh the real value of each platform upgrade against the cost to system owners and consider stopping platform upgrades all together when the system is at a platform that is meeting the current and long-term projected operational needs of system owners.

Task 2 – Current and Long-term Maintenance Costs for NG9-1-1 System

As of the writing of this report, the State was preparing to rebid its NG9-1-1 Backbone (also known as ESInet) contract which reverts to a monthly contract January of 2014. The contract will be rebid twice more over the next 15 years. It is unknown how this will affect cost projections.

FE notes that over the past 13 years, several national and federal initiatives to design the standards and plan the transition to NG9-1-1 have occurred; some have concluded successfully and others are ongoing. This means complete transition will occur over time and ***FE*** recognizes that it would be impossible for Minnesota to attempt to project the precise costs at this time. We provide high-level information to ensure all parties are aware that these are a necessary aspect of NG9-1-1 and will need to be budgeted and deployed when the standards and functionality are finalized and become available.

***FE*'s** analysis determined the following:

- Future NG9-1-1 implementation costs are projected to be $16,200,000. These costs include a preliminary version of "Text-to-9-1-1" and building a statewide Geographical Information System (GIS) database for call routing on latitude and longitude of the caller. Especially important for wireless and VoIP callers whose location is not fixed.

- Administrative costs including SECB Standards Development, training, etc. is currently $826,000 annually. We estimate based on U.S. Labor Statistics that an additional $110,347 annually will be required for the additional expertise necessary to implement and administer the NG9-1-1 system

- $1,670,000 will be required for NG9-1-1 data storage and retrieval

FE made the following determinations regarding local NG9-1-1 cost elements:

- The total implementation costs, fixed equipment costs, and non-recurring costs is estimated at $5,578,000

- The 2013 maintenance and operations budget was approximately $14,540,000

FE reviewed current 9-1-1 SRA fund amounts and notes the following:

- The current 9-1-1 fee in Minnesota is $.78 per subscriber line per month. In 2013 the 9-1-1 fee generated approximately $63,264,000. The estimate for 2014 is $61,811,000

- The total 9-1-1 fee revenue will likely increase in 2014 but at present that increase cannot be estimated since a new law took effect January 1, 2014 which allows the State to collect 9-1-1 fees on prepaid subscriber lines

- By statute PSAPs in aggregate receive $13,664,000 from the 9-1-1 SRA. This amount is budgeted to increase to meet the demands of increased training and equipment due to the NG9-1-1 migration

FE would like to make one additional observation about the long-term maintenance costs of the state and locally owned elements of the NG9-1-1 system. One impetus for this report was to examine the state versus local costs of the ARMER system upgrades and the desire for coordination to ensure all system owners can budget and make the system upgrades to ensure maximum system capabilities. This same level of coordination

regarding system hardware and software upgrades will be needed for the NG9-1-1 system in the future as the system matures to the full National Emergency Number Association (NENA) i3 NG9-1-1 solution.

Task 3 – Assessment of Current and Future 9-1-1 Revenue Stream

FE worked with ECN to obtain current and historical 9-1-1 fee collection amounts and identified and catalogued existing commitments of the 9-1-1 SRA. We analyzed the 9-1-1 fee collection data, paying close attention to emerging trends and developing assumptions about the future 9-1-1 fee revenue. We also evaluated the work by the National Highway Traffic Safety Administration (NHTSA, which is part of USDOT) and compared their findings to any identified trends in the Minnesota 9-1-1 fee analysis.

To assess current and future 9-1-1 revenue streams, ***FE*** considered historical 9-1-1 fee data, statutory use of 9-1-1 fees, comparison of 9-1-1 fee with other states, and technology and other costs.

We reviewed data going back to 1988. Early on revenue was relatively flat with modest yearly increases as small as $500K. Wireless fees (1995) and later fees on VoIP telecommunications (2006) increased revenues. The growth trend for wireless services and VoIP leveled off in the past few years as the market became saturated. Wireline phones are declining at a rate of 5% year over year, coinciding with the flatter growth trend in wireless and VoIP. The inclusion of prepaid wireless fees should result in a slight increase in revenue but little is known about the impact of that change since many carriers were submitting prepaid already.

The NHTSA commissioned a study to identify trends in 9-1-1 fee revenue. While the final study has not been released, it confirms the trend in 9-1-1 fee revenue ***FE*** identified in Minnesota.

FE also reviewed National Emergency Number Association (NENA) Next Generation Partner Program Funding Opportunities which included:

- Fixed amount surcharge on all calling services
- Surcharge on Access Infrastructure Provider (AIP)
- Universal Statewide Communications Surcharge
- User (incident) fee
- General Fund Tax Revenue (federal, state, and local)

FE then reviewed existing commitments and discovered that they consume nearly all of the 9-1-1 revenue. We also reviewed statutory use of 9-1-1 fees and compared these with the uses by other states.

Minnesota's eligible uses of 9-1-1 fee revenues at the PSAP level are similar in many respects to the three states ***FE*** analyzed for this report. Where Minnesota diverges greatly is with regard to the expenses of the Metropolitan Council, Medical Resource Communication Centers, and the statewide radio system (ARMER).

A comparison of all 50 states and Washington, D.C. shows that about 17 states have statutes that authorize the 9-1-1 fee to be set at $1.00 or higher. ***FE*** is not aware of any consumer issues with that rate structure. About 16 states set their 9-1-1 fees at $0.60 or less. Five states set their 9-1-1 fees as a percentage of the tariff rate. One state funds 9-1-1 through its State Universal Service Fund. The remaining 12 states (including the District of Columbia) set their fees between $0.65 and $0.99 per subscriber line. Minnesota is among these latter states.

Minnesota's collection and use of its 9-1-1 fee has not changed over the past five years; nor has it changed at the local level. This stability can be accounted for by virtue of the fact that authorized uses of the fee are set in statute.

Absent a change in statute, these uses will continue into the future. In addition to current authorized uses of the fee, one-time and recurring costs associated with the transition to NG9-1-1 will start to be incurred in 2014 and will roll out over the next several years as NG9-1-1 capabilities are developed and become commercially available.

The collection of 9-1-1 fees has changed over time as the statute was amended to assess the fee on new communications technologies such as wireless telephones, VoIP, and now prepaid wireless services; and as the cap on fees was adjusted. Each new revenue source has positively impacted the 9-1-1 fund and offset the decline in landline revenues until recently. The introduction of the 9-1-1 fee on prepaid wireless services is expected to provide a similar boost to the fund, but it must be understood that the decline of landlines is real, is part of a national trend, and is expected to escalate in the years ahead. At best, the introduction of the prepaid wireless fee will temporarily mask the underlying revenue issue. Even if the fee were set at the statutory maximum, this would continue to be true.

FE notes that while the collected amount of the 9-1-1 fee has been relatively stable over the last five years, that should the fund encounter revenue challenges as a result of the risks identified in this report state statute requires that bond debt service requirements be met before funding other costs. In essence this means that the payment of the ARMER

bonds takes precedence over all other 9-1-1 SRA obligations, including those for which the fund was originally established including the operational costs of the 9-1-1 network and payments to PSAPs. The existing commitments on the fund leave no room for new expenses and should fund diversions occur or new costs be added, according to MMB it would violate the pledge the state has made with bond holders and could be considered a contract violation. Attachment K provides more detail.

Task 4 - Assessment of 9-1-1 Revenue Bonds

Revenue from the 9-1-1 Special Revenue Account (SRA) was authorized for use by the Minnesota legislature to pay for debt service on the ARMER system bonds.

There have been five bond sales to support the build out of the ARMER system, one was completed by the Metropolitan Council in 1999 and the others by Minnesota Management and Budget (MMB) through the use of the 9-1-1 SRA in years 2006, 2008, 2009 and 2011. Funding to pay for the debt service on these bonds is transferred monthly from the 9-1-1 SRA to the Debt Service Clearing Account at MMB. The Metropolitan Council bonds totaling $14,280,000 were paid in full in 2013. To complete the ARMER backbone, an additional $198,095,000, in ARMER bonds have been let with average interest rate of 3.63% from the MMB administered sales. The remaining unpaid debt service balance on the bonds is $176,025,000 with an annual debt service payment of $18,213,000. The 2006, 2008, 2009 and 2011 bond sales have a payoff date of June 1, 2018, 2024, 2025 and 2026 respectively. The individual bonds are eligible for optional redemption as early as 2016, 2018 and 2019 depending on the bond series.

The State had legislative authority to bond for $262,780,000. The Met Council and MMB have issued to date $212,375,000 leaving a balance of bonds authorized but unissued of $50,405,000. As written in law and disclosed to bond holders, annually ECN is transferring $23,261,000 to MMB for debt service payments into the Debt Service Clearing Account. The average bond payment is $18,213,000. The legislation authorizes excess payments made into the Debt Service Clearing account to be used for transfer into the Capital Projects account. Since January 2006, $30,787,000 has been transferred and an additional $19,618,000 is anticipated to be transferred over the next year, ultimately reducing the state bond sales by the authorized but unissued amount of $50,405,000.

The use of the 9-1-1 SRA has proven to be a very sound decision by the Minnesota legislature. The stability of the 9-1-1 fee, strong support by the Minnesota legislature for emergency communications systems, the legislative authority to raise the fee (up to 95 cents), positive and steady growth of subscriber fees, and maximum annual debt service

(MADS) with more than three times coverage of the debt service obligation are a few of the reasons why bond rating agencies have rated the 9-1-1 revenue bonds very high (e.g. AA, AA+, etc.).

Task 5 – Funding Alternatives

Through the life cycle of a large capital project there are two separate, but distinctly important funding phases. For both the ARMER system and others like it across the country, there are the capital costs to construct the system, often referred to as Capital Expenditures (CAPEX), and the sustainment funding needed for ongoing upgrades, replacement and maintenance referred to as Operational Expenditures or (OPEX).

The Department of Homeland Security Office of Emergency Communications (OEC) recognizes that life cycle funding, both CAPEX and OPEX, are a major part of emergency communications and defines a full life cycle planning process as continual reassessment of the system. "*This includes assessment of ongoing operational suitability, operational stability, and potential failure as well as an overall cost analysis, which takes into account capital expenditures (CAPEX), recurring costs and maintenance costs (OPEX).*"[2]

In completing the Funding Alternatives Task ***FE*** acquired data from 11 states. States building large statewide ARMER-like systems have used bonding for CAPEX. While Minnesota supported these bonds from the 9-1-1 SRA other states have offered bonds supported by the state general fund. The sale of bonds is the most viable option for state CAPEX when the state chooses to own and operate the system. ***FE*** concludes that the other legitimate option for CAPEX is a Public Private Partnership (P3). The states of Florida, South Carolina and Illinois have used this approach with success. States have supplemented the building or updating of statewide system by using federal grant funds, but these funds are typically a fraction of the overall CAPEX, are one-time and bring about a series of federal regulations.

A variety of OPEX funding sources were examined and analyzed for this report. Minnesota uses the 9-1-1 SRA to pay for the state backbone OPEX and local ARMER system owners pay their OPEX from the local tax base. Many states piece together OPEX through state general fund appropriations and other fees or surcharges. The most common funding source beyond a general fund appropriation is user fees. These fees are typically assessed per radio (other piece of equipment), per month and range from $10 for special isolated system use to $65 a month for day-to-day statewide use.

[2] http://www.safecomprogram.gov/oec/oec_system_life_cycle_planning_guide_final.pdf; August 2011

Pennsylvania and Minnesota have generated a small amount of OPEX relief by leasing space on state owned Towers. Oklahoma and Florida have generated OPEX funds by placing a surcharge on license renewal. Oklahoma uses $500,000 annually from the Commercial Driver's License Fee to help pay for the OPEX and recently increased the state driver's license fee by $10 where a portion of that new revenue will be dedicated to system OPEX. Florida has two ticket surcharge provisions in state law. One provides OPEX for the state by placing a $3 traffic and criminal traffic violation surcharge. Florida also has a provision in state law that allows counties to collect up to $12.50 on each moving violation citation issued in their county. While both of the Florida ticket surcharges help to sustain radio systems, the revenue generated falls short of coverage full system OPEX.

Task 6 – Assessment of Funding Alternatives

To assess the funding alternatives ***FE*** categorized the alternatives into CAPEX and OPEX as in Task 5.

CAPEX

CAPEX funding alternatives include bonds, federal grants, public/private partnerships (P3), vendor financing and leasing.

Two bonding strategies are General Obligation (GO) bonds and Revenue bonds (used by Minnesota). From the viewpoint of the issuing authority, the positives and negatives are essentially the same and have been effective funding options to build large communications systems with little or no known negative consequences. These provide quick access to large sums of money and result in fixed, predictable costs. However, the 10-20 year commitment may outlive some of the system infrastructure and there are administrative and interest costs to consider.

Federal grants can provide one-time partial funding *assistance* but are not intended to fully fund a system. The match is usually no more than 20% and grants may be combined. Drafting the grant application, acquiring the matching funds, regulatory compliance, grant management and auditing add some burden to the State.

Public/Private Partnerships (P3) vary in size from small to an entire statewide system. Many of the costs and responsibilities of system management are outsourced to the selected vendor(s). This can save on administrative costs and up front expenses. System update and support are the responsibility of the vendor. However, this arrangement means vendor exclusivity and the State has no control over the management of the vendor company. Costs can be prohibitive for volunteer fire agencies and other small

agencies and the participating agencies often still bear the cost of upgrading their subscriber equipment and local enhancements to the ARMER network.

Vendor financing has gained in popularity in recent years due to the economic climate resulting in state and local tax revenues as well as federal grant dollars. Vendor financing terms vary greatly; however, are usually attractive for first time and large purchases.

OPEX

Various strategies have been used to supplement the OPEX of large communications systems. OPEX options include user fees, general fund, tower leasing and surcharges and traffic ticket fees. Many of them help offset the total costs but only two of the documented funding strategies typically generate enough revenue to actually pay for the OPEX of a statewide LMR network and they are user fees and a state fund appropriation.

User fees are an easy to understand and often turned to strategy for funding the OPEX of a radio system. They are however, controversial. While they are a reliable mechanism for paying partial or full OPEX and can be structured for the system service area, they disproportionately affect smaller rural agencies, administering the system may consume significant personnel resources and it may place the State in the position of service provider and debt collector.

To a minor degree, Minnesota's approach is the same as a General Fund appropriation except the state appropriation is from the 9-1-1 SRA and the Trunked Highway Fund, which is a much better strategy. These dedicated accounts take the system funding out of competition with other General Fund priorities such as education, human services, tax cuts and other politically charged budget items. A General Fund approach would pay some or all of the OPEX, could build legislative support, and could stabilize a reoccurring funding stream. However, the competition with other programs, increased scrutiny and the potential for a less than needed funding level during tough state budget times may outweigh these positives.

Leasing unused space on State-owned towers is a good way to offset and diversify a portion of their cost but is only a small piece of the funding equation. The leased tower space may be needed for future public safety capacity expansion, the revenue may not merit the administrative costs for the small amount received and it may compromise the security of the tower site by allowing not-State personnel on site.

Surcharges and traffic ticket fees are another option for OPEX. These revenue sources may be more palatable than a tax increase and can be tied to any penalty or registration

related to emergency response. These funds typically represent only a small portion of the budget and add to the State tracking and administration burden.

Funding Alternatives Summary

In reviewing and documenting the CAPEX and OPEX funding strategies used by states it is clear there is no one size fits all solution. If such a funding strategy existed, every state would have adopted it. In fact that is why different states adopt different funding strategies as discussed in this report. An ***FE*** provided list of "outside the box" funding strategies would be at best speculation. A funding strategy is not something a third-party reviewer such as ***FE*** can recommend with any level of confidence. State specific funding organically evolves and factors in many different considerations from emergency responders, residents, elected officials and in some cases industry lobbyists.

Based on ***FE's*** work on this project we have learned that state CAPEX or OPEX follows the path of least resistance. Minnesota has expanded the use of the 9-1-1 fee beyond its original uses to fund ARMER. According to some, this funding strategy has worked excellently for Minnesota, but it is not a viable solution in many states because the industry objects to the servicing of such an agreement, local officials fear the loss of local PSAP funds and other political reasons. Some states use multiple mechanisms to pay for their statewide systems since no one funding source typically provides for the entire system. This is not a bad approach as it diversifies revenue and helps to mitigate against a full loss of OPEX if funds were to come from one source.

The state of Minnesota's 9-1-1 fee has proven to be a viable funding source for both CAPEX and OPEX, which is rare based on our analysis. It has been a sustainable source of funding for 9-1-1, E9-1-1 and now both the NG9-1-1 and ARMER systems. ***FE*** works with a number states and many of them desire to use the 9-1-1 fee as Minnesota has done. However, it should be noted that the 9-1-1 revenue stream pays for the operating costs of only the state owned (MnDOT) portion of the system backbone and not the ongoing capital or operational costs for local entities or state agencies such as Department of Corrections, DNR, State Patrol, which must be addressed to keep the system operating at the highest levels of interoperability.

It is worthwhile to note that the sustained use of 9-1-1 fees does not come without risk. While a study recently conducted by Opinion Research Corporation (ORC) for the New Millennium Research Council (NMRC) found that although cell phone users cut back on features during the last recession they did not give up on cell phones all together. This is good news for Minnesota which is highly dependent on wireless 9-1-1 fees. The

disappointing news for Minnesota, is the report went on to say that wired landline counts continue to drop which results in a loss of 9-1-1 fee revenue. Perhaps most concerning to Minnesota is that the report indicated that cellular users are switching from monthly plans to prepaid plans and that could have a significant impact on the long-term sustainability of the 9-1-1 fee in Minnesota.

In our professional opinion, taking into account our work for many states and the funding analysis provided above, the state of Minnesota has found a funding solution that is working well for most constituencies and should for the foreseeable future if all stakeholders maintain a focus on emergency communications.

Communications technologies will continue to evolve at a fast pace requiring public safety responders to keep up with consumer technology used to request emergency assistance and their expectations for fast and efficient response. The NG9-1-1 migration is only in the initial stages and will need investment over the next three to five years. The ARMER system, like all large technology systems should be maintained and upgraded as needed to maintain maximum efficiency on a coordinated schedule with local and other state agencies that utilize the system. As such, the legislature must continue to play their leadership role of protecting the 9-1-1 SRA for the ongoing support of the 9-1-1, NG9-1-1 and ARMER systems. It is important they understand the local government and state agency costs and funding mechanisms associated with utilizing the state infrastructures for NG9-1-1 and ARMER.

The SECB must continue to be the body that works with and for all levels of government to devise communications system strategies that meet the needs of the citizens and emergency responders. MnDOT and DPS must continue to ensure these critical systems are reliable and constantly meeting the needs of responders and finally, local governments must continue to express their needs and continue to buy in to the efficiencies that are achieved by all levels of government working together as a force multiplier to manage these critical communications issues. Only through this collaboration between the legislature, SECB, state agencies and local governments can funding of these systems be coordinated to ensure seamless operation, reliability and effectiveness for those needing and those delivering lifesaving emergency services.

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1. Introduction

The state of Minnesota (State) has shown its commitment to statewide emergency communications as demonstrated by the successful build out of its Allied Radio Matrix for Emergency Response (ARMER) and 9-1-1 projects over the last decade. The ARMER backbone as well as some local enhancements were funded from the sale of 9-1-1 revenue bonds. Debt service for the bonds is supported by the 9-1-1 fees collected from every wireline, wireless, prepaid, and interconnected Voice over Internet Protocol (VoIP) telephone subscription in the state. As the ARMER system matures, the maintenance of the ARMER network and its life cycle costs will be a significant budget item that state and local governments must continue funding.

The migration to the Next Generation of 9-1-1 system (NG9-1-1) is another major capital project of equal concern that the State must support with the 9-1-1 fee. The State needs to know the estimated costs associated with completion of the implementation of NG9-1-1 as well as the ongoing maintenance, operation and growth costs, in addition to potential funding streams for the 9-1-1 system.

In the 2013 Legislative Session, changes were made to Minnesota Statutes, Chapter 403, governing public safety communications requiring the State Radio Board (SRB), now the Statewide Emergency Communications Board (SECB), to perform a study on long-term funding strategies for statewide public safety communications including but not limited to the ARMER and 9-1-1 systems. The Division of Emergency Communication Networks (ECN) sought a consultant with a detailed understanding of the Minnesota legislative process, the Minnesota 9-1-1 program, the ARMER program and the history of the governance structure of the SRB to support the SECB in conducting this study. The State engaged Federal Engineering (***FE***) to conduct a study to assist the State in this endeavor through the following activities:

1. Task 1—Current and Long-term Maintenance Costs for the ARMER System
2. Task 2—Current and Long-term Maintenance Costs for NG9-1-1 System
3. Task 3 – Assessment of Current and Future 9-1-1 Revenue Stream
4. Task 4 – Assessment of 9-1-1 Revenue Bonds
5. Task 5 – Funding Alternatives
6. Task 6 – Assessment of Funding Alternatives and Recommendations

FE held a project initiation meeting with representatives of the ECN and other participating agencies on November 7, 2013, at the MnDOT Training and Conference Center in Shoreview. This initial meeting established a common understanding of the project goals, objectives, and vision, items best understood through a face-to-face meeting between our respective management teams and stakeholders.

At the initiation meeting we discussed the procedural steps of collecting data needed from state and local agencies, other states, and Motorola for each of the six tasks, key points of contact for the participating agencies, and any other special processes that ECN would like to suggest in executing the project. This is an important part of this project, as a significant amount of outreach with local governments and agencies is necessary to collect the data needed to complete this legislative report.

During the project initiation meeting, we discussed the priorities of the state and the high-level approaches for each task to fulfill the requirements of the legislative study, and deadline for submission of the study by ECN.

1.1 Background

Minnesota uses a combination of funding streams (e.g., 9-1-1 Revenue Bonds, trunked highway funds, lease receipts, grants and local funding) to support its public safety communications infrastructure (see Table 1); but one portion of this funding, landline 9-1-1 fee collections, has fallen significantly in the State and across the country as consumers permanently move away from landline communications and, for some, exclusively to mobile wireless communications.

Table 1 – Current funding streams

Cost Element	Funding Streams
ARMER backbone infrastructure costs	- 9-1-1 revenue bonds
ARMER Backbone operating costs	- Transfer of 9-1-1 fees between DECN and MnDOT as budget line item - Trunked Highway funds - Tower lease receipts
State ARMER subscriber costs	- Operating budgets for state agencies on ARMER
Local shared ARMER infrastructure costs	- Federal and state grants - Local funds

Cost Element	Funding Streams
Local ARMER consoles and subscriber costs	- Federal and state grants - Local funds
Local ARMER Operating and Maintenance Costs	- Local funds

As the public safety communications infrastructure continues to grow and the revenue stream changes, the State must not only develop a comprehensive financial understanding of the ARMER and NG9-1-1 projects today, but also have the data to prepare solutions to sustain those networks in the future as well as prepare for emerging technologies.

There are ongoing maintenance and upgrade needs with the ARMER system, most notably the requirement to replace the Motorola Quantar repeaters and Gold Elite consoles in order to have continued vendor support going forward. In addition, in order to achieve fully functional NG9-1-1 there are a number of known and unknown costs that the 9-1-1 fund must continue to support. These are driving reasons for this report.

2. Methodology

In support of the State's efforts to understand the future financial requirements of the ARMER and NG9-1-1 systems, ***FE*** engaged in the following activities:

- Assessing the current and potential future revenue sources for existing public safety emergency communication projects and obligations
- Examining whether the current revenue sources are adequate to support the long-term needs of public safety emergency communications
- Outlining funding obligations necessary to retire the 9-1-1 Revenue Bonds that funded the construction of the ARMER backbone
- Evaluating funding alternatives and strategies that have been used by other states for their public safety communications infrastructure

The goals of these activities were to outline potential long-term funding strategies and alternatives and provide in this resulting *Minnesota ARMER And NG9-1-1 Funding Study Report*, a high level assessment of alternatives and recommendations that will assist the SECB and ECN in making informed decisions regarding the future financial health of Minnesota's ARMER and NG 9-1-1 systems.

To obtain the information needed for this report, meetings were held with and data was collected from the following agencies:

- State of Minnesota Department of Transportation/Office of Electronic Communications (MnDOT)
- State of Minnesota Department of Public Safety (DPS)
- Dakota Communications Center (DCC) and Dakota County
- St. Louis County, Minnesota
- Murray County, Minnesota

In addition to the above governmental agencies, ***FE*** interviewed multiple state emergency communications officials across the country and met with local Motorola System Development staff members to discuss the technical support services and programs associated with the ongoing maintenance and support of the ARMER system.

Compilation of the NG9-1-1 sections of the report involved gathering publicly available data and information from the U.S. Department of Transportation's NG9-1-1 initiative, the National Emergency Number Association's Next Generation Partner Program, the

Federal Communication Commission's Communications Security, Reliability and Interoperability Council, the National 9-1-1 Program. Information was also gathered from a sampling of other state-level 9-1-1 programs: specifically, the Indiana Statewide 9-1-1 Board, the Tennessee Emergency Communications Board, the Maine Emergency Services Communication Bureau and the Michigan 9-1-1 Office. Finally, the ***FE*** project team drew upon its internal industry knowledge.

3. Task 1—Current and Long-term Maintenance Costs for the ARMER System

The ARMER radio network is one of the largest statewide public safety radio networks in the country, based on the number of tower sites, Public Safety Answering Point (PSAP) dispatch centers and subscriber radios now operating on the system. It is also a fairly complex system, with six interconnected master sites and a microwave network linking all sites together. The system was designed for a high level of coverage throughout the state, with a goal of greater than 95% coverage to mobile radios throughout all 87 counties in the state.

The system was also designed for a high level of reliability, with a reasonable amount of tower site overlap, using multiple controllers, and redundant circuit routing to minimize the potential for wide-area outages when individual sites or links encounter problems.

The ARMER system has achieved a high level of operational performance along with a great deal of local city and county agency participation. At the writing of this report, 76 of Minnesota's 87 counties (87%) have migrated operations to the ARMER system, and several of the remaining counties and emergency response agencies within them are in the planning or implementation process. ***FE*** worked with ECN, Minnesota Department of Transportation (MnDOT), select non-State agencies, and Motorola to establish a date to begin collecting and analyzing current cost data and provide projections for long-term maintenance costs over the next 15 years.

Though the system is now nearing completion of the statewide infrastructure, and has recently received a significant system upgrade, there are core elements of the system that are now over 10 years old, which will require replacement within the next two years, and others that will require replacement by year 2019. This includes Motorola CENTRACOM™ Gold Elite dispatch consoles, and STR3000 base stations, equipment which is owned by both the State of Minnesota as well as many of the local city and county agencies who have been long-term users of the system. Additionally, many of the mobile and portable radios being used by state, county and city agencies will require replacement in the future, again based on the age of this equipment.

Table 2 below provides a summary of the state and locally owned equipment requiring replacement including the Gold Elite consoles (7.15 release), STR3000 stations (7.19 release) and portable and mobile radios and their associated cost estimates. The cost estimates are based on quantities of each of these system elements that were provided by MnDOT.

Table 2 - ARMER Equipment Replacement Summary

System Elements	State of MN Agency Costs	Local Agency Costs	Total Costs
Gold Elite Dispatch Consoles	NA	$13,940,000	$13,940,000
STR3000 Base Stations	$2,814,000	$29,711,000	$32,525,000
Other System Equipment	$4,673,000	$1,894,000	$6,149,000
800 MHz Mobile and Portable Radios	$34,152,000	$213,466,000	$247,618,000
Totals	$41,639,000	$259,011,000	$300,232,000

Refer to Sections 3.1.2, 3.2.2, and 3.2.7 for greater detail on this equipment and associated costs.

3.1 ARMER Cost Elements

3.1.1 Status of the ARMER Backbone Construction and Funding

At the time this report was prepared, the statewide system was considered to be 95% complete. The Minnesota Department of Transportation generates monthly project status reports, which provide a timely overview of the progress being made on the construction and implementation of the remaining tower sites and related equipment needed to complete the system.

FE interviewed MnDOT Office of Electronic Communications (OEC) and ECN personnel to verify which assets are considered to be ARMER backbone for the purposes of the Funding Study. ***FE*** understands that the key backbone components of the system are the following:

- Tower Sites and related site equipment (towers, lighting systems, shelters, generators, HVAC units, alarm systems, propane fuel and tanks, etc.)
- 800 MHz radio system equipment
  - Software and support
- VHF Interoperability radio stations

- Microwave radio system equipment

After verifying the backbone infrastructure elements, ***FE*** documented the status of the total number of sites planned for ARMER construction, the sites in progress, and the total number of sites completed and on the air with full Federal Communications Commission (FCC) approval. ***FE*** also documented the total backbone construction funds received through legislative authorization or other sources.

The costs associated with the local enhancements implemented by non-State agencies are included in this report, but addressed separately to provide some delineation between the core infrastructure that the state is responsible for, and the equipment added by these other agencies.

3.1.1.1 System Backbone Construction Status

The monthly status reports generated by MnDOT track and communicate to interested parties the overall level of completion of the system implementation. The monthly report includes these primary metrics:

- Overall completion status of the system, all factors included
- Recent equipment installation developments
- Status of the project budget
- Tower site development, replacements and associated issues
- System upgrade status (Motorola software)
- Microwave system improvements
- VHF Interoperability system
- 800 MHz system improvements

As noted, the overall completion status of the system at the writing of this report was 95%.

3.1.1.2 Tower Sites

One of the larger fixed-cost elements of the radio system are the radio tower structures, shelters which house the radio system equipment, emergency generators and related equipment at the sites. The expenditures on tower sites and related equipment comprise 51% of the total system cost.

When completed, the core ARMER system will utilize a total of 324 tower sites that are owned or leased by the state of Minnesota. Most of these sites are State-owned, with roughly 22% being leased or used through a cooperative agreement with a county. In addition to these core system sites, there are a large number of local enhancement tower sites that have been added to the system by city or county governments to increase coverage beyond the state offering.

Table 3 shows the current status of the State's ARMER tower site structures:

Table 3 – Current status of State ARMER towers

Item	Category	Number
1	Newer sites (no further structural work needed)	242
2	Leased sites	53
3	Older sites needing tower replacement	17
4	Sites under construction	12
	Total Number of State Sites:	**324**
5	Local Enhancement Sites:	83
	Total Number of System Sites:	**407**

All tower sites also include small shelters or buildings and generators for the protection and operation of the radio system equipment at the tower sites. All newer tower sites were implemented with new prefabricated shelters and generators, and no further improvements are needed. However, many of the existing tower sites had older buildings on site that require replacement. The cost analysis in this report includes replacement of or upgrade to these equipment shelters.

3.1.1.3 800 MHz Radio System Equipment and Software Status

The 800 MHz radio system equipment located at the tower sites and master sites is the primary communications mechanism used by ARMER users to provide voice communications between the radio system users. Each tower site is equipped with a quantity of 800 MHz repeaters (typically five at sites outside the Metro area), which are interconnected to the regional controller sites, and provide the digitized voice path between dispatch and field units. The regional controllers provide the management and operational control of the overall system, including voice path channel allocations, radio management and interoperability. These regional controllers (master sites) are installed in the following six locations:

1. Water's Edge (Roseville)
2. Hennepin County (Golden Valley)
3. Rochester
4. St. Cloud
5. Duluth
6. Detroit Lakes

The overall cost of the 800 MHz equipment is the second largest system expense, at 37% of the total project budget.

The funding, purchase and implementation of the 800 MHz equipment for this system began back in the late 1990s, with the first users of the system becoming operational in 2002.

Motorola was the vendor selected for the purchase and implementation of this large system, a decision based on Motorola's experience and success with large-scale systems, in conjunction with the fact that Motorola was the only company that could supply an APCO Project 25 (P25), standards-based radio system at that time. Maintenance of the ARMER backbone is accomplished by MnDOT employees. MnDOT does not maintain local enhancements. Those are maintained by local staff or vendors.

With the initial system implementation having been developed in three phases (through 2008), the radio system equipment purchased and installed in the early phases of the project is now over 10 years old, while the equipment implemented in the later phases is newer.

Although all system equipment continues to be in good operating condition and is used on a daily basis, the State needs a replacement plan for the older equipment in the near future. The primary factors affecting the need for upgrade and replacement of this equipment include:

- Vendor support of the system equipment
- Age of the equipment
- Repair costs

- Upgrades and replacements due to advances and changes in technology

These factors will affect the ARMER system equipment over the next few years, and are the main technical focus of this report.

The ARMER network is one of the newest generations of wide-area public safety radio systems, and like so many other new electronic systems, utilizes a software-driven architecture. As such, the system and therefore the State are reliant on Motorola, the vendor, to provide software support throughout the life of the system. This results in software version updates and upgrades, typically every other year, and associated equipment obsolescence.

Beyond the regional controller system equipment, two categories of critical equipment upgrades in the system that will be affected over the next few years are:

- 800 MHz repeater stations (located at the tower sites)
- CENTRACOM™ Gold Elite radio control consoles (located in the system user's dispatch centers)

There are an estimated 2,474 State-owned 800 MHz repeaters in the system. Of this total, only 134 (5%) are the older "STR3000" model (vs. the newer GTR8000) that will require replacement, so the overall impact to the State will be somewhat minimal.

In addition to the State's STR3000 stations, there are an estimated 827 STR3000 "Local Enhancement" stations owned and operated by the city and county governments throughout the state, including Twin Cities Metropolitan Area, which will need replacement. Section 3.1.3.1 of this report contains a case study of a Twin Cities metropolitan county and system equipment replacement plan.

3.1.1.4 VHF Interoperability System

In addition to the 800 MHz primary ARMER voice communications system, there was a need to implement a VHF Interoperability System, which would reside at many of the same tower sites used for the 800 MHz ARMER Trunked Radio System. This interoperability system is necessary because of the many agencies throughout the state that had not yet migrated operations from legacy VHF systems to the ARMER network, or had no plans to migrate to ARMER. This interoperability system also allows for communications with out of state responders in the event of a major disaster.

Historically, most of the public safety agencies throughout Minnesota operated VHF (150 – 160 MHz) radio systems. These systems were primarily independent, and were funded, owned and maintained by the local city and county governments. DPS, MnDOT, and other local public safety agencies also utilized VHF radio systems prior to the implementation of the ARMER system.

Recognizing the need for reliable communications interoperability between 800 MHz ARMER and VHF system radio users, VHF base radios were installed at 112 ARMER tower sites, and configured for operation on established VHF Interoperability radio channels, including VCALL, VLAW31 (MINSEF), VFIRE23 (Statewide Fire), VMED28 and other federal and state interoperability channels. This as a best practice as it allows federal and out of state responders to program these channels and provide them a communications pathway if they respond to an incident in Minnesota. This VHF system allows access to the common VHF channels by the dispatch centers in the state that are connected into the ARMER network.

A VHF Interoperability Plan was developed for the State in 2010 and revised in 2012, which identifies the radio channels included in the VHF Interoperability system.

The implementation of the “VHF Interop” system (as it is known) was accomplished with a combination of new and existing VHF radio equipment. The FCC mandated that all VHF radio channels and equipment operating on “Wideband” (25 KHz of band width) radio frequencies had to be converted to “Narrowband” (12.5 KHz) operation by January 1, 2013. This deadline was also a driving factor in many county agencies converting from VHF to the ARMER system, rather than replacing non-compliant VHF radio equipment.

For these reasons, the State reused existing VHF equipment that was capable of narrowband channel operation, and purchased new equipment where needed.

The Twin Cities Metropolitan Area also has a legacy interoperability layer maintained by MnDOT that consists of voted VHF repeaters, These repeaters have recently been narrowbanded, but in many cases where reused repeaters that are aged and closing in on end of life. While this interoperability layer is not a primary communications system, the SECB should discuss the merits of maintaining this additional communication pathway for catastrophic emergencies, special events or system redundancy.

3.1.1.5 Microwave Radio Network

The numerous tower sites that comprise the ARMER system need to be interconnected with a communications transport method to allow the desired operation of the radio voice system, and provide the many system features to function as designed. Although there

exist a variety of different technologies that could be implemented to provide this connectivity (optical fiber cable, or T-1 circuits through commercial telecommunications providers), the primary choice of technology used for the ARMER system is microwave radio.

