PUBLIC SAFETY
PSWN PROGRAM
WIRELESS NETWORK

Saving Lives and Property Through Improved Interoperability

Fee-for-Service Report

Final

October 2001

FOREWORD

The Public Safety Wireless Network (PSWN) Program works with public safety agencies nationwide to promote interoperability—seamless, coordinated, integrated public safety communications that promote safe, efficient protection of life and property. The PSWN Program works with the public safety community to improve the interoperability of wireless communications systems by promoting coordination and partnerships, seeking funding alternatives, advocating adequate public safety spectrum allocations and efficient spectrum use, supporting technical standards development, and fostering secure communications.

- **Coordination and Partnerships—**Promoting coordination and partnerships among public safety agencies to foster effective shared systems that are developed across jurisdictional boundaries

- **Funding—**Providing resources for developing strategies for funding interoperable communications systems

- **Spectrum**—Working with the Federal Communications Commission and the National Telecommunications and Information Administration to improve public safety spectrum rules and regulations

- **Standards and Technology**—Encouraging standards and technology development by manufacturers in order to create compatible wireless equipment

- **Security**—Working with the public safety community to promote the development of secure facilities, networks and reliable backup systems.

Of these, the PSWN Program recognizes funding as a primary barrier to any organization's ability to implement radio system improvements, including the replacement of old equipment or the addition of new technologies. Therefore, the PSWN Program is studying the feasibility of a fee-for-service arrangement, as an alternative land mobile radio system procurement option. This option gives any organization access to a system built, installed, and maintained by another entity, minimizing the need to budget for significant capital investments. Although the fee-for-service approach is not currently in widespread use, this concept warrants further study for the public safety community.

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SUMMARY REPORT

Introduction & Project Background

Faced with shrinking budgets and increasing responsibilities, government executives struggle to identify the millions of dollars typically associated with the procurement of a new system or the replacement of aging, outdated equipment. Agencies at all levels of government are under pressure to limit spending, reduce staff, and monitor service levels. Guidelines, described in Office of Management and Budget (OMB) Circular A-11, instruct government agencies and departments to consider outsourcing operations and maintenance (O&M) activities whenever possible. In light of the current emphasis on cautious spending, government executives must look for alternative LMR system solutions—those not requiring large capital investments. One such possible solution being considered today is a fee-for-service arrangement with a commercial provider.

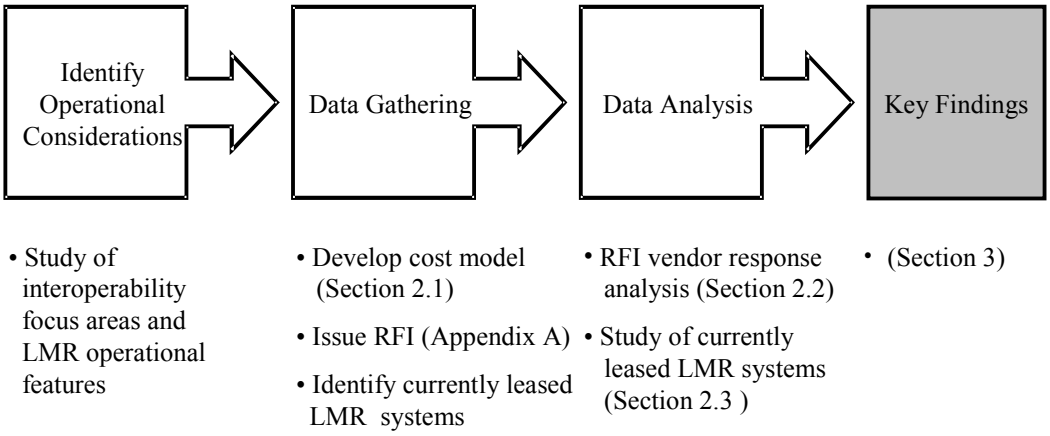
To determine whether the fee-for-service alternative is viable for public safety agencies and vendors alike, the Public Safety Wireless Network (PSWN) Program analyzed the fee-for-service concept.

This report addresses the relevant issues and considerations associated with leasing LMR services. For the purposes of this report, a fee-for-service arrangement is defined as leased LMR service from a commercial entity that builds, owns, maintains, and manages the system. This report is not intended to provide an endorsement of the fee-for-service approach. Rather, it actively seeks to inform interested public and private organizations of the key considerations in pursuing this option, as well as attempting to define the environment in which the approach may be most favorable for the user and vendor alike.

Project Methodology

To assess the current state of the industry relative to the fee-for-service approach, the PSWN Program analyzed data obtained from three data elements: cost model, review of request for information (RFI) responses, and review of existing leased LMR service arrangements in three states. Shown in the Figure A is the process used to complete the analysis of the current state of the fee-for-service option. In the initial step, operational considerations for public safety user agencies are identified to provide a framework in which to view the findings from the remainder of the analysis. The second step in the process is the data-gathering effort, during which the raw data to analyze is collected. The third step is the comprehensive data analysis, during which RFI responses and existing implementations are reviewed. The final step in the process was then the development of the key findings from the analysis.

Figure A
Fee-for-Service Process Model



Further detail is provided here for each of the major elements of the analysis process:

- **Operational Considerations.** The following considerations were identified: expansion, interoperability, operations & maintenance (O&M), and security.

- **Cost Model.** A cost model was developed by creating a baseline cost of a LMR system purchase and comparing that with leasing LMR services.

- **RFI Responses.** An RFI was issued to gain a telecommunications industry-wide perspective on the development of the fee-for-service approach.

- **Case Study.** A study of currently leased LMR services in the states of Florida, Illinois, South Carolina, and the Federal Specialized Mobile Radio (FedSMR) system in Washington, DC, was completed to add a user perspective to the study.

- **Data Analysis.** Through the analysis of the input sources, the PSWN Program identified common themes, vendor and user benefits, and the risks associated with implementing the fee-for-service approach. The key findings were derived from this analysis.

Key Findings

Collectively, the common theme of the analysis indicates that no single, universal fee-for-service approach is available. Further, the system functionality offered by the fee-for-service approach is determined by the specific requirements of the user organization. Implementation of a national solution would most likely begin with scalable, regional networks that could be interconnected to form a nationwide system. The vendors also suggest that, at least initially, implementing a hybrid of private and commercial systems might be the best method for obtaining wide-area leased LMR services. Federal user requirements would define system functionality, but state and local agencies, along with general mobile subscribers, would provide

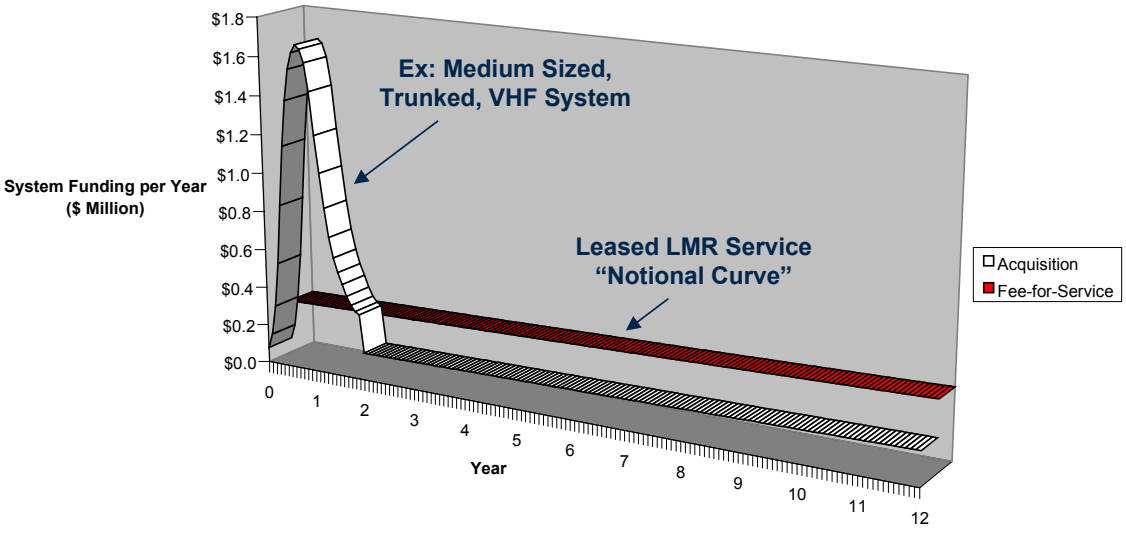
the economic base to justify full-scale deployment. System expansion and technology upgrades would depend on user demand for services.

The analysis yielded results that can best be grouped into three categories: 1) cost considerations, 2) vendor profitability issues, and 3) operational concerns. Highlighted below are the more significant findings in each category, however, a more detailed discussion is provided in Section 3.

1. Cost Considerations

Leased LMR services allow government organizations to develop smooth budget profiles, however, the actual annual costs are unclear. Until proven by modeling operational systems, cost considerations for the fee-for-service approach are based mostly in conjecture due to the uniqueness of each system. The most significant cost consideration derived from the analysis is that users can avoid large capital investments. This concept is illustrated in Figure B.

Figure B
Typical "Spend" Curve
System Purchase vs. Leased LMR Service



2. Vendor Profitability Issues

The results of the vendor response analysis emphasize the importance of profitability for the vendor. As a business venture, vendors will not pursue leased LMR services unless

the commercial marketplace will yield sufficient revenues. The most significant finding relative to vendor profitability may be the availability of adequate spectral resources.

Public safety organizations use different frequencies, which have varying levels of restriction. Use of federal spectrum is restricted to federal users only. These restrictions are of concern to the vendor community because vendors require long-term access to this spectrum to recoup the initial capital outlay. To facilitate vendor use of restricted spectrum, regulatory changes are required. These changes, however, are typically very slow in developing (e.g., four years to effect changes for co-equal access of public safety spectrum). A mechanism that guarantees licensing or allows vendors to license public safety spectrum, thereby opening sources of potential revenue, will be key to overcoming this obstacle.

3. Operational Concerns

A significant finding in this category is that there is a limited "track record" on which to base decisions regarding the fee-for-service option. Only three vendor responses were received from the RFI, potentially indicating a low level of industry interest at this time. In addition, only a small number of statewide system deployments have been attempted, and at this point, none are fully operational. Each of these statewide systems is unique and highly tailored to state-specific circumstances. Another hindrance to the analysis of the fee-for-service approach is the lack of a nationwide model. Vendors indicate that a nationwide system would likely consist of a "network of networks," but no plans exist for a deployment of this type.

Another significant finding is the user organization's loss of its inherent control over its primary means of public safety communications. Specific public safety operational requirements for expansion, interoperability, O&M, and security must be adequately supported by vendors offering leased LMR service.

The Future of Fee-for-Service Implementations

Analysis of the current state of the fee-for-service option indicates that the approach has not matured sufficiently for near-term implementation on a nationwide basis. In light of the considerations outlined above, it would be prudent to reevaluate the fee-for-service approach after systems of this type have been operational for at least 1 year. "Report cards" from the systems implemented in Florida, Illinois, and South Carolina will provide the benchmarks for further assessment of the fee-for-service approach at the statewide level. These assessments may provide the baseline information necessary to plan the mitigation of the vendor and user risks associated with implementation of the fee-for-service approach on a nationwide scale.

As vendors and customers begin to define and develop this new concept for use within the public safety community, they should anticipate changes in technical solutions, services and features, and expectations. The promotion of an open dialogue among vendors and user organizations at public safety forums, roundtables, symposia, and conferences should help guide the development of an optimal fee-for-service solution.

1. INTRODUCTION

Land mobile radio (LMR) systems are critical tools used by public safety providers nationwide. For protecting citizens and saving lives, these tools are as important as the police officer's service weapon or the firefighter's water hoses. Without effective radio systems, the safety of the public, the property protected by public safety providers, and the physical safety of the providers themselves, can be put in jeopardy. Yet, as the technology in many LMR systems in use today becomes outdated, and as the supply of older parts becomes increasingly limited, these systems are becoming very costly to maintain. Furthermore, many of these legacy systems lack advanced features such as those associated with the Telecommunications Industry Association (TIA)/ Electronics Industries Alliance (EIA)-102 suite of standards. These standards make it easier for agencies to conduct operations in an environment that allows emergency incident responders to communicate more readily with one another.

Often faced with shrinking budgets and increasing responsibilities, government executives commonly struggle to identify the millions of dollars typically associated with the procurement of a new system or the replacement of aging, outdated equipment. Agencies at all levels of government are under pressure to limit spending, reduce staff, and monitor service levels. Guidelines, described in Office of Management and Budget (OMB) Circular A-11, instruct government agencies and departments to consider outsourcing operations and maintenance (O&M) activities whenever possible. In light of the current emphasis on cautious spending, government executives must look for alternative LMR system solutions—those not requiring large capital investments. One such alternative solution is a fee-for-service arrangement with a commercial provider.

1.1 Purpose

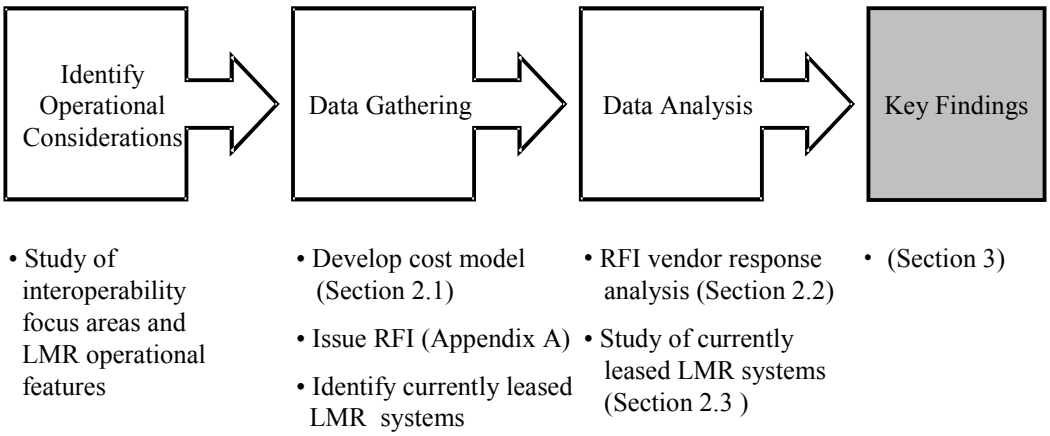
Fee-for-service, as an alternative to the traditional approach of procuring a privately owned and operated LMR system, offers public safety agencies feature-rich LMR services with little capital expenditure and O&M that is not their responsibility. From the user perspective, several anticipated benefits are associated with the fee-for-service approach, including cost savings, access to state-of-the-art technology, and the opportunity for outsourcing of non-core competencies. Is this a feasible, full-service solution? To determine whether the fee-for-service alternative is viable for public safety agencies and vendors alike, the Public Safety Wireless Network (PSWN) Program initiated an analysis of the fee-for-service concept.

This report addresses the relevant issues and considerations associated with leasing LMR services, i.e., the fee-for-service approach. For purposes of this report, a fee-for-service arrangement is defined as leased LMR service from a commercial entity that builds, owns, maintains, and manages the system. This report is not an endorsement of the fee-for-service approach. Rather, it actively seeks to inform interested public and private organizations of the key considerations in pursuing this option, as well as attempting to define the environment in which the approach may be most favorable for the user and vendor alike.

1.2 Methodology

To assess the current state of the industry relative to the fee-for-service approach, the PSWN Program analyzed data obtained from three sources: a cost analysis, a review of request for information (RFI) responses, and a review of existing leased LMR service arrangements in three states. As shown in Figure 1, the process comprises identification of operational considerations, a data-gathering effort, and a comprehensive data analysis, which in turn results in the development of key findings. This section further defines each of these processes. The end result, the development of key findings, is detailed in Section 3.

Figure 1
Fee-for-Service Process Model



1.2.1 Identification of Operational Considerations

Under the fee-for-service approach, the leasing agency has little inherent control over the system it is using. Rather, an outside entity is charged with managing the following operational considerations linked to public safety operations: expansion, interoperability, O&M, and security. These operational aspects, which stem directly from the PSWN Program's interoperability focus areas, provide the grounding necessary when considering the benefits and risks associated with leasing LMR services.

1.2.2 Data Gathering

The goal of the data-gathering effort was to assemble a substantial collection of information representative of both the vendor and user community perspectives. The data-gathering effort was accomplished using the following input sources:

- **Cost Model.** A cost model was developed by creating a baseline cost of a LMR system purchase and comparing that with leasing LMR services.

- **RFI Responses.** An RFI was issued to gain a telecommunications industry-wide perspective on the development of the fee-for-service approach.

- **Case Study.** A study of currently leased LMR services in the states of Florida, Illinois, South Carolina, and the Federal Specialized Mobile Radio (FedSMR) system in Washington, DC was completed to add a user perspective to the study.

1.2.3 Data Analysis

Following the data-gathering effort, the next component of the process was the data analysis. Through the analysis of the input sources, the PSWN Program identified common themes, vendor and user benefits, and the risks associated with implementing the fee-for-service approach. The key findings were derived from this analysis.

2. COMPONENTS OF THE ANALYSIS

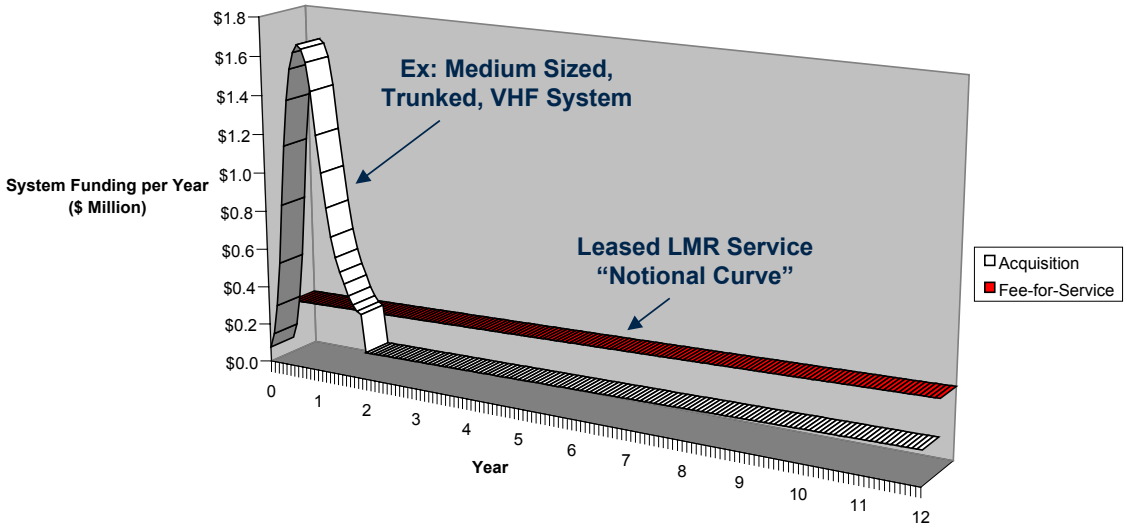
This section details the principal components of the analysis. Featured are the cost considerations, RFI response analysis, operational considerations, and a review of currently leased LMR arrangements.

2.1 Cost Considerations

An important issue, when considering the fee-for-service approach, as opposed to the traditional approach of procuring a system, is cost. The cost of these alternatives varies in two ways—the yearly profile of required funding and the total life-cycle cost. The yearly funding for a traditional procurement requires a large, up-front capital investment to deploy the new system (often occurring during the first 1 to 2 years) and is followed by a lower, relatively sustained level of funding used to operate and maintain the system. Funding for the fee-for-service approach generally requires a constant funding level from the first year of system use through the last year, which may be adjusted for inflation. The total cost and funding required each year for the fee-for-service approach would depend on the particular agreement negotiated with the system vendor.

To establish a baseline for comparison purposes, the PSWN Program developed expected costs for small, medium, and large systems. The assumptions used to define each are detailed in Appendix C. In brief, a small system assumes 500 users and the associated number of sites and channels to support that number; a medium system assumes 2,500 users and the associated number of sites and channels to support that number; and, a large system assumes 25,000 users and the associated number of sites and channels to support that number. Shown in Figure 2 is an example of the yearly funding profile associated with the purchase of a medium sized, trunked, very high frequency (VHF) system, as well as the expected costs (example only) associated with a fee-for-service approach over a typical 12-year system life cycle. Using a 12-year period captures a 2-year deployment period and an additional 10-year period during which a system owner would expect to support O&M of that system. The reader should understand that total costs for each of the two approaches are represented by the entire area under each curve. In this example, and as shown in Table 1, the investment cost and ongoing O&M costs for a medium sized, trunked, VHF system are $19.4 million and $20.4 million, respectively. The costs indicated for the fee-for-service approach are shown as an example (i.e., not based on any real system) and are shown for comparison purposes only. These annual costs could be higher or lower, depending on the particular service agreement. However, the relative indication of a constant, steady-stream amount of money required over time, as opposed to a significant spike in up-front capital requirements (i.e., for a system purchase), holds true, irrespective of the annual costs for the fee-for-service approach.

Figure 2
Cost Comparison: Fee-for-Service and Acquisition ($ Million)
Medium Sized Trunked System Operating in VHF Band



As shown in Table 1 the total cost for various system configurations ranges from approximately $6 million for a small, conventional VHF system to approximately $203 million for a large, trunked 800 megahertz (MHz) system. The investment and O&M costs, respectively, comprise approximately half of the total cost for each configuration. As indicated, an 800 MHz system is more expensive to implement than a comparable VHF system. This is because more sites are required. In addition, trunked systems are more expensive to implement than conventional systems, but trunked systems support a higher user capacity. The investment cost ranges from $5 million to approximately $99 million for a trunked system, and from $3 million to approximately $46 million for a conventional system.

Table 1
Total System Cost for Traditional Procurement Alternative ($ Million)

System Type	VHF			800 MHz		
	Investment	O&M	Total	Investment	O&M	Total
Conventional						
Small	$ 3.0	$ 3.4	**$ 6.4**	$ 5.3	$ 6.3	**$ 11.5**
Medium	$ 10.7	$ 12.8	**$ 23.5**	$ 18.0	$ 21.8	**$ 39.8**
Large	$ 29.2	$ 35.7	**$ 64.9**	$ 45.5	$ 56.1	**$ 101.6**
Trunked						
Small	$ 5.0	$ 5.1	**$ 10.1**	$ 8.8	$ 9.2	**$ 18.0**
Medium	$ 19.4	$ 20.4	**$ 39.8**	$ 33.0	$ 34.8	**$ 67.8**
Large	$ 62.6	$ 66.1	**$ 128.8**	$ 98.5	$ 104.2	**$ 202.7**

Shown in Appendix C are the detailed estimates for the infrastructure costs associated with the traditional purchase approach for the different system configurations outlined above. Cost estimates are not shown in Table 1 for the fee-for-service approach because few systems of this kind have been implemented, but more to the point, each negotiation is greatly affected by the resources and other potential system subsidies available to the user agency and vendor.

2.2 RFI Analysis

To gain further insight into the wireless communications industry regarding building, maintaining, and managing LMR networks using the fee-for-service approach, the PSWN Program issued an RFI in the *Commerce Business Daily*, a publication highlighting government projects and activities. As shown in Appendix A, the RFI solicits feedback on several important considerations relevant to the public safety community. These considerations include the vendors' perspectives on the feasibility of the fee-for-service approach for public safety agencies, the economics of such arrangements, enabling conditions or special arrangements required, and the overall commercial viability of the option.

To baseline the viability of the fee-for-service approach from the vendor perspective, the PSWN Program completed an analysis of the three vendor responses submitted as part of the PSWN Program's telecommunications industry-wide RFI. A summary matrix highlighting the responses to the RFI is shown in Section 2.5 of this report. The matrix features the questions, as posed in the RFI, along with a summary of each vendor's response. Where vendors did not offer a response to a particular question, this is indicated by the phrase, "Did Not Respond." Appendix B includes a more detailed report of each vendor response.

A comprehensive review of vendor responses yielded several significant commonalties, which are compiled here in summary form. Note that although these common themes are presented from the perspective of the vendor, they indicate for users what the enabling or limiting factors behind the fee-for-service approach may be. When viewed collectively, these commonalties serve as a guide when considering the fee-for-service approach. The common themes cover the following issues—

- Feasibility
- Financial Concerns
- Implementation Approach
- Spectrum Requirements
- Trade-Off Perspective.

➢ **Feasibility.** Feasibility implies the overall commercial viability, as well as the level of interest, for both vendor and customer for the fee-for-service alternative.

- Vendor A regards the fee-for-service option as suitable for public safety agencies and vendors. Yet, this vendor also notes that no single fee-for-service approach is applicable to all users. A combination of commercial networks and private systems is recommended. Initially, this approach would likely work well as a regional opportunity. However, because of the mission-critical operational requirements for public safety, Vendor A expresses concerns regarding system sharing by organizations outside the

public safety arena. Establishing effective working agreements between system participants is another potential obstacle to the successful application of this alternative. To combat these problems, working agreements (i.e., memoranda of understanding [MOU]) would require specifics regarding all aspects of system use including maintenance, options, terms, waivers, and financial expectations.

- Vendor B deems its fee-for-service approach feasible depending on current economic and technical conditions, as well as the user agency's specific mission goals. The vendor introduces several important considerations for public safety organizations, including a suitable business case (including organizational assessments), strategic and technical considerations, financial and contractual issues, implementation, interoperability, life-cycle management, and vendor experience. By analyzing these considerations, an organization would identify the applicability of this alternative LMR procurement approach.

- Vendor C considers the fee-for-service approach a viable alternative for public safety agencies. Vendor C's solution presents a private mobile radio network owned and operated by a commercial entity that would follow a hybrid migration path. This solution would provide flexibility to enable the vendor to adapt to the various requirements of public safety organizations. Additionally, the elimination of an initial capital outlay would free up funds that the user organization could commit to a recurring leasing fee. This would permit more user organizations to participate in such an arrangement and, in turn, create a larger subscriber base for the vendor. This approach would create a favorable environment for the user organization, as well as the vendor. Vendor C presents this solution as a network capable of serving the entire Nation.

➢ **Financial Concerns.** Financial concerns involve the economic conditions related to the fee-for-service approach and include the level of risk associated with this arrangement.