Microwave radio systems utilize radio frequencies to carry the digitized voice information between the tower sites and the regional controller sites, as well as to the local dispatch centers. The ARMER microwave system as noted is digital (not analog), and was included in the original system design.

While a full explanation of the technical makeup of the ARMER microwave system is beyond the scope of this report, we reiterate that the existing microwave system was designed to transport a specific level of traffic for operation of the ARMER network. The microwave system design is not unlike a highway system, with some larger major arteries carrying large amounts of traffic along busy corridors, and other lesser routes to smaller clusters of tower sites or dispatch centers.

It is important to note that the ARMER microwave network was designed specifically to transport ARMER system radio traffic throughout the state, and to support the agencies using the system. It was not designed as a high-capacity data transport system for other purposes. The primary reason for this was cost considerations. As is the case with many other technologies, capacity costs money, and this microwave system was designed to meet the needs of the ARMER voice radio network.

The microwave radio system that supports the ARMER system has been installed in conjunction with the construction of tower sites for the ARMER system. The construction status of the microwave network is generally aligned with the overall construction status of the ARMER network, which is 95% complete at the time of this writing. As additional tower sites are completed, the microwave equipment is added to them, establishing connectivity into the system.

The microwave radio equipment in place around the state varies in age. Some equipment is now 10+ years old, and other equipment relatively new. The system technology and overall configuration is considered stable at this point in time, with no significant equipment replacement needed. However, the State has been systematically replacing older microwave radios with new equipment at select sites as needed and/or the project funding allows.

The overall capacity of the existing system is also being reviewed and managed, to allow growth as needed. An example is a fairly recent decision to provide two circuits (full or partial T1's) to each 800 MHz tower site from the associated regional controller site

(currently, most sites have only one circuit). This change will result in improved reliability throughout the network, as this has been one of the few problem areas in the system. There have been occasional periods where signal fading has been experienced within a microwave path, which will result in one or more tower sites going off-line. These outages are usually very short (a minute or two), but other longer outages have occurred. By adding a second circuit to each site, and routing the second circuit along a different microwave path (known as alternate routing), the overall system reliability is greatly enhanced, and site down time reduced. This change is an ongoing effort, which will continue well into 2014.

3.1.1.6 Software and Support

The ARMER system, as noted above, is a heavily software-driven technology platform, and is highly dependent on the current software version provided by Motorola. During 2013, the ARMER system was upgraded from the previous version of 7.9 to the current version of 7.13. A 7.11 version was released, but the State chose to “skip” this version, which is allowable depending on the age of the existing version, and the need for features included in the new release.

The State has in place a Software Upgrade Agreement (SUA) which ensures that the system operates on a current software release.

The System Upgrade Agreement (SUA II) contract provides for:

- One on site dedicated field service technician
- Technical Support Services (Phone support from Factory, not onsite work)
- System Software Subscription Agreement
- System software installation.
- Subscriber Software Subscription Agreement
- Hardware changes (Not platform changes such as Gold Elite to 7500, STR3000 to GTR, and circuit based simulcast to IP simulcast.)

Each new system software version typically contains a number of new features and technology enhancements. An example of this is the recent 7.13 upgrade, which increased the number of RF resources per zone. The 7.9 upgrade increased the total number of available ID’s from a limit of 64,000 to 128,000 (an important element for the ARMER system).

An ID Is a unique identifier associated with each end user radio and console. When all the unique IDs have been allotted, the system can no longer allow new radios on the system. A driving reason for the upgrade to 7.13 is maintain a sufficient ID pool for growth.

Other features included P25 Phase 2/TDMA channel operation, Microsoft Windows® 7 operating system for client workstations, and an initial (limited) Inter SubSystem Interface (ISSI) capability (direct interface to other large-scale trunked radio systems).

However, these upgrades often include restrictions on older system equipment, such as is the case of the 7.15 version, scheduled for year 2016, which will not allow the use of the Gold Elite dispatch consoles. Future version releases (7.19 for example) will eventually affect the STR3000800 MHz base stations, which will no longer be supported. The State has already committed to the purchase of the 7.15 software upgrade (via the SUA), which would – in theory – be implemented in early 2016.

Motorola has established a “roadmap” for the ASTRO P25 system, which outlines the future software version release periods, the features to be provided in the releases, and potential technical obsolescence issues to be encountered within the version upgrade. One of the driving factors in the upgrade program is that these systems utilize a significant amount of Commercial Off-the-Shelf (COTS) hardware and software for the operation of the system. This includes network processors, routers, switches and other typical data network devices.

These COTS devices often have what could be called a “service life span” of 3 to 4 years, at which point they have been superseded by newer equipment, and may no longer be supported by the original vendor. An important element of the SUA is that Motorola ensures that these devices are replaced when needed. Motorola recommends that the regional controllers (master sites) be upgraded every three years.

Network security is also a significant issue with systems of this type. While the ARMER network is ultimately a radio network used for communications, much of the system is a large computer network, and is faced with the same access and security issues that are required of any computer network. The SUA with Motorola ensures that the versions of security software at all levels of the system are current and correct to maintain the highest level of security, including the dispatcher workstations at all PSAPs connected to the system.

Section 3.2.3 of this report provides additional information received from Motorola regarding their roadmap and lifecycle for the ARMER system.

Refer to Section 3.2.1 of this report for more discussion of the CENTRACOM™ Gold Elite radio console equipment and lifecycle discussion.

3.1.1.7 9-1-1 Dispatch Center/PSAP Equipment

All state, county and city government agency 9-1-1 dispatch centers operating on the ARMER network utilize radio consoles to operate and manage their agency's radio traffic on the system. The Motorola CENTRACOM™ Gold Elite radio consoles are the generation of product that has been used by these agencies since the system was initially implemented, but the Gold Elite consoles are now being replaced by the MCC7500 series of console. The Gold Elite console product has performed well, and met the needs of the agencies using them for public safety operations. At the time of this report, there are an estimated 199 Gold Elite consoles operating on the ARMER network, both in the Twin Cities Metropolitan Area and in rural agencies outside the Twin Cities.

The Gold Elite technology platform is now over 15 years old and nearly obsolete. As is the situation with most electronic equipment, advancements have been made in the product and applications, resulting in a newer product with improved features and capabilities. The Gold Elite product, though PC-based, uses older circuit-switched interface technology, and requires additional hardware and software for operation with the ARMER network. The amount of space required at the PSAP for the electronics is also greater than the MCC7500 because of the physical size of the electronics equipment.

Motorola is currently the only vendor that provides a dispatch console product capable of direct connectivity into the ARMER network. The ARMER system was developed using the APCO Project 25 (P25) standards, which developed and defined an industry standard for console connectivity requirements within the system. The P25 standards have evolved now to the point where a Console SubSystem Interface (CSSI) has been developed, which will eventually allow other vendors' P25-based console equipment to interface directly into the ARMER network. The P25 CSSI capability will be incorporated into the 7.15 version system software upgrade allowing other vendor's console products the capability to connect into the ARMER network. This will offer ARMER system PSAP users alternatives to the Motorola product.

The Motorola MCC7500 is the replacement for the Gold Elite product, which is an IP-based technology platform. The MCC7500 consoles provide several improvements over the Gold Elite product, to include:

- IP-based technology simplifies the interface to the ARMER system thereby reducing bandwidth requirements and reducing the physical space occupied by the equipment the dispatch center

- Results in improved audio quality, especially during high traffic level periods; channel patching between 800 MHz trunked and VHF/UHF conventional resources is greatly improved

- Significantly reduces ARMER system ID requirements; each MCC7500 console workstation requires only one ID, regardless of talkgroup/channel configuration

- Allows integrated audio logging (vs. circuit-based systems)

Motorola states that upon implementation of the 7.15 version System Software Upgrade they will no longer support the Gold Elite console nor will it be capable of working with the ARMER system. The recent installation of version 7.13 software has only recently been completed, and required approximately six months to complete. Therefore, all existing Gold Elite console users need to plan for the replacement of their Gold Elite consoles prior to the date that a 7.15 system software upgrade is implemented.

Replacement of the existing Gold Elite consoles is one of the more critical factors to address when planning for the next ARMER system software upgrade, especially for the larger agencies located in the Twin Cities Metropolitan Area, because they have the greatest number of installed console positions operating on the system. This will also affect a smaller number of non-metro/rural agencies who implemented the Gold Elite consoles between 2008 and 2011, although many of those agencies are now planning for the replacement of these consoles.

Some of the agencies in the Twin Cities Metropolitan Area that joined the ARMER system in later years installed the new MCC7500 consoles, and are unaffected by this issue; however, many others will be.

Note that local city and county dispatch centers have another option for accessing and using the ARMER network without the purchase of a Gold Elite or MCC7500 console system. This technology approach allows the use of either lower-tier Motorola console products (e.g., MCC5500) or other vendors' consoles (e.g., Zetron, Avtech, etc.) on the ARMER system through the use of 800 MHz RF control stations. When a user accesses the ARMER system through a control station, their radio consoles are not connected directly into the ARMER network via microwave radio, optical fiber or leased T-1 circuits, but instead are connected to a group of 800 MHz RF radio control stations located at the PSAP. These 800 MHz control station radios communicate with the ARMER system in the same way that a mobile or portable radio would work, through antennas at the dispatch center.

This method works well for agencies with a limited amount of radio traffic on the system, and/or provide dispatch services for a relatively small number of agencies. This approach also works well for agencies using the system primarily for interoperability with others, and not using the system for daily routine operations. However, there are some significant drawbacks to the use of control stations for access in that this configuration does not allow console priority, which allows the dispatcher to interrupt or override the mobile and portable radio transmissions. This can be an important safety feature for public safety operations. Additional limitations with the control station option is the large number of 800 MHz radios needed at the dispatch center for access to the many regional, statewide, and neighboring agency talkgroups incorporated into the ARMER system and the unnecessary load placed on the system due to the affiliation and monitoring of statewide interoperable talkgroups using these control station radios.

When the ARMER system was in initial planning, the State assumed that potentially 50% of the city and county agencies joining the ARMER network outside of the Twin Cities Metropolitan Area would choose the control station approach, due to the significantly reduced cost of this option (lower equipment costs, lack of microwave or other connectivity requirements, etc.). However, when reviewing the current radio console inventory of the 76 county agencies now using the ARMER system, only 10-15% have elected the control station option, with all others using the Gold Elite or MCC7500 full-featured consoles.

3.1.1.8 System Project Budget and Funding

The monthly ARMER Project Status Report generated by MnDOT provides a high-level overview of the project's implementation status, as well as the funding currently spent on the system, and a comparison to the original project budget.

The ARMER system was designed and implemented in distinct phases, to allow better management of the project, and align with the availability of funding for the development of the system:

- Phase 1: Twin Cities Metropolitan Area (2002) and local enhancements
- Phase 2: Enhancements in the Twin Cities Metropolitan Area
- Phase 3: Expansion of the system to the Rochester, St. Cloud and Central Minnesota areas (2005)
- Phase 456: Expansion of the system to the remaining areas of the state (2008 – present)

3.1.1.9 Phase 1

Phase 1 of the system plan included development of the system throughout the Twin Cities Metropolitan Area, and provided an initial core system for state and local agencies to begin utilizing in 2002. The total cost of Phase 1 was $36 million dollars, which was needed for tower site development, system equipment, installation services, and other project elements. Table 4 summarizes costs associated with Phase 1 of the system:

Table 4 – ARMER Phase 1 cost summary

System Elements	Costs ($millions)	% of Total
Site Development/Civil Construction	$5.9	16.4%
Radio Equipment (800 MHz, Microwave, Interoperability)	$22.8	63.3%
Vendor Installation Work	$2.9	8.1%
Vendor Program Management	$3.2	8.9%
Performance Bond/System Staging/Freight	$1.2	3.3%
Totals	$36.0	100%

The funding for Phase 1 of the system implementation was provided from a combination of State, Revenue bonds, General Obligation bonds, and 9-1-1 fund sources. Table 5 lists the funding sources for Phase 1.

Table 5 – Phase 1 State funding sources

Phase 1 Funding Sources	Costs ($millions)
State General Obligation Bonding	$7.50
State Trunk Highway Funds	$7.50
Revenue Bonds back by 4-cent per month 9-1-1 surcharge	$14.28
Metro Council General Obligation Bonds on behalf of Metro Transit	$3.00
Combination of Interest Earned and Cash from 9-1-1 Surcharge	$4.70
Total	**$36.98**

In addition to the funding spent by the state on the implementation of Phase 1, Hennepin County, the City of Minneapolis, Carver County, North Memorial Ambulance and Metro Transit invested in Local Enhancements to the ARMER system. These local enhancements included additional tower sites for improved radio coverage throughout the respective city and county population centers, including in-building coverage. Also

included in the local enhancements are the radio console equipment needed in the 9-1-1 dispatch centers for use with the new radio system. Table 6 provides a breakdown of the additional Phase 1 local enhancement costs.

Table 6 – ARMER local enhancement costs

Phase 1 Local Enhancements	Costs ($millions)
Hennepin County	$39.50
Carver County	$4.15
City of Minneapolis	$11.76

The funding shown in Table 6 for local enhancements and subscriber radios was sourced by the individual agencies, and no state funding sources were used for this work. These costs are not included in the State's total cost of system implementation.

3.1.1.10 Phase 2

Phase 2 of the system implementation consisted of enhancements to the core system implemented in Phase 1. The Phase 2 enhancements were primarily to accommodate additional Twin Cities Metropolitan Area agencies migration to ARMER system use. Table 7 is a breakdown of the Phase 2 costs and the amount funded by federal grants.

Table 7 – ARMER Phase 2 costs

Phase 2 Local Enhancements	Estimated Costs ($millions)	Amount Funded via Grants ($millions)
Anoka County	$8.30	$2.00
Hennepin County	$7.60	$4.40
Chisago County	$8.00	$0.97
Isanti County	$8.20	$0.32
Ramsey County	$11.60	$7.70
Dakota County	$11.90	$4.50
Scott County	$3.90	$0.54
Washington County	$4.70	$0.60
Total	**$64.20**	**$21.04**

As with the Phase 1 Local Enhancements, the funding in Table 7 for local enhancements was primarily sourced by the individual agencies. These costs are not included in the

State's total cost of system implementation. These costs included both system infrastructure and mobile/portable radio purchases for agency users.

3.1.1.11 Phase 3

Phase 3 of the system implementation expanded the ARMER radio system further outside of the Twin Cities Metropolitan Area, into the areas of St. Cloud/Stearns County and Rochester/Olmsted County, and provided the core system infrastructure to serve these areas. Funding issues from the State's 9-1-1 program were being experienced at the time, and only $27 million of the estimated $44 million needed were available for the project. For this reason, work on the expansion was temporarily suspended until the 9-1-1 Special Revenue Account balance was stabilized.

In spite of the funding issues, both St. Cloud and Rochester needed to move forward with the replacement of their existing radio systems, and had a desire to integrate with the ARMER system. Table 8 summarizes the funding for these two agencies for Phase 3, showing the total amount and federal grant funding components.

Table 8 – ARMER Phase 3 funding for St. Cloud and Rochester

Phase 3 Local Enhancements	Estimated Costs ($millions)	Amount Funded via Grants ($millions)
City of St. Cloud	$6.5	$2.9
Stearns County (system)	$1.8	$1.8
Stearns County (subscriber radios)	$1.8	$1.8
Rochester/Olmsted County	$7.5	$5.8

3.1.1.12 Phases 456

The original ARMER implementation plan established that the system would be built out in the remaining areas of the state in three additional phases:

- Phase 4 would complete the northeast area, from Cass County up to Cook County by 2005
- Phase 5 would complete the southwest and far west central areas by 2006
- Phase 6 would complete the northwest area of the state by 2007

The project funding problems noted above in the Phase 3 discussion persisted through 2007, and further development of the system was essentially stalled until these issues were resolved.

In May 2008 the Minnesota Legislature allocated $186 million dollars for completion of the ARMER system project. Rather than accomplishing this in the individual Phases 4, 5 and 6 noted above, it was determined that all undeveloped areas would be accomplished simultaneously; therefore, this final phase became generally known as “Phase 456”. This strategy allowed the state to more quickly build available sites or upgrade existing locations regardless of Phase to achieve a temporary level of 75% mobile coverage across the state.

This would prove to be a challenging task, because the development of the system in outstate Minnesota faced many obstacles, primarily in tower site development. Also, many city and county governments around the state were now expressing greater interest in joining the system, and wanted to migrate to ARMER from their existing VHF radio systems, which were facing the FCC’s January 1, 2013, narrowband channel deadline.

The funding for Phase 456 provided for the development of towers and site equipment, land acquisition, 800 MHz equipment, microwave equipment, and other items needed for completion of the project.

This final phase of the project, while not yet complete, has been highly successful (95% complete at this time), and 76 of Minnesota’s 87 counties now utilize the ARMER system for primary public safety communications operations. Tower site land acquisition, permitting, and tower construction has been the biggest challenge in completing the project, but work continues on the remaining sites, and progress continues to be made.

Table 9 shows a summary of the Phase 456 project funding and budget (sourced from the most recent ARMER DPS Project Status Report).

Table 9 – ARMER Phase 456 funding and budget

Phase 456 Funding	Original Budget	Spent to Date	Unspent Balance	Encumbered	Available Balance
FY 2009	$61,997,000	$61,981,000	$16,000	$16,000	$0
FY 2010	$62,015,000	$61,699,000	$316,000	$311,000	$6,000
FY 2011-13	$61,988,000	$26,505,000	$35,483,000	$4,500,000	$30,983,000
Total 456	**$186,100,000**	**$150,175,000**	**$35,815,000**	**$4,827,000**	**$30,989,000**

The state of Minnesota MnDOT staff provided ***FE*** with a complete inventory of the ARMER radio system equipment and resources purchased and implemented since the project's inception, along with an estimated value of this equipment. Table 10 provide a summary of this equipment and estimated values spent on the project since its inception:

Table 10 – ARMER complete asset inventory and estimated value

System Asset	Estimated Value
Radio Tower Structures	$112,350,000
Other Tower Site Equipment (generators, HVAC units, UPS, grounding, etc.)	$ 5,358,000
Radio Equipment Shelters	$ 24,475,000
Security Fencing, Propane and Tanks	$ 3,065,000
800 MHz Regional Controller (Master Site) Equipment	$ 24,050,000
800 MHz RF Site Equipment	$ 80,584,000
Microwave System Equipment	$ 25,238,000
Interoperability Site Equipment	$ 4,879,000
Alarm Systems	$ 1,909,000
Site Security and Other System Equipment	$ 2,524,000
Grand Total	**$284,432,000**

Summary

Completion of the remaining elements of the project are expected to continue through 2014 and possibly early 2015, depending on progress with the challenges of land acquisition and permitting for tower site development, which to a great extent is beyond the control of the State. Creative solutions have been used to mitigate these challenges, including partnering with local city and county governments, as well as leasing tower space from selected private parties where appropriate and cost effective.

Table 11 provides a summary of the State's total capital expenditures for the ARMER system since the initiation of the project in the late 1990's.

Table 11 – State's total ARMER capital expenditures to date

Project Phase	Costs ($millions)
Phase 1	$36.0
Phase 2 (local funding only)	$0.0
Phase 3	$45.0
Phase 456	$159.0
Total	**$240.0**

Note again that the expenses in Table 11 are the State's totals only, and do not include funding spent by city and county governments on local enhancements, or mobile and portable radio costs.

3.1.2 Capital and Operational Expenditures for ARMER System

The ARMER radio system requires ongoing funding to maintain the network at a high level of operational reliability and ensure long-term life and operation of the system. A system with the size and complexity of the ARMER network has a large inventory of hardware, electronics and equipment within the system, which requires ongoing maintenance and support. The ARMER system is one of the largest and most complex public safety radio systems in the U.S., with 310 tower sites (14 sites unfinished) and associated equipment.

FE understands that the State capital expenses for the ARMER system have come mainly from the sale of 9-1-1 revenue bonds, along with a negligible amount of Trunk Highway Funds. ***FE*** documented the State capital expenditures to date, the remaining bond authority and the total funds unspent, including contingency funds. ***FE*** also documented the State backbone operational expenditures, including both funding from the 9-1-1 special revenue account and real and/or in-kind costs from the MnDOT OEC budget. This estimated maintenance budgetary costs provided to ***FE*** for this report cover a three-year period.

The funding required for maintenance and operation of the ARMER system is categorized into two areas: Capital and Operational. The Capital expenditures include the purchase and replacement of radio system hardware, upgrades and replacements of towers, and hardware costs. Operational expenditures include ongoing annual maintenance

agreements, major software agreements and upgrades, along with technician and service-related expenses.

An area of uncertainty is whether the costs for the annual software maintenance agreement with Motorola should be included in the Operational or Capital category, because the major system software upgrades are "bundled" with the annual Software Maintenance Agreement, although these could be purchased separately. For the purposes of this report, these costs are incorporated into the Operational Expenses, because it is an annual recurring expense.

A. New Capital Expenditures (CAPEX)

Though the ARMER system is still in the final phases of completion, elements of the system are now over 10 years old, and will require replacement in the coming years. Of particular focus are the Gold Elite radio dispatch consoles, along with the STR3000 800 MHz stations and Prime Site Simulcast controllers at the tower sites. The continued upgrade and replacement of older tower sites are also incorporated into the ongoing system plan.

MnDOT staff provided ***FE*** a list of required equipment upgrades and replacements planned for the next three to five years. Table 12 lists these items and estimated costs.

Table 12 – Required equipment upgrades and replacements

State System Equipment	Estimated Total Cost	Year Required
16 Tower Site Structures (1)	$4,950,000	2014
134 - 800 MHz STR3000 Station Replacements (1)	$ 2,814,000	2015-2019
12 Simulcast Prime Site Controllers (1)	$ 4,673,000	2015-2019
12 Other Site Hardware (1)	$ 1,018,000	2015-2019
Total (State of MN)	**$13,455,000**	
Local Agency System Equipment	**Estimated Total Cost**	**Year Required**
860 - 800 MHz STR3000 Station Replacements (2)	$29,711,000	2015-2019
4 Simulcast Prime Site Controllers	$ 1,894,000	2015-2019
Total (Other Agencies)	**$31,605,000**	
Grand Total	**$45,060,000**	
(1): Cost estimates provided by MnDOT staff		

(2): Refer to Table 21 is Section 3.2.2 for individual agency details

Though the replacement of 800 MHz STR stations is not necessarily required until the 7.19 software version upgrade, Motorola announced that technical support of these stations will cease in 2014. As a result, the State and some other city/county agencies using these stations have started budgeting for and replacing these stations on an ongoing basis, to mitigate the need for a one-time major purchase.

One item brought to ***FE***'s attention during preparation of this report was that Hennepin County, which provides the physical location facility for Golden Valley Zone 2 regional controllers, is in the planning phase of relocating their PSAP and associated dispatch equipment to a new facility in Plymouth, MN in 2014. Motorola has estimated the cost of relocating the Zone 2 regional controller at $1.6 million dollars.

B. Operational Expenditures (OPEX)

The Operational Expenditures for maintenance and upkeep of the ARMER system are focused primarily in two areas: Service/Maintenance Agreements and Staff Technical Support costs.

3.1.2.1 System Software, Maintenance and Upgrades

The State has in place a System Upgrade Agreement (SUA) with Motorola.

The System Upgrade Agreement (SUA) is the Software Maintenance Agreement (SMA) but also provides any hardware changes and system software installation costs.

The System Upgrade Agreement (SUA) contract provides for:

- One on site dedicated field service technician
- Technical Support Services (Phone support from Factory, not onsite work)
- System Software Subscription Agreement
- System software installation.
- Subscriber Software Subscription Agreement
- Hardware changes (Not platform changes such as Gold Elite to 7500, STR3000 to GTR, and circuit based simulcast to IP simulcast.)

The state also has parts contracts with Motorola, Trak and Microwave Networks.

While it is possible to purchase the annual SMA without the SUA, The System Upgrade Agreement (SUA) is the SMA but also provides some hardware changes, such as replacement of desktop computers for dispatch consoles, and system software installation costs. Hardware platform changes such as Gold Elite and STR3000 replacement are not included under this agreement.

3.1.2.2 Maintenance Operations Support

The ARMER system has over 324 tower sites located throughout the state, and each site includes multiple system components that require maintenance and service, including:

- Tower structure, equipment shelter, emergency generator and propane fuel tank, HVAC units, alarm systems,
- 800 MHz and VHF radio system equipment
- Microwave radio system equipment

The primary on-site maintenance support of the ARMER system is provided by the MnDOT technical staff. MnDOT has a staff of technicians, at service facilities strategically located throughout the state, and these staff members conduct all radio system maintenance at the State's tower sites. MnDOT has maintenance facilities located in the following areas of the state:

- Twin Cities Metro (Golden Valley, Roseville, Oakdale)
- Northeast (Duluth, Virginia, Grand Rapids)
- Northwest (Brainerd, Bemidji, Crookston, Thief River Falls, Detroit Lakes)
- Southwest (Marshall, St. Cloud, Willmar, Windom)
- Southeast (Mankato, Owatonna, Rochester)

The MnDOT Electronic Communications division has a staff of approximately 90 personnel, who are responsible for design, purchase, installation, diagnostics, repair, and preventative maintenance of the ARMER system's 800 MHz, VHF and microwave radio equipment.

Their responsibilities also include other non-radio tasks that are critical to the ongoing performance, reliability and long-term life of the system. This work encompasses the routine inspection of tower site security, tower lighting, radio building condition, emergency generators and propane fuel levels, and HVAC system condition and performance.

MnDOT also has two full-time tower technicians, trained and certified to conduct the work needed for the maintenance of the many tower structures and lighting systems on the towers.

MnDOT has implemented a full alarm and monitoring system, to allow immediate notification of any tower site problems to the ARMER Network Operations Center, located at the Water's Edge facility in Roseville, Minnesota. This position is manned 24/7 and provides real-time monitoring of the status and performance of the ARMER radio system equipment, along with the tower site equipment status.

The MnDOT staff provided ***FE*** their planned operating budget for the 2014 and 2015 year periods as shown in Tables 13 and 14.

Table 13 – MnDOT Operating Budget for 2014

FY 2014 ARMER System Elements	Trunk Hwy Fund	9-1-1 Fund	Totals
Salaries	$ 571,000	$3,497,000	$4,068,000
Rent & Utilities	$0	$1,500,000	$1,500,000
Motorola SSA/SUA	$1,300,000	$2,328,000	$3,628,000
Facilities Maintenance	$ 250,000	$0	$ 250,000
All Other	$ 132,000	$1,865,000	$1,997,000
Totals	**$2,253,000**	**$9,190,000**	**$11,433,000**

Table 14 – MnDOT Operating Budget for 2015

FY 2015 ARMER System Elements	Trunk Hwy Fund	9-1-1 Fund	Totals
Salaries	$ 571,000	$3,645,000	$4,216,000
Rent & Utilities	$0	$1,600,000	$1,600,000
Motorola SSA/SUA	$1,300,000	$2,328,000	$3,628,000

Tower Replacement	$ 250,000	$0	$ 250,000
All Other	$ 132,000	$1,865,000	$1,997,000
Totals	**$2,253,000**	**$9,438,000**	**$11,681,000**

Note: the Fiscal year 2014 amount of $11,443,000 to the Fiscal year 2015 amount of $11,681,000 represents a 2.17% increase. No OPEX calculations have been provided for beyond Fiscal Year 2015.

3.1.3 Construction Status of Local Enhancements

The ARMER system was initially designed and engineered to provide a 95% level of coverage and reliability to mobile radios throughout the state. Upon feedback from county stakeholders, the design was later changed to provide a 95% level of coverage and reliability to mobile radios on a county-by-county basis. However, it was also implemented with the intention of providing service to any city, county or other governmental agency within the state that desired to utilize the system.

It was understood and expected that the level of radio system coverage provided by the State's tower sites may not meet the radio coverage requirements of all the local city and county agencies who chose to convert to the ARMER system for operational use. For those agencies that desire a greater level of coverage, they retained the option of constructing their own tower sites as needed, and connecting those sites to the ARMER network. Numerous local governments have elected to do this, both within the Twin Cities Metropolitan Area, as well as many outstate areas.

Public safety agencies that choose to join the network were required to fund the purchase, operation and maintenance of the radio console equipment in their respective dispatch centers, local enhancements to the tower site equipment (if desired or necessary) and the 800 MHz mobile and portable radios used on the system. This was not a departure from historical practice.

For the purposes of this report, three different types of local governments were identified for review and inclusion in this report. These counties were selected for the report based on their geographic location, differing size and types of public safety agencies within their county that are utilizing the ARMER radio system for day-to-day activities. The selected agencies are:

A. Dakota County, MN (large Twin Cities metropolitan agency)

B. St. Louis County, MN (larger rural agency with local enhancements)

C. Murray County, MN (smaller rural agency with no local enhancements)

Each of these local governments were interviewed by ***FE*** to determine the costs of initial implementation, technical requirements, equipment purchases, use of the system, ongoing maintenance costs, and future plans for upgrades or equipment replacements as required to maintain proper operation and/or coordinate with any upgrades planned or required by the state of Minnesota.

3.1.3.1 Dakota County, MN

Overview

Dakota County is located in the southeast area of the Twin Cities Metropolitan Area, with a geographical land area of 562 square miles, and a population of 398,552. The County Seat is located in the city of Hastings, and there are 24 active public safety agencies within the county, including 12 law enforcement and 12 fire/EMS, along with 5 public works entities that use the ARMER radio system. The agencies within the county have an estimated 2,195 active radios in use on the ARMER system.

Dakota County established a new combined 9-1-1 dispatch center in 2006, and all county agencies moved their radio communications to the ARMER system at that time. This combined 9-1-1 dispatch center is known as the Dakota Communications Center (DCC), which is located in Rosemount, MN, and provides all 9-1-1-related emergency communications and dispatching services for the public safety agencies in the county.

Technical Elements

As Dakota County planned to join the ARMER network, the County conducted an assessment of the radio needs for an ARMER implementation. The user needs assessment was designed to determine the operational and technical factors critical to a successful system migration. The assessment included the following assets:

- Tower sites for reliable coverage
- Channel capacity to handle expected traffic loads
- Dispatch center radio console equipment
- Mobile and portable radio inventories
- Interoperability with outside agencies

- Project funding

The State's ARMER system implementation plan included only two tower sites in the county. The assessment conducted by Dakota County showed that 10 sites would be required for the system to provide reliable coverage for mobile and portable radios, especially for in-building coverage in the more densely populated areas of the county.

The ARMER system within the county now has a total of 10 tower sites; eight of these are county-owned, leased or operated, and two are State-owned or shared. The tower sites within the county are:

- Empire (DCC) - shared with the state of Minnesota
- Hastings - state of Minnesota
- Palomino Water Tower
- Buck Hill Water Tower
- Fairfield
- Randolph - leased cellular
- Arbor Point Water Tower
- Sperry Water Tower
- Marie Water Tower
- Welch (Goodhue County – added in 2010)

The addition of these tower sites allows the ARMER subsystem within the county to provide an estimated 97% or greater level of coverage to portable (handheld) radios throughout the county's service area. There are very few locations within the county where radio coverage is an issue.

An important element in the county's tower site development plan was the use of as much existing physical infrastructure as possible, such as the use of water towers rather than the construction of new radio towers. This afforded the county significant savings in capital expense, and reduced future rental/leasing and maintenance costs. Partnering with local cities for the use of these water towers also provided some level of local community involvement in the system development.

Microwave radio is used as the primary method of connectivity between tower sites and the dispatch center, with optical fiber service used as a backup for selected locations.

The number of 800 MHz channels at each tower site, were determined based on expected radio traffic loading on the system. At the time of initial system deployment, the state of Minnesota planned to implement seven channels at the two initial tower sites. The assessment showed that additional radio channels would be needed to support the expected radio traffic loading for Dakota County public safety agencies, Minnesota State Patrol and MnDOT, as well as other public safety users who may roam on to the system.

Based on the loading analysis, the subsystem was implemented with a total of 15 channels at nine tower sites. Of the 15 channels, seven are licensed to the state of Minnesota, and eight are licensed to Dakota County. In 2010, a sixteenth channel has been added at all 10 sites. The County reports that they do not currently experience any system "busies" or other system congestions problems, even during periods of high system usage.

It is important to note that the Dakota County subsystem operates in the simulcast mode, which indicates that all tower sites use the same 800 MHz channel frequencies, and transmit and receive simultaneously from all sites with radio traffic. The simulcast mode of operation provides greatly improved in-building coverage throughout the service area. The cost for simulcast operation is greater than non-simulcast (Multicast) operation, which is used in most other areas outside the Twin Cities Metropolitan Area.

PSAP Equipment

When the new DCC 9-1-1 dispatch center was designed and constructed in 2006, Motorola CENTRACOM™ Gold Elite radio consoles were purchased and installed. The DCC is now equipped with 23 full dispatch operator positions. According to DCC personnel, the Gold Elite consoles continue to function well but they will be required to replace these consoles when the state upgrades the ARMER system upgrades to version 7.15.

800 MHz Mobile and Portable Radios

As noted, the Dakota County agencies have an estimated 2,195 radios active on the ARMER system. All of these radios are manufactured by Motorola, and the majority of them are the XTL/XTS generation products, purchased in 2007. The individual agencies within the county are responsible for the replacement funding and maintenance of these radios.

Future Operational and Technical Concerns

The Dakota County ARMER subsystem is a stable, reliable system, and provides excellent radio communications service to the agencies within the county. However, Dakota County and its agencies will be faced with replacement of a significant amount of radio system equipment in the coming years because the current generation of equipment reaches end of life and will no longer be supported for service by the manufacturer(s).

1. Motorola Gold Elite Dispatch Consoles: The Gold Elite consoles will no longer be supported for use on the ARMER system after the implementation of the 7.15 System Software release by Motorola. The implementation date for this release has been tentatively established by the state of Minnesota for early 2016. Prior to the completion of the software upgrade, Dakota County will need to replace all 23 operator positions. A proposal has been received from Motorola for the replacement of the Gold Elite consoles, with a cost of $1,640,000, which is being budgeted by DCC for the 2015-2016 time frame.

2. 800 MHz Base/Repeater Stations at Tower Sites: 15 of the 16 800 MHz RF channels at 9 of the 10 tower sites utilize Motorola STR stations, which were installed when the system was implemented in 2006/2007. The STR stations will require replacement at the time when the 7.19 System Software upgrade is implemented by the State.

   The Welch tower site, which was added in 2010, uses the new Motorola GTR stations, which are not affected by the 7.19 ARMER system upgrade. Nor is the 16th channel that was added to all ten sites in 2010.

   To begin preparing for these changes, Dakota County replaced one of the existing STR stations at nine of the tower sites with new GTR stations in 2013. The removed STRs will be retained as spares to support the remaining sites. Additional station replacements are planned for 2014 and beyond.

3. 800 MHz Mobile and Portable Radios: The majority of the existing mobile and portable radios used by the county agencies were purchased and became operational in 2006/2007. The portable radios are expected to have a service life extending to year 2017, and mobile radios two or three years beyond that date.

4. 800 MHz System Channel Loading: The County has indicated some concern over future growth in usage of the system, combined with a lack of additional 800 MHz frequency availability in their geographic area. They do not see any

significant expansion in the number of radios used by Dakota County agencies, but are more concerned about additional users on the system and the potential effect on system loading.

5. Future ARMER System Upgrades: Dakota County is aware of the near-term 7.15 ARMER System Software upgrades, and future version upgrades. They are planning for PSAP console replacement in 2015-2016 as noted above, and 800 MHz STR station replacements will be planned to coincide with the State's upgrade plan, targeted for 2019. The estimated cost of these station replacements is $1,512,000.

Capital Expenditures, Funding and Operational Costs for Dakota County are reviewed in Section 3.1.4.1 of this report.

3.1.3.2 St. Louis County, MN

Overview

St. Louis County is located in the northeast area of the state, and with a geographical land area of over 6,800 square miles is the largest county in the state. The population of the county is 200,226 based on current census data.

The county seat is located in the city of Duluth, and there are 186 active public safety agencies within the county, which were included in the county's ARMER Participation Plan process. Of that number there are now 122 agencies that have migrated to the system, with the associated quantities of radios shown in Table 15.