- Vendor A views the financial picture as unfavorable for the customer under the fee-for-service arrangement. Because of extensive vendor investments in infrastructure, spectrum acquisition, and relocation of users across the spectrum, high leasing fees would be passed onto the customer. However, this approach would allow greater freedom for public safety organizations to establish alternative funding mechanisms.

- Vendor B indicates the vendor would assume the financial burden with the fee-for-service approach. In light of this, the vendor must identify adequate sources of revenue to build, maintain, and operate the system. In turn, the customer must identify a funding stream that supports the terms of the lease agreement. Vendor B indicates that with a variety of financing schemes, the fee-for-service alternative is beneficial for the customer.

- Vendor C's response includes an analysis of the financial implications found in a business case model. The model can be used to determine whether this option is a feasible alternative from a vendor perspective. Based on an analysis of the business case model, the vendor would realize profits at a compound growth rate as the network

matured. The basic assumption, however, is that subscriber numbers would increase once the advantages of the system became apparent. Other caveats include the idea that system deployment would likely require private systems, or the use of cellular telephones, in rural areas where the revenue base does not exist to support the leased LMR system.

- **Implementation Approach.** The implementation approach is the method of deployment or facilitation of network access.

  - Vendor A notes that "there is no single, or universal, implementation option" available to potential system subscribers. Implementation requirements for each organization should be established during the earliest phases of the project. Vendor A provides a brief discussion of available technologies that could support the fee-for-service approach.

  - Vendor B recommends an implementation plan for transitioning users to the new system. To limit disruptions, the plan should include a predefined process that incorporates transition, life-cycle, and network management needs.

  - Vendor C presents two options for leased system implementation. The first option is a private mobile radio network built, owned, operated, and maintained by a commercial provider. This network would provide each of the mission-critical features required to address the day-to-day challenges faced by the public safety community. In the second option, the vendor suggests partnering with a national wireless service provider to supply complementary coverage during the build-out of the nationwide private mobile radio system. Implementation would begin in regions containing the greatest number of subscribers, and a national wireless service provider would service areas with a lower projected subscriber demand. Rural areas would be served by a cellular network through access to a virtual private network. Vendor C's response includes a detailed description of available technology, system configurations, and network architecture.

- **Spectrum.** Spectrum issues include the implications associated with leased systems and multiple users operating in designated bands for public safety users.

  - Vendor A identifies the availability of new spectrum as a potential means to reduce high lease fees. If the Federal Communications Commission (FCC) releases new spectrum at no cost or at a significant discount, the vendors would have adequate spectrum to accommodate a significant user load and could pass these savings to the customer. FCC cooperation is paramount for the success of this concept.

  - Spectrum concerns apply to private systems as well as commercial networks. Vendor B agrees with the Public Safety Wireless Advisory Committee (PSWAC) concept of a flexible regulatory environment, which encourages the development of shared system infrastructure supporting public safety communications. The 700 MHz spectrum is one resource that, when shared, offers the flexibility needed to support multiple users under the fee-for-service approach.

- Flexible spectrum management is an important concern of Vendor C. This vendor notes the efficient use of spectrum would allow the vendor to recoup and profit from its initial capital investment. To accomplish this, the user organization would have to negotiate the use of its national frequency licenses for a lengthy period of time. (The vendor suggests 50 years.) Additionally, the vendor suggests the creation of an agency to manage federal and other subscriber frequencies on a shared network.

  Additional considerations regarding spectrum, as presented by Vendor C, involve new user access to the network. Vendor C encourages the vendor and the customer to determine a method for new users to access existing spectrum. The vendor recommends that, as new users subscribe to the system, service levels be proportional to the amount of contributed spectrum. This approach means that the more spectrum an organization contributes, the higher the service level. Vendor C projects that the aggregation of this spectrum would generate the advantage of using subscriber frequencies for the good of the entire network.

➢ **Trade-Off Perspective.** The trade-off perspective provides the vendor or customer view of the fee-for-service alternative and the associated advantages and disadvantages.

- According to Vendor A, the public safety community should weigh several advantages and disadvantages before implementing a fee-for-service arrangement. Using a business case model, various segments of the user population would realize productivity gains, which would be viewed as a significant advantage by any participating organization. The actual measure of the productivity gain would be based on a number of variables. Another notable advantage is the prompt completion of mission functions resulting from consistent connectivity to information technology (IT) resources.

- Vendor B presents numerous benefits and limitations. The benefits include user agency access to a different financing option, a monthly or yearly fee, reducing the need for a large up-front investment. The vendor must shoulder costs associated with the build-out and maintenance of LMR infrastructure and services. Multiple spectrum licensing requirements add to the complexity of this solution. The user agency would likely be required to manage its respective frequency licenses. Vendor B recommends detailed consideration of the business case, operational practices, financial considerations, and technology requirements before committing to the fee-for-service approach.

- Although Vendor C's solution presents many advantages for the user, it passes significant risk to the vendor. The annual federal contract review process puts the vendor at great risk. If the contract is lost, the large amount of capital and infrastructure deployed would not easily convert to other purposes. Therefore, Vendor C suggests a contract minimum of 7 years to mitigate vendor risk. The benefits of this alternative include cost-effective service, the ability to serve multiple government entities, secure communications, efficient use of spectrum, and a "one-stop-shop" for all of an organization's communications needs. Vendor C can configure its system to adapt to any geographical area.

2.3 Operational Considerations and Vendor Responses

The vendor position regarding the operational considerations of expansion, interoperability, O&M, and security is a fundamental concern to any potential user organization and will likely determine the successful implementation of a leased LMR system. The operational features must support the mission requirements of the participating user organization, or the fee-for-service approach is not a suitable option within the public safety community. To understand the full impact of these features, expanded definitions of the operational considerations are provided below.

- **Expansion.** This capability guarantees a "usable future" for a LMR system. Related to several PSWN Program interoperability focus areas, expansion capabilities are a critical operational consideration. Without the ability to easily modify system attributes such as coverage and capacity, the public safety agency has little hope of keeping pace with the changing needs of the public it serves. Because of cost considerations, privately owned and operated systems often lack advanced expansion capabilities, and agency-specific changes could be problematic. For example, internal influences, such as a surge in staffing levels, would directly affect channel capacity requirements. To accommodate the numerous external and internal influences that often affect LMR system operations, investments in new LMR systems require a clear migration path that allows for simple, low-cost modifications. Large-scale replacements of hardware or subscriber units are incompatible with today's budget constraints. Also, the leased system must provide a mechanism to support short-term system expansion such as that required for large-scale, ad hoc emergency incident response. A LMR system offered under a leased service agreement must be capable of supporting expansion requirements.

- **Interoperability.** As determined by the PSWN Program, the ability for agencies to communicate with one another on demand, and in real time, is a necessity for the modern-day public safety organization. Yet, interoperability among local, state, federal, and tribal public safety agencies is often hindered by barriers such as different frequency bands and incompatible vendor equipment. Interoperability solutions exist, but variations in cost, effectiveness, and practicality make implementation for some agencies difficult or impossible. To be considered a viable option in the public safety arena, the fee-for-service option must support interoperability.

- **O&M.** As a facet of both the PSWN Program defined standards and technology, and security interoperability issues areas, O&M is an integral component of any LMR system. Although a considerable ongoing expense, O&M is required to maintain the integrity of a LMR system. For private systems, agencies must retain sufficient system and technical personnel to service the various aspects of the system, or they must contract for these services. These personnel are responsible for general system administration, as well as maintenance of equipment, software, and infrastructure. Service providers must be available at all times, must continually monitor system activity, and must respond to changes in technology. Without proper O&M, system

degradation will occur. Adequate service level agreements (SLA) must be established with a commercial provider offering leased LMR services.

- **Security.** Secure communications capabilities are vital for public safety responders. In support of this critical capability, the PSWN Program works with the public safety community to promote the development of secure facilities, networks, and reliable backup systems. The interception and alteration of information are major security concerns facing the public safety community today. However, security encompasses more than the transmissions heard across the radio. To protect sensitive information, as well as the physical system itself, computer and physical security measures must be instituted and consistently monitored. The key components of security for public safety communications are secure facilities and networks, reliable backup systems, secure transmissions, and constant security awareness. Vendors and public safety organizations alike must recognize the importance of security and ensure that appropriate safeguards are in place to protect all aspects of the system from possible intrusion and other risks.

Each vendor provides responses of varying degrees of similarity relative to the operational considerations of the fee-for-service approach. Shown in Table 2 are the vendor responses as they intersect with the operational considerations.

Table 2
Operational Considerations and Vendor Responses

Consideration Area	Vendor A	Vendor B	Vendor C
Expansion	• A regional approach is supported; nationwide system requires large vendor investment	• Vendor assumes risk for management and acquisition of new technology to support growth	• Nationwide network could be achieved by combining multiple networks • Network could easily be redesigned due to system architecture and customer requirements and budget could be supported
Interoperability	• Improved interoperability opportunities due to access to the latest technologies • Vendor A notes that technical solutions exist, however, coordination and partnership issues remain an impediment to interoperability	• Considers requirements for computer-aided dispatch (CAD) interoperability and other related software solutions • Incorporates Project 25 (P25) standards • Encourages sharing and consolidating systems • Recommends a review of numerous technical considerations including: coverage and capacity, user requirements, and communication methods	• Improved interoperability opportunities due to access to the latest technologies

Consideration Area	Vendor A	Vendor B	Vendor C
O&M	• System failure concerns; private systems are quicker to restore • Priority access issues • Creative cooperation is needed between user agency and vendor; includes the need for pre-approved terms and conditions	• Increased system efficiency and reliability • Network problems may be eliminated • Improved service levels	• All organizations must share the same infrastructure
Security	• Considered a qualitative factor and weighed heavily in business case	• Adheres to P25 security standards	• Virtual private network would provide operational independence • Vendor recognizes the importance of security and would provide secure voice and data transmissions for entire network • Security requirements are embedded into design

2.4 Review of Current Leased LMR Arrangements

Fee-for-service systems are not common in the public safety arena. However, the states of Florida and Illinois have determined that the fee-for-service approach is a suitable alternative. M/A-Com Private Radio Systems (formerly Com-Net Ericsson) and Motorola are actively developing large-scale systems for these two states, respectively. Another system of interest, SCANA, is located in South Carolina. Originally built by Motorola, in conjunction with state and local agencies, this not-for-profit system was owned by the SCANA Corporation[1] but provides LMR service to state and local public safety organizations and utility companies throughout the state. To help the reader fully understand the selection strategies, this report profiles the circumstances associated with each system. With the earliest system build-out date for Florida projected for late 2001, the public safety community anxiously awaits a vendor performance "report card" for an operational fee-for-service arrangement implemented solely for that purpose.

This section describes the fee-for-service systems used by the states of Florida, Illinois, and South Carolina, and the FEDSMR system in the Washington, DC metropolitan region. Each system was established based on a range of user requirements and as noted in the previous section, no single, universal approach is used. However, the featured systems offer some commonalties: coverage is required for a large geographic area; funding considerations were the predominant factor in choosing this approach; and significant resources were available for the user agency to offer the vendor.

[1] Motorola has recently purchased the SCANA system. The details of this transaction are not available to the public at this time.

Section 2.3 details several operational considerations for user agencies wanting to implement the fee-for-service arrangement with a system vendor. Along with some general background information for each system, these case studies highlight how three agencies currently using leased LMR services have addressed those same operational considerations.

Again, key system considerations for the fee-for-service approach are—

- Expansion—Ability to add new users
- Interoperability—Ability to communicate with other emergency incident responders
- Operations and Maintenance—Day-to-day upkeep of the system
- Security—Ability to prevent unauthorized system access and the ability to maintain the integrity of system transmissions.

2.4.1 State of Florida

The State of Florida began the funding and acquisition of a statewide radio system in 1988. Soon after initial system installation, however, it became apparent sufficient funding would not be available to complete the planned system build-out. To address this situation, the State of Florida State Technology Office (STO) and Com-Net Ericsson[2] entered into an agreement on September 28, 2000, whereby M/A-COM Private Radio Systems would implement and maintain the Statewide Law Enforcement Radio Network (SLERN) under a comprehensive Service and Access Agreement (SAA). Essentially, M/A-COM would provide statewide LMR service to authorized system users on a fee-for-service basis. The SAA became effective on October 23, 2000. This newly formed public–private partnership will accomplish two major end goals for the State of Florida:

- It will provide a statewide LMR infrastructure that, at full system build-out, is expected to consist of 130 sites and provide guaranteed coverage over 98 percent of the state.
- It will provide potential net savings to the state on the order of $850 million.

The State of Florida will benefit from two financial arrangements specified in the SAA. First, M/A-COM has negotiated the right to lease excess tower space that the state does not use to third parties such as cellular or personal communications services (PCS) carriers. During the 20-year term of the SAA, Florida will receive 15 percent of all revenues collected from third-party tenants on the conveyed towers. During the subsequent 30 years, Florida will receive 50 percent of all revenues. Second, the State of Florida will receive $300,000 per conveyed site, up to a cumulative total of $25.5 million, as purchase credit that can be used for subscriber units, i.e., either portable or mobile radios.

[2] Com-Net Ericsson sold its Private Radio Systems division to Tyco International. The former Com-Net Ericsson has been folded under one of Tyco's many subsidiaries, M/A-COM. M/A-COM Private Radio Systems will continue to support the Enhanced Digital Access Communications System (EDACS) technology deployed by Com-Net Ericsson for the State of Florida system.