Table 15 – St. Louis County radio quantities

Agency Type	# of Agencies	# of Radios
Law Enforcement	20	1,017
Fire & First Responders	75	2,033
EMS	13	197
Hospitals	8	49
Other	6	140
Totals	**122**	**3,436**

As shown, the St. Louis County ARMER implementation has resulted in a significant number of radios being added to the system, and the county reports that the system is being used very effectively throughout the area.

St. Louis County and its associated public safety agencies elected to join the ARMER system in 2012, after conducting a variety of radio system assessments and ARMER implementation planning work. Prior to that time, the county had a wide-area VHF system operating on "wideband" channels, and there was great concern with the loss of range and coverage that would be experienced with the required FCC narrowbanding mandate. A significant amount of the county's existing VHF infrastructure was not capable of narrowband operation, and would require replacement.

Technical Elements

In a similar manner as Dakota County, when St Louis County planned to join the ARMER network, the county conducted a technical and operational assessment of the radio needs for an ARMER implementation.

Tower Site Local Enhancements

The first technical factor to be addressed was the State's ARMER plan, which included 24 tower sites in the county. The number of tower sites had been a critical factor in the ARMER migration decision for St. Louis County, as the State's earlier ARMER tower site planning for the county did not include this number of towers.

At the time the ARMER Participation Plan was developed for St. Louis County and the City of Duluth, it became apparent that the State's initial plan for three tower sites (Duluth, Argus and Mirror Lake) to serve the greater Duluth area would not be sufficient for reliable coverage, especially for in-building coverage. The plan recommended a total of five or six total sites, operating in the Simulcast mode, to provide reliable coverage throughout the area. In the time since the plan was developed, three additional tower sites were implemented: Woodland/Orphanage (NE area of Duluth); St Louis County EOC; and Fond du Lac. These additional sites were developed through a combination of state and local funding sources.

There were concerns with coverage in the Hibbing area as well, due to the distance from the City of Hibbing area to the nearest ARMER tower sites (Sax and Virginia). The county elected to implement a local enhancement site in the Hibbing area to address this issue.

All of the ARMER tower sites outside of the Duluth service area were planned to operate as "Multicast" sites, with individual 800 MHz channels at each site. In this mode of

operation, the mobile and portable radios search for the nearest site with the best signal strength, and affiliate ("log on") to the site. This mode of operation generally works well around the state, and is a cost-effective method that does not require any special system equipment other than a connection to the master site.

However, this mode of operation also requires a new set of five frequencies at each tower site, and it is ***FE's*** understanding that problems were encountered with obtaining a sufficient number of frequencies for the operation of all sites in central St. Louis County, due in part to the proximity of these sites to the Canadian border, and the associated 800 MHz frequency sharing requirements, along with the county's need to add channel capacity to these sites.

As such, the group of seven sites in central and western St. Louis County were converted to "Simulcast" operation, as was done in the Duluth area. This mode of operation allows all sites to operate on the same group of 800 MHz radio channels, greatly minimizing the number of channels needed for operation. Simulcast also provides improvements in coverage within the site's service area, because of the signal overlap between sites.

The original ARMER plan also identified the need for additional trunked system channel capacity in the Duluth area, due to the number of users anticipated on the system. The State's original plan included a total of six RF channels at each site, which has since been expanded to a total of 10 channels at each of the six tower sites. This has been accomplished as a joint effort between the State and St. Louis County.

The county has indicated a need for additional capacity in the future as radio system use continues to expand, and has licensed the Duluth Simulcast site group for 12 channels at all sites, though funding has not been established for the purchase of the radio system equipment. They have expanded the "West Central" group of tower sites noted above to eight channels, and also obtained FCC licensing for a sixth channel for all remaining tower sites in the county, though again have not obtained the funding for the needed equipment to accomplish this work.

An important element of the tower site development and implementation for the ARMER system in St. Louis County has been the partnership between the county and state of Minnesota, as the State has dealt with challenges in obtaining the needed land or land use approvals for site development. The county has allowed the use of their existing tower for one permanent and five temporary ARMER tower sites in the county, and provides land for six ARMER tower sites.

Microwave Radio Equipment

The County has implemented additional microwave radio high-capacity connectivity throughout the St. Louis County area. This includes 6 and 11 GHz 4DS3 capacity with redundant routing from the county's PSAP to the State's Zone 5 master site in Duluth; 4DS3 capacity from the county's PSAP to the Douglas County, Wisconsin PSAP in Superior; 4DS3 capacity to the Woodland/Orphanage (Duluth) and Hibbing tower sites; 4DS3 capacity from the Duluth PSAP to the county's EOC (Emergency Operations Center) PSAP and local enhancement tower site. A 4DS3 microwave link has also been implemented between the St. Louis County PSAP and the Lake County PSAP in Two Harbors.

PSAP Equipment

When the county elected to move forth with ARMER migration and close the Virginia PSAP, a quantity of 12 new Motorola MCC7500 console operator positions were installed at the Duluth PSAP, which replaced the existing Gold Elite consoles. This console implementation includes 36 CCGW (conventional channel gateway) ports for connectivity to non-trunked radio channel resources, and a Network Management Terminal, for the management of trunked system resources and equipment. The county also has an EOC located in the Four Corners area, about 10 miles northwest of the Duluth PSAP. The EOC is equipped with a two-position MCC7500 console configuration, and 12 CCGW ports.

Both the main PSAP and EOC are equipped with a MOTOBRIDGE radio interface system, which allows direct and semi-permanent patching between different radio channel resources. The County has implemented an audio logging system sourced from Higher Ground to allow the recording of required radio system traffic and 9-1-1 telephone calls. This is the first trunked recorder implemented in the Northeast Region that is capable of functioning as a Regional recorder, which can be shared by other county agencies if desired.

800 MHz Mobile and Portable Radios

St. Louis County agencies now have approximately 3,436 radios active on the ARMER system. Most of these radios were sourced from Motorola, and the majority of them are the XTL/XTS generation product, purchased in the 2011-2012 period. The individual agencies within the county are responsible for the replacement funding and maintenance of these radios.

Future Operational and Technical Concerns

The St. Louis County ARMER subsystem is a relatively new implementation, which included numerous local enhancements to meet the needs of the large number of public safety and future public works agencies utilizing the system, and is reported to provide excellent radio communications service to the agencies within the county.

The number of radios now operating on the system is approximately 3,436, and is expected to grow in the future when additional public safety and public works agencies migrate to the system. The original ARMER Participation Plan for St .Louis County completed in 2010 included an expected maximum of 3,550 radios, which now appears to be a number that will need to be increased in the near future. It is estimated that the following agencies will join the system with significant radio inventories:

- 600 radios St. Louis County Public Works (County Highway)
- 400 radios City of Duluth Public Works
- 400 radios Other city Public Works
- 800 radios Various School Districts
- 2,200 radios Total Future Growth

The addition of these radios will require additional radio channel capacity at the tower sites within the county. The county has already implemented or planned for additional channel capacity at all sites, but will need to continue monitoring the traffic levels and number of “busies” being experienced by system users to determine where additional capacity may be needed. The county has also noticed some amount of radio traffic on the tower sites within the county from agencies based outside of the county, such as neighboring county users, which has affected overall traffic levels.

The completion of the State’s planned tower sites is a priority for both the County and the State. Several of the State’s planned sites are currently operating via temporary towers or locations, and may not provide the level of coverage needed or planned for these specific locations. Additional local enhancement tower sites may be needed in the future, depending on the specific coverage needs of the agencies using the system.

Interoperability with non-county agencies within the county and neighboring agencies outside the county is an important element for St. Louis County, as they are bordered to the north by Canada, and Wisconsin to the southeast. The State of Wisconsin and local city/county agencies utilize a VHF system, and St. Louis County has implemented the aforementioned microwave link directly from the St. Louis County PSAP to the Douglas County/City of Superior PSAP to provide direct connectivity between the systems. The

State of Wisconsin's radio system is Trunked VHF, and it may be possible to implement the ISSI between the two state's systems in the future, if the technical details can be addressed and resolved.

The Coast Guard Port Security is another concern, as they utilize conventional analog VHF for communications. This system can be "soft patched" through the St. Louis County PSAP consoles, but dual-band radios are desired for some local personnel to allow direct communications with the Coast Guard. The MOTOBRIDGE system also allows communications with other agencies not utilizing the ARMER 800 trunked radio system.

3.1.3.3 Murray County, MN

Overview

Murray County is located in the southwest area of the state, with a geographical land area of 705 square miles, and a population of 8,725 based on 2010 census data.

The county seat is located in the city of Slayton, and the Sheriff's Office provides 9-1-1 dispatching services for all agencies in the county. The public safety agencies within the county include three law enforcement, eight fire, and three EMS agencies, along with a small number of public works entities that use the ARMER radio system. The agencies within the county have an estimated 430 active radios in use on the ARMER system.

The County and its associated public safety agencies elected to join the ARMER system in 2011, after conducting a radio system assessment and ARMER implementation planning work. Prior to the ARMER conversion, the county utilized a dated VHF system. Similar to St. Louis County, the county was concerned with the lack of narrowband capable equipment of their existing system, as well as the projected loss of range and coverage that would be experienced with the implementation of the narrowbanding mandate.

Technical Elements

As Murray County planned to join the ARMER network, the county conducted an assessment of the radio needs for an ARMER implementation. This effort was to determine the operational and technical factors that were critical to a successful system migration.

Of main concern to the County was projected system coverage based on the State's ARMER implementation plan. The state plan included three tower sites in the county (Slayton, Chandler and Tracy) with additional coverage being provided by other ARMER

sites outside the county borders, but close enough to allow additional coverage in the border areas.

A key factor in deciding to migrate to the ARMER system for the County was the location of a State ARMER tower in Slayton (the county seat), which results in excellent coverage in and around the county courthouse, Sheriff's office, and other locations. As an aside, the state design constraints didn't allow for a tower in each county seat. This has been an issue for some counties, where the closest ARMER site to the county seat is 10 miles or more, resulting in poor coverage in these important areas.

The coverage review conducted by the county resulted in the conclusion that no local enhancement tower sites would be needed for the Murray County implementation. The only potential area of concern was around the city of Fulda, in the southeast area of the county, where coverage predictions indicated some weak signal areas. The County chose to take a "wait and see" approach before spending any funding on an additional tower site in that area.

Included in the County's implementation plan was a review of radio traffic usage, and it was determined that no additional 800 MHz channel capacity would be needed at the ARMER tower sites.

PSAP Equipment

New Motorola MCC7500 radio consoles were purchased and installed at the Murray County PSAP, with three dispatch operator positions. Microwave radio is used for connectivity from the PSAP to the Slayton ARMER tower site.

Radio voice recording is accomplished through a Regional NICE (brand) recording system. The recording of radio voice traffic when using the MCC7500 IP-based consoles is more complex when compared to the older Gold Elite consoles, which have individual wireline circuits from the console, which are then connected directly into a local recorder at the PSAP.

This wireline capability does not exist with the new consoles, because they are a network-based product. Murray County partnered with Lyon County, and each agency purchased the NICE® networked recording system. Radio traffic from the ARMER system is routed into the NICE® recording system, which serves as a host server for all county agencies in the southwest Region of the state. Each agency has a Virtual Private Network (VPN) connection to either the Murray or Lyon county recording site, and can then download specific dates and times of radio voice traffic from the system for their individual agencies.

800 MHz Mobile and Portable Radios

The Murray County agencies have an estimated 430 radios active on the ARMER system. These radios are a combination of Motorola and EF Johnson units, most of which were purchased in the 2010-2012 period. While the individual agencies within the county are responsible for the funding and maintenance of these radios, the majority of them were purchased with funding from a number of grants received by Murray County agencies.

Future Operational and Technical Concerns

The Murray County ARMER subsystem is reported to be a stable, reliable system, and provides excellent radio communications service to the agencies within the county. Because the radio system equipment implemented by the County is relatively new, they are not faced with the equipment obsolescence and replacement issues that need to be addressed by other agencies such as Dakota County reviewed earlier in this report.

As contemplated earlier in the planning process, the only significant issue of concern to Murray County after the ARMER system implementation was the lack of radio coverage in the city of Fulda area. The on-street portable radio coverage was usable but weak, and in-building coverage was non-existent.

To resolve this problem, the county reviewed the option of funding a new ARMER tower site in the Fulda area. The county considered this to be an expensive option, with a typical cost of $300,000 to $500,000, depending on tower site availability, equipment costs, installation services and other related items.

Instead of spending such a significant amount of money to resolve this problem for a small geographic area, the county implemented a somewhat creative solution – known as an Outdoor BDA (Bi-Directional Amplifier) - that was presented by a vendor, FiPlex.

The Outdoor BDA serves a similar purpose as a tower site – to provide reliable radio coverage to portable (and mobile) units, but does so by capturing the 800 MHz radio signals from a remote ARMER tower site, and rebroadcasting them into the target area (the city of Fulda). The BDA also receives the incoming signals from portable radios and links them back into the remote ARMER site.

Making this system work properly is somewhat technologically challenging, but if done properly it is a cost-effective solution to resolving 800 MHz radio coverage issues. The cost of the Outdoor BDA system was $100,000.

Capital Expenses, Funding and Operational Costs for Murray County are reviewed in Section 3.1.4.3 of this report.

3.1.4 Expenses and Funding for ARMER Local Enhancements (Capital and Operational)

Section 3.1.3 provided the technical details of the ARMER system local enhancements implemented by the three county agencies selected for this review process. Through interviews with local enhancement owners and MnDOT OEC, ***FE*** documented the capital and operational costs for locally owned and operated system enhancements.

3.1.4.1 Dakota County, MN

1. Initial Capital Costs:

   The initial cost for ARMER system implementation in 2006 was approximately $10.5 million, which included the Gold Elite consoles in the DCC PSAP, and the 15 800 MHz channels at the original nine tower sites. Of this amount, $4.48 million was covered by a UASI (Urban Area Security Initiative) grant.

   The cost of the mobile and portable radios was borne by the associated user agencies.

2. Future Capital Costs:

   The primary expenditures that will be required for continued ARMER system use will be replacement of the Gold Elite consoles in 2015-2016, and replacement of the STR3000 base stations and Simulcast control equipment in 2019. These costs are estimated at $1,640,000, $1,512,000 and $419,151 respectively, for a total cost of $3,571,121.

3. Operational Costs:

   Dakota County's annual operating budget for the ongoing maintenance of their ARMER subsystem is $650,750 (year 2013). This cost includes the following items and services:

   - Radio system infrastructure maintenance (PSAP consoles, tower sites, microwave radio)
   - Radio system software service agreements

- Two Dakota County staff members to oversee system operations and maintenance
- Tower site leasing and electrical utility costs

The funding for the County maintenance and operation of the system is obtained through a DCC instituted radio system "User Fee", which is charged to each associated agency for each radio being used on the system.

3.1.4.2 St. Louis County, MN

1. Initial Capital Costs

The initial costs for ARMER system implementation in 2011-2012 were slightly less than $10 million dollars, which included the following equipment and associated grant funding shown in Table 16.

Table 16 – St. Louis County initial capital costs

System Element	Cost	Grant Funding
PSAP Consoles	$1,030,000	$ 630,000 (a)
Microwave Radio	$1,202,000	$1,000,000 (b)
Tower Sites	$ 999,000	NA
800 MHz Radios – All agencies (c)	$5,131,000	$ 928,000 (d)
State Sales Tax on ARMER Equipment	$ 531,000	NA
City of Duluth Tower Site	$ 753,000	DECN Grant (e)
City of Duluth Microwave	$ 240,000	NA
City of Duluth, Virginia & Hibbing 800 MHz Radios (f)	NA	NA
Totals	**$9,886,000**	**$2,558,000**

a. State of MN DECN Infrastructure Grant

b. Multiple Federal Grants

c. St. Louis County funded the purchase of all 800 MHz mobile and portable radios for the public safety agencies within the county, except for the cities of Duluth, Virginia and Hibbing

d. Multiple Federal Grants

e. State of Minnesota DECN Grant; value unknown

f. The cities of Duluth, Virginia and Hibbing received some grant funding for the purchase of their new radios, but this information was not readily available

As shown, the county was able to obtain grant funding for 25% of the overall project implementation costs.

2. Future Capital Costs

Although St. Louis County's implementation is relatively new, it anticipates a cost of approximately $1.2 million dollars associated with the future ARMER 7.15 system software upgrade. They also anticipate future system capacity increases will be needed as additional city and county agencies migrate to the system, with the associated costs, which are not known at this time.

Some of the agencies that are expected to join the system are shown in Table 17, with the associated number of radios and costs.

Table 17 – St. Louis County future capital costs

Agency	# of Radios	Estimated Cost
St. Louis Co. Public Works (Hwy)	600	$1,800,000
City of Duluth Public Works	400	$1,200,000
Other City Public Works	400	$1,200,000
St. Louis County Schools	800	$2,400,000
Totals	**2,200**	**$6,600,000**

3. Operational Costs

St. Louis County is a self-maintained ARMER system user, and has a staff of six full-time technicians and supervisory personnel to install and maintain all PSAP, system and mobile/portable radio system equipment throughout the county. The county did not provide any specific costing data for the maintenance and operation of the ARMER system, but the following elements are included in these responsibilities:

- Radio system infrastructure maintenance (PSAP consoles, tower sites and local enhancements, microwave radio)
- Software agreements and support for the PSAP equipment

- Mobile and portable radio installation, removal, programming and maintenance

The funding for all system maintenance and future PSAP equipment upgrades or replacement is provided by the county's 9-1-1 fund, along with their general operating budget. The individual public safety agencies are responsible for funding the replacement of their ARMER radios in the future.

The St. Louis County radio service facility and staff also provides maintenance and support for Lake County, Minnesota's ARMER system equipment, and has been working with Cook County, Minnesota

The City of Duluth also has two full-time radio technicians, who are responsible for the maintenance of the City's ARMER radio system equipment.

3.1.4.3 Murray County, MN

1. Initial Capital Costs:

The initial costs for ARMER system implementation in 2011 were approximately $1.9 million, which included the equipment listed in Table 18:

Table 18 – Murray County capital costs

System Element	Cost
PSAP Equipment (MCC7500 consoles, microwave, logging recorder)	$ 800,000
Fire Agency Radios	$ 800,000
Law Agency Radios	$ 60,000
Public Works Radios	$ 85,000
Other Mobile and Portable Radios	$ 35,000
Radio Test Equipment	$ 100,000
ARMER Implementation Planning Work	$ 20,000

The funding for most of the project equipment needed for the ARMER migration, including mobile and portable radios, was provided through a variety of grants received by the county as shown in Table 19:

Table 19 – Murray County grant funding

Grant Funding Received	Value
Homeland Security (through state of Minnesota) for PSAP Equipment	$ 800,000
AFG (Aid to Firefighters) for Fire Agency Radios	$ 800,000
SHSP (through state of Minnesota) for Law Agency Radios	$ 60,000
Grant for Boat and Water radios	$ 15,000
ARMER Planning (state of Minnesota)	$ 20,000

As noted in the Operational Overview for Murray County, coverage problems were experienced in the city of Fulda area, which was resolved through the purchase and installation of an Outdoor BDA.

2. Future Capital Costs:

The system implementation in Murray County is relatively new, and will not require any of the PSAP console or STR3000 base station replacements required by other long-term ARMER system user agencies. As such, Murray County has not planned for any future capital costs associated with long-term ARMER system usage.

3. Operational Costs:

Murray County's annual operating budget for the ongoing maintenance of their ARMER system equipment is $20,000 (year 2013). This cost includes the following items and services:

- Radio system infrastructure maintenance (PSAP consoles, microwave radio)
- Software agreements and support for the PSAP equipment
- Mobile and portable radio maintenance(*)

The funding for all system maintenance and future PSAP equipment upgrades or replacement is provided by the County's 9-1-1 fund. The individual public

safety agencies are required to plan for funding the replacement of their ARMER radios.

As noted in Table 19 above, Murray County purchased the test equipment needed to allow them to conduct most of the required ongoing mobile and portable radio troubleshooting and first-level maintenance with County staff, which reduces monthly and yearly radio maintenance costs.

3.2 Comprehensive Life Cycle Assessment for the ARMER Backbone

FE understands that the backbone components of the ARMER system are tower sites, towers, ARMER trunked radio system, VHF interoperability system, microwave, and dispatch center equipment.

The reason for assessing the life cycle is because there are many factors that lead to refreshing the devices and software in the ARMER system. The elements that the system owners must address in the life cycle of the ARMER backbone, include the equipment that must be replaced because of deterioration and obsolescence, and at the system level, the effects of increasing system usage. Different components of the ARMER system are not at the same point in their life cycle. For this report, Motorola provided ***FE*** an ASTRO System Roadmap (Attachments A and B), along with a 10-year system Lifecycle Financial Plan (Attachment C), which sets forth the budgetary costs for the future software maintenance and upgrades to the ARMER system. Attachment D organizes the various component parts of the ARMER system into categories and presents a 15 year cost estimate.

Simply looking at a straight line depreciation of equipment's anticipated life does not address the ARMER system life cycle. In addition to looking at how long the existing equipment is expected to be economically and operationally effective, there must be consideration of system expansion because of added users. Also there must be an awareness of the continued escalation of the cost of maintaining the equipment and the system as physical components age, and there must be periodic adjustments to address the availability of new features that aid the users.

The most drastic change that could shorten the life cycle of the existing ARMER system is one in which the existing trunked radio system had to be replaced in its entirety. There are two ways this could happen. The first would come from FCC actions to increase spectral efficiency, but this is highly unlikely to happen within the practical life of the ARMER system. The FCC is unlikely to opt for more spectrum efficiency in the 700/800 MHz bands that the ARMER trunked radio system operates in. The second way is that

ARMER itself would need to replace the existing technology in order to make the radio system more efficient in order to add more users. At this time, it does not appear that ARMER is in need of this change, and therefore, the existing system technology should be able to continue on for many years to come. There is, therefore, a need to look at a finer detail of the various ARMER network subsystems and equipment to see which of those item needs replacement and at what time in the life of the system.

In Section 3.2.1 we look at Ongoing Capital Outlay Requirements that are focused on a 15 year projection of costs for the equipment and software that the ARMER system presently uses, and we look at a projection of growth in the number of ARMER sites and users. In Section 3.2.2 we address Ongoing Operational Costs. These ongoing operational costs include both operations and maintenance. Our discussions include suggestions on when existing equipment should be replaced, and enhancements in system capacity as there is an increase in the number of ARMER subscribers.

ARMER currently has 324 remote communication sites. Statewide radio systems that are multi-jurisdictional serving thousands of users are not used in all states. The states of Colorado, Ohio and Michigan are of special interest, because they utilize the P25 Motorola ASTRO25 system infrastructure, and are very similar in size and configuration to the Minnesota ARMER system. Alaska has a system similar to ARMER that covers metropolitan areas of the state. Because of its topography and size, geographically, the Alaska system is far from statewide.

3.2.1 Ongoing Capital Outlay Required

The state of Minnesota ARMER radio system is composed of two main elements:

- The ARMER system “backbone” which is the fixed-site equipment
- The 800 MHz mobile and portable radios used by agencies to communicate on the ARMER system

The state of Minnesota ARMER radio system is composed of two main elements, the ARMER system “backbone,” which is the core infrastructure and fixed-site equipment that consists of buildings, towers, 800 MHz repeaters, system control and management equipment, microwave radio connectivity, dispatch consoles, and other ancillary equipment. The second element is the 800 MHz mobile and portable radios used by agencies to communicate on the ARMER system. The ARMER backbone, or system infrastructure, including local investments, is the entire structure that exists to support mobile and portable radio users of the ARMER system. Whether communication is

between dispatchers and field users, or user to user, that communication is made possible because of the ARMER backbone.

The information technology network that is carried on the microwave system is frequently referred to as the microwave baseband. The function of the ARMER microwave baseband is similar to a highway system in that it routes high speed traffic to facilitate connectivity between the various devices in the ARMER system. About half of expenditures in microwave systems are for the microwave radios, and the other half is on the microwave baseband.

The ARMER backbone comprises five major elements:

1. Motorola P25 trunked radio subsystem (ARMER Trunked Radio System)
2. PSAP radio dispatch consoles (Dispatch System)
3. Conventional (not-trunked) radio subsystem that enables interoperability with units outside of ARMER (Interoperability Layer)
4. Site infrastructure (buildings, towers, power, real estate) (Site Infrastructure)
5. Microwave backhaul network that interconnects all of the elements of ARMER (Microwave System)

All five must be addressed in maintaining and operating the ARMER system. A failure in any one of the five areas could result in an interruption of ARMER service on a local, regional or statewide basis depending on the severity of the failure.

The second critical part of ARMER is the 800 MHz mobile and portable radios. Often, these radios may be called subscribers. The subscribers here are the ARMER users. The term subscriber here only denotes that the ARMER user radios subscribe to service from the ARMER backbone. They have limited usage by themselves, but they have broad capabilities because of their affiliation with the infrastructure.

ARMER Trunked Radio System (TRS)

A trunked radio system is one in which the system management computer network (regional controllers) assigns system frequencies to users based on channel availability and grouping of users. In non-trunked, or conventional, radio systems, users manually select a frequency to use. The ARMER TRS is a compendium of repeater stations and computer control devices for assigning talkgroups to predefined groups of users in real time. ARMER TRS technology is based on adherence to the Project 25 (P25) standards.

Adherence to standards allows operational compatibility between units from different manufacturers. The ARMER TRS operates in Project 25 Phase 1 technology. The Phase 1 standard dictates that the system provides one talk path for each 800 MHz radio channel used in the system. The standardized P25 Phase 1 technology entered the marketplace in 2000. The original system covering the Twin Cities Metropolitan Area was one of the first fully compliant Project 25 systems in the nation.

The ARMER TRS itself has had numerous changes and enhancements since it was first installed, but the technology is now over 10 years old. Technology and capabilities have continued to evolve in the 10 plus years that the ARMER system been in operation.

An important point to be made about a trunked radio system (such as ARMER) is that the repeater channels located at the tower sites are shared among all system users. It is critical that the number of radios and radio users operating in the geographic range of any tower site or group of sites can be supported by the number of channels available at the sites. As can be expected, the number of channels at the tower sites in the Twin Cities Metropolitan Area are greater than at sites in rural Minnesota due to the larger capacity needs driven by the larger number of users on the system.

As an example, the standard channel configuration for sites in rural Minnesota is five channels per site, which has been determined to be sufficient in most areas, unless a local city or county adds a significant number of radios to the system. When Crow Wing County (Brainerd area) joined the system in 2012, it was determined that additional channel capacity would be needed at the tower sites in the county, and Crow Wing County spent the funding needed to add two channels per site, for a total of seven channels per site.

By comparison, some of the sites in the downtown Minneapolis area have 24 channels, which are needed to handle the significant number of radios and associated radio traffic in the area.

MnDOT constantly monitors the levels of voice traffic on the system, and reports that there are very few areas of concern within the system where traffic levels occasionally cause any concerns with the system users. As such, there are no near-term plans to begin conversion of the system to Phase 2 operation, though the majority of the State's 800 MHz repeater stations would be capable of Phase 2 operation. This is not necessarily the situation within the Twin Cities Metropolitan Area, where a large number of the older STR stations are still being used, and it is within the Twin Cities Metropolitan Area that traffic congestion problems are more likely to be experienced in the future. Nearly all the

subscriber units on the system would need to be replaced before ARMER could migrate to Phase 2 operation.

See Section 3.2.2 of this report for a detailed total of the ARMER upgrade costs estimates.

Dispatch System Equipment

As discussed in Section 3.1.1 of this report, the ARMER system has a large number of city, county and State-owned dispatch console systems operating within it. Replacement of the existing CENTRACOM™ Gold Elite console system will be a high priority because the Gold Elite console will no longer be compatible with the ARMER system once system release 7.15 is installed in early 2016. This console system technology is now over 15 years old, though some of the newer installations are less than 7 or 8 years old. Computer hardware also wears out, and Motorola will not continue to support the CENTRACOM™ system past its useful life.

VHF Interoperability Overlay System

Since the ARMER system was built using 800 MHz radio spectrum, it was critical that ARMER also built an interoperability layer that would allow ARMER units to communicate with the non-800 MHz radio users throughout the state. This Interoperability system is located on 112 transmitter sites throughout the state, and uses VHF analog radio channels. It also employs a Motorola system called MOTOBRIDGE, which is an Internet Protocol (IP) switching system whose function it is to connect users to each other through the bridge.

The MOTOBRIDGE system has a centralized computer control element, additional control elements at each site and a radio or radios at each site that are programmed onto a local radio channel. MOTOBRIDGE allows connections between different local systems and between the ARMER system and local systems. If all in-state agencies were on the ARMER system, there would be little need for a separate Interoperability Layer system.

The equipment-only cost of the ARMER Interoperability Layer was approximately $4,879,000. This interoperability facility is another critical element of the ARMER system for public safety agencies throughout the state. Given the plethora of agencies and radio systems throughout the state, it is virtually the only way to assure even a medium level of interoperability for incident responses. The control system itself should be replaced in the event that Motorola ceases to support the existing product or the MOTOBRIDGE system capacity is exceeded.

Ongoing capital outlay for the Interoperability Layer are to accommodate growth in terms of additional sites throughout the state and in terms of more non-ARMER agencies requesting interoperability with the ARMER system. The 15 year capital cost for the Interoperability Layer is estimated to be about $1.6 million. This includes replacement of obsolete transmitters currently in the system, refreshing the MOTOBRIDGE servers, and the addition of 30 more interoperability sites to accommodate growth in interoperability needs during the 15 year period. Attachment D includes a year-by-year timeline and cost.

The Twin Cities Metropolitan Area also has a legacy interoperability layer maintained by MnDOT that consists of voted VHF repeaters, These repeaters have recently been narrowbanded, but in many cases where reused repeaters that are aged and closing in on end of life. While this interoperability layer is not a primary communications system, the SECB should discuss the merits of maintaining this additional communication pathway for catastrophic emergencies, special events or system redundancy.

Site Infrastructure

In the information that MnDOT supplied to ***FE*** is an inventory that includes a list of the number of state owned buildings along with a list of four different types of buildings currently in use. The list includes 242 sites that are newer and that do not require any more structural work, 17 older sites that need a tower replacement, and 12 sites currently under construction for a total of 271 state owned sites. MnDOT also supplied a cost of four different types of buildings they typically use in the ARMER system. Because 12 sites are currently under construction, we do not look at their cost. We are then concerned with the cost of additional buildings during the 15 year period.

In the estimate of 15 year costs, we used the MnDOT building cost of a masonry building and assumed installation of one new site per year (to account for normal system growth). Because we consider them to be the best long term investment for public safety mission critical systems, we assumed any building additions would be of masonry, prefabricated construction. MnDOT supplied a current value of $110,000 for one of these buildings. We assumed a modest annual escalating cost for this building over the 15 year period. Attachment D includes an item for Sites that includes an estimate for acquiring property, site architectural and civil engineering services, and purchase and installation of buildings. The total 15 year cost estimate for additional ARMER buildings due to system growth is approximately $8.4 million. Attachment D indicates the year-by-year estimated cost for establishing new buildings in the ARMER system and includes the component cost for each year.

FE understands that a number of new 330-foot free-standing towers were constructed during the ARMER build out. ***FE*** also understands that not all ARMER towers are new, as MnDOT appropriately leveraged use of existing towers in their network to lower the overall cost of the ARMER capital build out. Because of the agreed upon scope of this report, ***FE*** did not visit any sites as a part of this evaluation. Instead, we relied on information supplied by MnDOT as to the types of towers in the current system, and we estimated the growth in the number of sites to be one site per year. A more thorough listing of towers that should be replaced is not within the scope of this report.

Because MnDOT's information included the figure of 17 existing towers that needed replacement, we estimated replacing all 17 within five years. If these towers need replacement because of structural over stresses, their replacement should be accelerated. The estimated cost and timing of replacing these 17 towers is included in Attachment D. The estimated total cost is just under $5 million and the recommendation is to finish this work in a four year phase project starting in year 1.

FE reviewed the number and location of towers identified by the State as needing upgrade or replacement. These estimates are based solely on information provided by MnDOT Office of Emergency Communications. In total, we estimate that the 15 year capital cost of replacement and new towers is approximately $12.6 million. Attachment D lists the year-by-year projection and the total 15 year estimated cost.

Microwave System

The microwave system provides connectivity between the ARMER TRS sites and the dispatch centers. The existing microwave system does interconnect all of the existing sites and equipment into a single network.

Subscriber radios

The 800 MHz mobile and portable radios used by the participating ARMER agencies are referred to as "subscriber units". The term subscriber denotes that the ARMER user radios subscribe to service from the ARMER system backbone.

The radios operating on the system are owned and maintained by the State as well as the individual city and county agencies utilizing the system. Unlike backbone equipment used in a fixed or permanent location, subscriber units are used in a mobile environment, and are much more prone to wear and deterioration than are most system infrastructure devices. Because of this, the replacement of subscriber units occurs much more often than replacement of backbone radio equipment.

Replacement of subscriber radios is driven by the following factors:

1. Vendor discontinuation of support
2. Subscriber radio capability deficiency
3. Age and wear and tear of the radio reducing operational performance
4. Return on investment

MnDOT advises that there are an estimated 70,699 radios currently being used on the ARMER system, and a total of 81,610 authorized for use by the participating agencies. Refer to Table 28 in Section 3.2.7 of this report for a detailed total of the radios and cost estimates for eventual replacement.

3.2.2 Upgrade Costs and Feature Functionality

FE identified specific State ARMER backbone upgrade costs necessary for continued operation of the ARMER network, based on data received from MnDOT and Motorola. ***FE*** also documented, as provided by Motorola, known platform version upgrade costs and projected additional platform software upgrades over the next 10 years based on Motorola inputs. As a part of this subtask, ***FE*** identified whether the platform upgrade(s) are required by the vendor for ARMER system sustainability, or provide feature enhancements not required for sustained operations.

As identified in earlier sections of this report, there are significant hardware and software elements and costs associated with the ongoing operations and maintenance of the ARMER radio system. Motorola has established a roadmap of future software releases, release dates, and the features and functionality to be incorporated into these future releases.

The Motorola system software version release/upgrade program generally includes a new version on a yearly basis, which has been the approach used for the past several years. One of the reasons behind this is the use of Commercial off the Shelf (COTS) data network components from commercial vendors. Many of these devices have a relatively short service life, due to the constant and ongoing changes in products and technical support now common in the field of network equipment. This does not imply that all core system elements require replacement at these intervals, but rather key components within the overall system architecture.

The next version to be released by Motorola will be 7.14, but this will not be installed on the ARMER system. The Statewide Emergency Communications Board has adopted a policy where the software releases will only be implemented every two years. This is mainly because of the large size of the ARMER system and significant number of agency users, and the resulting system disruption that occurs during a system upgrade. Therefore the next major upgrade for ARMER will be version 7.15, which is planned for early 2016.

It is possible that the 7.15 version upgrade could be shelved for ARMER at that time, if the features are not needed, or the implementation of it was considered too disruptive or costly (i.e., Gold Elite console replacement).

As of December 2013, Motorola has not announced any specific features or enhancements for versions beyond 7.15. The upgrades and enhancements for the future versions are determined after the next generation's changes have been established.

The costs associated with these upgrades fall into three categories:

- Annual Software Maintenance Agreements (SMA)
- Software Upgrade Agreements (SUA)
- Equipment replacements required in conjunction with software upgrades

As documented, the support service and system upgrade agreements can be purchased independently, however it does appear that there are significant savings to be realized if they are purchased together.

Table 20 provides a summary of the 10-year budgeted costs for the individual and combined SMA and SUA programs.