Additionally, M/A-COM will market the radio frequency (RF) portion of the communications system to eligible third-party subscribers (e.g., local, state, or federal public safety agencies). Because M/A-COM has a financial interest in recouping initial investment costs, it will heavily market the system to other public safety users to obtain additional revenue. M/A-COM will receive 95 percent and the State of Florida will receive 5 percent of all gross revenues generated from additional system subscribers.

2.4.1.1 Expansion. Although the state holds the licenses for 69, 800 MHz frequencies, the addition of other radio users to the system, not part of the original system implementation, could create system capacity concerns for all system users. To avoid this eventuality, the state has mandated that any future system users must offer additional frequencies to the statewide system as a condition of being granted system access. The cost of any required additional base stations (i.e., procurement, operation, and maintenance) would be borne by the new user agency.

2.4.1.2 Interoperability. The state will support interoperability among radio users from local, state, and federal law enforcement agencies, as well as other public safety providers operating within the state, via the M/A-COM provided Enhanced Digital Access Communications System (EDACS) technology. Other local EDACS users will be directly interoperable with the radio network. M/A-COM will encourage non-EDACS public safety radio users in the State of Florida to become subscribers to the SLERN. Until other agencies using noncompatible communications systems subscribe to the system, the state can use conventional mutual-aid channels, "causeway" patches, or a simple exchange of RF control station channels to establish interoperable communications.

Because radio systems in the State of Florida are designed with different signaling protocols, Florida plans to work directly with the radio network managers throughout the state to establish common standards, patches of various sorts, subscriber unit exchange, and agreements for use of mutual-aid channels, where appropriate.

2.4.1.3 Operations and Maintenance. The SAA specifies that M/A-COM will maintain, repair, or upgrade (as required) the SLERN for the 20-year period of the contract. The SAA also specifies network maintenance service levels and identifies liquidated damage penalties for circumstances where established service levels are not supported.

Initially, Com-Net Ericsson received $40 million up front for immediate O&M of the SLERN. For 20 years thereafter, the state will pay approximately $15 million annually[3] from the Florida State Agency Law Enforcement Trust Fund. At the end of the term, Florida has the option to—

1) Purchase all system equipment, less towers, for $1, and extend service to third-party subscribers

2) Negotiate extension of the SAA

[3] The $15 million annual figure is only a projection, and this number may fluctuate as a function of the volume of vehicle and vessel tag registrations recorded in a given calendar year.

3) Terminate the SAA.

2.4.1.4 Security. The main security issue for the State of Florida is the "ownership" of frequencies. In the SAA, the State of Florida mandated that it be the license holder of all frequencies used for the SLERN and that it would maintain control over all system encryption keys. Essentially, the State of Florida desires to retain ultimate authority regarding system access and to what extent any system user may use the system.

2.4.2 State of Illinois

The Illinois State Police (ISP) is one of many public safety agencies faced with the need to replace an aging communications system that is nearing obsolescence. To address this issue, the ISP is planning to replace its existing LMR system with a leased system. Rather than procuring, owning, and operating a new system, the ISP will lease time on a vendor-owned, operated, and maintained system.

2.4.2.1 Background. The ISP began developing a plan for replacement of its LMR system in 1994. An independent consultant performed a study to determine the cost of procuring a new LMR system covering a six-county area. The results of the study were presented to the Governor's office for budget approval but were considered cost prohibitive. The ISP then considered partnering with the local utility company, which had extensive infrastructure throughout the state but did not have adequate spectrum to support the number of proposed users. This arrangement would have required the ISP to allow non-government entities to use its frequencies. The ISP did not feel this arrangement best served its interests and rejected this solution.

Ultimately, ISP officials considered a commercial option. They recognized that commercial entities already provided most of their communications capabilities, such as paging and wireless data. As a result, a commercial LMR system was viewed as a service they could possibly pursue.

The ISP released a performance-based request for proposals (RFP) through the Illinois Central Management Service (CMS). This RFP stipulated that a vendor would build, operate, and maintain a voice communications system for use by the ISP, the Chicago Police Department, and any other government organization within the State of Illinois.

The State of Illinois possesses a number of valuable resources that make a lease arrangement favorable for the vendor and the state. First, the ISP has been granted $25 million through the Illinois Fund for Infrastructure, Roads, Schools, and Transit (FIRST) project to fund the initial capital cost of the user equipment. Illinois FIRST funds are issued through the Governor's office and are intended to revitalize critical infrastructure within the State of Illinois. This significant amount of start-up money considerably mitigates the ISP's funding challenges.

Another resource that the ISP offers to the vendor is real estate. The State of Illinois owns a considerable number of radio towers and sites throughout the state, which the vendor in turn can use for site development or infrastructure installation.

Finally, frequencies already licensed to the ISP will be reused whenever possible. The ISP realizes a significant monetary value is associated with this resource and expects the vendor to note the value in its discounted pricing for the ISP.

2.4.2.2 System Details. The ISP is seeking to lease a trunked, 800 MHz LMR voice system capable of providing interoperable communications with other public safety providers. This system should be expandable to support additional users over time, provide the required system security measures, and meet minimum performance criteria as defined by the ISP. Under the current terms of the RFP, the ISP will purchase the user equipment, and the selected vendor will provide the network and infrastructure equipment.

As of this writing, Motorola was awarded a contract, but the ISP and Motorola are engaged in contract negotiations. Motorola's proposed solution, the Starcom 21 system (built and maintained by Motorola), will be accessible to all levels of public safety agencies (i.e., local, state, federal) throughout the State of Illinois. The ISP will lease time on the network for voice traffic only. Although Motorola owns and maintains the system, the ISP will be the primary administrator of the system (e.g., adding users and assigning talk groups).

2.4.2.3 Expansion. System expansion is a common concern for organizations, especially when they do not own the system. The ISP does not anticipate system expansion to be an issue because the RFP states that the ISP expects the system to grow in size and capacity. Furthermore, the RFP stipulates that the vendor would be responsible for accommodating additional users, at no additional cost to the ISP (except through subscriber fees).

2.4.2.4 Interoperability. The Starcom 21 system is proposed as a virtual shared system that will facilitate interoperable communications. Although owned by a vendor, the system will be available to all government organizations in the State of Illinois. The arrangement will also enable participating organizations to contribute resources (e.g., frequencies and towers), where feasible. Resource sharing promotes cost savings and interoperable communications, and prevents organizations from establishing isolated, redundant networks.

2.4.2.5 Security. The ISP fully expects the vendor to implement secure communications on an as-needed basis. The ISP is negotiating with Motorola to implement secure channels for federal agencies that have indicated they would like to join the system. The ISP is working with these federal entities and Motorola to identify the frequencies and locations where encryption will be used. The ISP requires encryption standards to comply with Project 25 (P25) standards (i.e., that messages are not de-encrypted during transmission, but only at the termination point).

The ISP does not perceive loss of control as an issue. Although the vendor will own, operate, and maintain the system, the ISP will administer the system. The ISP will also set the performance criteria for the system and conduct its own tests of the system. System reliability will be entirely determined by the ISP. The ISP has also indicated that although the vendor will build and own the system, any upgrades to the infrastructure will belong to the ISP when the lease expires, at no cost.

2.4.2.6 Summary. The Starcom 21 system is being embraced by public safety agencies throughout the state. All agencies within the state, including federal agencies, will be able to join the lease agreement. The new system will alleviate funding challenges faced by many smaller agencies and municipalities that do not have the resources to establish their own systems. More importantly, agencies will now be able to communicate on a single system, improving interoperability and coordination during emergency incident responses.

2.4.3 State of South Carolina (SCANA)

In 1991, Hurricane Hugo's devastating impact on the State of South Carolina created a critical need for statewide emergency radio communications. As a result, SCANA Communications and several state and local agencies jointly developed an LMR system. SCANA Communications offered an existing system to the government agencies as a foundation for the statewide system. During the initial planning phase, the original system was used by state utility organizations. Initially formed as a cost sharing "for-profit" system, the SCANA system was expanded by combining government resources, existing SCANA infrastructure, and numerous new sites and towers. In 1995, however, SCANA Communications and the State of South Carolina entered into a contract that restructured the system as "not-for-profit". With the advent of the new structure, a formal users group, consisting of representatives of various public safety agencies, was created to set policies regarding system usage and functionality. This group is committed to improving interoperability and using technology to overcome the limitations of legacy VHF and ultra high frequency (UHF) systems.

2.4.3.1 System Overview/Security. SCANA Communications, a subsidiary of the SCANA Corporation, operates an 800 MHz Motorola Type II mixed mode Astro SmartZone trunked mobile radio network. Encryption is available in the digital mode for the appropriately equipped user. Designed initially to support up to 20,000 users, the system currently supports approximately 9,500 users in a basic coverage area that includes the more densely populated regions of the state. A variety of organizations use the SCANA system, including public safety and public works agencies, hospitals, local power utilities, and other state agencies. The fire and law enforcement agencies of Lexington, Richland, Orangeburg, Spartanburg, and Dorchester counties are the primary public safety fee-for-service users. To become an active SCANA user, few mandates exist. To be considered eligible, the requesting agency must be a local, state, or federal government; power utility; special emergency; or special-purpose service district organization. The eligible agency must sign a system user agreement and pay the required fees. As defined in the state contract, these fees are based on the number of sites an agency is expected to access. In some cases, user fees can be negotiated if the agency contributes infrastructure to the system. Federal agencies such as the Federal Bureau of Investigations (FBI) and the National Guard have expressed an interest in using the SCANA system; however, the recurring monthly fee may be a barrier to federal use.

2.4.3.2 Expansion. The participating agencies and SCANA Communications share the burden of system expansion. The government agencies must identify funding streams, whereas the vendor is charged with implementation and O&M responsibilities associated with expansion requirements. Previously, a state-level Public Safety Communications Coordination Committee recommended expanding the SCANA system to cover the full geographic area of the state. To support this system expansion, an adequate funding mechanism is needed. The state is focusing

on the fees collected from private sector companies leasing airtime on state-owned wireless network towers. These fees are incurred by several major wireless carriers. To further this effort, the state Office of Information Resources (OIR) issued an RFP soliciting plans for the implementation and development of a uniform asset management program for existing and future county-owned towers.

2.4.3.3 Interoperability. Many agencies choose to join the SCANA system to take advantage of the trunked, shared features that otherwise would be unaffordable if built as a privately owned and maintained system. The SCANA system is developing links to regional trunked radios systems, including those deployed in Beaufort/Hilton Head, Charleston, Myrtle Beach, and Florence. In support of interoperability with other 800 MHz systems, mutual-aid agreements and 30 preset mutual-aid talk groups have been established statewide.

2.4.3.4 Operations and Maintenance. SCANA Communications performs O&M. The vendor maintains the infrastructure and will assist with programming services for participating agencies. Furthermore, the vendor ensures that technical and support resources are available to all agencies on demand. However, the owning agency bears the responsibility for maintaining subscriber equipment. This responsibility may require retaining an internal technical repair staff or establishing a maintenance agreement with local repair shops.

2.4.3.5 Future Outlook. The SCANA Corporation sold the system to Motorola in June 2001. Motorola will be completing the system expansion and plans to refurbish or replace some of the existing infrastructure and equipment for full digital operation. Motorola has committed to a statewide build-out within 18 months. Generally, this transaction is viewed as favorable for agencies using the SCANA system. Looking forward, users statewide will realize enhanced coverage and expanded services scheduled to be paid for and implemented by Motorola.

2.4.4 Federal Specialized Mobile Radio System (FEDSMR)

2.4.4.1 Background

In 1989, Motorola installed the Government Specialized Mobile Radio (GOSMR) system in the Washington, DC metropolitan region. After a privately held company, named Pegasus Corporation, purchased the system in the mid 90's, the GOSMR system was renamed FEDSMR. Pegasus Radio Corporation, a division of the Pegasus Corporation, owns and manages the FEDSMR system, and is contracted by NTIA to provide LMR service via the FEDSMR system to various government users in the Washington, DC metropolitan region. NTIA maintains a 2nd contract with Pegasus Radio Corporation for collective FEDSMR service in the cities of Boston, New York, Philadelphia, Norfolk, and Baltimore.

2.4.4.2 Washington, DC System Overview

The Washington, DC FEDSMR system is comprised of a single site, 8-channel, trunked Motorola Smartnet UHF site transmitters in the 406-420 MHz government bands, and provides LMR coverage within the "beltway". This system supports over 1,200 active subscriber units. Only federal government agencies have system access and current system users include: Bolling Air Force Base, Smithsonian Institution, United States Holocaust Memorial Museum, United

States Senate, Office of the Inspector General, and the Naval District of Washington Transportation. These user organizations pay a monthly fee based on the number of subscriber units accessing the system. Depending on the number of talk group assignments, monthly fees may be as low as $17.00 a month. To lower monthly fees or receive discounts for new equipment purchases, activation cost or installations, participating organizations can trade resources. In fact, frequency resources are considered a valuable asset and when traded, may help reduce the user organizations initial cost. Due to federal frequency use restrictions, no state and local government agencies, or private organizations utilize the FEDSMR system

2.4.4.3 Expansion

NTIA discourages expansion beyond existing venues due to the limited availability of government frequencies. Any future expansion would likely require user organizations to "donate" frequencies and contract for a minimum number of subscribers to support the endeavor. Note that the Boston FEDSMR system is not in active use due to the lack of customer interest.

FEDSMR officials are reviewing technical improvements that would provide a greater coverage area, and accommodate additional users without sacrificing customer service and the current low fees. Plans are underway to implement a multisite analog base system with the Trident Micro System's PassPort trunking protocol. This trunking protocol provide a digital backbone supporting system enhancements such as seamless roaming, over-the-air reprogramming (OTAR), console interfaces, privacy, and increases compatibility with other systems. In addition, subscriber equipment for this new system is available from multiple manufactures at a lower cost than the current equipment.

2.4.4.4 Interoperability

The federal organizations currently using the FEDSMR system do not have significant interoperability requirements. These user organizations generally perform their respective business activities independently from one another and have not requested LMR interoperability.

2.4.4.5 Operations and Maintenance

To support FEDSMR O&M requirements, Pegasus Radio Corporation established a customer resource center in Baltimore. The center provides 24-hour, 7 days-a-week support for fixed and subscriber equipment, depending on contractual agreements. An accessory service is also offered as an additional O&M feature and includes hardware support for items such as batteries and subscriber unit antennae. NTIA representatives consider the O&M services provided by FEDSMR staff as reliable and timely.

2.4.4.6 Security

The National Zoo, Smithsonian Institution, United States Holocaust Memorial Museum, and Bolling Air Force Base employ security or public safety personnel. Encryption capabilities are often utilized by this segment of the user base. The encryption capability is transparent to the

user. However, the majority of FEDSMR system users do not conduct public safety operations and their radio transmissions are generally not law enforcement or government sensitive.

2.4.4.7 Future Outlook

Federal agency participation in the FEDSMR system is relatively small. This may be due to the limited coverage area and capacity features. The Pegasus Radio Corporation is planning internal changes that will likely support FEDSMR system improvements. These improvements may include expanded coverage footprints, additional channels, and enhanced security features, such as over-the-air rekeying (OTAR).

2.5 RFI Summary Matrix

Questions	Vendor Response		
Key Issues	**Vendor A**	**Vendor B**	**Vendor C**
Do you believe that a fee-for-service arrangement is feasible for public safety agencies?	• No common solution for each organization's diverse needs • Recommends a combination of commercial and private networks	• No universal solution • Requires an organizational benchmark	• Recommends a private network owned and operated by a commercial entity, with a hybrid system migration path
What economic issues would be involved with a fee-for-service arrangement?	• ROI is main risk factor for vendor • Leasing fees must recapture initial capital investments in— - Infrastructure - Relocation of existing users to new spectrum - Acquisition of additional spectrum	• User has access to alternate financing schemes • Operating budgets help to limit long-term review and procurement process • Participants can share technology costs • Vendor assumes risk for management and acquisition of technology	• Elimination of initial capital investment will likely attract a subscriber base to support a broader network deployment • Potential state and municipal subscribers provide a favorable environment for the vendor to provide service
What enabling conditions or special arrangements would be required to apply such an alternative?	• MOU is required and should address the following items: - Flexibility - New user criteria • Pre-approved terms and conditions	• Comprehensive review of these key consideration areas: business case, strategic and tactical issues, financial and contractual concerns, implementation issues, interoperability, lifecycle management needs, and vendor competency review • MOU is required and should address the following items: emergency operations, new user criteria, service level agreement, spectrum and technical improvements	• 7-year contract minimum • Establish an entity to manage frequencies • MOU addressing the following items: - Participation requirements - Performance indices - Security criteria
What are your plans and concepts for pursuing the fee-for-service option?	• Develop a system based on the participating organizations needs	• Develop a system based on the participating organizations needs	• Highly interested, yet further exploration of stable funding mechanisms is needed
Regarding each of the following factors, what would make the fee-for-service option attractive: - Geography	• Did Not Respond	• Did Not Respond	• Network is adaptable to any geographical area
- Demographics	• Densely populated areas	• Did Not Respond	• Significant number of local, state, and general mobile users
- Other Factors/Spectrum	• FCC offers free or discounted "green" spectrum to vendors	• Flexible regulatory environment that encourages partnering in public safety bands	• Regulatory agencies must allow the use of spectrum for the vendor to recoup and profit from their original investment • Use of federal and other subscriber frequencies should be negotiated for a period of 50 years

RFI Summary Matrix (cont.)

Questions	Vendor Response		
Level of Interest	**Vendor A**	**Vendor B**	**Vendor C**
What are the reasons for your interest in leasing LMR services to public safety agencies?	• Interest dependent on MOU and organization's management procedures	• Did Not Respond	• Profitable for vendor over time
Do you believe that the fee-for-service wireless industry segment could develop over time?	• Did Not Respond	• Relies on substantial coordination and partnership agreements between participants	• As the network matures, subscriber numbers should grow rapidly

Implementation	**Vendor A**	**Vendor B**	**Vendor C**
How would you propose to implement a regional leased network?	• No single universal implementation option • Endorse creative cooperation between organizations and the vendor • Use private network and use commercial services for IT services	• Use a 3-phase process based on a set of criteria including day-to-day operations, equipment standards, MOU, and spectrum requirements • Address mission-critical functions and day-to-day operations in planning stages for all potential users • Incorporate equipment and personnel resources	• Mission-critical services provided via private mobile radio network while other services provided via commercial public network during build-out • Rural areas could be served by cellular network • Vendor is responsible for the design, operation, and maintenance of the network • Virtual private network access will provide operational independence
Describe any terms, waivers, or conditions necessary to enable federal user access to regional, leased LMR systems.	• Did Not Respond	• Recommend partnering in the 700MHz band • Federal Government users must comply with FCC rules for 700 MHz public safety licensed spectrum (Section 2.103)	• Did Not Respond
Do you believe that the nationwide implementation of a leased system is feasible?	• Possible to achieve using a patchwork approach within 5 to 10 years • Build out and connect regional networks	• Achievable depending on the participating organizations requirements	• Achievable by combining multiple networks • Federal users will drive the functionality of the nationwide network • National utility network designed with "5 nines" reliability, that would charge a fee, and would meet minimum service requirements
Interoperability	**Vendor A**	**Vendor B**	**Vendor C**
How would you propose to facilitate network access by other users for interoperability purposes?	• Use the latest technologies	• Vendor should monitor technical trends • Share and consolidate systems • Participating entities should contribute their licensed frequencies to the system • Technology considerations must be incorporated in MOU to supports interoperability	• Vendor would address the aggregation of spectrum for future users • Guaranteed service would be proportional to the amount of contributed spectrum
What are the implications of leased systems operating in the numerous frequency bands for public safety?	• Did Not Respond	• Spectrum concerns relate to need for FCC compliance, licensing requirements, and detailed MOU for shared systems • Flexible regulatory environment is desirable • Uses numerous operating bands to support a variety of users • Multiple licenses add to complexity	• Determination for how private entities will access federal spectrum
In what ways could a leased system be utilized to foster improved interoperability?	• Access to latest technologies	• Access to latest technologies • Considers requirements for CAD and other related software solutions • Incorporates P25 standards	• Access to latest technologies

RFI Summary Matrix (cont.)

Questions	Vendor Response					
Trade-Off Perspective	**Vendor A**		**Vendor B**		**Vendor C**	
Describe the advantages and disadvantages of the trade-off of leased systems with each of the traditional system options below:	**Advantages**	**Disadvantages**	**Advantages**	**Disadvantages**	**Advantages**	**Disadvantages**
General advantages and only disadvantages of the Fee-for-Service alternative	• Access to technology • Inexpensive radios • Risk transferred to vendor • Gain productivity through commercial IT services *When limited to only public safety users, no trade off regardless of system structure	• Rural areas require large investment and provide little revenue • Priority access issues • System failure concerns	• Provides flexibility • Access to technology and subject matter expertise • Participants shift focus to mission fulfillment as opposed to LMR management • Reduce customer capital investment and redirect those investments to mission focus requirements • Reduce customer operating costs • Increase system efficiency and reliability • Chronic network problems can be eliminated • Improve service levels • Financing tailored to participants budgetary needs • New users would reduce monthly costs	• Human resources and existing equipment must be accounted for	• Virtual private network will provide operational independence • Implement a network that serves multiple organizations • Up-front capital investment is eliminated • Use spectrum of subscriber organizations	• All organizations must share same infrastructure
Regional or statewide shared system	• Benefits depend on user requirements		• Benefits depend on user requirements		• Did Not Respond	
Consolidated nationwide system	• Benefits depend on user requirements		• Benefits depend on user requirements		• One stop shop for all communications needs	

3. KEY FINDINGS

The findings for the fee-for-service analysis have been derived from the examination of these principal data components: cost model, RFI responses, and a review of currently leased LMR arrangements. Analysts assessed the issues associated with each component to determine the circumstances in which leased LMR services are feasible and desirable for both vendors and user organizations. To gain a better understanding of the results of the analysis, the findings are divided into the following categories: cost considerations, vendor profitability issues, and operational concerns.

Collectively, the common theme of the analysis indicates that no single, universal fee-for-service approach is available. Further, the system functionality offered by the fee-for-service approach is determined by the specific requirements of the user organization. Implementation of a national solution would most likely begin with scalable, regional networks that could be interconnected to form a nationwide system. The vendors also suggest that, at least initially, implementing a hybrid of private and commercial systems might be the best method for obtaining wide-area leased LMR services. Federal user requirements would define system functionality, but state and local agencies, along with general mobile subscribers, would provide the economic base to justify full-scale deployment. System expansion and technology upgrades would depend on user demand for services.

3.1 Cost Considerations

Leased LMR services allow government organizations to develop smooth budget profiles, however, the actual annual costs are unclear. Until proven by modeling operational systems, cost considerations for the fee-for-service approach are based mostly in conjecture. These considerations include—

- User organizations could avoid large capital investments.
- System life-cycle costs might be greater for leased LMR services than they would be for a comparable system purchase
- User organizations would avoid costs associated with retaining the technical support personnel needed to maintain and administer the system
- Vendors might offer technology refresh, however, the associated costs could be passed to user agencies via increased service fees
- There is no universal fee-for-service approach. Each implementation is a custom solution with service fees unique to each negotiated service agreement
- Costs could be offset by in-kind trade of resources and other methods of subsidization
- Subsidization is critical to establish viable vendor profit centers.

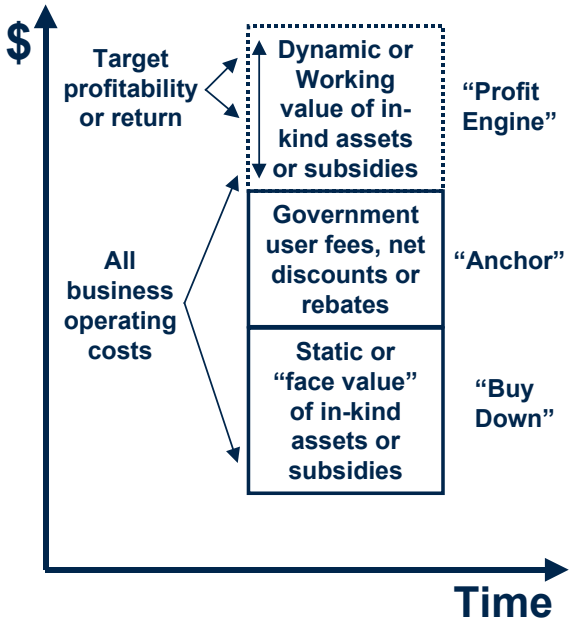
3.2 Vendor Profitability Issues

The results of the vendor response analysis emphasize the importance of profitability for the vendor. Vendor profitability issues include—

- **Long-Term Contracts.** Generally, government contracts are awarded annually. This funding process does not provide the vendor with the time commitment necessary to financially justify the build-out of a LMR system. The solution may be to authorize long-term contract vehicles.
- **Access to Public Safety Spectrum.** Public safety organizations use different frequencies, which have varying levels of restriction. Use of federal spectrum is restricted to federal users only. These restrictions are of concern to the vendor community because vendors require long-term access to this spectrum to recoup the initial capital outlay. To facilitate vendor use of restricted spectrum, regulatory changes are required. These changes, however, are typically very slow in developing (e.g., four years to effect changes for co-equal access of public safety spectrum). A mechanism that guarantees licensing or allows vendors to license public safety spectrum, thereby opening sources of potential revenue, will be key to overcoming this obstacle.
- **Creative Mechanisms for Generating Revenue.** Public safety organizations have responsibilities in regions beyond the populated, urban areas. However, outside of densely populated areas, little revenue base is available to support a system deployment. A mechanism that allows revenue generation, potentially by leasing excess system capacity, including tower space and available channels, might encourage vendors to complete a system build-out.

Figure 3 graphically depicts how some of the cost considerations and vendor profitability issues intersect. The most telling theme is that in-kind assets and other forms of subsidization are truly what drive the ability for vendors to profit from the fee-for-service approach and what allow user agencies to afford on-going access to leased LMR services.