Table 20 – ARMER 10-year budgeted costs for SMA and SUA programs

FY SMA/SUA	SMA Only Cost	SUA only Cost	Packaged Cost (1)	Estimated Savings
2013	$1,108,000	$8,756,000	$5,308,000	$4,556,000
2014	$1,247,000	$2,833,000	$5,539,000	-($1,460,000)
2015	$1,059,000	$9,148,000	$5,259,000	$4,948,000
2016	$1,091,000	$2,833,000	$5,291,000	-($1,368,000)
2017	$1,124,000	$8,756,000	$5,324,000	$4,556,000
2018	$1,158,000	$2,833,000	$5,358,000	-($1,368,000)
2019	$1,192,000	$9,148,000	$5,392,000	$4,948,000

FY SMA/SUA	SMA Only Cost	SUA only Cost	Packaged Cost (1)	Estimated Savings
2020	$1,228,000	$2,833,000	$5,428,000	-($1,368,000)
2021	$1,265,000	$8,756,000	$5,465,000	$4,556,000
2022	$1,303,000	$2,833,000	$5,503,000	-($1,368,000)
Totals	**$11,775,000**	**$58,729,000**	**$53,867,000**	**$16,632,000**
The SUA costs are included in the 2014, 2016 and 2018 calculations, even though these upgrades are not being pursued for the ARMER system; all even-year features will be incorporated into the odd-year upgrades				

The Motorola SMA/SUA pricing includes some system hardware and all software required for the upgrade. As shown, there is a potentially significant savings to be achieved by the combined SMA/SUA program, assuming that the future ARMER system version upgrades will be pursued over the next 10 years. For 2014, the state costs for the SUA are $3,984,000 while the local costs are $1,555,000 for an aggregate total of $5,539,000.

The State currently has an SUA contract with Motorola through 2015. The SMA could be considered "insurance" for continued reliable operation of the system, and provides ongoing support from the vendor, in conjunction with the work conducted by the MnDOT technical staff. The SUA allows relatively stable annual costs for future upgrades to the system, when done in conjunction with the SMA.

In addition to the software costs, there will be the need to replace certain hardware components associated with the system, specifically the Gold Elite dispatch consoles, and eventually the STR3000 800 MHz base stations and simulcast site controllers.

The total number of Gold Elite consoles operating on the system continues to be reduced as agencies upgrade and relocate PSAPs, and often replace their consoles at the same time. Table 21 provides an estimate of the costs associated with replacement of Gold Elite consoles and STR stations as future software (7.15 and beyond) releases are implemented:

Table 21 – Estimated cost to replace Gold Elite consoles and STR stations

Agency	Gold Elite Costs (1)	STR Costs (2)	Simulcast Costs (3)
State of MN	NA	$2,814,000	$4,673,000
Hennepin County	NA (7500s)	$11,151,000	$ 516,000
Ramsey County	$1,350,000	$4,410,000	$ 492,000

Agency	Gold Elite Costs (1)	STR Costs (2)	Simulcast Costs (3)
Anoka County	$ 825,000	$3,780,000	State
Carver County	$ 525,000	$1,071,000	State
Isanti County	$ 225,000	$ 126,000	State
Scott County	$ 600,000	NA	NA
Chisago County	$ 375,000	$ 63,000	State
Dakota County (4)	$1,640,000	$4,826,000	Included in STR
Ridgeview Medical	$ 300,000	NA	NA
Minneapolis, City of	$1,200,000	$2,520,000	$ 468,000
St. Cloud, City of	NA (7500s)	$ 410,000	State
Olmsted County	NA (7500s)	$1,103,000	State
Goodhue County	NA (7500s)	$ 252,000	State
Hennepin EMS	$1,275,000	NA	NA
North Memorial EMS	$525,000	NA	NA
Allina EMS	$825,000	NA	NA
Metro Transit	$1,125,000	NA	NA
White Bear Lake	$150,000	NA	NA
Bloomington	$ 300,000	NA	NA
Edina	$ 300,000	NA	NA
Saint Louis Park	$ 225,000	NA	NA
Minnetonka	$ 225,000	NA	NA
University of Minnesota	$150,000	NA	NA
Other Agencies outside of Metro	$1,800,000	NA	NA
Totals	**$13,940,000**	**$32,525,000**	**$6,149,000**

(1) Assumes $75,000 per position upgrade cost
(2) Assumes $31,500 per station upgrade cost, other than State of MN, who provided separate data
(3) Based on data from MnDOT
(4) Actual pricing provided from Dakota County

FE discussed with Motorola technical staff the long-term future for the ASTRO P25 Trunked Radio System. Motorola's current plan includes continued development and system upgrades for the next 10 years, through 2022. They advise that there are no plans

for a replacement for the existing ASTRO 25 system architecture at this point in time, and expect continued enhancements and options, such as the Phase 2 TDMA channel operation and associated expansion in capacity; the capability for direct connectivity between systems through the ISSI (Inter Sub System Interface), and CSSI (Console Sub System Interface) which will allow the option of other vendors' consoles connecting directly to the ARMER system.

3.2.3 Comprehensive Life Cycle Assessment for the Local Enhancements to the ARMER Backbone

FE worked with the ECN project manager to select one county from the nine-county metro area, one urban non-metro county, and one rural county to complete a life cycle analysis of their local enhancement. ***FE*** documented the core cost components of each local enhancement, the projected life cycle of each enhancement, and the estimated sustainment and/or replacement costs over the next 15 years.

The following agencies were included in the Local Enhancement review:

1. Dakota County, MN (large Twin Cities metropolitan agency)
2. St. Louis County, MN (larger rural agency with local enhancements)
3. Murray County, MN (smaller rural agency with no local enhancements)

The initial cost of each agency's ARMER system implementation are documented in Section 3.1.3 of this report. Provided herein are summaries of each agency's future costs associated with the local ARMER system maintenance and operation.

3.2.3.1 Dakota County, MN

As reviewed previously in this report, Dakota County migrated to the ARMER system in 2006, and therefore implemented the Gold Elite dispatch consoles and STR800 MHz base stations. As a result, they will be required to replace the Gold Elite console equipment in conjunction with the implementation of the future 7.15 version update, and the STR3000 base stations and simulcast control equipment when the ARMER 7.19 system software upgrade is implemented. . This equipment replacement is being included in the County's budget cycles for the associated years required.

In addition to the system infrastructure equipment, the mobile and portable radios used by the County agencies will eventually require replacement. The majority of these radios are Motorola XTL and XTS model units, and were purchased and placed into service in

2006. These radios remain a current product from Motorola, although production is expected to cease later in 2014. Nonetheless, these radios are subject to daily use (and abuse), and will require eventual replacement. For budgeting purposes, ***FE*** typically recommends a 7 year replacement cycle for portable radios, and 10 years for mobile radios. The cost of replacing the radios is the responsibility of the individual agency, and therefore not included in the County's ARMER operating budget. The County assumes that mobile and portable radios will requirement replacement by 2017-2019. The estimated cost of radio replacement is included in the 15-year cost summary shown in Table 22.

In addition to the future upgrade costs, the County expends $587,150 annually on system maintenance and operating costs (year 2013 data). This has been a relatively stable cost over the past few years, but a 1% annual increase has been included in the calculations used for the long-term maintenance costs for this report. The summary in Table 22 also includes Dakota County's future ARMER system operating costs.

Table 22 – Dakota County estimated radio replacement and operating costs

Dakota County: Equipment & Services	Estimated Costs
Gold Elite Console Replacement	$1,640,000
STR 800 Station Replacement	$4,826,000
15 Years Maintenance (1)	$10,346,000
1200 Portable Radios - $3,000 each	$3,600.000
1000 Mobile Radios - $3,500 each	$3,500,000
Total Cost – 15 year period	**$23,912,000**

(1) Includes an annual 1.0% CPI cost increase

3.2.3.2 St. Louis County, MN

As stated previously in this report, St. Louis County only recently migrated to the ARMER system from a VHF system, and therefore has an inventory of mostly new system equipment, including MCC7500 consoles, GTR stations, and mobile/portable radios. It is expected that no new equipment or replacements should be needed within the next 10 years. No upgrades will be needed at the time of ARMER 7.15 and subsequent software releases. We are still awaiting information from St. Louis County.

3.2.3.3 Murray County, MN

Murray County is another agency that recently migrated to the ARMER system and therefore has an inventory of mostly new system equipment, including MCC7500 consoles and mobile/portable radios. It is expected that no new equipment or replacements should be needed within the next 10 years. No upgrades will be needed at the time of ARMER 7.15 and subsequent software releases.

Murray County currently spends an estimated $20,000 annually for radio system maintenance. As a result, the only known cost at this time will be the annual fees for the maintenance of equipment, and related software maintenance agreements, as shown in Table 23.

Table 23 – Murray County estimated maintenance costs

Murray County: Equipment & Services	Estimated Costs
15 Years Maintenance	$ 300,000
Total Cost – 15 Year Period	**$ 300,000**

3.2.4 Comprehensive Life Cycle Assessment for Subscriber Equipment

MnDOT provided data that indicated approximately 70,000 radio ID's were active on the system. A radio ID is assigned to any portable or mobile subscriber unit, as well as PSAP consoles (although consoles are not included in the above number). MnDOT was unable to provide any specific data on the type or age of the radios being used on the system other than what is being used by the state agencies, as discussed in Section 3.2.8. There is typically a 7-year replacement cycle for portable radios and 10 years for mobile radios.

3.2.5 High-level Assessment of Costs of other Maintenance Alternatives

Recognizing that the state of Minnesota has an annual service level agreement with Motorola, ***FE*** investigated with MnDOT their capability to perform ARMER maintenance and estimated a cost for this capability based on MnDOT provided data. ***FE*** worked with Motorola to determine what shared maintenance programs would be available, and perform a cost comparison of a Motorola-only maintenance alternative with a shared Motorola-MnDOT maintenance alternative. According to MnDOT, Some level of Original Equipment Manufacturer (OEM) support will be necessary to sustain the network.

Maintenance for the ARMER backbone is currently accomplished through technical support services provided by the MnDOT radio technical staff. MnDOT does not maintain local enhancements. Those are maintained by local staff or locally funded vendors. Most of the primary diagnostic and on-site repair work needed at the ARMER system's 324 tower sites is provided by the MnDOT technical staff. As discussed in Section 3.1.2, MnDOT has a service organization with 18 service facilities staffed with approximately 90 employees who oversee the maintenance of the ARMER system. This work includes the core 800 MHz and microwave radio system equipment, along with basic maintenance of tower structures and lighting systems, emergency power generators, heating and cooling systems, alarm systems, site security, and general upkeep for the system's tower site locations. They also provide maintenance services for the approximately 5,400 mobile and portable radios used by the various state public safety agencies.

The current total annual costs for maintenance of the ARMER system are as shown in Table 24 (data provided by MnDOT).

Table 24 – ARMER total estimated annual maintenance costs

ARMER System Elements	FY 2014 Totals	FY 2015 Totals
Salaries	$4,068,000	$4,216,000
Rent & Utilities	$1,500,000	$1,600,000
Motorola SMA/SUA	$3,628,000	$3,628,000
Facilities Maintenance	$ 250,000	$ 250,000
All Other	$1,997,000	$1,997,000
Totals	**$11,443,000**	**$12,691,000**

These maintenance costs do not include any city or county local enhancement equipment, or 800 MHz mobile and portable radio equipment, or dispatch equipment.

Overall, (using the data from the above table) the percentage of the ARMER system's maintenance costs breaks down as shown in Table 25.

Table 25 – ARMER system projected maintenance costs by percentage per category

FY 2015 ARMER System Elements	Amount	Percent of Total
Salaries	$4,216,000	36.0%
Rent & Utilities	$1,600,000	13.7%
Motorola SMA/SUA	$3,628,000	31.1%
Facilities Maintenance	$ 250,000	2.1%
All Other	$1,997,000	17.1%
Totals	**$11,691,000**	**100%**

As shown, the two largest factors are the MnDOT technical staff costs, and the Motorola SMA/SUA.

The option of utilizing specific vendor-based technical support services, rather than a combination of State and vendor services, might be a reasonable option for the ARMER system. It may be possible to reduce some operational costs via this approach, but we suspect there may be some operational consequences to this approach, in terms of service outage and response times, although it is possible to address some of this within the service contract requirements.

Another factor that may have an effect on the ARMER system operational costs are the fact that the system remains in a construction phase, as the installation and programing of the system have continued over the past several years, and is now finally approaching completion. It may be possible that the level of MnDOT technical staff needed for operational maintenance of the system may be less than what has been historically needed for development of the system.

A general summary of some future maintenance options that may be considered are the following:

1. Continue MnDOT radio support at current levels along with agreement(s) with Motorola for specified services.

2. Discontinue Motorola agreements and use support services provided only by MnDOT. Use time and material with Motorola whenever service is required.

3. Have MnDOT contract with local public entities for radio services in their locations. MnDOT would continue all other services.

4. Contract with Motorola for turnkey services for the entire ARMER system.

5. Competitively ask for proposals for service for the whole state or for parts of it.

3.2.6 Backbone Operating Costs

Approximately 80% of the funding for the annual operating costs of the backbone of the ARMER system is provided from the State's 9-1-1 special revenue account, and 20% from the State's Trunk Highway Fund. This funding only supports the state-owned operating costs for the core backbone of the ARMER system, which is owned by MnDOT. Other state agencies, such as the Department of Corrections who have significant local enhancements to the ARMER system to support their network of institutions across the state rely solely on general fund appropriations to cover their ongoing maintenance, replacement or upgrades of equipment. The funds from these accounts are transferred to MnDOT Office of Emergency Communications (OEC) to cover the costs of:

- System operations
- System maintenance
- Technical personnel in the field; and
- The Network Operation Center (NOC).

FE documented the total operating costs, the funds that come from the 9-1-1 Special Revenue Account, the Trunked Highway Fund, and any revenue received by MnDOT for lease of tower sites. Tables 26 and 27 lists cost categories and funding allocations for those categories for years 2014 and 2015 respectively.

Table 26 – ARMER estimated 2014 funding sources by category

FY 2014 ARMER System Elements	Trunk Hwy Fund	9-1-1 SRA	Totals
Salaries	$ 571,000	$3,497,000	$4,068,000
Rent & Utilities	$0	$1,500,000	$1,500,000
Motorola SMA/SUA	$1,300,000	$2,328,000	$3,628,000
Facilities Maintenance	$ 250,000	$0	$ 250,000
All Other	$ 132,000	$1,865,000	$1,997,000

Totals	**$2,253,000**	**$9,190,000**	**$11,443,000**
Grand Total $11,443,000			

Table 27 – ARMER estimated 2015 funding sources by category

FY 2015 ARMER System Elements	Trunk Hwy Fund	9-1-1 SRA	Totals
Salaries	$ 571,000	$3,645,000	$4,216,000
Rent & Utilities	$0	$1,600,000	$1,600,000
Motorola SMA/SUA (1)	$1,300,000	$2,328,000	$3,628,000
Facilities Maintenance	$ 250,000	$0	$ 250,000
All Other	$ 132,000	$1,865,000	$1,998,000
Totals	**$2,253,000**	**$9,438,000**	**$11,792,000**
Grand Total: $11,792,000			

(1) The MnDOT budgetary cost for the Motorola SMA/SUA does not match the pricing provided by Motorola for these services; the pricing from Motorola was more expensive ($5,447,312) than the amount budgeted by MnDOT. Refer to Section 3.2.3 for a more detailed review of the proposed SSA/SUA

The State also receives approximately $375,000 in revenue from the leasing of tower space, primarily to cellular carriers.

As shown, the near-term operating costs are fairly stable, with no significant changes or large increases expected.

3.2.7 State and Local Subscriber Costs

It is estimated that over 87% of the public safety agencies within the state now utilize the ARMER system for day-to-day mission critical voice radio communications. This includes State of Minnesota, city, county, federal, medical, transportation and other types of agencies. There are a total of nearly 82,000 mobile and portable radios currently allocated for use on the system by the agencies in Minnesota. ***FE*** obtained from MnDOT an inventory of these radios, based on agency type. These agencies have invested significant funding in the purchase, training, and maintenance of these radios.

No specific data was received regarding the make, model, age or condition of the radios. However, it is important to note that some of the agencies have been using the system for over 10 years, dating back to 2002, which then correlates to the age of their subscriber

equipment. Other agencies have only recently joined the system, and purchased subscriber equipment. The agencies with the largest number of radios on the system are county agencies, followed by State agencies. These groups account for over 83% of the system's radios. Because of the differing periods at which agencies joined the system, some agencies will need to replace radios within the next few years, but others will not require replacement for many years. ***FE*** has used a baseline for replacement of 7 years for portable radios, and 10 years for mobile radios. Table 28 below lists 800 MHz mobile and portable radio inventory data provided to ***FE*** by MnDOT, along with the estimated costs for replacing these radios.

Without specifics on subscriber equipment age, ***FE*** is estimating the following:

- State of MN Radios:
    - 25% of the State agency radios were purchased in year 2002, which results in an estimated 2,850 radios that will require replacement no later than 2014. This estimate was based solely on the migration of MnDOT and MSP to the ARMER system in 2002 as they were the two largest state agencies to make the metro area transition at that time. ***FE*** has no insight into the subscriber unit replacement programs of MSP and MnDOT in the metro area. It is possible that some of these units have already been updated, but if they haven't these units are now 11+ years old and candidates for replacement.
    - 75% of the State agency radios were purchased in the year 2008-2009 period, when a significant expansion of the system statewide was initiated. This results in an estimated 8,550 radios that are five years old.

- Twin Cities Metropolitan Area agency radios: Most of these city and county agencies joined the system by the year 2007, and will need to plan for replacement of radios in the year 2014-2017 time frame. It is possible that some radio replacements have occurred or are in process, but no specific data is available.

- Other County agency radios: The county agencies outside the Twin Cities Metropolitan Area have been migrating to the ARMER system slowly over the past several years, with some agencies such as a Stearns and Olmsted Counties joining the system in 2004-2005, and others only now in the process of purchasing radios and beginning to use the system.

  FE assumes that 20% of the non-Metro county agency radios were purchased prior to 2007, and will require replacement sooner than other agencies who have only

recently purchased radios for system use. We also assume that 20% were purchased in the year 2010 and the remainder purchased since that time.

- Other agency radios: ***FE*** assumes for the remaining agencies that approximately 75% of the radios have been in service since the 2005-2006 period, and 25% are newer.

- Of the total subscriber units on the system, 50% are portable radios and 50% are mobile radios.

FE used the following cost estimates for the replacement of 800 MHz mobile and portable radios:

- Portable: $2,500
- Mobile: $3,500

These averages are based on the understanding that there are a variety of radio models, options, accessories and associated costs. The type of radio used by law enforcement, fire agency and other public safety agency are typically more expensive than the radios used by MnDOT or other public works personnel.

Table 28 – ARMER 800 MHz mobile and portable radio inventory and costs

Agency Type	Total Qty. of Radios Authorized	Estimated Cost of Radios needed by 2015	Estimated Cost of Radios needed by 2019	Estimated Cost of Radios needed by 2025	Total Agency Costs
State of MN (all agencies)	11,455	$19,238,000	$14,914,000	NA	$34,152,000
Metro Cities & Counties	23,377	$52,597,000	$17,532,000	NA	$70,129,000
Other Counties	39,723	$23,833,000	$23,833,000	$71,502,000	$119,168,000
Federal	1,030	$4,638,000	$1,546,000	NA	$6,184,000
Medical	2,097	$4,718,000	$1,572,000	NA	$6,290,000
Metropolitan Council	2,680	$6,030,000	$2,009,000	NA	$8,039,000
Interoperability	627	$1,410,000	$ 470,000	NA	$1,880,000
All Other	590	$1,332,000	$ 444,000	NA	$1,776,000
Totals	81,579	$113,796,000	$62,320,000	$71,502,000	$247,618,000

3.3 Long Term Evolution (LTE)

Most readers of this report are aware of the development of LTE (Long Term Evolution) technology, which is expected to be the next generation of public safety communications. LTE is an IP-based high capacity cellular radio communications technology, that is being designed to provide public safety grade mission critical voice communications. It is anticipated that these future LTE voice and data networks will mirror, to a certain extent, the commercial cellular telephone and data networks, but will be dedicated to public safety usage.

At this time it is extremely difficult to predict when these next-generation mission critical "one-to-many" voice LTE systems will begin to develop and become available, and whether or not they will eventually replace the current 800 MHz trunked radio systems. It is expected that the first LTE systems will primarily provide high-capacity data services, a feature that is lacking in the current public safety radio systems. Most public safety agencies have embraced the use of wireless mobile air cards through commercial cellular service providers, which are available for a monthly fee of $25 to $50 per unit.

It is important to note that the ARMER system was first and foremost designed as a voice radio system, with the goal of providing highly reliable voice communications for the users of the system. It was not designed for the purpose of delivering data services to mobile and portable field units. While it is true that the near-term version upgrades of the Motorola ASTRO 25 systems will allow or provide low-speed data services over the control channel of the trunked radio system, this is not intended to be a substitute for true higher-speed data applications on an LTE network. It will; however, provide data transport for interesting applications such as GPS location services and text messages.

4. Task 2—Current and Long-term Maintenance Costs for NG9-1-1 System

FE appreciates the critical importance of the Next Generation 9-1-1 (NG9-1-1) project to the state of Minnesota, to the citizens who dial 9-1-1 seeking emergency services, and to the emergency personnel providing the services. We understand the state of Minnesota has been heavily involved in the procurement of an emergency services Internet Protocol (IP) network (ESInet) for NG9-1-1 services and, more recently, the transition of Minnesota's public safety answering points (PSAP) to the leased ESInet.

4.1 Why NG9-1-1 is Necessary

NG9-1-1 is necessary because the telecommunications technology on which 9-1-1 was built is many decades old and the telecommunications technologies the majority of people use in their day-to-day communications has evolved beyond what this legacy technology can accommodate. The telephone companies are replacing their legacy telephone systems with modern IP technology platforms. Likewise 9-1-1 must take the same migratory path if it is to continue to provide a reliable mechanism for the public to get help in an emergency.

Minnesota has made tremendous progress in implementing landline and wireless Enhanced 9-1-1 service (E9-1-1) statewide. All Minnesota counties provide E9-1-1 for landline telephones and Phase II E9-1-1 for mobile / wireless telephones. Despite these advances in the level of 9-1-1 service, communication technologies are advancing at a faster rate than 9-1-1 can accommodate. A recent publication of the National Emergency Number Association (NENA) put it this way:

> *"Our nation's 9-1-1 system is being pushed to the edge and is increasingly falling behind as technology in the hands of consumers rapidly advances past the capabilities of the current E9-1-1 system. Text messaging and instant messaging are becoming a more common method of communication than the traditional two-way voice telephone call. Pictures and videos from phones and PDAs are being shared instantly with friends and colleagues around the world. Video and text based communications are replacing traditional TTY communications for the deaf and hard of hearing. Automobiles are being outfitted with telematics systems that automatically open up a voice call and provide valuable crash data when a car is involved in an accident. These are all amazing technologies, and citizens can reasonably expect to be able to contact 9-1-1 with technologies they use to communicate every day. Yet, all of these advancements in*

> *consumer communications technology have one important characteristic in common: today's legacy 9-1-1 system cannot deliver any of this information to 9-1-1 centers [emphasis added]."*[3]

Several years ago, Dale Hatfield, a former Federal Communications Commission (FCC) Office Chief, described today's 9-1-1 system as "*...an analog technology in an overwhelmingly digital world*."[4] Thus, the reason the legacy 9-1-1 system cannot handle these new modes of communication and new types of data is because analog circuit-switched telephone technology is too antiquated to do the job.

NG9-1-1, based on IP technology, is the long-term solution to this problem. An IP-based 9-1-1 system provides a high-speed backbone to transport 9-1-1 calls and data, and has the capability to encompass the existing landline, wireless and VoIP voice services, as well as telematics, still image and video transmissions, text and data messaging, and future communications technologies. It will enable first responders to be better informed, thereby improving their safety and their ability to save lives and property. NG9-1-1 is flexible, scalable, efficient and better able to adapt to the future.

Over the past 13 years, several national and federal initiatives to design and plan the transition to NG9-1-1 have occurred; some have concluded successfully and others are ongoing. These initiatives include:[5]

- The National Emergency Number Association's (NENA) Future Path Plan set forth the basic concepts of the migratory path toward what is now known as NG9-1-1.
- The Internet Engineering Task Force (IETF), the international standards body for the Internet, developed some of the most important protocol and data architectures that underpin NG9-1-1.
- The 3rd Generation Partnership Project (3GPP) is the standards organization for mobile broadband services; it developed the requirements and architecture for emergency calls originating from IP Multimedia Systems (IMS).

[3] NENA Next Generation Partner Program, "A Policy Maker Blueprint for Transition to the Next Generation9-1-1 9-1-1 System: Issues and Recommendations for State and Federal Policy Makers to Enable NG9-1-1," September 2008, Page 2.
[4] Hatfield, Dale N. "A Report on Technical and Operational Issues Impacting the Provision of Wireless Enhanced 9-1-1." October 2002, Page ii.
[5] Information taken from CSRIC *Working Group 4B Transition To Next Generation9-1-1 9-1-1 Final Report*, March 2011, pages 20-23

- The Alliance for Telecommunications Industry Solutions (ATIS) is the standards organization for the telecommunications industry. ATIS, in conjunction with 3GPP, continue work to define the interfaces between IMS-based networks and the Emergency Services IP network (ESInet) of NG9-1-1 for emergency voice and non-voice calls.

- The National Emergency Number Association (NENA) developed standards to incorporate IP-based mechanisms into 9-1-1 in three interim phases leading to end-state NG9-1-1: i1 (interim stage 1), i2 (interim stage 2) and i3 (interim stage 3). i3 defines the requirements[6], the architecture[7], and the detailed technical standards[8] for the ESInet and the NG9-1-1 services that are provided on the network.

- The Federal Communication Commission's (FCC) Network Reliability and Interoperability Council VII (NRIC VII), the predecessor to CSRIC, addressed the need for nationwide IP-based E9-1-1 capability and recommended that such capability should be deployed within an internetwork of managed and secured ESInets.

- The U.S. Department of Transportation (USDOT) developed a national framework and deployment plan for NG9-1-1 system, encompassing technical/engineering and institutional/ transitional considerations.

Minnesota has benefitted from the significant body of work these entities have accomplished; NG9-1-1 system elements have been identified and some standards are in place – at least enough to guide states in implementing the core NG9-1-1 system. It is in this context that Minnesota initiated its own NG9-1-1 transition.

4.2 *Next Generation 9-1-1 Project*

Minnesota's NG9-1-1 transition has begun and good progress has been made. An initial feasibility study was conducted in 2008. The state 9-1-1 program has implemented a statewide Emergency Services IP Network (ESInet) and all but a handful of Public Safety Answering Points (PSAPs) are now interconnected with this system; the remainder will be connected in the opening months of 2014. The next phases are to move the legacy telecommunications end office networks onto the statewide ESInet and decommission the legacy selective routers, to implement text-to-9-1-1 capability and to initiate a major

[6] NENA 08-751 *NENA i3 Technical Requirements document*
[7] NENA 08-002 *Functional & Interface Standards for NG9-1-1 (i3)*
[8] NENA 08-003 *Detailed Functional and Interface Specification for the NENA i3 Solution—Stage 3*

undertaking to meet the NENA i3 standard: transition the legacy 9-1-1 databases to a GIS-based NG9-1-1 database system. Future NG9-1-1 functionalities will be implemented over time as they become commercially available, for example enabling PSAPs to receive supplemental and supportive data with a 9-1-1 call, and a mechanism to store and retrieve these new data types.

4.2.1 Status of NG9-1-1 Backbone Construction and Funding

As a baseline for Minnesota's NG9-1-1 system, ***FE*** provides here a brief history of the project, the current status of the backbone construction, and documentation of the funding allocated for construction and the amount spent to date.

4.2.1.1 Minnesota's Next Generation 9-1-1 (NG9-1-1) Project History

As with nearly all states, Minnesota's existing 9-1-1 network is more than 30 years old and was designed to handle only traditional fixed landline calls. The communications technologies Minnesotans now use in their everyday lives have evolved to a level of sophistication beyond what this legacy 9-1-1 network can accommodate.

Minnesota understood the urgent need to address the looming problem and, in 2008, initiated a study of the existing network that identified a path to transition from the legacy 9-1-1 system to a modern IP-enabled, NG9-1-1 infrastructure utilizing high speed data connectivity.[9] Such an infrastructure would better meet the needs and expectations of Minnesota's telecommunications consumers.

Following that initial study, Minnesota began a strategic initiative to transition to NG9-1-1. The initiative began with the two incumbent 9-1-1 system providers (Independent Emergency Services, LLC (IES) and CenturyLink in partnership with Intrado). CenturyLink was awarded the contract to build the ESInet backbone, which would become the foundation for NG9-1-1. The backbone was to be deployed in three phases:

- Phase 1 was to build interoperability between the two 9-1-1 service providers, CenturyLink and, IES by installing the IP router between the 10 legacy selective routers.

[9] Minnesota Emergency Communications Networks Division Memo dated August 10, 2010: NG9-1-1 Fact Sheet, page 1. (Available at: https://dps.mn.gov/divisions/ecn/programs/9-1-1/Documents/MN_NG9-1-1_fact_sheet_8-10-2010.pdf [last accessed 11/20/2013])

- Phase 2 was a trial with a limited group of PSAPs to test the new IP network and IP router functionality, verify the installation process, and ensure a solid migration plan.

- Phase 3 was to extend the redundant diverse and high-speed network to all PSAPs statewide[10].

4.2.1.2 Current Status of the Backbone Construction

Phase 1 was completed in September 2010. From that point forward, PSAPs have been able to transfer 9-1-1 calls to any other PSAP in Minnesota regardless of its 9-1-1 service provider and with no loss of the two most vital pieces of information: the telephone number (or automatic number identification [ANI]) and location of the caller (or automatic location information [ALI]).)..

Phase 2 was completed on November 1, 2011, at Carver County and on March 1, 2012, at Kandiyohi County.

Phase 3 is nearing completion. As of December 31, 2013, 99 of 104 PSAPs had been migrated to the new IP network backbone. Wherever CenturyLink could not provide a diverse secondary path to the 9-1-1 call answering center, they utilized the state IP network (MNiT). Approximately half of all PSAPs' secondary path is provided by MNiT. In doing so, the division consolidated resources with other divisions within the Department of Public Safety (DPS), which lowered the cost to all. The project is on target to complete the migration of all 104 PSAPs by the end of the first quarter of 2014.

4.2.1.3 Documentation of Funding and Expenditures to Date

Funding for Phases 1 and 2 was provided by a grant[11] from the National 9-1-1 Office within the National Highway Traffic Safety Administration (NHTSA). The amount of Minnesota's award was $1,744,926.44, which the State matched with 9-1-1 funds. The grant funds were expended on the non-recurring costs to build the Phase 1 interoperable 9-1-1 network between the legacy selective routers and the new IP routers, the non-recurring costs to build the Phase 2 i3 network to the Beta test PSAP locations, and the services of the State's NG9-1-1 consultant. In addition, the grant required the State to match the grant amount with its own funds. This freed up budget and enabled the State

[10] For a detailed technical description of the three phases, see the Minnesota State 9-1-1 Plan, Version 1, July 2009, pages 24-27.
[11] Grant program described in the federal ENHANCE 9-1-1 Act of 2004 as amended.

9-1-1 Program to offer up to $10,000 to each PSAP to offset all of their non-recurring costs to migrate to NG9-1-1 backbone. PSAPs used these funds to pay for:

- Uninterruptible power supplies (UPS) for PSAP gateway modules (PGM)
- Electrical wiring for PGMs
- Labor for customer premises equipment (CPE) vendor
- Labor for logging recorder vendor
- Demarcation point extensions

The State used its own 9-1-1 funds to pay for the capital expenses associated with Phase 3 – extending the i3 network backbone statewide.[12] The total expended to date is approximately $9,315,000. Table 29 provides an overview of expenditures to date and recurring costs (monthly and annually).

Table 29 – Total NG9-1-1 Costs to Date

System Element	System Provider	Cost as of 11/15/2013
Backbone	CTL	$34,000
Backbone	IES	$246,000
NG9-1-1 PSAP Circuits	CTL	$101,000
NG9-1-1 PSAP Circuits	MNiT	$22,000
Consulting		$908,000
Total		**$1,311,000**

[12] There is a difference between the amount of the ENHANCE 9-1-1 Act grant awarded to Minnesota and the total capital expenditures to date; in essence, the state did not use all of the funds awarded. The reason was because the term of the grant expired before Phase 3 was complete.

Recurring Costs			
Monthly		**Annually**	
CTL Backbone	$73,000		$876,000
IES Backbone	$62,000		$744,000
NG9-1-1 PSAP Circuits	$131,000		$1,572,000
MNiT PSAP Circuits	$17,000		$204,000
NG9-1-1 ALI	$371,000		$4,452,000
FUSF	$13,000		$156,000
Total	**$667,000**		**$8,004,000**

4.2.2 Projected Future Phases of NG9-1-1 Project

In consultation with ECN and its NG9-1-1 consultant, ***FE*** identified and outlined the remaining phases to bring a fully featured and standards-based NG9-1-1 system to Minnesota residents.

Building the high speed network backbone is only the first step toward end-state i3 and future NG9-1-1. There is still much work to be done and that work will span the next several years.

4.2.2.1 Phase 4

The next planned phase, Phase 4, is to move the legacy telecommunications end office networks onto the statewide ESInet and decommission the legacy selective routers. The Minnesota 9-1-1 Program conducted a due diligence exercise with its NG9-1-1 consultant to solicit input from vendors regarding how they might approach the Phase 4 initiative. The Minnesota 9-1-1 Program plans to issue a Request for Proposals (RFP) to procure a vendor or vendors to do this work.

As a result of the work associated with Phase 4, the State will have the opportunity to review the sizing of the network to ensure that it does not have an excess of 9-1-1 trunks. It is not uncommon for 9-1-1 service providers to provision the legacy system with more end office trunks than are needed. There may be rational reasons why this is done, but it does result in unnecessary cost. If Phase 4 validates this, then right-sizing the network could reduce the cost of the network by as much as $2-3 million, according to State 9-1-1 program officials. That savings could well cover the cost of Phase 4. If it is proven

otherwise, or if providers file new tariffs requiring the State to incur new costs, then the State will need to reconsider how it approaches the migration of the legacy end office networks to the ESInet. One option would be to migrate the wireless providers and delay the migration of the landline end office networks until a future time.

Ideally, when Phase 4 is complete, landline, cellular and Voice over IP (VoIP) 9-1-1 calls all will be transported over the new IP backbone network. Until the responses to the Phase 4 RFPs are in, it is not known exactly how much this aspect of the transition to NG9-1-1 will cost, but the State has a budgetary placeholder of $3 Million.

4.2.2.2 ESInet Rebid

As this report was being compiled, the Minnesota 9-1-1 Program was preparing to rebid the ESInet due to state laws limiting contract extensions without periodically going out to bid. We note that this network may be rebid twice more over the period covered by the 15-year cost projection that is part of this report. It is important to keep in mind that this could have a major impact on the cost projections set forth if the State has to procure the same network all over again from a different vendor. For the purposes of this study, we have assumed ESInet status quo.

The Minnesota 9-1-1 Program also intends to include text-to-9-1-1 in its pending ESInet procurement. Based on pricing from the current ESInet provider, the text-to-9-1-1 costs can be estimated and are presented in Section 4.3.1 of this report. Actual costs for text-to-9-1-1 will be known when the procurement has occurred. It is also necessary to note that the text-to-9-1-1 that will be implemented in Minnesota as a result of the upcoming procurement is an interim solution and not the final NG9-1-1 solution; thus, there will likely be additional future costs to fully implement NG9-1-1 text-to-9-1-1 service.

4.2.2.3 Remaining Phases

After Phase 4, other aspects of the transition to NG9-1-1 must be implemented. The industry standard for the transition to NG9-1-1 is the NENA i3 standard. The i3 standard is ‘interim stage 3’ along the migratory path toward NG9-1-1. It is *not* end-state NG9-1-1:

> *"Critically, the i3 standard is not, by itself, the same thing as an NG9-1-1 system. The i3 standard describes only the network, components, and interfaces required to establish Next Generation 9-1-1 service."*[13]

During the interim between the legacy 9-1-1 environment and the NG9-1-1 environment, transitional steps must be taken. These include maintaining support for legacy interfaces from originating service providers such as landline, VoIP and cellular service providers, and to accommodate legacy equipment at the PSAP. These steps also include transitioning from the legacy database structure to the i3 database structure that will ultimately support NG9-1-1.

The NENA i3 standard lists a number of conditions that must exist for a 9-1-1 system to be considered to have met the standard.[14] Among the most important is the necessary transition from the tabular Master Street Address Guide database (MSAG) and Emergency Service Numbers (ESNs) to a Geographic Information System (GIS) based Location Validation Function (LVF), Emergency Call Routing Function (ECRF), Emergency Services Routing Proxy (ESRP) and Location to Service Translation (LoST) protocol. Additionally, seamless, statewide GIS data suitable for NG9-1-1 (another of NENA's necessary conditions) must exist. Neither of these conditions exists in Minnesota and so they must be developed and implemented.

Stressing the importance of the database transition to the proper functioning of NG9-1-1, the CSRIC Working Group 4B Final Report states:

> *"NG9-1-1 relies on up-to-date and precise spatial data. It is extremely important for 9-1-1 Authorities and PSAP management to understand the level of accuracy and precision required [emphasis added] and how spatial data can best be verified and maintained. Having MSAG, ALI, and GIS datasets reconciled and synchronized as part of an NG9-1-1 transition is crucial to creating the NG9-1-1 databases responsible for both routing the NG9-1-1 call and providing telecommunicators with the information they need to correctly verify the location of a caller and provide proper emergency response. 9-1-1 authorities will need to possess the technical*

[13] NENA 08-003 Detailed Functional and Interface Specification for the NENA i3 Solution, June 2011. (Available at: http://c.ymcdn.com/sites/www.nena.org/resource/collection/2851C951-69FF-40F0-A6B8-36A714CB085D/08-003_Detailed_Functional_and_Interface_Specification_for_the_NENA_i3_Solution.pdf> page 16 [last accessed 11/15/2013])
[14] Ibid, Introductory page

> *database skills necessary to create, edit, and maintain these complex geospatial datasets."*[15]

The State could include these and other remaining i3 capabilities in its upcoming ESInet procurement, but its preference is to procure the ESInet and the i3 database components separately. The latter procurement is projected to take place in the second or third quarter of 2014. Until responses to the RFP(s) have been submitted, it will not be known exactly what these additional i3 components will cost the state of Minnesota. Nevertheless, the USDOT NG9-1-1 System Initiative produced a Cost, Value, Risk Analysis report, which provides a scientific estimate of what the database components of NG9-1-1 could cost. That said, the report itself contains a strong caution in the use of these data:

> *"The cost data collected for this report were developed based on general population segments and may not be suitable for use in costing out individual county or state needs for NG9-1-1 investment purposes."*[16]

Nevertheless, in the absence of actual pricing information from a formal procurement, this is a reasonable approach that will give Minnesota policy makers an idea of what to expect. The information is presented in Section 4.3.1 of this report.

Once i3 is fully implemented, the foundation will exist for each PSAP to have NG9-1-1 features and functionality as they are developed and become commercially available in the future.[17] These future features and functionalities are reviewed in the next section of this report. In order for future features and functionalities to be implemented, much more work must be done at the national level to prepare. NENA notes:

> *"In order to deploy a fully-operational NG9-1-1 system, 9-1-1 authorities, equipment and software vendors, originating service providers, and access network providers will require detailed specifications for technical,*

[15] CSRIC Working Group 4B Final Report, March 2011, page 69
[16] USDOT NG9-1-1 System Initiative, *Final Analysis of Cost, Value and Risk*, 2009, page 52. (Available at: http://www.its.dot.gov/ng9-1-1/pdf/USDOT_NG9-1-1_4-A2_FINAL_FinalCostValueRiskAnalysis_v1-0.pdf. [last accessed 11/20/2013])
[17] It must be noted that a PSAP's ability to take full advantage of any future NG9-1-1 applications and functionality is not within the control of the Minnesota 9-1-1 Program. While the network infrastructure may be capable of providing new features and functions, and offer new types of applications, the PSAP will not be able to take full advantage of the new capabilities until its Customer Premises Equipment (CPE) is IP end-to-end and its call-handling applications are ready to handle the new types of data and new transactions, The replacement of legacy CPE with IP CPE may take years to accomplish. Furthermore, software upgrades will be required as new capabilities become commercially available.

> *operational, and human elements that are not described in the i3 standard.[18]"*

Some of these detailed specifications are under development and others in planning. Clearly, the transition to end-state NG9-1-1 will occur over time. Ultimately, the Federal Government's plan for NG9-1-1 is for there to be seamless nationwide NG9-1-1 coverage. This will require Minnesota to build interconnectivity between its ESInet and those of its neighboring states as those states complete their own individual migrations to NG9-1-1. When this will occur is not within Minnesota's control.

4.2.3 Review of Potential Features and Functionalities Available in the Future

Our subject matter experts reviewed documentation provided by the National Emergency Number Association (NENA) and the United States Department of Transportation (USDOT) to outline the potential features and functionalities of a fully featured and standards-based NG9-1-1 system.

We observe that some, but not all, potential features and functionalities of NG9-1-1 have been identified. The reason is that the telecommunications industry is constantly evolving and there will be new capabilities that will come into being in the future that cannot be known or anticipated right now. For now, the most commonly discussed NG9-1-1 features and functions are the capability to send, receive, relay, store and retrieve text messages, photographic images, streaming video and data.

Text-to-9-1-1 is the first new capability to have been introduced. Several text-to-9-1-1 trials have already occurred or are presently occurring around the nation. In December of 2012, the dominant wireless telecommunications providers announced they would voluntarily implement "bounce-back messages" to callers who attempt to send a text to 9-1-1 in areas where the service is not yet available. In May of 2013, the FCC issued an order mandating text-to-9-1-1 service by May 15, 2014, in all areas where a 9-1-1 call center is prepared to receive the texts, and mandating an automatic bounce-back message in areas where the service hasn't been deployed. However, the text-to-9-1-1

[18] NENA 08-003 Detailed Functional and Interface Specification for the NENA i3 Solution, June 2011. (Available at: http://c.ymcdn.com/sites/www.nena.org/resource/collection/2851C951-69FF-40F0-A6B8-36A714CB085D/08-003_Detailed_Functional_and_Interface_Specification_for_the_NENA_i3_Solution.pdf> page 16 [last accessed 11/15/2013])

service that is being deployed is limited and does not meet expectations for NG9-1-1, the most important of which is that location information must accompany the message.

In the NG9-1-1 environment, essential data[19], analogous to today's telephone number (ANI) and location information (ALI) data, must be included in the data stream that accompanies the call. Essential data would include:

- Call back number
- Location information
- Origination code
- Call routing code
- Database access routing code
- Responding agencies

Photographic and video information could fit into NENA's definitions of "supportive" or "supplemental" data,[20] that is, additional information used to facilitate call handling and dispatch that could be included in the call stream or retrieved from internal or external data sources after the call reaches the PSAP. Supportive data could include:

- Medical records
- Disability information
- Automatic Crash Notification (ACN) information (vehicle roll over, airbag deployment, safety belts engaged, number of passengers, speed at time of crash)
- Pre-arrival instructions
- Non-English language preference

Supplemental data are retrieved after the call reaches the PSAP and could include:

- Building blueprints

[19] NENA, *Future Path Plan*, 2002, page 9. The concepts of essential, supportive and supplemental data were first presented here.
[20] Ibid

- Telematics
- Spatial data
- Amber Alerts

NG9-1-1 envisions that PSAPs would have this kind of information available to their call-takers.

Related to these new types of data is the matter of data storage and retrieval. Today's 9-1-1 system includes the capability to record, store and retrieve location data and voice; but it was not designed to handle photographs, video, supportive or supplemental data. The need for the NG9-1-1 system to have these capabilities is well known and has been described by NENA and the U.S. Department of Transportation[21], but, to date, this functionality and capacity has not been built into any system anywhere.

Provisioning Minnesota's ESInet and PSAPs to be able to handle new types of data as well as the processes associated with delivering, accessing, storing and retrieving them will be the result of future effort involving many parties. Until there is a formal procurement, it is not known what provisioning this functionality will cost. That said, the USDOT's NG9-1-1 Cost, Value and Risk Analysis includes data storage capacity in its cost estimates.

4.3 NG9-1-1 State Cost Elements

At the state level, NG9-1-1 cost elements are analogous to today's cost elements: network, databases and connectivity, as well as operational cost elements such as personnel. This is not to say that actual costs are also analogous; NG9-1-1 costs may be higher once a competitive bidding process has occurred. It cannot be overstated that NG9-1-1 recurring and non-recurring cost elements are *in addition* to current obligations on the 9-1-1 special revenue fund.

4.3.1 Implementation Costs and any Fixed Equipment Costs, Non-recurring Cost Elements

Based on input from ECN and its NG9-1-1 consultant, ***FE*** documented the estimated implementation costs for the remaining phases of the NG9-1-1 system. Included in the

[21] U.S. Department of Transportation NG9-1-1 System Initiative, *System Description and Requirements Document*, 2007, page 5-26 et seq. (Available at: http://www.its.dot.gov/ng9-1-1/pdf/NG9-1-1_HI_RES_Requirements_v2_20071010.pdf. [last accessed 11/15/2013])

cost estimate are one-time non-recurring cost estimates and an estimate of NG9-1-1 system fixed equipment.

While the remaining NG9-1-1 cost elements are known, the non-recurring and recurring costs associated with these elements are not known with precision. Formal procurements must be initiated and responses from vendors received before actual pricing can be known. Therefore, the information presented here is high level and is based on information provided by the Minnesota 9-1-1 Program staff, ***FE***'s industry knowledge, information published by USDOT previously mentioned, and information provided by Minnesota's NG9-1-1 consultant.

See Table 30 for a presentation of cost elements, known non-recurring costs and non-recurring cost estimates. These costs do not represent local government costs. Phase 4 will not have a cost to local government. However, increases in the 9-1-1 fee distribution occur in years 2016 and 2020 to represent the increase in cost that textText-to-9-1-1 and GIS deployment require. These increases may need to occur earlier if these projects are deployed earlier and they may need to be increased if the costs to locals come in higher than anticipated.

Table 30 – Estimated State Remaining Phases Non-Recurring Costs

Remaining Phases	Non-Recurring Cost (assumes implementation in 2014)
Phase 4	$3,000,000
Text-to-9-1-1	$520,000
Develop Seamless Statewide GIS Data	$3,400,000[22]
i3 Databases	$8,600,000
Total	**$15,520,000**

[22] This figure was based on the federal ENHANCE 9-1-1 Act grant awarded to the state of Michigan for the development of a GIS database accessible to all PSAPs, and the 50% match the state provided from its own funds. The project involved data design, and workflow and replication processes; the development of web services to enable access to and extracts from the datasets; programming to ensure data security and protection; installation of data repository server hardware and software; creation of a statewide PSAP boundary layer and the acquisition of all existing road centerlines and ensuring all segments that meet at political boundaries were snapped and edge-matched correctly.

4.3.2 Maintenance and Operations Costs and other Recurring Cost Elements

FE documented the current E9-1-1 and NG9-1-1 operation and maintenance costs and recurring costs and projected them over the next 15 years. These costs are summarized in Attachment E *–15 Year ARMER and 9-1-1 Maintenance and Operations Recurring Costs*.

4.3.3 Administrative Costs including SECB, Standards Development, Training, etc.

FE documented the existing administrative costs, including the Statewide Emergency Communications Board (SECB), to manage the State's E9-1-1 system and the growing NG9-1-1 network. We also appreciate the need to develop standard operating procedures for network utilization and the need for statewide training to ensure a consistent and effective use of the full features and functionality of the NG9-1-1 system. Therefore, we provide here a high-level recommendation on the annual funding amount necessary for standards development, review, revision and management and for a statewide training program on system utilization, features and standards, based on the inputs received during this study.

Proper administration of the State's part of the NG9-1-1 system may require additional staff with expertise in NG9-1-1 network, database and GIS technology if the current technical coordinator does not have the specific skillsets necessary or if the additional workload cannot be handled by a single person. Other necessary functions related to standards and training could be handled by existing staff to the extent the additional responsibilities could be absorbed by a single individual. ***FE*** expects that the State will need to develop the same types of technical and operational standards for NG9-1-1 as it did for the ARMER system. Local/regional ESInets would be required to meet the minimum standards developed for the State ESInet, and there would need to be standards for interconnection between these ESInets and the State ESInet. On the operational standards side, there will be the need to establish standards and training for handling text messages, streaming video, still photographs, supportive and supplemental data, and other NG9-1-1 capabilities as they are implemented. Due to the nature of NG9-1-1, it will be essential that all Minnesota PSAPs provide the same level of service and that all telecommunicators have the same level of training. The Minnesota 9-1-1 Program's existing standards and training staff could develop training and certification standards in conjunction with the Statewide Emergency Communications Board (SECB). That would help ensure broad stakeholder acceptance. Once training and certification

standards are developed, ***FE*** expects the training program would be managed as it is today – by the Sheriff's Association.

It is possible that the State could use its NG9-1-1 consultant for some or all of these activities. Assuming these would be staff functions and not consultant services, and assuming additional expertise would need to be hired or procured through a cooperative arrangement with another state agency, we have provided information from the USDOT's Final Analysis of Cost, Value and Risk on what new staff positions for NG9-1-1 technology and GIS/database could cost.[23] See Table 31.

Table 31 – New Staff Expertise Compensation

New State Staff Expertise[24] Compensation ($2014)	
NG9-1-1 Network IT Manager	$64,000
NG9-1-1 GIS & Database Technician	$47,000

Based on the assumptions previously stated, the only changes to the Minnesota 9-1-1 Program's normal administrative budget should be the addition of these new staff positions at a future point in time. Thus Table 32, *Current State 9-1-1 Program Administrative Costs*, presents actual administrative costs (including the SECB) for 2013 and projected administrative costs for 2014.

[23] Derived from Sahr, Robert C., Political Science, Oregon State University, *Consumer Price Index (CPI) Conversion Factors 1774 to estimated 2023 to Convert to Dollars of 2012*, 2012. The calculation presented in this Report assumed the OMB's inflation rate for 2018-2023 would apply to the years 2024-2028.

[24] USDOT NG9-1-1 System Initiative, *Final Analysis of Cost, Value and Risk*, 2009, page 121. (Available at: http://www.its.dot.gov/ng9-1-1/pdf/USDOT_NG9-1-1_4-A2_FINAL_FinalCostValueRiskAnalysis_v1-0.pdf. [last accessed 11/20/2013]

Table 32 – Current State 9-1-1 Program Administrative Costs

Administrative Expenditures	2013 Actual	2014 Projected
Compensation 9-1-1 (P079609)	$366,000	$472,000
Compensation SRB (P079679)	$70,000	$0
Compensation ARMER Interop (P079689)	$283,000	$354,000
Compensation TOTAL	**$719,000**	**$826,000**

Local expertise for GIS will also be required. Each county will most likely need to add a GIS and Database Technician to the PSAP to ensure that any addressing changes are uploaded into a statewide GIS system in a timely manner. This will require coordination between the county addressing departments and the PSAPs. The costs of additional personnel are not covered by the 9-1-1 fee distribution to the PSAPs and will need to be covered by the county's budget unless the statute is expanded to include personnel costs of the PSAP. Some counties may choose to hire an outside vendor rather than create this expertise in house.

4.3.4 Projected Costs of Future NG9-1-1 Phases

Based on the sub-tasks associated with assessing NG9-1-1 funding, the cost estimates contained here in Table 33 provide a high-level estimate for each identified future phase of the NG9-1-1 project.

Since text-to-9-1-1 capability will be part of the upcoming ESInet re-bid, ***FE*** did not include it in this presentation of future NG9-1-1 phases and costs. Other NG9-1-1 functionalities that are currently known, but not yet developed, are the ability for PSAPs to receive streaming video, still photographs, and for the NG9-1-1 system to provide supportive and supplemental data.

The addition of new data types will also require greater data storage capacity than is necessary in the legacy 9-1-1 environment. Since the ESInet has, or should have, the bandwidth to transport these types of data, we have assumed that the addition of the future capabilities we have described will require only:

- The procurement of a data storage and retrieval system/service

- System modifications necessary to incorporate supportive and supplemental data into the call stream or to enable a 9-1-1 call-taker to otherwise get access to the information

Table 33 – Projected Future Costs of NG9-1-1 Phases

Phases	Non-recurring Cost Estimates	Annualized Recurring Cost Estimates
Data Storage/Retrieval System[25]	$550,000	$1,120,000
System Modifications for Supportive/Supplemental Data[26]	Unknown	Unknown

The pricing estimates for these future costs are based on 2008 dollars and are derived from the USDOT's NG9-1-1 project. NENA has developed standards for the data, but there are no standards for how, exactly, supportive and supplemental data will get into the NG9-1-1 call delivery system nor is it known when vendors will develop that capability, ***FE*** does not recommend Minnesota attempt to project these costs at this time. We provide the information to ensure all parties are aware that these are a necessary aspect of NG9-1-1 and will need to be budgeted and deployed when the standards and functionality become available.

4.4 NG9-1-1 Local Cost Elements

Local NG9-1-1 cost elements at the local level are largely analogous to legacy 9-1-1 cost elements: 9-1-1 call handling equipment and ancillary equipment. Local government already covers the cost to maintain GIS for wireless Phase 2 mapping; however, meeting the i3 standard for GIS data will require greater attention to the accuracy and timeliness of GIS data development and maintenance activities. This will likely involve increased costs for most counties. Additionally, the NG9-1-1 location database will now be in GIS format, which will represent an entirely new cost at the local level.

4.4.1 Implementation Costs and Fixed Equipment Costs, Non-recurring

FE received input from the ECN, drew upon its industry knowledge and used the USDOT's NG9-1-1 *Final Analysis of Cost, Value and Risk* to identify the costs for local

[25] USDOT NG9-1-1 System Initiative, *Final Analysis of Cost, Value and Risk*, 2009, page 137. (Available at: http://www.its.dot.gov/ng9-1-1/pdf/USDOT_NG9-1-1_4-A2_FINAL_FinalCostValueRiskAnalysis_v1-0.pdf. [last accessed 11/20/2013])
[26] No one has studied this, so there is no information available about what it would cost. This is one of those areas identified previously where standards still have to be developed.

implementation. These costs include local non-recurring and fixed equipment costs to fully migrate to Minnesota's NG9-1-1 system.

In Minnesota's 9-1-1 and NG9-1-1 environment, the State covers the common backbone costs (network, databases, routing); counties receive an annual aggregated amount of $13,664,000 in aid from the State 9-1-1 Program for their 9-1-1 costs[27]. Counties use these funds to maintain and upgrade the 9-1-1 equipment and systems within their PSAPs and to perform certain tasks necessary for the proper operation of 9-1-1 at the local level.

In an NG9-1-1 PSAP environment, there will be few completely new costs associated with equipment hardware and software; however, these costs may be higher overall due to the sophistication of the technology and the fact they are IP-based. PSAPs already must maintain and periodically replace or upgrade their 9-1-1 telephone systems and related call-handling hardware and software (including map display capability); when these cost elements reach the end of their lifecycle, PSAPs would simply replace them with their IP-enabled equivalents. PSAPs already must record 9-1-1 calls; the NG9-1-1 call recording system will have the capacity to record and store new types of incoming calls and data, but the function is still the same. It is important to note that this equipment life cycle is now much shorter. The upgrade and replacement cycle will be about every 3-5 years.

As mentioned above the largest new expense will be the cost to maintain the location information data in a GIS-based format. PSAPs already maintain their MSAGs, but the NG9-1-1 MSAG will be GIS-based. While some counties may already pay an employee or a contractor to maintain structures for E9-1-1, this work will continue and become even more important in a NG9-1-1 environment, because GIS is an integral component of NG9-1-1 database structure and functionality. Most counties will require additional GIS talent on board (either direct employees or contractors) to ensure the data meet the requirements of the NG9-1-1 system. Other counties may have no GIS staff or GIS data, and will need to initiate the process to prepare for NG9-1-1. Personnel costs are not currently acceptable use of the 9-1-1 fee distribution. This will be an additional expense to the PSAP budget funded by the county tax base.

Finally, there will be additional technical and operational standards that PSAPs must meet. For example, there will be new security requirements. In addition, training will be necessary for PSAP personnel as new equipment, NG9-1-1 features and functionality are added to Minnesota's NG9-1-1 system.

[27] PSAPs have other costs not exclusively attributable to 9-1-1, and they cover these costs using local funding sources.

Table 34 provides an overview of NG9-1-1 cost elements at the PSAP level. The information is derived from the USDOT's *Final Analysis of Cost, Value and Risk*, page 134. For the purposes of the USDOT's initiative, specific NG9-1-1 deployment scenarios were developed as a means to identify the cost elements and costs to implement NG9-1-1 nationwide. The PSAP "unit" in the USDOT's study used an actual state with the number of PSAPs it had at the time as the model; that state operated a single statewide E9-1-1 system engineered to the American Society for Testing and Materials (ASTM) standard for sizing 9-1-1 systems. In the USDOT model, a PSAP "micro unit" was 10-12 PSAPs with 32 equipment positions. A "PSAP unit" equated to 100 PSAPs with 320 call-handling equipment positions. Minnesota has 104 PSAPs and 462 call-handling equipment positions; the number of PSAPs is close to the model, but the number of equipment positions is larger than the model. *This means that Minnesota's costs might be higher than what is presented.*

Table 34 – Non-recurring Local Implementation Costs and Fixed Equipment Costs per PSAP Unit

Architecture Hardware Component	Description	Units	Estimated Unit Cost	Acquisition Cost	Implementation Cost
Hardware					
PSAP IP ACD	Automatic Call Distributor	12	$16,000	$195,000	$185,000
NG9-1-1 Call Termination	Workstations with HMI[28]	32	$50,000	$1,600,000	$1,520,000
	Peripherals	12	$20,000	$240,000	$228,000
GIS	Server (legacy)	12	$14,000	$165,000	$157,000

[28] Human-Machine Interface

Architecture Hardware Component	Description	Units	Estimated Unit Cost	Acquisition Cost	Implementation Cost
Software					
PSAP IP ACD	ACD software (bundled in HW)	0	$ 0	$ 0	$ 0
NG9-1-1 Call Termination	HMI (bundled in CPE)	0	$ 0	$ 0	$ 0
GIS	GIS Software (legacy)	12	$3,000	$34,000	$33,000
Total PSAP Unit Estimate				**$2,234,000**	**$2,123,000**

Counties would continue to use their 9-1-1 monies for all of these cost elements. The State will need to provide additional funding for the GIS aspect of NG9-1-1 to ensure the data meet the standards for NG9-1-1.

4.4.2 Maintenance and Operations Costs and other Recurring Cost Elements

FE received input from ECN, the NG9-1-1 consultant, and the 104 PSAPs in Minnesota for local operations and maintenance costs and recurring costs of their 9-1-1 systems as projected for NG9-1-1.

The statute at Chapter 403.113 Subdivision 3 defines what local costs are eligible uses of 9-1-1 funds. A complete discussion of this subject may be found in Section 5.2 of this report.

Counties are required to submit an annual audit report to the Minnesota 9-1-1 Program documenting their use of their 9-1-1 fund distributions. Their current maintenance and operational costs are reported in specific categories and are presented in summary form in Table 35.

As noted in the previous section of this report, it is anticipated that some counties may need to obtain additional GIS staff or contractor support to ensure the GIS data and MSAG meet the standards required for NG9-1-1.

Table 35 – 2012 PSAP Maintenance & Operational Recurring Cost Summary

Cost Elements	Amount
Telephone equipment	$2,476,000
Recording equipment	$752,000
Computer hardware	$4,761,000
Computer software	$3,283,000
Trunk lines	$301,000
MSAG	$424,000
Training	$721,000
Equipment to notify and respond (dispatch)	$1,518,000
Community alert system	$303,000
Long distance call transfer charges	$3,000
Total	**$14,542,000**

A spreadsheet showing the county-by-county breakdown for 2012 may be found in Attachment F – *PSAP Maintenance Operations and Recurring Costs*. 2013 figures will not be available until sometime after the middle of 2014.

4.5 Current Funding Strategies

At the state level, the 9-1-1 program has funded its NG91-1 initiative with a federal ENHANCE 911 ACT grant and its 9-1-1 fee revenues. The federal ENHANCE 911 Act grant awarded to the State by NHTSA in the amount of $1,744,926.44, was used to fund Phases 1 and 2 of its NG9-1-1 initiative. The 9-1-1 fee generated approximately $63,264,000 in 2013 and is expected to generate about $61,811,000 in 2014. At the local level, 9-1-1 is partially funded from the 9-1-1 fee distribution counties receive from the state; most of the needed funding comes from local taxes and other sources.

4.5.1 State Costs

FE documented the amount of funds the 9-1-1 fee provides annually and the amount of federal grant funds received by the State for NG9-1-1 migration or planning.

The Minnesota 9-1-1 fee is currently $0.78 per subscriber line per month and is assessed on landline, wireless, VoIP and prepaid wireless telecommunication subscribers. There have been no revenues from prepaid wireless service, because the law just went into

effect on January 1, 2014.[29] Until there is a historical record of remittances from prepaid services, it will not be possible to project revenue. Nevertheless, all states that have implemented a prepaid wireless 9-1-1 fee saw an increase in revenue. It is important to note that Minnesota has been collecting the fee from some prepaid wireless subscribers already. The State will lose an additional 5% of the 9-1-1 fee because the retailers and the Department of Revenue retain a portion of the fee to cover their overhead expenses of collecting the fee. Despite the addition of prepaid wireless to the revenue stream, The ECN budget anticipates an increase in the fee will be necessary to accommodate the increased costs to deploy the future phases of the NG9-1-1 migration.

4.5.2 Local Costs

FE documented the amount of funds provided to each PSAP based on the statutory formula. We also worked with ECN to identify and document any grants awarded to the PSAPs and the annual local funding to each PSAP. We reviewed the annual reports submitted by each PSAP, documented reserve balances by PSAP, and identified trends in spending.

The State 9-1-1 Program provided ***FE*** with a summary spreadsheet of the 2012 reports submitted by all counties. This is the most current data; the spreadsheet is included in this report as Attachment G – *2012 E9-1-1 Fund Audit Summary*.

It is important to understand that these annual reports account only for how PSAPs use their 9-1-1 funds; they do not contain any information about a county's overall PSAP budget or what other sources of funding they use to cover their capital and operational expenses. Personnel costs to answer 9-1-1 calls and other PSAP operational costs are not allowable uses of 9-1-1 funds. Thus, counties must fund much of their PSAP costs through county or city budgets. This could be the subject of a future more detailed research project.

By statute, the PSAPs in the aggregate receive a $13,664,000 distribution annually from the State 9-1-1 fee revenues. Chapter 403.113, Subdivision 2, Subsection 1-2d sets forth the formula for the distribution to individual PSAPs. Attachment G documents the amount distributed to each county. The 2012 ending balance total for all counties was approximately $20,593,000.

[29] 3% of the prepaid wireless fee will be retained by the retailer collecting the fee; 2% will be retained by the Minnesota Department of Revenue. Therefore, approximately $0.04 of every fee collected will be subtracted from the fees the 9-1-1 program will receive from prepaid wireless.

FE reviewed the annual reports from 2011 and 2012 to identify spending trends in each reported category. This comparison is shown as a percentage of their overall expenditures in Table 36.

Table 36 – PSAP Spending Analysis

Cost Element	2011 Percentage	2012 Percentage	Change
Telephone equipment	22.4%	17.0%	5.4% decrease
Recording equipment	7.2%	5.2%	2.0% decrease
Computer hardware	12.5%	32.7%	20.2% increase
Computer software	25.6%	22.6%	3.0% decrease
Trunk lines	2.0%	2.1%	.1% increase
MSAG	4.5%	2.9%	1.6% decrease
Training	6.7%	5.0%	1.7% decrease
Equipment to notify and respond (dispatch)	5.1%	10.4%	5.3% increase
Community alert system	14.0%	2.1%	11.9% decrease

FE's assessment of this information is that it reflects normal fluctuations of equipment replacement cycles and new equipment procurements. Since a significant percentage of Minnesota's call handling CPE is reaching or is past the end of its lifecycle,[30] it is not surprising to see an overall increase in hardware and software expenditures at the local level.

[30] L.R. Kimball *Final Report on state of Minnesota Current9-1-1 9-1-1 Assessment and Next Generation (NG)9-1-1 9-1-1 Strategy*, 2008. Pages 33 and 41

5. Task 3—Assessment of Current and Future 9-1-1 Revenue Stream

Building on the assessment of this funding stream completed in 2008, ***FE*** worked with ECN to project future 9-1-1 revenues based on historical and predicted changes in consumer telecommunications habits. Landline 9-1-1 fee collection has fallen in Minnesota and across the country as consumers permanently move away from landline communications and migrate to mobile wireless communications. We also understand that cellular technology has a very high penetration in the consumer market (i.e., in many families, all members have cell phones) and that VoIP and prepaid wireless services may have an impact on the future 9-1-1 revenue stream. For now, it appears that future funding needs can be met with simple adjustments to the fee rate. In the interest of providing information for consideration, should alternative funding mechanisms be necessary in the future, several options are summarized in this section.

5.1 Historical 9-1-1 Fee Analysis

FE worked with ECN to obtain current and historical 9-1-1 fee collection amounts and identified and catalogued existing commitments of the 9-1-1 Special Revenue Account. We analyzed the 9-1-1 fee collection data, paying close attention to emerging trends and developing assumptions about the future 9-1-1 fee revenue. We also evaluated the work by the National Highway Traffic Safety Alliance (part of USDOT) and compared their findings to any identified trends in the Minnesota 9-1-1 fee analysis.

5.1.1 Historical Revenue Trends in Minnesota

The State 9-1-1 Program staff provided ***FE*** with historical information spanning the years from 1988 to the present and future forecasts from the present to 2017. From 1988 through 1994, the 9-1-1 fee was imposed only on landline telephone services. The revenue trend during that period of time was relatively flat, with only modest increases in some years (less than $500K).

Since 1995, the fee has been assessed on wireless telephone services; and since 2006 the fee has been required of packet-based (VoIP) telecommunications. Overall revenues increased from 1995 to the present due to wireless and VoIP remittances, but the landline contribution to the overall bottom line revenue began to decline in 2007 and has continued as consumers abandon landlines in favor of wireless or VoIP. See Table 37 for a 15-year 9-1-1 revenue forecast. Please see Attachment H for a spreadsheet showing the entire financial forecast, including revenue projections which anticipate the need for a fee increase in future years depending on the outcome of prepaid wireless fee remittances

Table 37 – 15-Year 9-1-1 Revenue Forecast

Year	Revenue Projection
2014	$61,811,000
2015	$67,471,000
2016	$73,237,000
2017	$73,531,000
2018	$74,006,000
2019	$76,882,000
2020	$77,322,000
2021	$77,741,000
2022	$78,140,000
2023	$78,521,000
2024	$78,886,000
2025	$79,236,000
2026	$79,572,000
2027	$71,486,000
2028	$63,322,000

As previously noted, the Minnesota Legislature passed a law in 2013 that would require prepaid wireless services to pay the 9-1-1 fee at the point of sale. That law just went into effect on January 1, 2014, so there are no Minnesota-specific data available regarding the impact this will have on revenues. Many prepaid providers were already submitting fees to the program. It is important to note that although the fee is set at $.78, the same rate for wireline, wireless and VoIP, there is a 5% reduction in the amount received by the 9-1-1 Special Revenue Account because retailers will keep 3 % and the Department of Revenue will keep 2% of total prepaid fees collected each month to offset their administrative costs of collecting the fee.

The projected revenue for FY 2014, the year the prepaid wireless fee will start being collected in Minnesota, reflects a decrease because the decline in landline revenues is not expected to be offset by the new revenue source immediately. That said, it must be clearly noted that this is the State's expectation, which may or may not be borne out by actual data once the law goes into effect. Over the next several years, the State has projected a return to FY13 revenue levels, but landline revenue will continue to decline and is not expected to be offset by a one-for-one increase in wireless and VoIP revenues.

In the years toward the end of the 15-year forecast, revenues are expected to decline again as the landline telephone network itself begins to be replaced by IP telecommunications systems.

This same trend in subscribership is occurring nationwide as documented in the latest FCC report, "*Local Telephone Competition: Status as of December 31, 2012*," released as this report was being compiled. FCC Commissioner Pai, in his comments on the release of the report, summed it up clearly:

> *"There can be no doubt, if ever there was, that the IP Transition is upon us. The FCC Wireline Competition Bureau's Local Telephone Competition Report, issued today, observes that Americans continue to flee the copper networks of the 20th century. About one in seven households with copper dropped their landline last year, and 33.6 million Americans dropped their copper landlines over the past four years. And competition is rampant... Interconnected VoIP providers added 14.6 million subscriptions over the last four years, and wireless providers added 43.6 million. These changes underscore how dynamic the communications marketplace is."*[31]

The FCC's report for Minnesota is in line with the State 9-1-1 Program's findings.[32]

Minnesota, like the rest of the nation, finds itself in a situation where telecommunications devices capable of accessing the 9-1-1 system are no longer a one-to-one with what is contained in the 9-1-1 location (ALI) database. Devices sold as a prepaid service may provide its user with service for a whole year, which means that the 9-1-1 fee would be assessed just once in the entire year for that device. While the major wireless carriers that offer services on a prepaid basis do collect and remit the fee, other types of prepaid service providers such as TracFone and Magic Jack are fighting having to do so. In fact, TracFone is in litigation with the state of Minnesota over this issue.

In conclusion, Minnesota's historical record in the context of the national picture simply does not support a more positive forecast for 9-1-1 funding. The projections presented in this report do indicate that Minnesota has a few years' time to study options for funding its 9-1-1 system and to implement a new funding mechanism.

[31] DOC 324418A1 Statement of Commissioner Ajit Pai on the Release of the 2013 Local Telephone Competition Report, November 26, 2013.
[32] Federal Communications Commission, November 2013, *Local Telephone Competition Report: Status as of December 31, 2012*, pages 24, 25 and 29.

5.1.1.1 NHTSA Funding Report

In its final report to the FCC, the CSRIC Working Group 4B of the Nation Highway Transportation Safety Administration (NHTSA) recommended that "the FCC should encourage the National 9-1-1 Program to convene a Blue Ribbon Panel as soon as possible, to address 9-1-1 funding issues and make recommendations for funding construction and maintenance of NG9-1-1 systems."[33] The National 9-1-1 Program (within NHTSA, part of the USDOT) acted on this recommendation. In March 2013, the Blue Ribbon Panel produced its first report, *Current State of 9-1-1 Funding & Oversight*. The final report entitled *Report to the National 9-1-1 Program* is nearing completion, but the information has not yet been published.

The 'current state' report lists 11 separate funding mechanisms currently in existence around the nation:

- Wireline surcharge
- Wireless surcharge
- VoIP surcharge
- Prepaid charge
- General fund tax
- State Universal Service Fund (USF)
- Percentage of local service revenue
- Percentage of toll revenue
- State and federal grants
- Public-Private Partnerships (P3)
- Other

The presentation of this information is a bit misleading. First, it lists the typical fees on wireline, wireless and VoIP as though they were unique funding mechanisms, whereas they are the same mechanism. Second, grants and P3 are not used as mechanisms for ongoing funding anywhere. With only a handful of exceptions, the 9-1-1 fee on

[33] CSRIC Working Group 4B Final Report, March 2011, page 5.

telecommunications subscribers, and increasingly on prepaid wireless subscribers, is the prevailing funding mechanism.

As noted, the final Blue Ribbon Panel report has not yet been published. Based on informal discussions with members of the Blue Ribbon Panel, ***FE*** has learned that the final report will validate the trend of declining landlines and its impact on 9-1-1 program revenues, and will set forth a variety of funding options for states to consider. ***FE*** has also learned that the report will present evidence that the traditional funding mechanism (surcharge/tax/fee on telecommunications subscribers) will, for some states, continue to provide adequate funding.

5.1.2 NENA Next Generation Partner Program Funding Options Report[34]

In 2007, NENA's Next Generation Partner Program (NGPP) published the first-ever national report addressing the topic of funding for NG9-1-1. The report, entitled *Funding 9-1-1 Into the Next Generation: An Overview of NG9-1-1 Funding Model Options for Consideration*, set forth six possible models, which are outlined below. The pros and cons of each model are presented in the *NG9-1-1 Funding Model Options* report.

5.1.2.1 Fixed amount surcharge on all calling services

A fixed amount surcharge on all calling services option is the predominant 9-1-1 funding model. NENA observes, "*It has historically been primarily a reactive model whereby every time a new technology emerges that provides access to 9-1-1 (such as wireless, and now VoIP) new legislation is needed or existing legislation must be modified to incorporate the new service into the system*."