Figure 3
Vendor Profitability Graph



Vendors place static, or "face", values on assets users have available for "in-kind" trade. Examples of these types of assets include spectrum, excess capacity on radio towers, real estate, etc. The static value associated with these assets can then result in a profitable working asset for the vendor. Thus, in-kind trade of capital (or other) assets can be viewed as a form of subsidy used to "buy down" the cost of the system. In other words, the cost incurred by the vendor while implementing the system can be somewhat mitigated by the assets given in trade, and those same assets can then provide the vendor with the means to generate additional profit outside of revenue streams solely derived from system usage fees. In addition, straight subsidies (e.g., in the form of set-aside funding or block grants) can also be used to "buy down" system cost.

Above the "buy down" portion of the graph is a section representing revenues generated from user fees. This portion of the graph effectively represents the primary means for vendors to recoup costs, however, it should not be inferred that this "anchor" revenue generates the fastest way for the vendor to realize 100% return on its investment. Rather, the "anchor" only indicates the steady revenue stream on which vendors can rely over the long term. Once vendors are operating at a profit, they can then potentially offer discounts, or rebates, to their participating government user organizations.

The portion of the graph of most interest to the vendor community is the section identified as the "profit engine". Based on the "value" (i.e., earning potential) of the assets offered in trade, the system then becomes more affordable for user agencies. The higher the earning potential of the working assets offered for trade in-kind, the more the vendor is able to continue supporting the system. The inference here is that those same valuable assets allow the vendor to reap greater profits while continuing to offer use of the system to its "base" users at an affordable rate. By fully exploiting the assets given in trade, vendors will be better positioned financially to allow slow growth of the user base, beyond public safety users, thereby decreasing the fee structure per user. This would be the goal over the long term, but in the short term, it would be the assets traded in-kind that would enable this evolution.

An important aspect of the profitability model not immediately evident from the graphic shown in Figure 3 is that the fee-for-service approach is more immediately feasible over a small geographic footprint. Having expended capital to implement a system in an urban area, a vendor can offer affordable system access rates because the "per user" costs remain low. Once the coverage footprint extends beyond the metropolitan area, however, the number of users decreases, while the infrastructure costs to maintain adequate levels of coverage remains high. Thus, the vendor would be forced to increase the "per user" costs, making the option less attractive to potential users. The remedy for this situation is then tied back into the concept of system subsidization via in-kind trade of assets or direct subsidy.

3.3 Operational Concerns

Operational considerations must also be included when assessing the merits of the fee-for-service option. These operational concerns include—

- **Unproven Approach.** There is a limited “track record” on which to base decisions regarding the fee-for-service option. Only three vendor responses were received from

the RFI, potentially indicating a low level of industry interest at this time. In addition, only a small number of statewide system deployments have been attempted, and at this point, none are fully operational. Each of these statewide systems is unique and highly tailored to state-specific circumstances. Another hindrance to the analysis of the fee-for-service approach is the lack of a nationwide model. Vendors indicate that a nationwide system would likely consist of a "network of networks," but no plans exist for a deployment of this type.

- **Loss of System Control.** User organizations lose the inherent control of their primary means of public safety communications when they lease service. Specific public safety operational requirements for expansion, interoperability, O&M, and security must be adequately supported by vendors offering leased LMR service.

  - Expansion—Although the fee-for-service approach might support long-term, slow growth, it is unclear how ad hoc expansion requirements would be supported
  - Interoperability—If the system is proprietary in nature, user agencies would have few options for gaining interoperability with other agencies
  - O&M—Priority maintenance requirements might drive higher system usage fees, and there is no remedy for delayed maintenance on failed systems during critical incident response
  - Security—Many questions remain unanswered related to approaches for encryption and general system access.

- **Memorandum of Understanding.** MOUs govern the relationship between mutual system users and must be comprehensive from the inception of the implementation process. Detailed MOUs are necessary to support the day-to-day and mission critical operations of all participating organizations. MOUs may include specific provisions for, among others, priority access, mutual aid and interoperability, and access requirements for new users to join the system.

- **Service Level Agreement.** SLAs specify the system performance requirements for which vendors must design systems and provide both routine and critical operation support. The SLA is very important in the fee-for-service approach and must be explicitly defined from the inception of the implementation process. A shortcoming exists, however, as no actual remedy exists for failure to effect repairs in a timely manner when the system is required for critical operations. To guard against this maintenance issue and other potential service concerns, the SLA may include specific requirements for coverage, reliability, security, and other system features and functionality, but operational risk still exists.

Analysis of the current state of the fee-for-service option indicates that the approach has not matured sufficiently for near-term implementation on a nationwide basis. In light of the considerations outlined above, it would be prudent to reevaluate the fee-for-service approach after systems of this type have been operational for at least 1 year. "Report cards" from the

systems implemented in Florida, Illinois, and South Carolina will provide the benchmarks for further assessment of the fee-for-service approach at the statewide level. These assessments may provide the baseline information necessary to plan the mitigation of the vendor and user risks associated with implementation of the fee-for-service approach on a nationwide scale.

As vendors and customers begin to define and develop this new concept for use within the public safety community, they should anticipate changes in technical solutions, services and features, and expectations. The promotion of an open dialogue among vendors and user organizations at public safety forums, roundtables, symposia, and conferences should help guide the development of an optimal fee-for-service solution.

APPENDIX A:
REQUEST FOR INFORMATION (RFI)

PUBLIC SAFETY WIRELESS NETWORK (PSWN) PROGRAM
Fee-for-Service Report

Commerce Business Daily (CBD)
Request for Information (RFI) Announcement

PART: SPECIAL NOTICES
OFFADD: U.S. Department of Justice, Federal Bureau of Investigation, ERF – Bldg. #27958A, Quantico, VA 22135
SUBJECT: Public Safety Wireless Network (PSWN) Program
DESC: The PSWN Program is seeking information from the wireless communications industry and its affiliates regarding building, maintaining, and/or managing land mobile radio (LMR) networks offered to public safety users under leased service agreements. The program is interested in such information in support of an analysis it is conducting, and of a subsequent open report it will publish, to inform the public safety community and others about the viability of this concept. The benefits of industry responding to this notice is that they will have a chance to have their views regarding this service offering reflected in a report that will receive broad distribution to the public safety community.

The number of users such networks would support is indefinite at this time. Interested parties should consider opportunities targeted at the state and local levels (i.e., regional in nature) that could also potentially support federal users operating in these regions. In addition, interested parties should consider the viability and availability of such services on a nationwide basis in their own right to support federal agencies with public safety missions. More specifically, the PSWN Program is examining the key issues associated with fee-for-service arrangements for public safety LMR. These issues include: the feasibility for public safety agencies, economics of such arrangements, enabling conditions or special arrangements required, overall commercial viability, vendor plans and concepts for pursuing this option, attractiveness of this option based on geographic, demographic, or other factors, etc. Thus, the program is interested in obtaining information in relation to these issues as well as in response to the following:

(1) Level of Interest in Providing Such Leased Services – Respondents interested in providing leased LMR services to public safety agencies are asked to explain the financial, business operations, billing, technological, systems management and maintenance, and other reasons behind their view. Respondents are also asked to comment on the shape that this wireless industry segment could take over time in terms of the types of firms, organizations, partnerships, and the like that may emerge. Respondents not interested in such an arrangement or who believe such an industry segment will not emerge are asked to provide their rationale as well.

(2) Implementation Options – Respondents interested in providing leased LMR services to public safety agencies are asked to describe how they would propose to implement regional, leased networks, as well as how they would propose to facilitate network access by other users for interoperability purposes. Respondents should describe any relevant terms, waivers, or conditions necessary to enable federal user access to regional, leased LMR

systems. They should also elaborate on the feasibility of nationwide implementation and availability. Presenting multiple options is encouraged.

(3) Trade-Off Perspective – Respondents interested in providing leased LMR services are asked to describe their view of the trade-off of leased systems with the more traditional government owned-and-operated private network concept, to include single-agency standalone systems, regional or statewide shared systems, and consolidated nationwide systems. Respondents are asked to comment on the relative advantages and disadvantages in hopes their responses will help develop a framework for decision makers considering different alternatives as part of capital investment analyses and decisions.

(4) Barriers and Enablers to Interoperability – Respondents should describe the risks and other potential roadblocks to interoperability associated with such arrangements. This should include characteristics that could hinder other users (including federal users) from seeking access on existing leased systems designed for certain state or local public safety users. This should also include the feasibility of interconnecting non-leased systems with leased systems (and the factors associated with this). Respondents are asked to also address the implications of leased systems operating in the numerous frequency bands to which public safety has or will soon have access, and other characteristics of such systems that the respondents feel could impede interoperability. Conversely, respondents should also comment on the extent that such systems could be fashioned or utilized to foster improved interoperability among public safety LMR communications.

(5) Existing Leased Systems or Those Currently Under Development – Respondents having implemented or in the process of implementing leased LMR networks utilized by a public safety organization(s) are asked to describe the scenario that lead to the implementation and to describe the scope of the network implemented. They are asked to provide lessons learned for public safety. They are also requested to provide specific examples where possible, and remedies taken in relation to, issues raised above.

The PSWN Program is a joint initiative between the Department of Justice and the Department of the Treasury focusing on improving wireless communications interoperability among public safety organizations. (See www.pswn.gov or call (800) 565-PSWN for additional information on the program.) POCs Derek H. Siegle, Program Manager, PSWN Program, Department of Justice; Julio R. Murphy, Program Manager, PSWN Program, Department of the Treasury. Please submit responses postmarked or time-stamped no later than June 25, 2001. Information can be mailed to: The PSWN Program, P.O. Box 3926, Fairfax, VA 22038-3926, or sent via FAX to (703) 279-2035.
CITE: W-152 SW50N6L5

APPENDIX B:
RFI RESPONSE SUMMARIES

B.1 VENDOR A RFI RESPONSE SUMMARY

B.1.1 Feasibility

Vendor A notes that no single fee-for-service approach is applicable to all users. Ultimately, the goals of the public safety community will drive the configuration of the system. The vendor recommends a combination of commercial networks and private systems. Initially, this approach would likely work well as a regional opportunity. However, because of the vast array of mission-critical operational requirements for public safety, Vendor A expressed concerns regarding system sharing with organizations outside the public safety arena. The vendor regards establishing effective working agreements between system participants as a potential obstacle to the successful application of this approach. To combat these problems, working agreements should require specifics regarding all aspects of system use including maintenance, options, terms, waivers, and financial expectations.

B.1.2 Financial Conditions

Vendor A views the financial picture as unfavorable for the customer under the fee-for-service arrangement. As a result of extensive vendor investments in infrastructure, spectrum acquisition, and relocation of users across the spectrum, high leasing fees would be passed onto the customer. The vendor features the availability of new spectrum as a potential means to reduce high lease fees. If the Federal Communications Commission (FCC) releases new spectrum at no cost or at a significant discount, the vendors would have adequate spectrum to accommodate a significant user load and could pass these savings to the customer. FCC cooperation is paramount for the success of this concept.

B.1.3 Technical Approach to Implementation

A regional system could be deployed by using a combination of private network and commercial wireless second or next generation information technology (IT) services. This is an ideal and cost effective approach; however, barriers such as preemption and priority, dispatch control, and security exist.

The vendor notes that "there is no singular or universal implementation option" available to all potential system subscribers. Service level agreements (SLA) that specify implementation requirements for each organization must be established during the early phases of contract negotiations and must be kept current. Eligibility requirements that address participant access and system use must be detailed in advance. Although technical solutions are available, nationwide implementation within the next 5–10 years could likely occur in a patchwork fashion.

B.1.4 Interoperability

Vendor A provides a brief discussion of interoperability solutions available today—the software-defined radio (SDR) and the audio patch. The vendor notes that technical solutions for interoperability currently exist; however, coordination and partnership issues remain an impediment to interoperability.

B.1.5 Spectrum

The vendor discusses spectrum as it relates to leasing fees, and therefore provides spectrum issues in the Section B.1.2, Financial Considerations, above. The vendor does not offer information regarding spectrum usage for a fee-for-service alternative.

B.1.6 Trade-Off Perspective

According to Vendor A, the public safety community should weigh several advantages and disadvantages before implementing a fee-for-service arrangement. In the event that the system is to be accessed only by public safety users, the vendor gives no clear benefit or limitation for fee-for-service alternatives over a traditional private network. This opinion extends to regional or consolidated systems. The vendor notes concerns regarding non-public safety user access and priority during emergency or critical incidents.

Using a business case model, the vendor shows that productivity gains, often viewed as a significant advantage by any participating organization, can be realized by various segments of the user population. These gains accrue from the prompt completion of assignments resulting from consistent connectivity to IT resources.

Public safety responsibilities extend past highly populated regions. Yet, rural areas require significant infrastructure investment and offer limited revenues to support build-out. A mechanism to generate revenue in these areas would provide additional vendor incentive.

The commercial provider can upgrade and implement new technologies often at reduced cost and without a lengthy review and procurement process. This advantage benefits the user agency in two ways: users may shift their funding focus from land mobile radio (LMR) procurement to mission fulfillment, and users have access to state-of-the-art technologies.

B.2 VENDOR B RFI RESPONSE SUMMARY

B.2.1 Feasibility

Vendor B considers fee-for-service arrangements viable, depending on the situation. The vendor notes that no single solution exists for all potential users. The fee-for-service alternative gives participating organizations the opportunity to focus on mission fulfillment and refrain from LMR and wireless communications management and maintenance.

Vendor B recommends using a business case model to assess the viability of this option. The assessment would address several issues, including current system environment, expectations, operational requirements, and other technical criteria.