5.1.2.2 Surcharge on access infrastructure provider (AIP)

The surcharge on access infrastructure provider (AIP) option would move the surcharge from the calling network provider (current model) to the access infrastructure provider (AIP). The AIP provides the physical interconnection to the end user; for example a cable TV company or a broadband Internet access provider.[35]

[34] All information in this section is excerpted from the NENA NGPP Funding Models report, pages 4-8.
[35] Note that this approach has never been attempted, and there has never been any discussion at the national level as to how, exactly, this could be successfully implemented.

5.1.2.3 Universal Statewide Communications Surcharge

The Universal Statewide Communications Surcharge option would assess a single statewide universal communications surcharge (UCS). This surcharge would be a single flat fee that would likely range 3-5% on all communications services. The revenues generated by the UCS could pay for 9-1-1 and other state communications needs.

5.1.2.4 Universal Federal Communications Surcharge

The Universal Federal Communications Surcharge approach would be a national model, similar to the UCS model, but rather than assessing a uniform fee on all communications services at the state level, this would be done nationally. The Federal Government would collect and distribute the fee revenues to states, which would distribute funds to local 9-1-1 authorities. It must be noted that the Federal Government has not indicated any interest in taking on this responsibility.

5.1.2.5 User (incident) fee

A user (incident) fee funding option would assess a user fee for each 9-1-1 call, much as users of 900 numbers are charged for use of the 900 service. NENA cautions there would be challenges associated with collecting the fee from 9-1-1 callers and comments on the fact that this model would be unlikely to raise enough funding to cover the costs of 9-1-1.

5.1.2.6 General Fund Tax Revenue (federal, state and local)

Local 9-1-1 operations are typically funded in part by general tax revenues; and some local 9-1-1 systems are entirely funded by the general fund. Since other emergency service functions, such as police, fire and emergency medical services (EMS) are paid for by general tax dollars, the report asserts that 9-1-1 could adopt this model as well.

5.1.3 Existing Commitments

Table 38 lists the existing commitments on Minnesota's 9-1-1 fund.

Table 38 – Existing Commitments

Existing Commitments on the Minnesota Special Revenue Account		
Appropriation Transfers	**FY 2013**	**FY 2014**
Debt Service - Metropolitan Council	$ 1,410,000	$ 0
Debt Service - ARMER	$ 23,261,000	$ 23,261,000
ARMER Maintenance State Backbone to MnDOT	$ 8,650,000	$ 9,250,000
Medical Resource Communication Center	$ 683,000	$ 683,000
Subtotal Transfers	**$ 34,004,000**	**$ 33,194,000**
Expenditures		
Compensation	$ 719,000	$ 826,000
Rent / State Ops / Other TOTAL	$ 13,076,000	$ 16,513,000
Zone Controller/ Project Dev./ Systems Design	$ 0	$ 0
Public Safety Answering Points (PSAPS)	$ 13,664,000	$ 13,664,000
NG9-1-1 Backbone Implementation	$ 3,004,000	$ 6,002,000
ARMER Local Infrastructure grants to local gov.*	$ 5,162,000	$ 0
Subtotal Expenditures	**$ 35,625,000**	**$ 37,005,000**
Total Transfers and Expenditures	**$ 69,629,000**	**$ 70,199,000**

Existing commitments consume nearly all of Minnesota's 9-1-1 revenues.

5.2 Statutory Use of 9-1-1 Fees

FE identified statutory acceptable uses of the 9-1-1 fee for the ARMER and 9-1-1 networks and worked with ECN to review, compare and document the use of 9-1-1 fees in three other states with a fee collection model similar to Minnesota (fees collected at the state level and distributed).

Chapter 403.113 Subdivision 3 and related guidance from the Minnesota State 9-1-1 Program allows the following uses of the 9-1-1 fee at the local level:

- Lease, purchase, lease-purchase, or maintain enhanced 9-1-1 telephone equipment

  - Telephone switching equipment (PBX) for administrative lines
  - Headsets
  - Telephone sets for administrative lines
  - The equipment listed above for secondary PSAPs once the Primary PSAP's funding needs have been met

- Lease, purchase, lease-purchase, or maintain enhanced 9-1-1 recording equipment
  - Logging recorders

- Lease, purchase, lease-purchase, or maintain enhanced 9-1-1 computer hardware
  - ANI/ALI controllers
  - Computer hardware to support allowable software listed below. All hardware within the PSAP used by dispatcher to communicate to the responding agencies
  - Hardware to support allowable software listed below for Secondary PSAP

- Computer software for database provisioning, addressing, mapping, and any other software necessary for automatic location identification or local location identification
  - Computer Aided Dispatch (CAD)
  - Mapping
  - Geographic Information Systems (GIS)
  - Records Management Systems (RMS)
  - Management Information Systems (MIS)
  - Software to support Secondary PSAP allowable hardware as listed above once the Primary PSAP's funding needs have been met

- Trunk lines
  - Additional telephone trunk lines or data circuits into the PSAP to support dispatcher functions such as Criminal Justice Information Services (CJIS)
  - Internet

  - Wireline and wireless service provider 9-1-1 trunks, PSAP/EM trunks and ALI circuits used to transport the 9-1-1 call from the Selective Router and ALI to the Secondary PSAP

- Master street address guide
  - Creation of MSAG
  - Maintenance of MSAG
- Dispatcher public safety answering point equipment proficiency and operational skills
  - Cost of vendor training on ANI/ALI, CAD/RMS, Map, GIS applications
  - Dispatcher training (excluding training on the criminal justice and bureau of criminal apprehension systems)
  - Field Training Officer (FTO) Training of new employees
  - NENA and APCO conference training
- Equipment necessary within the public safety answering point for community alert systems
  - Emergency notification systems, commonly referred to as “Reverse 9-1-1” type systems
- Equipment necessary within the public safety answering point used to notify and communicate with the emergency services requested by the 9-1-1 caller
  - Installation, maintenance and repair of equipment and telecommunications transport costs for connecting the PSAP to the prime tower site such as microwave, power supplies, T1 lines, etc.
  - Ergonomically correct workstation and chair and light fixture necessary for dispatcher to answer 9-1-1 call in compliance with ADA requirements
  - Electrical power costs

Chapter 403.113 Subdivision 3 allows these additional uses of the 9-1-1 fee at the state level:

- 9-1-1 Program costs, which includes statewide E9-1-1 and NG9-1-1 common backbone system components and 9-1-1 program administration

- The Met Council
- Medical Resource
- ARMER debt payment on bonds
- ARMER maintenance state backbone to MnDOT
- ARMER 800 Megahertz improvements – State Radio Board
- ARMER interoperability planning
- ARMER local infrastructure grants to local government

5.2.1 State Comparisons

FE compared Minnesota's allowable use of 9-1-1 fees with three states that similarly collect the fees at the state level and distribute the monies to local government: Indiana, Florida and Michigan.

5.2.1.1 Indiana

State-level 9-1-1 authority exists with the Indiana E9-1-1 Board within the Office of the State Treasurer. A 2012 statutory change expanded the scope of the E9-1-1 Board from wireless only to E9-1-1 broadly and increased its membership from 7 to 13. That statute simultaneously eliminated all county 9-1-1 fees. Beginning July 1, 2012, all 9-1-1 fees began to be remitted to the State and thence distributed to PSAPs.

The allowable uses of 9-1-1 fees at the local level are found in Indiana Code 36-8-16.7-38:

- The lease, purchase, or maintenance of communications service equipment
- Necessary system hardware, software and data base equipment
- Personnel expenses, including wages, benefits, training, and continuing education, only to the extent reasonable and necessary for the provision and maintenance of:
    - The statewide 9-1-1 system

  - A wireline enhanced emergency telephone system funded under IC 36-8-16 (before its repeal on July 1, 2012)

- Operational costs, including utility costs
- Maintenance
- Equipment designed to provide backup power or system redundancy, including generators
- Call logging equipment
- Emergency notification systems
- Connectivity to the Indiana data and communications system (IDACS)
- Rates associated with communications service providers' enhanced emergency communications system network services
- Mobile radio equipment used by first responders, other than radio equipment purchased under Subdivision (9) as a result of the narrowbanding requirements specified by the Federal Communications Commission
- Up to 50% of the costs associated with the narrowbanding or replacement of radios or other equipment as a result of the narrowbanding requirements specified by the Federal Communications Commission

The Indiana 9-1-1 statute authorizes the State 9-1-1 Board to use its portion of the 9-1-1 fee for its costs to administer the statewide 9-1-1 system.

5.2.1.2 Florida

State-level 9-1-1 authority exists with the Public Safety Bureau (Bureau) of the Division of Telecommunications within the Department of Management Services. There is an eleven-member E9-1-1 Board (Board), chaired by the Secretary of the Department of Management Services. The Board's primary function is to administer the 9-1-1 fee revenues and assist the State program. All fees are remitted to the State and distributed to local governments. Local governments do not have authority to assess 9-1-1 fees.

The allowable uses of 9-1-1 fees at the local level are found in Title 27 Chapter 365.172:

- The acquisition, implementation, and maintenance of PSAP equipment and E9-1-1 service features, including:
  - Call answering equipment
  - Call transfer equipment
  - ANI/ALI controllers
  - ANI/ALI displays
  - Station instruments
  - E9-1-1 telecommunications systems
  - Visual call information and storage devices
  - Recording equipment
  - Telephone devices and other equipment for the hearing impaired used in the E9-1-1 system
  - PSAP backup power systems
  - Consoles
  - Automatic call distributors
  - Interfaces, including hardware and software, for CAD systems
  - Integrated CAD systems for that portion of the systems used for E9-1-1 call taking
  - Network clocks
  - Salary and associated expenses for E9-1-1 call takers for that portion of their time spent taking and transferring E9-1-1 calls
  - Salary and associated expenses for a county to employ a full-time equivalent E9-1-1 coordinator position and a full-time equivalent mapping or geographical data position and a staff assistant position per county for the portion of their time spent administrating the E9-1-1 system
  - Training costs for PSAP call takers, supervisors, and managers, including fees collected by the Department of Health for the certification and recertification of 9-1-1 public safety telecommunicators
  - Expenses required to develop and maintain all information, including ALI and ANI databases and other information source repositories, necessary to properly inform call takers as to location address, type of emergency, and

other information directly relevant to the E9-1-1 call-taking and transferring function

- NG9-1-1 network services
- NG9-1-1 database services
- NG9-1-1 equipment
- Wireless E9-1-1 routing systems

The Florida 9-1-1 statute authorizes the State 9-1-1 Program to use its portion of the 9-1-1 fee for its costs to administer the statewide program and to give grants to counties.

5.2.1.3 Michigan

Michigan has both state and local 9-1-1 authorities. At the state level, oversight is provided by the State 9-1-1 Committee (SNC), which is attached to the State 9-1-1 Administrator's Office (Office) within the Michigan State Police (MSP). The MSP provides staffing for the SNC to carry out the SNC's duties, including the State 9-1-1 administrator position. The SNC has authority to recommend technical and operational standards for PSAPs, to recommend model 9-1-1 systems and to provide assistance for the design, implementation and operation of those systems. However, the SNC does not have rulemaking authority or any real authority to make anything happen.

The Office coordinates 9-1-1 statewide and oversees the distribution of funds from the State's surcharge to local government. Michigan currently has three statutory funding provisions for 9-1-1:

1. A state "all devices" fee
2. A county "all devices" fee
3. A Technical Charge fee (rate unknown, which is wireline based and is the mechanism whereby the LECs recover their costs to provide 9-1-1 services

Michigan's allowable uses of 9-1-1 fees at the local level are found in rules adopted by the Michigan Public Service Commission pursuant to Michigan Compiled Laws (MCL) 484.1401:

- Personnel Costs directly attributable to the delivery of 9-1-1 service (e.g., directors, supervisors, dispatchers, call-takers, technical staff, support staff):
  - Salaries

- MSAG Coordination
- Uniforms
- Fringe Benefits
- Addressing/Database
- EAP

Note: If 9-1-1 staff serves dual functions (i.e., a director who is also in charge of Emergency Management, a dispatcher who is also a police officer) then only those portions of personnel costs attributable to their 9-1-1 functions should be allowable.

- Facility Costs of the dispatch center directly attributable to the delivery of 9-1-1 service:
  - Capital improvements for construction, remodeling, or expansion of dispatch center
  - Electrical/heat/AC/water
  - Fire suppression system
  - Cleaning, maintenance, trash removal
  - Telephone
  - Generator/UPS and grounding
  - Insurance
  - Office supplies
  - Printing and copying
  - Furniture

  Note: In a shared facility, only those portions of facility costs attributable to the 9-1-1 functions should be allowable.

- Training and Memberships directly related to 9-1-1 service:
  - On the job training
  - Vendor provided training
  - Conferences
  - Travel and lodging as necessary

  - Membership in associations (APCO, NENA, etc.)

- Hardware, software, connectivity and peripherals directly attributable to the delivery of 9-1-1 service:
  - Customer premise equipment
  - Remote CPE hardware/modems
  - Computer-aided dispatch
  - Radio system (consoles, infrastructure, field equipment)
  - Law Enforcement Information Network (LEIN) costs for dispatch purposes
  - Paging system, pagers and related costs
  - Voice logging equipment
  - Mobile data systems
  - GIS/mapping systems/AVL systems
  - Alarms/security systems
  - Connectivity for any of the above
  - Maintenance and service agreements of above
  - Software licensing of the above
  - Associated database costs

- Vehicle costs (staff vehicle, pool car, mileage reimbursement, fuel, etc.) directly attributable to the delivery of 9-1-1 service:
  - Travel for meetings, training, conferences
  - Travel for MSAG verification and testing
  - Travel for 9-1-1 Public Education purposes

- Professional Services
  - Attorneys
  - Consultants
  - Insurance
  - Architects

- Auditor

- Public Information/Education expenses directly attributable to the delivery of 9-1-1 service

The Michigan statute sets aside a percentage of revenues for the state-level 9-1-1 program to use to cover its operating costs.

5.2.1.4 State Comparison Summary

Minnesota's eligible uses of 9-1-1 fee revenues at the PSAP level are similar in many respects to the three states considered. Where Minnesota diverges greatly is with regard to the expenses of the Metropolitan Council, Medical Resource, and the statewide radio system (ARMER).

5.3 Comparison of 9-1-1 Fee with Other States

With regard to evaluating the real or perceived limits upon the 9-1-1 fee, ***FE*** documented the 9-1-1 fee amount for wired and wireless lines in other states. We identified how Minnesota compares with other states and documented information discovered (if any) relative to a perceived cap on 9-1-1 fees. This information is presented in tabular form in Table 39.

Table 39 – 9-1-1 Fee Comparison

	State	WLN Fee	WLS Fee	VoIP Fee	Prepaid WLS Fee
1	Alabama	$1.60	$1.60	$1.60	$1.60
2	Alaska	Up to $2.00	Up to $2.00	N/A	
3	Arizona	$0.20	$0.20	$0.20	
4	Arkansas	5% or 12% of tariff rate	$0.65	$0.65	$0.65 per retail transaction
5	California	.5% of intrastate toll	.5% of intrastate toll	.5% of intrastate toll	
6	Colorado	Up to $0.70, higher with PUC approval	Up to $0.70, higher with PUC approval	Up to $0.70, higher with PUC approval	
7	Connecticut	$0.67	$0.67	$0.67	$0.67

	State	WLN Fee	WLS Fee	VoIP Fee	Prepaid WLS Fee
8	D.C.	$0.76 per access line	$0.76 per TN with a DC billing address	$0.76 per access line	2% of retail sale price
9	Delaware	$0.60	$0.60	$0.60	
10	Florida	Up to $0.50	$0.50	$0.50	
11	Georgia	Up to $1.50	Up to $1.50	$1.50	$0.75 per retail transaction
12	Hawaii	$0.27	$0.66	$0.66	
13	Idaho	Up to $1.00	Up to $1.00	$1.00	2.5% of the sales price of each retail transaction
14	Illinois	$0.30 up to $5.00	0.73 (city of Chicago $2.50)	$0.30 up to $5.00	1.5% per retail transaction; Chicago 7% per retail transaction
15	Indiana	$0.90	$0.90	$0.90	$0.50 per retail transaction
16	Iowa	$1.00	$1.00	$1.00	$0.33 per retail transaction
17	Kansas	$0.53	$0.53	$0.53	1.06% per retail transaction
18	Kentucky	Varies by County; no limitation; Current Range $.50 to $4.50	$0.70	Varies by County; no limitation; Current Range $.50 to $4.50	Provider selects from 3 statutory options (1)Collect from each account w/ a balance of at least $0.70; (2)Formula dividing prepaid revenue by 50 then multiplying by $0.70; (3) Board regulation (optional w/ Board & no regulation has been adopted)

	State	WLN Fee	WLS Fee	VoIP Fee	Prepaid WLS Fee
19	Louisiana	5% of tariff rate	$0.85	Varies per wireline structure	
20	Maine	$0.45	$0.45	$0.45	$0.45 per retail transaction
21	Maryland	$1.00	$1.00	$1.00	$0.60 per retail transaction
22	Massachusetts	$0.75	$0.75	$0.75	Provider selects from 2 options: (1) collect fee monthly from each subscriber; (2) calculate the total surcharge for the month by (a) dividing its total Massachusetts prepaid revenue for the month by its national average revenue per prepaid wireless user and (b) multiplying the result by $0.75
23	Michigan	State $0.19/Local Varies (up to $3.00)	State $0.19/Local Varies (up to $3.00)	State $0.19/Local Varies (up to $3.00)	$0.90
24	Minnesota	$0.78	$0.78	$0.78	$0.78 3% of retail transaction is kept by the retailer and 2% is kept by the Dept. of Revenue to offset the cost of

	State	WLN Fee	WLS Fee	VoIP Fee	Prepaid WLS Fee
					collecting and remitting the fee
25	Mississippi	$0.85 to $2.05	$1.00	$1.00	$1.00 per retail transaction
26	Missouri	2% - 15% of Base Rate (52 Counties) 1/8% - 3/4% of Sales Tax (44 Counties) General Revenue (2 Counties) Unfunded (16 Counties)	None	N/a	
27	Montana	$1.00	$1.00	$1.00	
28	Nebraska	$0.50 or higher under certain conditions	$0.50 to $0.70	N/a	
29	Nevada	$0.25 or tax base	$0.25 or tax base	N/a	
30	New Hampshire	$0.57	$0.57	$0.57	
31	New Jersey	$0.90	$0.90	$0.90	
32	New Mexico	$0.51	$0.51	N/A	
33	New York	$0.35 or $1.00	$0.35 and $1.25	N/A	
34	North Carolina	$0.60	$0.60	$0.60	
35	North Dakota	$1.00 - $1.50	$1.00 - $1.50	$1.00 - $1.50	2% on gross receipts collected at point of sale
36	Ohio	Property tax and/or fee up to $0.50	$0.28	N/A	0.2% of retail sale
37	Oklahoma	Up to 15% of tariff rate	$1.50	Varies per wireline structure	
38	Oregon	$0.75	$0.75	$0.75	
39	Pennsylvania	$1.00 to $1.50	$1.00	$1.00	$1.00 per retail transaction

	State	WLN Fee	WLS Fee	VoIP Fee	Prepaid WLS Fee
40	Rhode Island	$1.00	$1.26	$1.26	
41	South Carolina	$0.50 to $1.50	$0.58	N/A	
42	South Dakota	$1.25	$1.25	None	2% per retail transaction
43	Tennessee	Up to $1.50 on residential; up to $3.00 on business	Up to $3.00; currently set at $1.00	Up to $3.00; currently set at $1.00	$0.53 per retail transaction
44	Texas	$0.50 State; varies per HRC and ECD	$0.50	$0.50	2% per retail transaction
45	Utah	$0.61 local fee plus $0.08 State fee	$0.61 local fee plus $0.08 State fee	$0.61 local fee plus $0.08 State fee	1.9% per retail transaction
46	Vermont	USF	USF	USF	None
47	Virginia	$0.75	$0.75	$0.75	$0.50 per retail transaction
48	Washington	$0.25 State; $0.70 local	$0.25 State; $0.70 local	$0.25 State; $0.70 local	
49	West Virginia	$0.98 - $6.40	$3.00	$0.98 - $6.40	6% per retail transaction
50	Wisconsin	$0.40 - $1.00	None	Varies	
51	Wyoming	$0.25 - $0.75	$0.25 - $0.75	$0.25 - $0.75	N/a

About 17 states have statutes that authorize the 9-1-1 fee to be set at $1.00 or higher. ***FE*** is not aware of any consumer issues with that rate structure. About 16 states set their 9-1-1 fees at $0.60 or less. Five states set their 9-1-1 fees as a percentage of the tariff rate. One state funds 9-1-1 through its State Universal Service Fund. The remaining 12 states (including the District of Columbia) set their fees between $0.65 and $0.99 per subscriber line. Minnesota is among these latter states.

5.4 Technology / Other Costs

FE worked with ECN to identify other existing emergency communications costs or emerging technology costs that may be considered eligible in the State's current regulatory environment.

The Minnesota 9-1-1 Program has received numerous requests from PSAPs to use their 9-1-1 funds in ways that do not currently fit into an existing eligibility category. Specific requests have been made for:

- Back-up power – Uninterruptible Power Supply (UPS) systems and generators
- Equipment (such as a web browser) and associated software that would give dispatchers the ability to monitor video cameras in the field
- Traffic cameras so dispatchers can reroute emergency responders around traffic jams
- Cell phones for 9-1-1 supervisors
- Air cards for field unit computers
- Field unit computers
- Software in computers so they can access Records Management System
- Training for IT staff to work on squad computers so they can interface with dispatch
- Architectural services for PSAP expansion

The first one on the list, back-up power, would be a reasonable use of 9-1-1 funds because it is essential to the continued operation of a PSAP during a commercial power outage. Furthermore, back-up power capability is an eligible use of 9-1-1 funds in many states.

The statute at 403.113 Subdivision 3(a) provides that "*equipment necessary within the public safety answering point used to notify and communicate with the emergency services requested by the 9-1-1 caller*" is an eligible use of 9-1-1 funds. The 9-1-1 Program's guidance to PSAPs interprets this provision of statute to include facility electrical requirements and applies a formula to calculate the cost for the portion of the building that houses the 9-1-1 center. However, the interpretation does not specifically address back-up power. It could be included as an eligible expense as long as there was a similar pro-ration calculation to allow 9-1-1 funds to be used only for the percentage of the cost that supports PSAP critical functions.

The remaining items on the list should not be considered because they broaden the use of 9-1-1 funds too far beyond the PSAP and are not eligible uses of 9-1-1 funds in any other state known to ***FE***.

5.5 Summary of Assessment of Current and Future 9-1-1 Revenue Stream

The summary documentation and analysis presented here provides the state of Minnesota a comprehensive understanding of how the current 9-1-1 fees are collected and used. The summary also provides projections for the future of the 9-1-1 fees and details limitations on the current and future uses of the fees.

Minnesota's collection and use of its 9-1-1 fee has not changed over the past five years; nor has it changed at the local level. This stability can be accounted for by virtue of the fact that authorized uses of the fee are set in statute.

Absent a change in statute, these uses will continue into the future. In addition to current authorized uses of the fee, one-time and recurring costs associated with the transition to NG9-1-1 will start to be incurred in 2014 and will roll out over the next several years and on into the future as NG9-1-1 capabilities are developed and become commercially available.

Collection of 9-1-1 fees has changed over time as the statute was amended to assess the fee on new communications technologies such as wireless telephones, VoIP, and now prepaid wireless services; and as the cap on fees was adjusted. Each new revenue source has positively impacted the 9-1-1 fund and offset the decline in landline revenues until recently. The introduction of the 9-1-1 fee on prepaid wireless services is expected to provide a similar boost to the fund, but it must be understood that the decline of landlines is real, is part of a national trend, and is expected to escalate in the years ahead. At best, the introduction of the prepaid wireless fee will temporarily mask the underlying revenue issue. Even if the fee were set at the statutory maximum, this would continue to be true.

The ARMER bond payment takes priority over all other commitments, including day-to-day program expenses (including staff), transfers, payments to ARMER, the legacy 9-1-1 network and NG9-1-1.

These existing commitments on the fund leave no room for new expenses, such as those outlined in Section 5.4 of this report that are clearly outside the scope of 9-1-1.

For more detail see Attachment H, which shows past, current and projected collection and use of 9-1-1 fees at the state level.

6. Task 4—Assessment of 9-1-1 Revenue Bonds

Revenue from The 9-1-1 Special Revenue Account (SRA) was authorized for use by the Minnesota legislature to pay for debt service on the ARMER system bonds.

There have been five bond sales to support the build out of the ARMER system, one was completed by the Metropolitan Council in 1999 and the others by Minnesota Management and Budget (MMB) through the use of the 9-1-1 SRA in years 2006, 2008, 2009 and 2011. Funding to pay for the debt service on these bonds is transferred monthly from the 9-1-1 SRA to the Debt Service Clearing Account at MMB. The Metropolitan Council bonds totaling $14,280,000 were paid in full in 2013. To complete the ARMER backbone, an additional $198,095,000, in ARMER bonds have been let with average interest rate of 3.63% from the MMB administered sales. The remaining unpaid debt service balance on the bonds is $176,025,000 with an annual debt service payment of $18,213,000. The 2006, 2008, 2009 and 2011 bond sales have a payoff date of June 1, 2018, 2024, 2025 and 2026 respectively. The individual bonds are eligible for optional redemption as early as 2016, 2018 and 2019 depending on the bond series.

The State had legislative authority to bond for $262,780,000. The Met Council and MMB have issued to date $212,375,000 leaving a balance of bonds authorized but unissued of $50,405,000. As written in law and disclosed to bond holders, annually ECN is transferring $23,261,000 to MMB for debt service payments into the Debt Service Clearing Account. The average bond payment is $18,213,000. The legislation authorizes excess payments made into the Debt Service Clearing account to be used for transfer into the Capitol Projects account at DPS. Since January 2006, $30,787,000 has been transferred and an additional $19,618,000 is anticipated to be transferred over the next year, ultimately reducing the state bond sales by the authorized but unissued amount of $50,405,000.

The use of the 9-1-1 SRA has proven to be a very sound decision by the Minnesota legislature. The stability of the 9-1-1 fee, strong support by the Minnesota legislature for emergency communications systems, the legislative authority to raise the fee (up to 95 cents), positive and steady growth of subscriber fees, and maximum annual debt service (MADS) with more than three times coverage of the debt service obligation are a few of the reasons why bond rating agencies have rated the 9-1-1 revenue bonds very high (e.g. AA, AA+, etc.).

6.1 Metropolitan Council Bonds – 1999C (2007D)

Established in 1967 by the legislature, the Metropolitan Council was created as a regional governance entity responsible for planning and coordination in the seven-county metro area. It is well documented that the roots of what is known today as the ARMER system sprung from the communications needs in the metro area.

In 1999, the radio system was only a metro project, but it was being coordinated in partnership with MnDOT. It emanated from studies indicating a lack of frequencies needed to provide services to accommodate projected metro area population growth and the identified lack of interoperable communications for the 1990 visit of Soviet Union President, Mikhail Gorbachev.

The Metropolitan Transit Commission (MTC), a division under the Metropolitan Council and operators of the regional public transit bus line in the metro area, urged the Metropolitan Council to build out a region wide emergency communications system and in 1999, the Metropolitan Council issued bonds in the amount of $14,280,000. These bond proceeds were partial funding for what is now known as ARMER Phase 1, which was backed by a four cent 9-1-1 fee increase.

Phase 1 was jointly coordinated by the Metropolitan Radio Board, known today as the Metropolitan Emergency Services Board (MESB), and MnDOT. ARMER Phase 1 was procured through an RFP. Motorola Solutions was awarded the contract and designed and implemented the system. MnDOT was the project manager for ARMER Phase 1 and has provided system administration, operation and management since.

ARMER Phase 1 was funded as noted below in Table 40.

Table 40 – ARMER Phase 1 funding

Source of Funds	Amount
State General Obligation Bonding	$7,500,000
State Trunk Highway Funds	$7,500,000
Metropolitan Council Bonds (back by 4 cent 9-1-1 fee increase)	$14,280,000
Metropolitan Council General Obligation Bonds on behalf of MTC	$3,000,000
Interest and 9-1-1 SRA Funds	$4,700,000
Total	**$36,980,000**

Note: The 1999C-issued bonds were later refunded by the sale of the Series 2007D Metropolitan Council Bonds. This transaction, effectively a refinancing, saved the

Metropolitan Council enough debt service to shorten the life of the bonds from the original payoff year of 2015 to 2013.

The annual debt service for the Metropolitan Council Bonds was approximately $1,400,000 per year and ECN transfers funds from the 9-1-1 SRA to the Metropolitan Council on a monthly basis to cover the debt service. These bonds were paid back in full on February 1, 2013.

6.2 9-1-1 Revenue Bonds – 2006

In 2005, the Minnesota legislature supported the expansion of the ARMER system by supporting the Series 2006 Bonds. The Series 2006 Bonds, were issued to make Twin Cities Metropolitan Area coverage enhancements (Phase 2), but primarily to finance Phase 3 of the ARMER System backbone. Phase 3 encompassed 23 counties in central and southeastern Minnesota. The $35,000,000 in bonds were sold on November 1, 2006, with an 11 year term and at an average rate of 3.764072%. To date, these bond proceeds have been spent in full and there is $20,727,250 remaining debt service rounded and average to approximately $3,910,000 per year. The Series 2006 Bonds have a final maturity of June 1, 2018, but are subject to optional redemption by the State on or after December 1, 2016. On December 1, 2016, the callable amount for 2017 and 2018 would be $7,590,000.

6.3 9-1-1 Revenue Bonds – 2008

The Series 2008 Bonds, which were issued in part to complete ARMER Phases 2 and 3, but largely to finance a portion of Phases 4, 5, and 6, renamed Phase 456 to reflect the implementation strategy change of building available or low effort sites first across the remaining 55 counties in the state. The State issued the Series 2008 Bonds on December 2, 2008, in the amount of $42,205,000. The bonds were offered with a 15 year term and the State was able to sell them at an average rate of 4.604968%. These bond proceeds have been spent in full by MnDOT, but a total debt service of $37,129,000 averaging $3,524,000 annually remains. The Series 2008 Bonds, have a final maturity of June 1, 2024, but have an optional redemption date of June 1, 2018, or any date thereafter.

6.4 9-1-1 Revenue Bonds – 2009

The state of Minnesota sold bonds again in 2009 to continue the build out of ARMER Phase 456. The Series 2009 Bonds, with a 15 year term totaling $60,510,000, were issued on October 22, 2009 with an average rate of 3.171552% secured. Rounded and

averaged the annual debt service of the Series 2009 Bonds is $5,142,746 with a total debt service amount of approximately $62,612,000 remaining through the final maturity date of June 1, 2025. As in the case of the Series 2006 and 2008 Bonds, the Series 2009 Bonds have an optional redemption clause. The 2009 Series Bonds offer optional redemption on or any date after June 1, 2019. These bond proceeds have been spent in full by MnDOT.

6.5 9-1-1 Revenue Bonds – 2011

With the support of MMB, ECN and MnDOT determined that the final bond sale to complete the conceptual ARMER system plan statewide was needed in 2011. The Series 2011 Bonds, were offered to investors on August 30, 2011, in the amount of $60,380,000 for a term of 15 years and an annual average rate of 2.964296% was obtained. Annual debt service for the Series 2011 Bonds averages $5,461,000 with a remaining total debt service amount of approximately $73,008,000. The Series 2011 Bonds have a final maturity date of June 1, 2026, and an optional redemption date of June 1, 2019, and any date thereafter for the Series 2011 Bonds maturing on and after June 1, 2020.

*Note: The MnDOT Phase 3 and Phase 456 project budgets don't perfectly align with the 2006, 2008, 2009 and 2011 Series' Bond sales. Therefore determining unspent funds is not a true comparison, but **FE** notes in the MnDOT ARMER monthly status report provided to the SECB and ECN, a remaining unencumbered balance of approximately $28,988,000 and a projected contingency amount of $3,408,000.*

Table 41 indicates the annual average debt service for all the currently outstanding bonds of $18,213,000, a total remaining debt service of approximately $176,025,000 and summarizes the five major bond sales by the state of Minnesota for construction of the ARMER backbone.

Table 41 – Bond Sale Summary

Year/Series	Amount	Term	Rate	Amount Used to Date	Annual Debt Service	Remaining Debt Service	Pay Off Date
1999 (2007)	$14,280,000	15		$14,280,000	$1,400,000	Paid in Full	February 1, 2013
2006	$35,000,000	11	3.764072%	$35,000,000	$3,910,000*	$20,727,000	June 1, 2018
2008	$42,205,000	15	4.604968%	$42,205,000	$3,524,000*	$37,129,000	June 1, 2024
2009	$60,510,000	15	3.171552%	$60,510,000	$5,143,000*	$62,612,000	June 1, 2025
2011	$60,380,000	15	2.964296%	$31,392,000	$5,461,000*	$73,008,000	June 1, 2026
TOTAL	**$212,375,000**						

*Amount rounded and averaged

6.6 Debt Service and Coverage Schedule

A comprehensive evaluation of the year over year debt service and coverage schedule can be found in Attachment I. This Debt Service and Coverage Schedule contains previous and projected 9-1-1 Fee Revenues as submitted in the 9-1-1 Revenue Bonds Continuing Disclosure Document from March 2013.

Attachment I also contains the following:

- The debt service requirements for the Metropolitan Council Bonds and the Series 2006, Series 2008, Series 2009, and Series 2011 Bonds
- The combined debt service for the Metropolitan Council Bonds and the Series 2006, Series 2008, Series 2009, and Series 2011 Bonds
- The annual debt service coverage ratio for all debt
- The net 9-1-1 fee revenues after payment of the Metropolitan Council Bonds debt service
- The combined debt service requirements for the State issued Series 2006, Series 2008, Series 2009, and Series 2011 Bonds and the annual debt service coverage ratio for the State issued bonds.

6.7 Remaining Bond Authorization

Minnesota's bond official statements note that they reserve the right to issue additional debt up to the maximum amount authorized by the legislature, assuming sufficient debt service coverage exists in the 9-1-1 SRA. In total, the Minnesota legislature has allowed the Metropolitan Council and ECN, working in conjunction with MnDOT and MMB, to issue $262,780,000 in bonds to support the construction of the statewide ARMER backbone.

The Metropolitan Council issued bonds to their full authorization in 1999 and those bonds were satisfied in full earlier this year. However, the ECN authorized bonding authority of $248,500,000 has not been fully issued. To date, $19,618,000 remains authorized, but unissued because extra debt service cash has been used to fund a portion of the project. The debt service transfers to DPS and the ability to pay cash for any of the capital improvements to the ARMER system for which bonds were authorized was signed in session law.

Minnesota laws 2007, Chapter 86, article 1:

> *"$23,261,000 each year is to the commissioner of management and budget to pay debt service on revenue bonds issued under Minnesota Statutes, section 403.275. Any portion of this appropriation not needed to pay debt service in a fiscal year may be used by the commissioner of public safety to pay cash for any of the capital improvements for which bond proceeds were appropriated by Laws 2005, Chapter 136, Article 1, Section 9, Subdivision 8; or Laws 2007, Chapter 54, Article 1, Section 10, Subdivision 8.*

The above language, authorizing the use of excess debt service to pay cash for the statewide ARMER build out has been a part of the biennial Public Safety omnibus bill since 2005, when Phase 3 funding was passed.

While $19,618,000 remains unissued, the State currently does not expect to issue any additional bonds since transfers will be made from the Debt Service Clearing account directly to pay cash for the additional $19,618,000 needed for the project ultimately reducing the state bond sales by the authorized but unissued amount of $50,405,000.

6.8 Debt Service Clearing Account

Each month ECN transfers its debt service payment to a Debt Service Clearing Account at MMB. The Clearing Account is used as a holding account by MMB for the purpose of aligning business practices with Federal Internal Revenue Service (IRS) requirements.

When a debt service payment is needed MMB transfers funds from the Debt Service Clearing Account to the Debt Service Fund. Annually, ECN is transferring $23,261,000 to MMB for debt service payments that average $18,213,000 through Fiscal Year 2018. From fiscal year 2019 forward the annual debt service on the bonds falls incrementally from an estimated $18,164,000 to about $9,647,000 in 2025.

A portion of the annual overpayment of debt service has been transferred out of the Debt Service Clearing Account to the Capital Projects Account for the purpose of reducing the amount necessary to bond for the build out of the ARMER backbone and saving interest charges resulting in $50,405,000 less in bonds sold.

Table 42 shows the dates, amount and cumulative total of funds transferred from the Debt Service Clearing Account to the Capital Projects Account.

Table 42 – Funds transfer from Debt Service Clearing Account to Capital Projects Account

Date	Laws 2005, Chapter 136	Laws 2007, Chapter 54	ARMER Program Total	Cumulative Amount
January 31, 2006	$1,138,000	-	$1,138,000	$1,138,000
May 12, 2006	$5,000,000	-	$5,000,000	$6,138,000
June 18, 2007	$6,149,000	-	$6,149,000	$12,287,000
June 16, 2008	$2,000,000		$2,000,000	$14,287,000
June 8, 2010	-	$5,000,000	$5,000,000	$19,287,000
June 20, 2011	$2,000,000	$3,000,000	$5,000,000	$24,287,000
June 1, 2013	-	$6,500,000	$6,500,000	$30,787,000
Total Transfers	**16,287,000**	**$14,500,000**	**$30,787,000**	

The higher level debt service was projected in the 2009 Series bond sale and transfer was attested to in Minnesota's official bond statement and appropriated in session law.

6.9 Optional Redemption of Bonds

In the bond sale official statement for each of the 2006, 2008, 2009 and 2011 Series bonds the state of Minnesota included a provision that allows for the optional redemption or early prepayment of the bonds in whole or in part.

Table 43 shows the bond series, date the bonds may be called for optional redemption, early redemption years and the total remaining amount.

Table 43 – Optional Redemption of Bonds

Year/Series	Optional Redemption Date	Early Redemption Years	Total Remaining Amount
2006	December 1, 2016	2017 & 2018	$7,590,000
2008	June 1, 2018	2019-2024	$14,320,000
2009	June 1, 2019	2020-2025	$23,020,000
2011	June 1, 2019*	2020-2026	$28,870,000
TOTAL			**$73,800,000**

**Note: While the 2011 series bonds are available for optional redemption on June 1, 2019, the Clearing Account is not projected to have a balance to pay off both the series 2009 and 2011 bonds on June 1, 2019. The 2011 series bonds could be paid off in part in 2019 or in full one year later in 2020.*

7. Task 5—Funding Alternatives

Through the life cycle of a large capital project there are two separate, but distinctly important funding phases. For the ARMER system, and others like it across the country, there are the capital costs to construct the system, often referred to as Capital Expenditures (CAPEX) and the sustainment funding needed for ongoing upgrades, replacement and maintenance referred to as Operational Expenditures or (OPEX).

The Department of Homeland Security Office of Emergency Communications (OEC) recognizes that life cycle funding, both CAPEX and OPEX, are a major part of emergency communications and defines a full life cycle planning process as continual reassessment of the system. "*This includes assessment of ongoing operational suitability, operational stability, and potential failure as well as an overall cost analysis, which takes into account* capital expenditures (*CAPEX*), recurring costs and maintenance costs (*OPEX*)."[36]

In completing the Funding Alternatives Task ***FE*** acquired data from 11 states. States building large statewide ARMER-like systems have used bonding for CAPEX. While Minnesota supported these bonds from the 9-1-1 SRA other states have offered bonds supported by the state general fund. The sale of bonds is the most viable option for state CAPEX when the state chooses to own and operate the system. ***FE*** concludes that the other legitimate option for CAPEX is a Public Private Partnership (P3). The states of Florida, South Carolina and Illinois have used this approach with success. States have supplemented the building or updating of statewide system by using federal grant funds, but these funds are typically a fraction of the overall CAPEX, are one-time and bring about a series of federal regulations.

A variety of OPEX funding sources were examined and analyzed for this report. Minnesota uses the 9-1-1 SRA to pay for the state backbone OPEX and local ARMER system owners pay their OPEX from the local tax base. Many states piece together OPEX through state general fund appropriations and other fees or surcharges. The most common funding source beyond a general fund appropriation is user fees. These fees are typically assessed per radio (or other piece of equipment), per month and range from $10 for special isolated system use to $65 a month for day-to-day statewide use.

Pennsylvania and Minnesota have generated a small amount of OPEX relief by leasing space on state owned towers. Oklahoma and Florida have generated OPEX funds by placing a surcharge on license renewal. Oklahoma uses $500,000 annually from the Commercial Driver's License Fee to help pay for the OPEX and recently increased the state driver's license fee by $10 where a portion of that new revenue will be dedicated to

[36] http://www.safecomprogram.gov/oec/oec_system_life_cycle_planning_guide_final.pdf; August 2011

system OPEX. Florida has two ticket surcharge provisions in state law. One provides OPEX for the state by placing a $3 traffic and criminal traffic violation surcharge. Florida also has a provision in state law that allows counties to collect up to $12.50 on each moving violation citation issued in their county. While both of the Florida ticket surcharges help to sustain radio systems, the revenue generated falls short of covering full system OPEX.

7.1 Capital Expenditures (CAPEX)

To fund the implementation of an emergency communications system, states have used capital funds to acquire new infrastructure and assets or upgrade existing infrastructure and assets. Capital funds are typically used for towers, network backhaul, and internal and external equipment. Because statewide emergency communications systems typically cost tens or hundreds of millions of dollars, states have used a variety of funding sources to make these capital purchases. The following subsections outline a variety funding options successfully used by states.

7.1.1 Bonds

Minnesota is perhaps the best example of a state using bonds to fund the capital costs of building the ARMER system. Section 6 of this report detailed 9-1-1 revenue bonds sold for the ARMER system. The states of Michigan, Ohio and Pennsylvania have also used bonds to fund all or a portion of their LMR systems.

7.1.1.1 Michigan

The Michigan Public Safety Communications System (MPSCS) is a Motorola 800 MHz, digital, trunked system consisting of 244 towers and more than 62,000 radios covering 59,415 square miles. The initial system funding was allocated by the Michigan legislature in 1992 and in 1995 the State broke ground for Phase 1 of MPSCS. Currently, MPSCS provides interoperable voice and data (limited slow speed) to over 1,400 federal, state, local and private public sector agencies.

7.1.1.2 Ohio

The state of Ohio operates the Multi-Agency Radio Communications System (MARCS), which is also a Motorola 800 MHz, digital, trunked voice and data network with coverage expanding 10 miles outside state lines. The system also offers a Computer Aided Dispatch (CAD) function. Currently, there are over 1,200 public safety/service agencies

from local, state and federal agencies using over 47,500 voice units and 1,800 mobile data units accessing 130 state owned towers and 80 leased towers.

Two deadly events, the Shadyside Flood of 1990 and a riot at the Lucasville prison in 1993, led to the conception of the MARCS system. In 1999, a contract for $222 million was awarded for the capital costs of MARCS. The funding was obtained for 203 towers and the core network infrastructure through a bond sale with a 20-year term. The debt service on the bonds was paid for through an increase in the general revenue funding allocated by the legislature to the Departments of Public Safety and Administrative Services.

Ohio recently committed to a P25 Internet Protocol (IP) based statewide system upgrade costing $90 million. This upgrade was funded through the letting of Certificate of Participation tax free bonds to be paid back over 15 years at 2.25% interest with the debt service coming from the system user fees.

7.1.1.3 Commonwealth of Pennsylvania

Pennsylvania Statewide Radio Network (PA-STARNet) is an 800 MHz, M/A-Com Open Sky Network consisting of 972 sites (248 high-profile towers and 724 low-profile microcells). The system provides voice communications and low speed data communications with mobile land mass coverage of 96.7%. There are over 23,000 subscriber devices authorized for system use, logging an average of 140,000 calls (push-to-talks) daily.

PA-STARNet was originally funded and built through capital bond appropriations in 1996 totaling $179 million and by subsequently adding an additional appropriation of $189 million, for a total to date amount of $368 million.

7.1.2 Federal Grants

Local governments used funding through the Homeland Security Grant Program (HSGP) for a portion of the metro area ARMER build out. The state of Minnesota used funding through the Public Safety Interoperable Communications Grant Program (PSIC) for end user equipment and radio control stations at each PSAP in the rest of the state. The Twin Cities Metropolitan Area is deemed an Urban Area Security Area (UASI) by the Department of Homeland Security and as a result counties in the metropolitan area have received millions of dollars for various emergency response capability enhancements.

FE is unaware of any state that has received enough federal grants to fully fund the build out of a statewide LMR system. Many states have used federal grants to help fund specific infrastructure components of a statewide P25 system build out.

7.1.2.1 Wisconsin

Perhaps the state of Wisconsin has come the closest to using federal grants to fully fund the build out of their statewide system when they used their full allotment, $15.3 million, of Public Safety Interoperable Communications Grant Program (PSIC).

The Wisconsin Interoperable System for Communications (WISCOM) is an EF Johnson digital, trunked, P25, VHF system, largely built for the Wisconsin State Patrol. Upon completion, it will consist of 80 RF (existing) sites, providing 95% mobile coverage across the state. WISCOM provides the framework for linking systems together. A small number of communities are opting to move onto the WISCOM system, but local communities typically must bring spectrum and tower sites to meet their local needs.

While WISCOM is a statewide system, its coverage, capacity, scalability, and interoperability is vastly different than the other statewide systems noted above.

7.1.2.2 Ohio and Connecticut

The states of Ohio and Connecticut also leveraged the PSIC funding to upgrade a portion of their respective systems. Ohio used approximately $30 million for the Cleveland area MARCS upgrade. Connecticut funded a P25 controller allowing for state and local agencies to link together at the state's 800 MHz sites.

7.1.2.3 Oklahoma

Oklahoma has taken the system-of-systems approach to create the Oklahoma Wireless Information Network (OKWIN). In tying those local and state assets together the state used multiple federal grants (e.g., PSIC, UASI, HSGP) to fund the expansion of OKWIN over the last 9 years.

7.1.2.4 Alaska

The Alaska Land Mobile Radio (ALMR) system is a statewide (covering most of the state's population not land mass) P25, VHF digital trunked system with 84 sites and 16,408 users. ALMR has two regional controllers in Fairbanks and Anchorage connected via the State of Alaska Telecommunications System (SATS). The ALMR system was built in

cooperation with the Department of Defense. A breakdown of state/federal funding to build the system was requested but not obtained by the completion of this report.

7.1.3 Public/Private Partnership

A Public/Private Partnership (P3) is a contractual arrangement between a government entity and a private business. The term Public/Private Partnership (P3) has become en vogue over the last several years as governments have tried to stretch tax dollars and be more efficient in their use. In emergency communications systems projects, P3 arrangements can range from small in scope to all encompassing. For example, MnDOT currently has a services agreement with Motorola which under the broadest definition could be considered a small P3 arrangement. Other states have larger and more comprehensive P3 arrangements that cover multiple services and the sharing of vast amounts of network infrastructure.

7.1.3.1 Florida

The state of Florida entered into a "public/private partnership" with Harris Corporation to implement the State Law Enforcement Radio System (SLERS). SLERS is a proprietary Enhanced Digital Access Communication System (EDACS). It functions as a trunked and encrypted 700/800 MHz radio system covering 60,000 square miles, including 25 miles offshore, offering 98% mobile coverage. The system has nearly 20,500 radios operating on it at locations across the state. SLERS connects 14 different state agencies and approximate 40 other local counties, federal entities and private companies.

In this arrangement, the State conveyed selected State-owned communications towers and tower assets to Harris in exchange for $26.4M in credits to the State for radios, radio equipment, and accessories. Harris also provided additional credits to replace 6,000 radios that were being used by state agencies. For providing the services in the contract, Harris was paid a $40M advance payment. The contract expires June 30, 2021, with a $1 buyback option for SLERS equipment. It also provides for a $1 buyback option for State-owned towers in 2051.

The Florida Department of Management Services receives funding to improve and enhance SLERS through surcharges on certain criminal offenses and moving violations. Florida pays Harris approximately $18.2M annually for system operation and maintenance including 24/7/365 SLERS monitoring and management at the Network Operations Center (NOC).

Under terms of the agreement, Harris can combine public and private usage of towers for additional revenue. In these cases, the State receives a 15% revenue share for private sector rentals on the towers conveyed by the State through 2021 and a 50% share for the period of 2021 through 2051. As other public entities (Partners) choose SLERS for their communications, the State receives a 5% revenue share.

The state of Florida commissioned a study regarding this P3 arrangement. The study indicated a savings to the State of over $622M through avoidance of State tower, equipment and operations investment. ***FE*** has not reviewed the study or validated its findings in anyway, but we note it here for example.

7.1.3.2 South Carolina

As a result of several large natural disasters including hurricane Hugo in 1989, the state of South Carolina began developing a statewide interoperable communications system. In 2001 Motorola took over network ownership, management and support responsibility for what is now the Palmetto 800 MHz system (the State still maintains some infrastructure ownership). The Palmetto 800 system is a trunked Motorola SmartZone system and a partnership between state and local governments, public safety agencies, power utilities, and Motorola. The Palmetto 800 system has 27,781 users and 79 sites across South Carolina and Georgia. Motorola provides 24/7/365 network monitoring at their Network Operations Center in Schaumburg, Illinois.

Approximately 650 different agencies representing federal, state, local government, law enforcement, fire, EMS services, and power utilities in Georgia, North Carolina, and South Carolina participate in the system.

The Palmetto 800 system is a fee-based system and subscribers purchase and cover the maintenance cost for their own radio equipment. Motorola receives 100% of the user fees which are stipulated by contract. They range from $14 per unit per month for access to a single site up to $62.50 per unit per month for 10 or more sites or system wide access. The contract allows for 2.5% to 10% discount on monthly fees based on agency size, but also has additional one-time and recurring fees for roaming, private call, etc. In total the subscriber fees generate approximately $12M a year.

7.1.3.3 Illinois

The STARCOM21 system is used by emergency responders in the state of Illinois. STARCOM21 is an IP-based, P25 compliant, 700/800 MHz radio system with 270 tower sites statewide providing service to over 36,000 users. In 1997, STARCOM21 was

conceptualized as a state-owned $400M statewide LMR system for all Illinois state agencies, but a lack of support by many state agencies and only $25M in available funds prompted the Illinois State Police to move forward with a P3 approach.

STARCOM21 is owned and operated by Motorola Solutions. The contract with the state expired in 2011 and was recently renewed through 2022. Network users pay per month per radio costs ranging from $10 a month for "users that require only occasional emergency use of the network" up to $65 a month for state agencies that require "routine statewide system access" and have a user count of less than 9,500 users.

The monthly network access fee also covers Motorola Support Services to users. The Motorola STARCOM21 website identifies the following services for network customers:

- **Call Management**
  24x7 Dispatch
  Notification/Escalation

- **Infrastructure Maintenance and Repair**
  24x7 Monitoring/On Site Response (2 Hour)
  Backhaul Management
  Depot Repair
  Technical Support

- **Site Management**
  Property Maintenance
  Utilities/Power Systems/HVAC
  Generator Maintenance/Fueling
  Tower/Antenna/Line Maintenance

- **Network Management**
  Fleet Map Management
  Configuration Management
  Performance Management
  Security Management
  Fault Management
  Database Administration
  Software Support/Upgrades

- **Motorola System Manager**
  Service Level Compliance
  Single Point of Contact

Response Management
Provisioning/Activation
Disaster Response
Performance Reporting

Today 22 state and federal agencies, over 100 local agencies and three non-governmental agencies uses the STARCOM21 system for emergency response communications.

7.1.3.4 Iowa

The state of Iowa, recently published an RFP for a statewide 700 MHz P25 system, it requires that the successful contractor purchase all state-owned sites that the contractor has included in the system design, and sell these sites back to the state at the end of a 10-year lease term. Site infrastructure (towers, shelters, and power system) are to be purchased. The state of Iowa is not selling any land. The system infrastructure will be leased to the state for a period of 10 years, following acceptance of the system by the state.

If new greenfield sites are built specifically for the new system, the successful contractor is required to sell these to the state at the end of the 10 year lease term.

The successful contractor is able to place additional tenants on the purchased sites during the lease term, and the successful contractor will keep these tenants after the lease term (although the state will charge a fee (lease) for space on the tower and in the shelter after the 10-year lease term).

For the duration of the lease period the successful contractor is responsible for the site, including: bringing the site up to industry standards for grounding and lightning protection; replacing or upgrading any towers and shelters that are not able to support the new 700 MHz P25 system; FCC and FAA administration; site upkeep; and all maintenance on the system equipment (radio/repeaters, microwave, and power equipment).

The state's purpose in this approach is to make the successful contractor responsible for all site upkeep, equipment maintenance, and all site administration. Also, any upgrades or replacement of tower and shelters would be the responsibility of the successful contractor during the lease term. The state noted that any major tower upgrades, tower replacements, shelter replacements, or major civil work required during the lease term would have to be obtained through a competitive bidding process if the state owned the sites. Having the successful contractor own the sites would negate the need for the state to bid-out these tower and shelter replacements, and civil works.

7.1.4 Vendor Financing

Vendor financing means that the vendor provides their equipment and services to a customer with an agreement that the vendor bears the cost of the procurement, and the customer makes payments to the vendor according to contract terms. The current economic landscape has increased pressure on vendors to offer these financing packages. The effective interest rates vary from offering to offering and vendor to vendor, but are usually in the 3% to 4.5% range. These vendor offerings are usually in the form of a lease/purchase package. While there are many nuances among these vendor offerings, ***FE*** recognized that one of the items that varies widely, are the payment terms. These are some of the offerings we have seen recently:

- Annual payments in arrears beginning at system acceptance
- Annual payments in advance starting at system acceptance
- Monthly or quarterly payments in advance starting at system acceptance

With these arrangements, usually the financial underwriter will want the customer to restrict the term to 10 years and require a full maintenance contract including software and hardware updates for the term of the lease. Agencies that have in-house maintenance, can negotiate modifications to the agreement.

In utilizing this approach for system construction, the customer should understand that they will not own the equipment until the lease ends and the buyout clause (generally a $1 payment) is exercised. Once the lease is executed, a separate transaction is necessary to add equipment or expand the system unless that requirement is negotiated into the lease terms in the initial contract.

While leases can be constructed for a system without a purchase option the customer must consider the following which will result in additional costs, in some cases substantial, to the system being financed:

- The LMR vendors usually quote the effective life of the system as 12 to 15 years, assuming maintenance and upgrades are performed on a timely basis
- The technology changes exponentially. Depending on the point in the manufacturing life of a product when the product is purchased, replacement models may have compatibility issues with the existing system even though the system may not be anywhere near its end of life.

7.1.5 Leasing Options

Section 7.1.3 of this document detailed three states that have utilized a P3 approach for realizing a statewide communications system. In essence, the P3 arrangements created a system lease for users and a lease-to-purchase agreement for the state. Note, in the Florida agreement for SLERS there is a $1 buyout option at the end of the term.

While not the case in the state of Florida agreement, typically during the installation, no monies are given to the radio vendor until the system is accepted, meaning there is no financial risk to the lessor if something goes wrong or the completion is delayed. Further, the financial liability for the value of the entire system is generally not carried, only the payments to be made in the current fiscal year are deemed a financial liability for the lessor.

Under a leased arrangement, the lessee determines total system and services cost, including maintenance and upgrades, over the length of the term and the desired level of profit and then determines a monthly fee per user radio or system component. In this scenario where all costs, including maintenance and upgrades, less subscribers, are included in the yearly lease payment, it is very simple to distribute the purchase and operating costs to the users. Simply divide the annual lease payment by the number of subscribers on the system, add the overhead per subscriber for the managing agency and you have the yearly payment per subscriber. In nearly all leasing arrangements users are still required to buy the subscriber equipment.

7.2 Operational Expenditures (OPEX)

The production of every good or availability of every service has operational costs. Governments have operational costs for such things as road maintenance, business inspections and certifications and salaries and benefits for employees. Businesses have operational costs for research and development and emergency communications systems have operational costs for sites, network equipment, and power (energy). There are dozens of costs for operating and maintaining an emergency communications system. Everything from cutting the grass at the sites or repairing a fence to the personnel monitoring site alarms or network traffic in the Network Operations Center.

States have leveraged a variety of revenue generating strategies to pay for the ongoing operations and maintenance of emergency communications systems.

7.2.1 User Fees

User fees are one of the more common strategies states or large regional system administrators use to pay for the ongoing operation and maintenance of an emergency communications systems. For use of the system, the owner charges a fee directly to the user for the purpose of developing a continuous revenue stream which in turn can theoretically cover the operations and maintenance costs for the emergency communications system.

Section 8 discusses the merits and drawbacks of such an approach.

7.2.1.1 Michigan

The state of Michigan has a four-level user fee program for voice services and a single user fee for data services. Fees generate no more than $2M annually. Some entities that have come on to the MPSCS have brought frequencies, towers or other infrastructure assets that have allowed them to receive a temporary credit toward user fees. If credits were not extended to system users the total annual fees would generate approximately $6M.

Michigan was one of the first states to move forward with a statewide LMR system and as a result user fees were arbitrarily set. So even if the state was collecting the full $6M it still falls short of covering just the staff operating costs, which are approximately $8.2M annually.

The four fee levels are based on the system access or use of the radio. While South Carolina and Illinois charge monthly fees, Michigan's fees are annual. Table 44 details Michigan's annual per radio fees and Table 45 lists the data system access fees.

Table 44 – Michigan's voice system four-level user fee structure

Voice System Access Fees				
Service Level	**Level 1**	**Level 2**	**Level 3**	**Full**
Mobile, Portable, Control Station, Consolette voice fee	0	$50	$100	$200
PSAP Console/Control Station (Full Member Agency)	N/A	N/A	N/A	$0
Talkgroups: Event 1 - 30 (Non-Law Enforcement)	Incl.	Incl.	Incl.	Incl.
Talkgroups: Event 31 -45 (Law Enforcement only)	Incl.	Incl.	Incl.	Incl.
Talkgroups EMMD 1-8 (with MSP's EMD written approval)	Incl.	Incl.	Incl.	Incl.
Dynamic Regroup	Incl.	Incl.	Incl.	Incl.
Request Event Talkgroups	No	Yes	Yes	Yes
I-Call / I-TAC	Yes	Yes	Yes	Yes
Statewide 1-8	No	Incl.	Incl.	Incl.
Additional System Talkgroups	None	1 to 8	1 to 16	Unlimited
Template/Archive annual rewrite	N/A	Fee	Fee	Incl.

Table 45 – Michigan's data system four level user fee structure

Data System Access Fees				
Service Level	Level 1	Level 2	Level 3	Full
DATA Service Fee (PMDC - IV&D)	$600	$600	$600	$600

7.2.1.2 Ohio

The Ohio MARCS system also uses fees to recover ongoing operation and maintenance costs. The fees are based on the type of unit activated on the system. These are the per-unit annual costs for MARCS:

- Portable/mobile radio - $240
- Control station - $480
- Mobile data terminal - $4,200

- Computer aided dispatch - $21,000

Unlike Michigan, fees were developed by systematically determining the budget for the ongoing operation and maintenance costs. The MARCS goal was to develop a fee structure so the system could be self-sustaining from an operations and maintenance stand point. In Ohio, user fees generate approximately $14M a year.

The user fees received from local public safety agencies comprise only about eight percent of MARCS' total budget. MARCS does not waive fees for any agencies, even those that can show financial distress. MARCS administrators believe, a practice of waiving fees would put future funding capacity for MARCS at risk by encouraging new or currently enrolled agencies to plead financial distress.

Because of federal government rules regarding the use of federal funds in state programs (known as SWICAP, the Statewide Indirect Cost Allocation Plan), MARCS is required to charge all agency, federal, state, or local government entities, the same fee.

7.2.1.3 Illinois

As mentioned in Section 7.1.3.3, the STARCOM21 system is owned and operated by Motorola Solutions. ***FE*** requested annual revenue and operation and maintenance costs from Motorola for the purpose of comparing them to the Michigan and Ohio revenues and OPEX costs, but Motorola indicated that those figures are confidential.

Table 46 outlines the current STARCOM21 fee structure.

Table 46 – STARCOM21 Fees

Rate Category	Description	Year 2 -10 7/1/2013-6/31/2022	Loading Discount* (per every 500 radios over 36,000) Based on Total System User Count
Statewide Use*	**Allows for routine statewide system access.**		
	State Agency User Count <=9,500	$65/mo.	$1 (up to $30 max discount)
Level 1 Reduction	State Agency User Count >9,500 & <=13,000	$58/mo.	$1 (up to $23 max discount)
Level 2 Reduction	State Agency User Count	$54/mo.	$1 (up to $19 max discount)

Rate Category	Description	Year 2 -10 7/1/2013-6/31/2022	Loading Discount* (per every 500 radios over 36,000) Based on Total System User Count
	>13,000 & <=16,000		
Level 3 Reduction	State Agency User Count >16,000	$50/mo.	$1 (up to $15 max discount)
County Use	**Applies to users that typically operate within the geographic boundaries of a single designated county. Usage outside the designated county is allowed only for emergency or mutual aid situations.**		
		$39/mo.	$1 (up to $11 max discount)
Local Use	**Applies to users that typically operate within the jurisdictional boundaries of a city, village, town or designated campus type environment. Usage outside the designated boundaries is allowed only for emergency or mutual aid situations.**		
		$34/mo.	$1 (up to $9 max discount)
Limited Use	**Applies to users that require access on a limited basis for the purpose of mutual aid, interoperability or intermittent operations. May also apply to occasional access to data features, local emergency and event coordination outside of the ITTF program irregular or infrequent use.**		
		$18/mo.	None
Specialty Use	**Applies to users that require only occasional emergency use of the network or as authorized under agreement with the Illinois Terrorism Task Force (ITTF), IDPH or other entities as approved by the STARCOM21 Oversight Committee and/or its designee and Motorola Solutions.**		
		$10/mo.	None
Campus Use	**Applies to users with geographically concentrated operations and high user counts. Typical examples include prisons, college campuses or hospitals. Assumes users will rarely roam off their designated campus. Use of the Campus Use rate is subject to the approval of the STARCOM21 Oversight Committee and/or its designee and Motorola Solutions. Rates are negotiated on a case-by-case basis and are determined by assessing User operational and technical parameters and will be reviewed by the STARCOM21 Oversight Committee and/or its designee. Rates are memorialized in the State's Basic Ordering Agreement (BOA) for State Agency Users and in User Agreements for non-State Agencies Users.**		
		Variable	None
Port Access	**Applies to users that have unique requirements and do not fit any of the defined rates categories. Typically Port Access will apply to operation on user owned sites connected to the STARCOM21 Network Master Site. Port user fees are negotiated between Motorola Solutions and the applicant agency(s) on a case-by-case basis. Port access is subject to STARCOM21 Oversight Committee approval and/or its designee.**		
		Variable	None

Rate Category	Description	Year 2 -10 7/1/2013-6/31/2022	Loading Discount* (per every 500 radios over 36,000) Based on Total System User Count
Gateway Access	**There are two types of Gateway Access supported, traditional Audio Patching and P25 ISSI.** **<u>Audio Patching</u>** **Users that require Gateway Access for audio patching that has been approved by the STARCOM21 Oversight Committee and/or its designee will pay a monthly fee for Gateway Use which shall be calculated as follows:** **The base rate shall be equivalent to the Specialty Rate ($10 per radio per month) Usage outside the parameters of the Specialty rate shall be charged airtime as follows:** **o ISR Sites – $1 per minute/per site (rounded to the nearest minute and billed monthly)** **o Simulcast Sites – $2.25 per minute/per site (rounded to the nearest minute and billed monthly)** **<u>P25 ISSI</u>** **Project 25 (P25) Inter RF Subsystem Interface (P25 ISSI) provides an IP interface for connecting multiple P25 systems together. This will allow users to roam onto other P25 systems providing network-to-network interoperability and will be used as approved by the STARCOM21 Oversight Committee and/or its designee.** **The specific rate structure for P25 ISSI services will be determined when the technology is fully enabled on the STARCOM21 network. An associated Impact Fee and the installation of user purchased infrastructure equipment may also be required to utilize P25 ISSI services.**		
		Variable	None
Dual Radio Discounting*	**Users with vehicles that have a mobile and portable STARCOM21 radio assigned would be billed at the $18 per month Limited use rate for their secondary radio. The primary radio would be billed at their normal rate class. Limitations apply. See notes below.**		
		$18/mo.	None

7.2.2 General Fund

A General Fund is a state's primary financial account providing the funding to sustain the operational and administrative costs for day-to-day activities. In Minnesota, as in most states, virtually all of state government is funded from this account. There are a few exceptions to note, such as the funding for MnDOT coming from the Trunked Highway Fund (gas tax revenue) and the account for which this study is being conducted, the 9-1-1 Special Revenue Account.

This section (General Fund), while a conceivable alternative to fund the CAPEX of an emergency communications system, is a better fit in the OPEX section of this report. Many state general funds pay for the OPEX of an emergency communications system, typically through an annual or biennial appropriation to a state agency. ***FE*** is unaware of any state or region that has effectively paid cash from a General Fund for the construction of a large multi-agency statewide P25 emergency communications system.

7.2.2.1 Connecticut

State agencies in Connecticut use a digital, 800 MHz Motorola SMARTZONE 4.1 simulcast system that provides 98% mobile coverage throughout the state. Since the 1990's, the general fund has covered the $3M a year in operation and maintenance costs for the system.

The Connecticut system is primarily a state agency system. Local entities can connect to the state system for interoperability purposes, but they operate and maintain their own systems for day-to-day operability.

7.2.2.2 Commonwealth of Pennsylvania

The STARNet system in the Commonwealth of Pennsylvania, as detailed in Section 7.1.1.3, is provided $21.6M from the Commonwealth general fund for annual operating and maintenance costs. Of this allocation approximate 17% is for Commonwealth personnel. The STARNet system administrator indicated that covering the annual operating costs and adhering to the maintenance schedule the $21.6M appropriation is $1-2M short of what is needed.

7.2.3 Tower Leasing

FE notes that the state of Minnesota does have a tower leasing program mainly for other governmental agencies. MnDOT currently collects about $375,000 a year in tower rent revenue. The county governmental agency piece of this revenue is relatively small because they usually only pay about $300-$500 per year per site depending on the amount of equipment at the site.

MnDOT has received interest from cellular carriers to lease space on ARMER towers, but no official requests have been made. MnDOT expects revenue from tower leasing to increase, but it is difficult to predict an annual amount at this time.

7.2.3.1 Commonwealth of Pennsylvania

In 2010, the Commonwealth of Pennsylvania sought to leverage their nearly 1,000 emergency communications sites to raise additional operating revenue and also encourage cellular companies to expand their coverage footprint. Cellular coverage in the Commonwealth is difficult to obtain because the topography is influenced by both the Allegheny and Pocono Mountains. Coverage is especially light in northern Pennsylvania and the Cook State Forest.

The Commonwealth sought a vendor relationship because they lacked the in-house tower leasing skillset. Near the end of 2010, the state signed a contract with a major tower company to find potential lessees for space identified on 110 state owned sites. The terms of the contract included a revenue sharing agreement with the tower company and the Commonwealth. It also required the tower company to guarantee funds each year and a 50/50 revenue split after the guaranteed amount was received. The Commonwealth collects revenue paid by private telecommunications companies on Commonwealth-owned towers. The program is expected to raise about $1M year after 5 years.

7.2.4 Commercial Carrier Assets (FirstNet example)

Leveraging of commercial carrier assets involves a contractual agreement between a government entity and the commercial carrier. The commercial carrier would provide the government entity with accommodation at their site facilities or on their network in exchange for monetary or some other form of payment. In theory both parties would benefit from the arrangement as the government entity would be able to expand their network at a relatively lower cost than building out the sites in the network themselves while the commercial carrier garners more revenue.

FirstNet is said to be considering such an arrangement but nothing has been decided at this time so the details are not available. ***FE*** is not aware of other states that have entered into a contract with a commercial carrier for purposes of build out of their statewide network. This is still a relatively unknown strategy because there are still concerns with site control and the resiliency of the commercial carrier site to outages from power disruption, weather, and other potential hazards. Commercial carriers do not typically harden all of their wireless sites to public safety grade levels.

States do periodically lease some commercial carrier sites, but ***FE*** is unaware of a large scale deployment of a regional or statewide system where commercial carrier sites have predominantly been used.

7.2.5 Surcharges and Traffic Ticket Fees

Traffic ticket fees and surcharges are another revenue generator states use to help offset the cost of OPEX. This strategy helps offset the cost, but falls short of raising the amount of revenue needed to pay the full OPEX costs of a major statewide system.

7.2.5.1 Connecticut

Codified in state law, the state of Connecticut utilizes a 9-1-1 surcharge of $.50 on each phone line to help sustain the emergency communications equipment at approximately 150 sites.

7.2.5.2 Oklahoma

The system administrator at the Oklahoma Department of Public Safety (DPS) receives $500,000 annually from the Commercial Driver's License Fee to help pay for the OPEX cost of OKWIN. The remaining amount of the state obligation is funded by a general fund appropriation to the Oklahoma Department of Public Safety. As previously mentioned in Section 7.1.2.3, the OKWIN system is a system-of-systems, therefore the other seven local, tribal and federal partners also cover OPEX obligation out of their general fund budget.

Oklahoma DPS recently increased the state driver's license fee by $10. A portion of the projected revenue can be used to fund "statewide public safety communication systems." Because this is a new funding source the total revenue and amount allocated to support OKWIN has not been determined at this time.

7.2.5.3 Florida

The Florida Statewide Law Enforcement Radio System (SLERS), discussed in Section 7.1.3.1, has a variety of fees to support SLERS at both the state and local level.

The state imposes a $1 annual surcharge on initial and renewal registrations of motor vehicles and vessels (minus an 8% trust fee). The annual revenues are deposited into a SLERS trust account and are paid to the Harris Corporation for OPEX.

The state also has a $3 traffic and criminal traffic violation surcharge. These funds are administered by The Florida Department of Administrative Service (DMS) and are used to pay for SLERS improvements, as well as, the OPEX for DMS SLERS management staff and system operation and maintenance.

It is important to note that because the renewal registrations and traffic tickets fluctuate from year to year, the annual revenue from these fees fluctuate as well.

Florida also has a provision in state law that allows counties to collect up to $12.50 on each moving violation citation issued in their county. These funds can be used for maintaining or enhancing voice and data communications capabilities. Because citations issued in a county follow the county court system, even the revenue generated from citations issued by a state or city officer are collected at the county level and made available for only county purposes. As an example, in Lake County, Florida the traffic ticket surcharge generates approximately $1 per county resident annually or about $300,000.

8. Task 6—Assessment of Funding Alternatives

FE recognizes that the goal of the *Minnesota ARMER and 9-1-1 Funding Study* is not only to provide a comprehensive financial understanding of the ARMER and NG9-1-1 projects today, but to also provide the data to begin working on solutions to sustain the holistic approach the state has taken to emergency communications, as well as prepare for emerging technologies, such as the National Public Safety Broadband Network (NPSBN).

Funding strategies discussed in Section 7 for the various states are documented here to note the positive and negative attributes as they are considered for viability by the state of Minnesota. It is important to note that, ***FE*** had discussions with personnel from the states listed above and have in most cases documented the positive and negative perspectives from the state practitioners who have used these funding strategies. ***FE*** has supplemented the positive and negative attributes of these strategies based on our 30 years of experience in this field.

8.1 CAPEX

Only a handful of different funding strategies have been used by states to build large communications systems. The identified strategies, noted above and assessed below are bonds (both General Obligation and Revenue), public/private partnership, federal grants, vendor financing and leasing options. Each of these funding options provide states different considerations.

8.1.1 Bonds

Two bonding strategies were identified above. Ohio sold state General Obligation (GO) bonds and Minnesota has used Revenue bonds. While there are some differences for investors in GO and revenue bonds to consider, the positive and negative attributes for the issuing authority remain largely the same. ***FE*** notes, many states have effectively used this funding option to build large communications systems with little or no known negative consequences.