B.2.2 Financial Conditions

Vendor B believes that the financial conditions are favorable for user agencies under the fee-for-service arrangement. The customer would have access to vendor financing and this opportunity could potentially allow participants to avoid the lengthy review and acquisition processes associated with bond issues, assuming there is no generation of capital funds. In addition, participants could limit capital fund expenditures for functions or purchases not directly associated with mission needs. Participating organizations would share technology solutions, related costs, and risks using the fee-for-service approach.

B.2.3 Technical Approach to Implementation

According to Vendor B, the fee-for-service approach provides user organizations with access to improved and more reliable technology. These system enhancements result in better, customized service and may reduce persistent network problems. Despite these significant advantages, Vendor B recommends that potential users consider technology needs that address issues such as mission-critical functions, day-to-day operational needs, coverage requirements, and priority levels before committing to a fee-for-service arrangement. Vendor B also recommends that participating organizations should consider equipment and infrastructure standards, as well as vendor experience, in the public safety arena.

Vendor B indicates that regional or national implementation would depend on each organization's requirements. To facilitate a smooth transition, the vendor recommends several management concepts, including transition management, life-cycle management, and network enhancements. Vendor B recommends life-cycle management processes that incorporate a technical needs assessment, design of technical functions, site surveys, and customization of agency-specific requirements. To support the life-cycle management functions, statements of work, retention of capable technical resources, and clear technology and equipment migration paths should be completed. Equipment and personnel resources should also be accounted for within implementation plans. To evaluate the success of a regional implementation, the vendor suggests that metrics be established to measure user satisfaction, network downtime, number of calls processed, number of system busies, and actual system savings and improvements.

B.2.4 Interoperability

The fee-for-service arrangement, as noted by Vendor B, supports interoperability. The establishment of this arrangement encourages sharing and consolidating systems. However, the vendor must have a clear of understanding of existing MOUs involving interoperability. To gain a clear understanding, the vendor recommends that user agencies develop a plan to capture interoperability capabilities and established partnerships. Additionally, Vendor B suggests that user agencies must also identify interoperability requirements for computer aided dispatch (CAD) interfaces, application program interfaces (API), and other potential software needs.

Access to state-of-the-art technology available via the fee-for-service approach supports additional opportunities for interoperability. However, prior to committing to a leased service agreement, user organizations should review the following technology considerations relating to interoperability: number of calls in multisite system, coverage and capacity, user requirements, communication methods, emergency response functions, grade of service, system configuration requirements, frequency band, encryption, and data throughput.

B.2.5 Spectrum

Spectrum considerations apply regardless of system ownership and include the need for spectrum for interoperability improvements, and license administration. Vendor B discusses 700 megahertz (MHz) frequency band considerations and FCC requirements governing its use. Public safety organizations operate in different frequency bands, and Vendor B emphasizes the need for effective spectrum management.

B.2.6 Trade-Off Perspective

Vendor B presents several advantages for the use of the fee-for-service approach. The vendor believes that the fee-for-service approach offers users state-of-the-art technology and subject-matter expertise. The vendor also states that outsourcing would likely improve service levels, system efficiencies, and reliability. Persistent network problems might also be eliminated.

Vendor B mentions additional benefits related to financial considerations. The fee-for-service alternative would reduce customer operating costs and capital investments, and allow the customer to redirect those funds to mission fulfillment objectives. Additionally, the vendor indicates it might offer financing tailored to the participant's budgetary needs.

B.3 VENDOR C RFI RESPONSE SUMMARY

B.3.1 Feasibility

Vendor C believes the fee-for-service approach is a viable alternative for the public safety community. Vendor C's response, however, indicates the vendor should be capable of implementing a network that can service multiple organizations with diverse needs, while at the same time accommodating each of their budgets. Vendor C suggests a solution in which the vendor would design, build, operate, and maintain a private mobile radio network with a hybrid migration course. This solution would eliminate the initial capital outlay required and present a favorable environment for the user organization. Funds that would normally go toward the implementation of a system would then be available for other uses, such as a recurring leasing fee. With the user agency free from the initial capital outlay, the vendor could anticipate a large subscriber base to support the deployment of its network. However, the vendor must take into consideration the annual review process of the Federal Government before initiating such an arrangement. The potential that the contract might be lost upon re-bid poses a significant risk to the vendor because the capital outlay would not easily convert to other purposes. Therefore, Vendor C suggests a contract minimum of 7 years. This vendor also suggests the creation of a MOU that addresses system participation requirements, performance indices, and security criteria. Vendor C considers its solution capable of servicing the entire Nation. Interest is high in the fee-for-service approach; however, further exploration of stable funding mechanisms for such an endeavor would be required by this vendor.

B.3.2 Financial Conditions

Vendor C provides a business case to validate the deployment of a commercial private mobile radio network. The vendor conducted an analysis to determine the potential size of subscriber markets. The vendor concludes that federal agency requirements would drive the functionality of the network. However, potential state and municipal subscriber numbers would provide the economic base to deploy a nationwide private mobile radio network. A large number of general mobile users, not requiring mission-critical service, would present a favorable environment for the vendor. Vendor C estimates that approximately 10 percent of the total subscriber base would require mission-critical service. The case assumes that the implementation phase would consist primarily of federal users. After other organizations recognize the advantages of the system, Vendor C concludes that subscriber numbers would increase significantly. This growth would, in turn, lower subscriber fees, thereby attracting new users.

Vendor C supplies estimates for the capital expenditures required to build a nationwide private mobile radio network. This network would cover all suburban, urban, dense urban, and 25 percent of the rural areas in the country. Vendor C estimates that 2,516 base stations in the ultra high frequency (UHF) spectrum would be required to cover this area. Base station numbers would double in rural areas operating in the 700 or 800 MHz bands. It is estimated that a system of this size could be deployed within 4 years, and if necessary, possibly sooner. The business case indicates that there would be negative cash flow in the first 4 years of deployment. However, cash flow would become positive in the fifth year and increase at a compound growth rate thereafter.

B.3.3 Technical Approach to Implementation

Vendor C presents a cost-effective leased service solution that multiple government organizations can use to fulfill mission requirements. The vendor provides two approaches to network implementation, each of which would be designed, built, owned, operated, and maintained by a commercial entity. The first option is a fully digital private mobile network that would meet the needs of federal agencies and other public safety organizations. This system would provide integrated mobile voice and data applications, interoperable communications, security features, spectral efficiency, adaptability to unusual operational situations, and nationwide capabilities. The mobile office solution contained in the network would set the stage for improved efficiency and independence.

The network infrastructure is based on the following interconnected layers: the radio layer, Internet Protocol (IP) routing layer, and a network management layer. The radio layer consists of base stations and radios. Depending on system capacity and frequency availability, it could be configured as a cellular or simulcast system. The IP layer interconnects the various cells and provides services such as call routing, mobility management, and external voice and data interconnections. The network management layer allows a system administrator to oversee the operation of the network. The system uses digital technology to assure high-quality service. Vendor C uses frequency division multiplex access (FDMA) in rural areas to increase available capacity. Urban areas are densely populated and create higher traffic loads. For rural areas, Vendor C suggests the use of half channel coding, which would reduce the cell range and provide twice the channel rate and capacity.

These scalable networks, when connected, have the ability to service the entire Nation. The networks are built using an independent set of base stations and control nodes that are connected to the same IP backbone. Several regional networks can be interconnected to form a larger network. This architecture gives Vendor C the ability to adapt its network to virtually any geographical area. Additionally, this configuration gives the vendor the ability to expand or upgrade the network at any time.

Security is one of the primary concerns of the public safety community. Vendor C recognizes this need and would take the appropriate steps to guard against security threats such as illicit access, eavesdropping, terminal masquerading, terminal theft, and network sabotage. Secure voice and data transmissions would be available throughout the entire network.

For federal agencies and the public safety community to carry out their missions successfully, priority levels must be established. In a leased system, mission-critical communications must be a priority and should be based on the operational situation rather than the hierarchy of the person. Vendor C suggests implementing an emergency call feature that would guarantee that mission-critical calls receive the highest priority. This means that the call would be received and processed without delay.

After the network has been deployed, systems management would play a key role in the day-to-day operations of the system. Vendor C suggests an operations and management network to manage the system. The responsibilities of the network are classified into three areas: technical management, tactical management, and operational management. Technical

management consists of configuration, alarm management, monitoring, supervision, and maintenance of the system. Tactical management includes subscriber and terminal management, organization management, and group management. Operational management consists of routine network administrative responsibilities related to system subscribers.

The second approach presented by Vendor C is to partner with a nationwide wireless service provider to supply complementary coverage during the build-out of the private mobile radio network. The private mobile radio network infrastructure would be configured similarly to the first approach described above. System implementation would begin in major metropolitan areas that have the greatest number of users. The areas with a lower number of users would receive service via a nationwide wireless service provider. This nationwide provider would service rural areas throughout the first years of the deployment phase. However, interoperability between the private mobile radio network and the national provider would be required. Security must also be taken into consideration when entering into this kind of a partnership. Therefore, Vendor C suggests that mission-critical communications should be restricted to the virtual private network.

The "complementary" nationwide network would use code division multiplex access (CDMA) technology. This technology enables the reuse of frequencies, thereby increasing the total number of available channels. This system would provide the user with benefits such as a dropped call rate below 2 percent, near wireline call quality, 1 percent call blocking, and 95 percent confidence in the coverage area. This technology would allow the vendor to configure system features to each organization's unique requirements.

B.3.4 Interoperability

The private mobile network proposed by Vendor C would facilitate wireless communications interoperability between user organizations. These organizations would have access to the latest technologies as part of a leased system and, in turn, would lead to improved interoperability. In addition, network security would improve as technology becomes more advanced. The fee-for-service approach may increase interoperability, but it could pose security risks and infrastructure sharing issues that could impede interoperability.

B.3.5 Spectrum

The fee-for-service approach enables new users to access spectrum when available but obstacles to spectrum use and licensing exist. The vendor and user organizations must determine how private users will access public safety spectrum. Vendor C also suggests that federal and other user organizations negotiate the use of their frequencies for a period of 50 years. Regulatory agencies must support efficient use of spectrum to allow the vendor to recoup and profit from its original investment. The vendor recommends the establishment of a new entity to manage these frequencies would lead to better spectrum management.

B.3.6 Trade-Off-off Perspective

The deployment of a leased system presents several advantages and disadvantages. A leased system provides a "one-stop-shop" for all of an agency's communications needs and nationwide capabilities. The proposed virtual private network would support the tactical and

operational independence required by federal agencies and the public safety community. Federal, public safety, and private users would be operationally independent; however, each user organization must agree to share common infrastructure. Finally, a leased service arrangement would allow for spectrum aggregation of participating organizations. This might alleviate channel congestion and facilitate efficient use of spectrum.

APPENDIX C: COST MODEL

COST MODEL—ASSUMPTIONS

Outlined below are the assumptions developed for the cost model used to generate the example shown in Section 3.2. These assumptions are not meant to be comprehensive, but rather, are presented to provide a boundary for the model.

1. Analysts identified three essential system variables to provide a basis for the estimates. Other requirements were held constant. The three system variables are: 1) system type (i.e., conventional or trunked), 2) system size, and 3) frequency band.

2. Analysts estimated costs for three different sized systems: small, medium, and large. The number of users and sites defines the system size. The number of sites, in turn, is directly affected by the frequency band, which, for this estimate, is assumed to be either very high frequency (VHF) High-Band or 800 megahertz (MHz).

System Size	Number of Users	Number of Sites		Number of Repeaters	
		VHF	800 MHz	Conventional	Trunked
Small	500	5	12	3	5
Medium	2,500	25	45	5	10
Large	25,000	75	120	5	15

3. The estimate includes acquisition costs over the first 2 years and operations and maintenance costs for 10 years.

4. Subscriber equipment is not included in the cost estimate.

5. The system has three types of sites that will affect the type of support facilities required at the site: new, minor upgrade required, and major upgrade required.

Type of Site	Attributes	Percentage of Total Sites
New	• No utilities or facilities present, except for access road	10
Minor Upgrade	• Additional radio equipment or other support equipment needed (e.g., larger uninterruptible power supply [UPS], additional antenna combiner, additional microwave channel bank)	60
Major Upgrade	• Major upgrades are required (e.g., conventional to trunked upgrade, new towers and backup power)	30

6. Transmitter sites are owned by the user; therefore, no site acquisition or leasing costs are required.

7. The system supports simulcast technology.

8. The estimates provide an approximate cost for the type of system to be deployed. The costs for the privately owned system approach are based on a preliminary design for a generic, digital land mobile radio (LMR) system, not specific to a region. The

total cost to deploy a new system will vary significantly, depending on the local requirements.

As shown in Tables C-1 through C-12, system size, type, and frequency segment the infrastructure costs.