Positive attributes

- Viable funding mechanism for large capital projects
- Ability to access large sums of money relatively quickly
- Costs are fixed and predictable

Negative attributes

- 10 to 20 year financial commitment – potentially beyond useful life of system components
- Time and cost to issue bonds and manage debt service
- Interest payments

8.1.2 Federal Grants

Federal grants remain a viable alternative for acquiring a sizable amount of funds for "assisting" with the capital costs of a communications system; however, the grant funds available are being reduced. ***FE*** adds emphasis to *assisting* because ***FE*** is unaware of any large ARMER-like systems that have been built using mostly federal funds. The Public Safety Interoperable Communications (PSIC), Homeland Security Grant Program (HSGP) and Community Oriented Police Services (COPS) grants have been or continue to be nice supplemental funds, but fall short of being able to finance a statewide radio system.

Positive attributes

- Typically 80% of the grant is free
- Multiple programs can be accessed
- Small to medium sums can be received

Negative attributes

- One-time funding source
- Acquiring the grant match
- Following National Environmental Policy Act and other regulatory requirements for receiving federal funds
- Drafting the grant application
- Grant management and auditing

8.1.3 Public/Private Partnerships

As referenced in Section 7, a Public/Private Partnership (P3) can range from small in scope to all encompassing, such as the state of Illinois' arrangement with Motorola Solutions for the STARCOM21 system. The following positive and negative attributes are specific to the Illinois STARCOM21 arrangement as noted by the former Statewide Interoperability Coordinator:

Positive attributes

- Outsourced management and technical support to vendor so Illinois saved money on employee salaries and benefits
- Reduced up front cost
- Contract required vendor to keep system up to date while keeping backward compatibility intact
- Required vendor to perform system upgrades
- State paid less in user fees over the 10 years than the cost of the network upgrades
- In the event of a system outage the vendor is required to bring the system back on line because of contractual performance metrics
- Monthly fees are less than cell phone fees and includes warranty and support
- Many local agencies have joined the system enhancing interoperability
- Expedited implementation

Negative attributes

- Vendor exclusivity and the vendor may be taken over by another entity and maintenance and support might slip. State has first right to buy the system outright.
- Annual operating budget expense
- Volunteer fire agencies cannot afford the fee so many utilize cross band repeaters for fire apparatus

- Other state agencies as well as numerous local agencies are still not on the STARCOM21 system
- Long negotiation period with vendor
- Agencies with subscriber equipment (consoles, radios, logging recorders) pay for upgrades on their own

8.1.4 Vendor Financing

With the reduction of grants over the last five years, vendors have watched their government clients to acquire funding for new radio projects. As a result, the vendors have partnered with several financial firms to offer financing and leases to their clients. Vendor financing offers are not always fully predictable. Vendors can "buy down" the interest rates to close a deal or they can just go with whatever they feel the client will accept. Finance terms can also vary widely regarding the term of the loan and the payment frequency. Generally however, the terms are good, particularly for first time and/or large purchases.

Positive attributes

- Low interest costs
- Long payment terms

Negative attributes

- Usually, the State will have to carry the entire amount of the loan as a liability on their books

8.1.5 Leasing Options

Many vendors are now offering a lease option on system purchases. These leases vary in interest rates but are typically 3 to 4 percent with terms from 5 to 10 years. Title for all equipment leased remains in the name of the vendor or their financial underwriter for the duration of the lease. At the conclusion of the lease, a payment is made to the lease holder (usually $1.00) and title for all leased equipment transfers to the State.

Positive attributes

- Payment terms are very flexible

  - Monthly
  - Quarterly
  - Yearly
  - In advance or in arrears

- Payments start at system acceptance
- Vendor is a partner in the lease which lessons the risk to the state
- If upgrades and maintenance are included in the lease (usually required) the State will have a firm budgetary number for the cost of the system for the term of the lease
- Would allow for all upgrades to be made immediately instead of piecemeal over the next five years.
- Usually only the lease payments for the fiscal year are carried as a current liability

Negative attributes

- New purchases cannot usually be added to the lease over the term
- Financial underwriter will usually require a maintenance contract that covers system infrastructure maintenance, software upgrades, equipment replacement (if necessary to run the new software upgrade)
- At lease conclusion the system is typically past its useful life and in need of replacement

8.2 OPEX

As identified above, various strategies have been used to supplement the OPEX of large communications systems. And, many of them help offset the total costs but only two of the documented funding strategies can generate enough revenue to actually pay for the OPEX of a statewide LMR network and they are user fees and a state fund appropriation.

OPEX funds are critical for the sustainment of systems. It is important to have an established and properly funded maintenance plan to mitigate more costly infrastructure repairs in the future or in the worst case scenario system outages.

8.2.1 User Fees

User fees are an easy to understand and often turned to strategy for funding the OPEX of a radio system. They are however, controversial. The following are some documented pros and cons from the states using them.

Positive attributes

- Ability to raise funding to pay a portion or full OPEX
- Can be structured based on system usage (e.g., tower, zone, region, statewide)
- All users contribute and have a sense of participation

Negative attributes

- Loss of interoperability as some agencies cannot afford the user fees
- Disproportionately impacts smaller rural agencies, such as volunteer fire fighters
- Local agencies not joining a statewide system due to fees results in increased costs for taxpayers (duplicity of parallel systems)
- Billing and tracking can consume significant state employee staff time
- Limited recourse if fees are not paid since they do not deny public safety users access to the system
- State becomes a service provider
- State may become a debt collector

8.2.2 General Fund

As noted in Section 7, Pennsylvania and Connecticut are just two examples of states that pay OPEX from a General Fund appropriation to a state agency. To a minor degree, Minnesota's approach is the same only the state appropriation is from the 9-1-1 SRA and the Trunked Highway Fund. Though, the Minnesota approach of using dedicated accounts is a better strategy than using the state's General Fund because as you will notice in the negative attributes below, there are always limited General Fund dollars and this pits emergency communications sustainment against such things as education, tax

cuts and other more politically appealing investment areas. Here are some positive and negative attributes of a general fund allocation for OPEX.

Positive attributes

- Ability to receive an appropriation to pay some or all of OPEX
- Opportunity to build legislative support for emergency communications systems and interoperability through an annual or biennial budgeting process
- Opportunity for a reoccurring funding stream

Negative attributes

- OPEX funds are in competition with education, health and human services, environmental, tax and other General Fund funded programs
- Higher level of annual or biennial level of review and scrutiny as to the program needs
- Subject to a funding level below the necessary amount to sustain OPEX programs based on state fiscal climate

8.2.3 Tower Leasing

MnDOT currently collects about $375,000 a year in tower rent revenue and the Commonwealth of Pennsylvania also has a tower leasing program as outlined in Section 7. This strategy remains another viable piece of the funding equation.

Positive attributes

- Opportunity to raise a portion of OPEX
- Excess tower capacity is used to generate revenue
- Diversifies OPEX revenues

Negative attributes

- Some believe excess tower capacity should be reserved for future public safety needs

- Typically a small amount of money for the effort by the state and dedication of staff resources
- Misconception that this funding option can raise funds sufficient to cover the OPEX of a statewide LMR system
- May lead to additional non-state personnel in shelters and at sites

8.2.4 Surcharges and Traffic Ticket Fees

Similar to tower leasing, surcharges or fees present another funding option for OPEX. Here are some of the positive and negative attributes of using this funding strategy.

Positive attributes

- Opportunity to raise a portion of OPEX
- Funding strategy is often legislatively more palatable then a tax increase
- Can be associated with any fee, penalty or registration related to emergency responders

Negative attributes

- Often associated with a fee, penalty or surcharge unrelated to emergency communications
- Typically, surcharge or fee only raises a small portion of OPEX
- Requires government tracking and administration

8.3 Funding Alternatives Summary

In reviewing and documenting the CAPEX and OPEX funding strategies used by states it is clear there is no one size fits all solution. If such a funding strategy existed, every state would have adopted it. In fact that is why different states adopt different funding strategies as discussed in this report. An ***FE*** provided list of "outside the box" funding strategies would be at best speculation. A funding strategy is not something a third-party reviewer such as ***FE*** can recommend with any level of confidence. State specific funding organically evolves and factors in many different considerations from emergency responders, residents, elected officials and in some cases industry lobbyists. Based on

FE's work on this project we have learned that state CAPEX or OPEX follows the path of least resistance. Minnesota has expanded the use of the 9-1-1 fee beyond its original uses to fund ARMER. According to some, this funding strategy has worked excellently for Minnesota, but it is not a viable solution in many states because the industry objects to the servicing of such an agreement, local officials fear the loss of local PSAP funds and other political reasons. Some states use multiple mechanisms to pay for their statewide systems since no one funding source can provide for the entire system. This is not a bad approach as it diversifies revenue and helps to mitigate against a full loss of OPEX if funds were to come from one source.

The state of Minnesota's 9-1-1 fee has proven to be a viable funding source for both CAPEX and OPEX, which is rare based on our analysis. It has been a sustainable source of funding for 9-1-1, E9-1-1 and now both the NG9-1-1 and ARMER systems. ***FE*** works with a number states in the country and many of them desire to use the 9-1-1 fee as Minnesota has done.

It is worthwhile to note that the sustained use of 9-1-1 does not come without risk. While a study recently conducted by Opinion Research Corporation (ORC) for the New Millennium Research Council (NMRC) found that although cell phone users cut back on features during the last recession they did not give up on cell phones all together. This is good news for Minnesota which is highly dependent on wireless 9-1-1 fees. The not so good news for Minnesota, is the report went on to say that wired landline counts continue to drop which results in a loss of 9-1-1 fee revenue. Perhaps most concerning to Minnesota is that the report indicated that cell users are switching from monthly plans to prepaid plans and that could have a significant impact on the long-term sustainability of the 9-1-1 fee in Minnesota.

In our professional opinion, taking into account our work for many states and the funding analysis provided above, the state of Minnesota has found a funding solution that is working well for most constituencies and should for the foreseeable future.

Attachment A - Motorola Technology Roadmap

See separate file – *Motorola Technology Roadmap.pdf* provided electronically.

Attachment B - Motorola Release Roadmap

See separate file – *Motorola Release Roadmap.pdf* provided electronically.

Attachment C - Motorola ARMER 10 Year Lifecycle Plan

See separate file – *Motorola ARMER 10 Year Lifecycle Plan.pdf* provided electronically.

Attachment D - ARMER 15 Year Plan

See separate file – *ARMER 15 Year Plan.pdf* provided electronically.

Attachment E – 15 Year ARMER and 9-1-1 Maintenance & Operations Recurring Costs

See separate file – *15 Year ARMER and 9-1-1 Maintenance & Operations Recurring Costs.pdf* provided electronically.

Attachment F - PSAP Maintenance Operations and Recurring Costs

PSAP	2012 Ending Total Balance	Telephone Equipment	Recording Equipment	Computer Hardware	Computer Software	TRUNK LINES	MSAG	Training	Equip To Notify And Respond	Community Alert System	LD Charges to Transfer Calls(Only Applicable To Border Counties)	TOTAL SPENT
Aitkin	$633,103.11	$ -	$ 2,391.00	$ -	$300.00	$ -	$ -	$897.78	$ -	$ -	$ -	$3,588.78
Anoka	$887,613.75	$60,188.63	$5,768.00	$20,779.50	$1,820.00	$20,538.49	$61,526.00	$10,966.36	$42,296.90	$ -	$ -	$223,883.88
Becker	$462,107.99	$ -	$3,814.31	$227,658.65	$66,429.45	$2,331.27	$5,385.25	$ -	$1,815.27	$ -	$ -	$307,434.20
Beltrami	$132,105.29	$1,534.87	$3,628.00	$91.99	$22,162.95	$870.45	$1,787.04	$3,598.76	$13,150.98	$2,763.80	$ -	$49,588.84
Benton	$404,045.44	$ -	$ -	$3,774.83	$56,508.06	$ -	$ -	$1,975.39	$ -	$ -	$-	$62,258.28
Big Stone	$32,628.99	$83,300.00	$ -	$ -	$ -	$ -	$4,944.60	$ -	$4,153.81	$ -	$ -	$92,398.41
Blue Earth	$344,487.82	$200,072.36	$27,897.15	$6,353.72	$20,479.62	$ -	$ -	$999.94	$ -	$ -	$ -	$255,802.79
Brown	$556,966.69											$0.00
Carlton	($4,468.29)	$1,776.01	$15,974.61	$236,520.23	$26,386.83	$6,235.73	$ -	$31,206.24	$72,578.55	$ -	$ -	$390,678.20
Carver	$432,050.31	$ -	$6,126.00	$ -	$ -	$ -	$ -	$4,274.03	$ 7,345.56	$ -	$ -	$17,745.59
Cass	$212,065.22	$119.40	$3,227.38	$38,697.72	$7,988.58	$ -	$36,656.38	$ -	$ -	$ -	$ -	$86,689.46
Chippewa	$40,905.07	$364.02	$ 29,966.46	$ -	$200,947.24	$ -	$ -	$650.67	$6,000.00	$ -	$ -	$237,928.39
Chisago	$21,700.80	$37,000.00	$15,000.00	$19,000.00	$44,900.00	$9,500.00	$ -	$ -	$ -	$ -	$ -	$125,400.00
Clay	$0.00	$ -	$ -	$ -	$60,000.00	$ -	$84,316.77	$ -	$ -	$ -	$ -	$144,316.77
Clearwater	$60,438.05	$2,325.00	$15,931.82	$1,208.68	$43,577.91	$82.05	$10,634.04	$75,622.49	$13.49	$ -	$ -	$149,395.48
Cook	$106,980.34	$ -	$2,555.38	$236,731.10	$ -	$ -	$6,390.07	$4,142.10	$5,330.48	$1,678.50	$ -	$256,827.63
Cottonwood	$225,482.84	$4,211.02	$35,495.41	$135,458.09	$5,096.00	$ -	$ -	$750.00	$18,515.17	$ -	$ -	$199,525.69
Crow Wing	$148,161.92											$0.00

PSAP	2012 Ending Total Balance	Telephone Equipment	Recording Equipment	Computer Hardware	Computer Software	TRUNK LINES	MSAG	Training	Equip To Notify And Respond	Communit y Alert System	LD Charges to Transfer Calls(Only Applicable To Border Counties)	TOTAL SPENT
Dakota	$0.00	$109,882.00	$32,200.00	$ -	$280,316.90	$21,001.00	$ -	$81,107.00	$9,289.00	$47,900.00	$ -	$581,695.90
Dodge	$268,388.29											$0.00
Douglas	$326,624.80	$7,385.08	$2,348.00	$243,074.57	$8,026.09	$47.40	$47.50	$392.00	$17,512.09	$ -	$ -	$278,832.73
Faribault	($137,689.96)	$887.19	$44,982.44	$307,196.20	$9,728.12	$ -	$6,350.00	$854.32	$5,527.88	$ -	$ -	$375,526.15
Fillmore	$346,136.56	$16,347.49	$ -	$192,387.28	$1,760.00	$ -	$ -	$444.00	$57,372.78	$3,281.25	$ -	$271,592.80
Freeborn	$382,405.93	$679.73	$ -	$5,850.77	$ -	$ -	$ -	$ -	$18,371.47	$ -	$ -	$24,901.97
Goodhue	$251,357.12	$3,386.15	$633.68	$144,569.34	$10,286.72	$707.48	$ -	$ 985.68	$12,590.01	$699.44	$561.05	$174,419.55
Grant	$346,127.98	$ -	$ 42.74	$4,054.59	$52,948.60	$1,501.37	$ -	$ -	$ -	$ -	$ -	$58,547.30
Hennepin+ Hopkins (Sept-Dec)	$243,312.85	$60,394.21	$160.00	$15,523.50	$348,873.99	$ -	$19,211.06	$1,522.00	$1,876.96	$ -	$ -	$447,561.72
Bloomington	$192,527.17	$12,318.00	$4,292.00	$13,368.00	$19,173.00	$292.00	$870.00	$4,437.00	$9,318.00	$3,000.00	$ -	$67,068.00
Eden Prairie	$311,044.95	$8,160.47	$ -	$ -	$ -	$3,885.59	$ -	$ -	$26,918.47	$16,000.00	$ -	$54,964.53
Edina	$363,488.60	$683.48	$22,879.55	$87,001.35	$3,074.47	$ -	$ -	$14,031.66	$1,771.09	$15,000.00	$ -	$144,441.60
Hopkins (Jan thru Aug)	$0.00	$ -	$2,381.31	$3,368.96	$30,327.14	$5,132.31	$ -	$ -	$4,000.00	$1,626.66	$ -	$46,836.38
Minneapolis	$233,632.51	$342,085.37	$ -	$95,078.04	$ -	$ -	$ -	$19,403.63	$ -	$ -	$1,187.94	$457,754.98
Minnetonka	$132,432.79	$1,829.96	$27,286.73	$24,020.39	$ -	$11.25	$ -	$ -	$1,458.79	$ -	$ -	$54,607.12
Richfield	$10,368.38	$43,402.93	$ -	$14,917.56	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$58,320.49
Saint Louis Park	$458,447.87	$17,790.16	$ -	$ -	$ -	$ 952.40	$ -	$738.00	$ -	$ -	$ -	$19,480.56
Houston	$29,211.39	$277.08	$ -	$300.00	$2,439.07	$519.93	$ -	$ -	$15,390.20	$10,000.00	$125.27	$29,051.55
Hubbard	$206,157.26	$158.04	$ -	$8,710.18	$5,340.00	$ -	$15,474.22	$822.00	$430.95	$7,983.33	$ -	$38,918.72

PSAP	2012 Ending Total Balance	Telephone Equipment	Recording Equipment	Computer Hardware	Computer Software	TRUNK LINES	MSAG	Training	Equip To Notify And Respond	Communit y Alert System	LD Charges to Transfer Calls(Only Applicable To Border Counties)	TOTAL SPENT
Isanti	$159,110.06	$8,304.00	$15,752.63	$24,447.20	$14,160.00	$ -	$ -	$ -	$ -	$ -	$ -	$62,663.83
Itasca	$771,328.40											$0.00
Jackson	$253,520.20	$2,055.82	$29,037.00	$166,345.01	$20,887.69	$ -	$ -	$1,280.96	$1,559.00	$ -	$ -	$221,165.48
Kanabec	$53,764.02	$11,687.30	$5,584.00	$2,356.16	$54,856.26	$ -	$ -	$2,088.25	$ -	$ -	$ -	$76,571.97
Kandiyohi	$643,178.58	$5,370.46	$ -	$18,597.54	$ -	$ -	$ -	$7,017.90	$ -	$ -	$ -	$30,985.90
Kittson	$450,135.87											$0.00
Koochiching	$137,665.71	$3,541.49	$1,984.00	$16,948.01	$5,700.00	$914.15	$37,825.00	$6,051.48	$6,971.00	$ -	$ -	$79,935.13
Lac qui Parle	$439,453.80	$572.92	$0.00	$8,947.59	$7,509.20	$3,022.64	$ -	$2,287.36	$309.87	$ -	$ -	$22,649.58
Lake	$82,543.26											$0.00
Lake of the Woods	$248,630.55	$16,703.57	$ -	$2,143.41	$33,927.32	$ -	$ -	$1,775.09	$5,678.14	$15,532.02	$ -	$75,759.55
Le Sueur	$221,621.71	$55.95	$ -	$13,845.68	$ -	$5,974.51	$ -	$ -	$ -	$ -	$ -	$19,876.14
Lincoln	$7,870.01	$49,045.06	$ -	$86,748.42	$4,489.00	$ -	$ -	$ -	$ -	$ -	$ -	$140,282.48
Lyon	$166,383.59	$146,210.88	$29,572.49	$25,034.80	$1,620.79	$1,282.56	$ -	$3,514.21	$7,770.64	$ -	$ -	$215,006.37
Mahnomen	$99,492.37	$23,410.64	$3,109.81	$3,431.75	$62,465.82	$1,341.31	$19,315.51	$2,958.43	$19,032.61	$1,857.50	$ -	$136,923.38
Marshall	$382,002.37	$1,428.72	$1,589.00	$9,764.36	$20,801.97	$ -	$3,019.43	$350.00	$2,857.21	$19,958.92	$ -	$59,769.61
Martin	$326,761.83	$ -	$ -	$225,412.34	$51,541.50	$ -	$ -	$513.99	$ -	$ -	$ -	$277,467.83
McLeod	$123,927.67	$11,930.65	$2,013.96	$319.68	$41,755.75	$ -	$ -	$1,390.00	$ -	$ -	$ -	$57,410.04
Hutchinson	($238,360.01)	$ -	$3,640.16	$4,870.56	$28,493.48	$1,899.00	$ -	$19,392.02	$935.74	$2,153.53	$ -	$61,384.49
Meeker	($225,925.15)	$320.63	$29,870.76	$74,408.91	$1,330.00	$1,820.66	$1,318.56	$712.48	$31,721.61	$ -	$ -	$141,503.61
Mille Lacs	($54,973.37)	$39,636.60	$7,401.88	$82,654.21	$10,264.96	$ -	$ -	$ 746.64	$233,149.66	$ -	$ -	$373,853.95

PSAP	2012 Ending Total Balance	Telephone Equipment	Recording Equipment	Computer Hardware	Computer Software	TRUNK LINES	MSAG	Training	Equip To Notify And Respond	Communit y Alert System	LD Charges to Transfer Calls(Only Applicable To Border Counties)	TOTAL SPENT
Morrison	($302,211.39)	$176.16	$ -	$36,903.43	$6,589.38	$ 591.87	$1,575.53	$ -	$2,520.38	$ -	$ -	$48,356.75
Mower	($89,346.50)	$14,460.83	$ -	$ -	$ -	$5,630.96	$ -	$ -	$ -	$ -	$ -	$20,091.79
Murray	$221,917.20	$ -	$ -	$8,409.34	$25,866.66	$1,713.45	$7,053.57	$ -	$ 573.38	$ -	$ -	$43,616.40
Nicollet	($536,641.49)	$ -	$9,821.49	$250,000.00	$7,640.00	$84.86	$ -	$ -	$7,786.19	$7,500.00	$ -	$282,832.54
Nobles	$192,446.12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$63,587.06	$ -	$ -	$63,587.06
Norman	$117,599.52	$176,530.94	$ -	$7,286.32	$50,156.77	$48.49	$ -	$1,282.56	$5,673.38	$ -	$ -	$240,978.46
Olmsted	$198,235.67	$255,616.24	$14,908.03	$ -	$109,274.57	$ -	$715.77	$6,217.59	$1,930.32	$ -	$ -	$388,662.52
Otter Tail	$284,245.25	$194,913.84	$ -	$38,692.46	$ -	$8,737.37	$-	$4,576.68	$2,817.20	$ -	$ -	$249,737.55
Pennington	$465,458.18	$ -	$4,748.49	$8,276.65	$49,555.60	$4,564.61	$118.42	$-	$7,516.90	$ -	$ -	$74,780.67
Pine	$30,822.34	$22,093.51	$2,391.00	$11,824.64	$39,675.61	$27,973.86	$ -	$2,367.37	$9,271.11	$ -	$ -	$115,597.10
Pipestone	$5,932.93	$180,266.69	$2,653.00	$39.00	$2,900.00	$23,724.98	$1,646.72	$252.12	$14,291.07	$ -	$ -	$225,773.58
Polk	$104,706.84	$15,625.11	$ -	$9,714.61	$18,471.88	$14,593.55	$ -	$9,174.89	$9,701.60	$10,781.98	$ -	$88,063.62
Pope	$255,545.53	$ -	$3,008.00	$99,656.29	$ -	$4,735.29	$9,404.67	$ -	$2,481.79	$ -	$ -	$119,286.04
Ramsey	($340,267.61)	$72,898.15	$36,750.00	$61,449.29	$290,733.56	$72,523.70	$ -	$230,136.23	$37,123.79	$ -	$ -	$801,614.72
White Bear Lake	$0.00	$16,500.00	$5,000.00	$ -	$ -	$7,840.00	$ -	$3,802.00	$16,038.00	$ -	$ -	$49,180.00
Red Lake	($230.78)	$10,962.92	$1,783.74	$1,590.13	$26,967.09	$1,029.49	$5,216.59	$37,920.75	$4,919.68	$5,751.13	$ -	$96,141.52
Redwood	$296,276.93	$14,815.68	$38,382.57	$ -	$ -	$1,823.90	$ -	$ -	$195,320.64	$ -	$ -	$250,342.79
Renville	$181,714.30	$ 2,249.16	$8,268.42	$22,936.22	$5,756.91	$ -	$ 7,805.60	$ -	$45,276.23	$ -	$ -	$92,292.54
Rice (see Steele)	$150,287.00											$0.00
Rock	$160,559.56	$ 523.53	$ -	$ 21,035.21	$ -	$6,061.78	$ -	$ -	$46,656.60	$ -	$ -	$74,277.12

PSAP	2012 Ending Total Balance	Telephone Equipment	Recording Equipment	Computer Hardware	Computer Software	TRUNK LINES	MSAG	Training	Equip To Notify And Respond	Communit y Alert System	LD Charges to Transfer Calls(Only Applicable To Border Counties)	TOTAL SPENT
Roseau	$349,602.19	$ 600.00	$10,160.03	$19,270.28	$ 600.00	$83.26	$ -	$656.19	$36,840.04	$11,800.00	$ -	$80,009.80
Saint Louis	$1,027,223.26	$13,912.27	$5,372.61	$2,131.62	$97,021.52	$ -	$55,810.00	$1,860.99	$14,534.64	$ -	$ -	$190,643.65
Scott	$154,359.73	$ -	$5,100.00	$667.50	$ -	$5,529.01	$16,536.96	$15,349.99	$67,746.15	$ -	$ -	$110,929.61
Sherburne	$419,725.07	$ -	$ 3,249.92	$ 8,779.57	$1,001.44	$ -	$ -	$ -	$ -	$ -	$ -	$13,030.93
Sibley	$88,218.18											$0.00
Stearns-2nd req. 4/12	$440,283.55	$11,934.50	$65,754.66	$45,845.00	$78,052.14	$4,623.72	$ -	$7,365.32	$15,180.30	$32,390.00	$ -	$261,145.64
Steele (& Rice)	($421,333.84)	$78,133.38	$ -	$444,698.69	$86,111.00	$ -	$ -	$ -	$56,265.93	$22,500.00	$ -	$687,709.00
Stevens	$236,627.32	$ -	$ -	$284.42	$48,620.19	$3,918.65	$ -	$2,304.32	$455.00	$ -	$ -	$55,582.58
Swift	$250,546.76	$ -	$ -	$85,287.83	$1,593.28	$ -	$ -	$881.55	$17,178.16	$6,841.68	$ -	$111,782.50
Todd	$401,172.05	$1,366.79	$1,499.94	$1,259.84	$9,102.39	$2,294.06	$ -	$29,989.89	$2,512.31	$ -	$ -	$48,025.22
Traverse	$48,291.91	$2,270.08	$2,643.66	$37,246.51	$139,198.27	$ -	$ -	$ -	$ -	$1,318.56	$ -	$182,677.08
Wabasha	($313,204.73)	$5,179.90	$ -	$8,758.90	$41,435.35	$ -	$ -	$11,572.49	$8,509.33	$ -	$ -	$75,455.97
Wadena	$76,976.34	$ -	$2,832.00	$14,281.42	$24,281.34	$2,137.56	$1,531.20	$6,879.09	$2,702.86	$ -	$ -	$54,645.47
Waseca	$335,407.77	$190.64	$ -	$69,755.71	$3,971.26	$ 71.10	$ -	$853.08	$ -	$17,289.20	$ -	$92,130.99
Washington	$715,811.53	$19,672.63	$26,030.29	$31,859.30	$ -	$ -	$ -	$13,435.44	$5,217.49	$17,967.01	$ -	$114,182.16
Watonwan	$64,167.61	$2,065.20	$24,068.06	$318,147.97	$15,847.20	$7,068.26	$ -	$438.30	$23,986.69	$ -	$ -	$391,621.68
Wilkin	$77,030.94											$0.00
Winona	$572,756.83	$5,274.34	$3,696.39	$27,472.67	$204,572.33	$ -	$ -	$ 1,200.00	$47,917.21	$15,000.00	$ -	$305,132.94
Wright	$590,594.46	$3,997.60	$25,676.79	$7,418.92	$119,961.19	$ 3,747.19	$ -	$859.47	$ -	$4,310.00	$ -	$165,971.16
Yellow Medicine	$43,807.61	$12,031.00	$10,113.02	$203,620.99	$31,518.63	$ -	$1,318.56	$ -	$31,813.70	$ -	$ -	$290,415.90

PSAP	2012 Ending Total Balance	Telephone Equipment	Recording Equipment	Computer Hardware	Computer Software	TRUNK LINES	MSAG	Training	Equip To Notify And Respond	Communit y Alert System	LD Charges to Transfer Calls(Only Applicable To Border Counties)	TOTAL SPENT
Airports Comm.	$500,403.71	$609.00	$ -	$3,400.31	$6,578.24	$ -	$ -	$21,638.15	$3,026.00	$ -	$ -	$35,251.70
Univ. of MN PD	$138,601.27	$4,240.00	$3,095.75	$714.22	$41,490.11	$ -	$ -	$418.00	$5,527.70	$ -	$ -	$55,485.78
Red Lake Nation	$150,296.17	$ -	$ -	$ -	$9,490.00	$ -	$ -	$ -	$42,290.45	$ -	$ -	$51,780.45
State Patrol-2nd req. 5/1	$540,190.18											$0.00
	$20,593,086.77	**$2,475,943.43**	**$751,545.52**	**$4,760,686.13**	**$282,728.39**	**$301,014.52**	**$423,805.02**	**$21,332.32**	**$518,202.66**	**$302,884.51**	**$1,874.26**	**$4,540,016.76**
		Phone	**Recorder**	**Hardware**	**Software**	**Trunks**	**MSAG**	**Training**	**Dispatch**	**Alert System**	**LD Charges**	**Total Spent**

Attachment G - 2012 E9-1-1 Fund Audit Summary

See separate file – *2012 E9-1-1 Fund Audit Summary.pdf* provided electronically.

Attachment H - Budget FY2009-2028

See separate file – *Budget FY2009-2028.pdf* provided electronically.

Attachment I – Debt Service and Coverage Schedule

State of Minnesota

[redacted]

Projected 911 Fees
Projected Debt Service Schedule and Coverage Ratios

Period Ending 30-Jun	Monthly Fee	Historical and Projected Fees	Metropolitan Council Series 1999C Annual P & I	Metropolitan Council Series 2007 $ 7,265,000 Annual P & I	State of Minnesota Bond Issues: Series 2006 $ 35,000,000 Annual P & I	Series 2008 $ 42,205,000 Annual P & I	Series 2009 $ 60,510,000 Annual P & I	Series 2011 $ 60,380,000 Annual P & I	Total Debt Annual P & I	Debt Service Coverage (including all debt)	Net Revenues After Metropolitan Council Bonds	State-Only Debt Service	Debt Service Coverage (State debt only)
[redacted]													
(4)		(1)(2)(3)(5)(6)						(7)	(9)		(8)(9)	(8)(9)	(8)
2003	$0.33	$ 20,792,730	$ 1,393,918	-	-	-	-	-	$ 1,393,918	14.92	$ 19,398,813	-	-
2004	0.40	25,838,597	1,396,578	-	-	-	-	-	1,396,578	18.50	24,442,020	-	-
2005	0.40	27,323,188	1,401,928	-	-	-	-	-	1,401,928	19.49	25,921,261	-	-
2006	0.65	46,229,523	1,399,668	-	-	-	-	-	1,399,668	33.03	44,829,856	-	-
2007	0.65	49,527,236	1,404,953	-	$ 975,545	-	-	-	2,380,497	20.81	48,122,284	$ 975,545	$ 49.33
2008	0.65	50,751,000	-	$ 1,311,163	4,262,363	-	-	-	5,573,526	9.11	49,439,837	4,262,363	11.60
2009	0.65	51,269,513	-	1,411,538	4,258,763	$ 3,557,762	-	-	9,228,062	5.56	49,857,976	7,816,525	6.38
2010	0.75	58,821,937	-	1,413,300	4,229,263	7,445,138	$ 6,342,940	-	19,430,640	3.03	57,408,637	18,017,340	3.19
2011	0.80	61,966,800	-	1,414,050	4,199,513	4,860,138	$ 8,190,425	-	18,664,125	3.32	60,552,750	17,250,075	3.51
2012	0.80	61,885,600	-	1,411,800	4,203,313	3,399,800	5,138,425	1,862,670	16,016,007	3.86	60,473,800	14,604,207	4.14
2013	0.80	61,267,000	-	1,419,600	4,199,750	3,398,225	5,140,675	5,559,844	19,718,094	3.11	59,847,400	18,298,494	3.27
2014	0.78	59,138,000	-	-	4,172,250	3,393,625	5,141,425	5,555,944	18,263,244	3.24	59,138,000	18,263,244	3.24
2015	0.85	63,639,000	-	-	4,143,250	3,395,825	5,138,175	5,557,144	18,234,394	3.49	63,639,000	18,234,394	3.49
2016	0.85	63,639,000	-	-	4,117,500	3,399,425	5,139,175	5,556,644	18,212,744	3.49	63,639,000	18,212,744	3.49
2017	0.85	63,639,000	-	-	4,094,500	3,399,225	5,137,375	5,559,144	18,190,244	3.50	63,639,000	18,190,244	3.50
2018	0.85	63,639,000	-	-	4,068,750	3,395,225	5,141,375	5,559,144	18,164,494	3.50	63,639,000	18,164,494	3.50
2019	0.85	63,639,000	-	-	-	3,396,000	5,137,175	5,555,144	14,088,319	4.52	63,639,000	14,088,319	4.52
2020	0.85	63,639,000	-	-	-	3,402,000	5,139,425	5,558,144	14,099,569	4.51	63,639,000	14,099,569	4.51
2021	0.85	63,639,000	-	-	-	2,486,000	5,140,625	5,557,994	13,184,619	4.83	63,639,000	13,184,619	4.83
2022	0.85	63,639,000	-	-	-	2,488,750	4,092,125	5,555,744	12,136,619	5.24	63,639,000	12,136,619	5.24
2023	0.85	63,639,000	-	-	-	2,486,250	4,087,550	5,557,744	12,131,544	5.25	63,639,000	12,131,544	5.25
2024	0.85	63,639,000	-	-	-	2,488,500	4,087,788	5,557,244	12,133,531	5.24	63,639,000	12,133,531	5.24
2025	0.85	63,639,000	-	-	-	-	4,089,263	5,557,869	9,647,131	6.60	63,639,000	9,647,131	6.60
2026	0.85	63,639,000	-	-	-	-	-	759,806	759,806	83.76	63,639,000	759,806	83.76
Column Totals			$ 6,997,043	$ 8,381,451	$ 46,924,757	$ 56,391,887	$ 82,283,940	$ 74,870,220	$ 275,849,298	-	-	$ 260,470,805	-
Totals from FY 2013 to FY 2026			-	$ 1,419,600	$ 24,796,000	$ 37,129,050	$ 62,612,150	$ 73,007,550	$ 198,964,351	-	-	$ 197,544,750	-

(1) Under current law, upon retirement of the Metropolitan Council Bonds (see "SECURITY FOR THE BONDS - the Metropolitan Council Bonds" above), the 911 Fee is required to be reduced by the amount that was applied to the payment of the debt service on the Metropolitan Council Bonds. This would require a reduction of the 911 Fee in the amount of approximately $1,400,000 per annum (or approximately two cents) per customer access line per month of the current 911 Fee.

(2) Projected fees include no fee increase until July 2014 then no additional fees afterward. Full authorization would allow for $0.95 by FY2012.

(3) It is expected that the fee will be decreased to $0.78 as the corresponding Metropolitan Council debt matures (2/1/2013).

(4) Annual principal is June 1, with semi-annual interest payments on June 1 and December 1.

(5) Fiscal Years 2003 - 2012 fees are actual collections based on audited numbers. Fiscal Years 2013 - 2017 revenues are Department of Public Safety (DPS) projections.

(6) DPS does not make revenue estimates beyond Fiscal Year 2015, so revenues are flat for projection purposes.

(7) 2012 debt service for Series 2011 is net of $7,044,345 debt service fund deposit. These funds have been applied to the payments in the period ending 6/30/2012.

(8) Net Revenue analysis (Debt Service Coverage of state-only debt) complies with the Additional Bonds Test of 150% coverage.

Attachment J – SECB Organizational Chart

See separate file – *SECB Organizational Chart.pdf* provided electronically.

Attachment K – 9-1-1 Revenue House Question

See separate file – *9-1-1 Revenue House Question.pdf* provided electronically.