Table C-1
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Small, Conventional, VHF Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	10	10	-	-	-	-	-	-	-	-	-	-	**20**
Channel Bank	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Communications Circuits Installation	2	2	-	-	-	-	-	-	-	-	-	-	**4**
Console Dispatch Position Equipment	30	31	-	-	-	-	-	-	-	-	-	-	**61**
Console System Central Electronics	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Engineering Design Services	59	60	-	-	-	-	-	-	-	-	-	-	**119**
Major Site Upgrades	278	283	-	-	-	-	-	-	-	-	-	-	**561**
Master Site Equipment	430	439	-	-	-	-	-	-	-	-	-	-	**869**
Microwave Radio w/Antenna	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Minor Site Upgrades	45	46	-	-	-	-	-	-	-	-	-	-	**91**
New Site Acquisition	185	189	-	-	-	-	-	-	-	-	-	-	**374**
Project Management	22	23	-	-	-	-	-	-	-	-	-	-	**45**
Receiver Multicoupler	8	8	-	-	-	-	-	-	-	-	-	-	**15**
Repeater	113	115	-	-	-	-	-	-	-	-	-	-	**227**
RF Control Station Equipment	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Simulcast Repeater Site Equipment	38	38	-	-	-	-	-	-	-	-	-	-	**76**
System Staging, Installation, & Optimization	147	150	-	-	-	-	-	-	-	-	-	-	**297**
Training	7	8	-	-	-	-	-	-	-	-	-	-	**15**
Transmitter Combiner	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Trunking Site Controller	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Uninterruptable Power System	38	38	-	-	-	-	-	-	-	-	-	-	**76**
Total Radio System	**1,480**	**1,511**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,991**
Recurring Costs													
Communications Circuits	5	15	21	22	22	22	23	23	24	24	25	26	**253**
Maintenance	62	190	259	265	270	276	282	288	294	300	307	313	**3,108**
Total Recurring Costs	**67**	**206**	**280**	**286**	**292**	**299**	**305**	**311**	**318**	**325**	**332**	**339**	**3,361**
Total System Cost	**1,547**	**1,717**	**280**	**286**	**292**	**299**	**305**	**311**	**318**	**325**	**332**	**339**	**6,352**

Table C-2
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Medium, Conventional, VHF Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	50	51	-	-	-	-	-	-	-	-	-	-	**101**
Channel Bank	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Communications Circuits Installation	9	10	-	-	-	-	-	-	-	-	-	-	**19**
Console Dispatch Position Equipment	80	82	-	-	-	-	-	-	-	-	-	-	**162**
Console System Central Electronics	50	51	-	-	-	-	-	-	-	-	-	-	**101**
Engineering Design Services	166	170	-	-	-	-	-	-	-	-	-	-	**336**
Major Site Upgrades	1,388	1,417	-	-	-	-	-	-	-	-	-	-	**2,805**
Master Site Equipment	430	439	-	-	-	-	-	-	-	-	-	-	**869**
Microwave Radio w/Antenna	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Minor Site Upgrades	225	230	-	-	-	-	-	-	-	-	-	-	**455**
New Site Acquisition	925	945	-	-	-	-	-	-	-	-	-	-	**1,870**
Project Management	62	64	-	-	-	-	-	-	-	-	-	-	**126**
Receiver Multicoupler	38	38	-	-	-	-	-	-	-	-	-	-	**76**
Repeater	938	957	-	-	-	-	-	-	-	-	-	-	**1,895**
RF Control Station Equipment	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Simulcast Repeater Site Equipment	188	191	-	-	-	-	-	-	-	-	-	-	**379**
System Staging, Installation, & Optimization	415	424	-	-	-	-	-	-	-	-	-	-	**839**
Training	21	21	-	-	-	-	-	-	-	-	-	-	**42**
Transmitter Combiner	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Trunking Site Controller	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Uninterruptable Power System	188	191	-	-	-	-	-	-	-	-	-	-	**379**
Total Radio System	**5,286**	**5,399**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10,685**
Recurring Costs													
Communications Circuits	25	77	106	108	110	112	115	117	120	122	125	128	**1,265**
Maintenance	231	707	962	983	1,004	1,025	1,047	1,069	1,092	1,115	1,139	1,163	**11,537**
Total Recurring Costs	**256**	**784**	**1,068**	**1,091**	**1,114**	**1,138**	**1,162**	**1,187**	**1,212**	**1,238**	**1,264**	**1,291**	**12,803**
Total System Cost	**5,542**	**6,183**	**1,068**	**1,091**	**1,114**	**1,138**	**1,162**	**1,187**	**1,212**	**1,238**	**1,264**	**1,291**	**23,487**

Table C-3
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Large, Conventional, VHF Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	150	153	-	-	-	-	-	-	-	-	-	-	**303**
Channel Bank	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Communications Circuits Installation	28	29	-	-	-	-	-	-	-	-	-	-	**57**
Console Dispatch Position Equipment	150	153	-	-	-	-	-	-	-	-	-	-	**303**
Console System Central Electronics	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Engineering Design Services	412	421	-	-	-	-	-	-	-	-	-	-	**834**
Major Site Upgrades	4,163	4,251	-	-	-	-	-	-	-	-	-	-	**8,414**
Master Site Equipment	430	439	-	-	-	-	-	-	-	-	-	-	**869**
Microwave Radio w/Antenna	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Minor Site Upgrades	675	689	-	-	-	-	-	-	-	-	-	-	**1,364**
New Site Acquisition	2,775	2,834	-	-	-	-	-	-	-	-	-	-	**5,609**
Project Management	155	158	-	-	-	-	-	-	-	-	-	-	**313**
Receiver Multicoupler	113	115	-	-	-	-	-	-	-	-	-	-	**227**
Repeater	2,813	2,872	-	-	-	-	-	-	-	-	-	-	**5,685**
RF Control Station Equipment	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Simulcast Repeater Site Equipment	563	574	-	-	-	-	-	-	-	-	-	-	**1,137**
System Staging, Installation, & Optimization	1,031	1,053	-	-	-	-	-	-	-	-	-	-	**2,084**
Training	52	53	-	-	-	-	-	-	-	-	-	-	**104**
Transmitter Combiner	225	230	-	-	-	-	-	-	-	-	-	-	**455**
Trunking Site Controller	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Uninterruptable Power System	563	574	-	-	-	-	-	-	-	-	-	-	**1,137**
Total Radio System	**14,445**	**14,753**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**29,199**
Recurring Costs													
Communications Circuits	76	232	317	323	330	337	344	352	359	367	375	383	**3,796**
Maintenance	638	1,956	2,664	2,720	2,778	2,838	2,898	2,960	3,023	3,087	3,153	3,220	**31,936**
Total Recurring Costs	**714**	**2,188**	**2,980**	**3,044**	**3,109**	**3,175**	**3,242**	**3,312**	**3,382**	**3,454**	**3,528**	**3,603**	**35,732**
Total System Cost	**15,160**	**16,942**	**2,980**	**3,044**	**3,109**	**3,175**	**3,242**	**3,312**	**3,382**	**3,454**	**3,528**	**3,603**	**64,930**

Table C-4
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Small, Trunked, VHF Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	10	10	-	-	-	-	-	-	-	-	-	-	**20**
Channel Bank	35	36	-	-	-	-	-	-	-	-	-	-	**71**
Communications Circuits Installation	0	0	-	-	-	-	-	-	-	-	-	-	**1**
Console Dispatch Position Equipment	30	31	-	-	-	-	-	-	-	-	-	-	**61**
Console System Central Electronics	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Engineering Design Services	120	122	-	-	-	-	-	-	-	-	-	-	**242**
Major Site Upgrades	278	283	-	-	-	-	-	-	-	-	-	-	**561**
Master Site Equipment	750	766	-	-	-	-	-	-	-	-	-	-	**1,516**
Microwave Radio w/Antenna	142	145	-	-	-	-	-	-	-	-	-	-	**287**
Minor Site Upgrades	45	46	-	-	-	-	-	-	-	-	-	-	**91**
New Site Acquisition	185	189	-	-	-	-	-	-	-	-	-	-	**374**
Project Management	45	46	-	-	-	-	-	-	-	-	-	-	**91**
Receiver Multicoupler	8	8	-	-	-	-	-	-	-	-	-	-	**15**
Repeater	188	191	-	-	-	-	-	-	-	-	-	-	**379**
RF Control Station Equipment	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Simulcast Repeater Site Equipment	38	38	-	-	-	-	-	-	-	-	-	-	**76**
System Staging, Installation, & Optimization	299	305	-	-	-	-	-	-	-	-	-	-	**604**
Training	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Transmitter Combiner	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Trunking Site Controller	188	191	-	-	-	-	-	-	-	-	-	-	**379**
Uninterruptable Power System	38	38	-	-	-	-	-	-	-	-	-	-	**76**
Total Radio System	**2,480**	**2,533**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,014**
Recurring Costs													
Communications Circuits	1	4	5	5	6	6	6	6	6	6	6	6	**63**
Maintenance	100	307	418	427	436	445	454	464	474	484	494	505	**5,007**
Total Recurring Costs	**101**	**311**	**423**	**432**	**441**	**451**	**460**	**470**	**480**	**490**	**501**	**511**	**5,070**
Total System Cost	**2,582**	**2,844**	**423**	**432**	**441**	**451**	**460**	**470**	**480**	**490**	**501**	**511**	**10,084**

Table C-5
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Medium, Trunked, VHF Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Channel Bank	185	189	-	-	-	-	-	-	-	-	-	-	**374**
Communications Circuits Installation	5	5	-	-	-	-	-	-	-	-	-	-	**10**
Console Dispatch Position Equipment	80	82	-	-	-	-	-	-	-	-	-	-	**162**
Console System Central Electronics	50	51	-	-	-	-	-	-	-	-	-	-	**101**
Engineering Design Services	429	438	-	-	-	-	-	-	-	-	-	-	**866**
Major Site Upgrades	1,388	1,417	-	-	-	-	-	-	-	-	-	-	**2,805**
Master Site Equipment	750	766	-	-	-	-	-	-	-	-	-	-	**1,516**
Microwave Radio w/Antenna	614	627	-	-	-	-	-	-	-	-	-	-	**1,242**
Minor Site Upgrades	225	230	-	-	-	-	-	-	-	-	-	-	**455**
New Site Acquisition	925	945	-	-	-	-	-	-	-	-	-	-	**1,870**
Project Management	161	164	-	-	-	-	-	-	-	-	-	-	**325**
Receiver Multicoupler	38	38	-	-	-	-	-	-	-	-	-	-	**76**
Repeater	1,875	1,915	-	-	-	-	-	-	-	-	-	-	**3,790**
RF Control Station Equipment	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Simulcast Repeater Site Equipment	188	191	-	-	-	-	-	-	-	-	-	-	**379**
System Staging, Installation, & Optimization	1,071	1,094	-	-	-	-	-	-	-	-	-	-	**2,166**
Training	54	55	-	-	-	-	-	-	-	-	-	-	**108**
Transmitter Combiner	150	153	-	-	-	-	-	-	-	-	-	-	**303**
Trunking Site Controller	938	957	-	-	-	-	-	-	-	-	-	-	**1,895**
Uninterruptable Power System	375	383	-	-	-	-	-	-	-	-	-	-	**758**
Total Radio System	**9,613**	**9,818**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**19,431**
Recurring Costs													
Communications Circuits	13	39	53	54	55	56	57	59	60	61	62	64	**633**
Maintenance	395	1,209	1,647	1,682	1,718	1,754	1,792	1,830	1,869	1,909	1,950	1,991	**19,746**
Total Recurring Costs	**407**	**1,248**	**1,700**	**1,736**	**1,773**	**1,811**	**1,849**	**1,889**	**1,929**	**1,970**	**2,012**	**2,055**	**20,379**
Total System Cost	**10,020**	**11,066**	**1,700**	**1,736**	**1,773**	**1,811**	**1,849**	**1,889**	**1,929**	**1,970**	**2,012**	**2,055**	**39,810**

Table C-6
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Large, Trunked, VHF Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	225	230	-	-	-	-	-	-	-	-	-	-	**455**
Channel Bank	560	572	-	-	-	-	-	-	-	-	-	-	**1,132**
Communications Circuits Installation	21	22	-	-	-	-	-	-	-	-	-	-	**43**
Console Dispatch Position Equipment	150	153	-	-	-	-	-	-	-	-	-	-	**303**
Console System Central Electronics	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Engineering Design Services	1,415	1,446	-	-	-	-	-	-	-	-	-	-	**2,861**
Major Site Upgrades	4,163	4,251	-	-	-	-	-	-	-	-	-	-	**8,414**
Master Site Equipment	750	766	-	-	-	-	-	-	-	-	-	-	**1,516**
Microwave Radio w/Antenna	1,796	1,834	-	-	-	-	-	-	-	-	-	-	**3,629**
Minor Site Upgrades	675	689	-	-	-	-	-	-	-	-	-	-	**1,364**
New Site Acquisition	2,775	2,834	-	-	-	-	-	-	-	-	-	-	**5,609**
Project Management	531	542	-	-	-	-	-	-	-	-	-	-	**1,073**
Receiver Multicoupler	113	115	-	-	-	-	-	-	-	-	-	-	**227**
Repeater	8,438	8,617	-	-	-	-	-	-	-	-	-	-	**17,055**
RF Control Station Equipment	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Simulcast Repeater Site Equipment	563	574	-	-	-	-	-	-	-	-	-	-	**1,137**
System Staging, Installation, & Optimization	3,539	3,614	-	-	-	-	-	-	-	-	-	-	**7,153**
Training	177	181	-	-	-	-	-	-	-	-	-	-	**358**
Transmitter Combiner	450	460	-	-	-	-	-	-	-	-	-	-	**910**
Trunking Site Controller	2,813	2,872	-	-	-	-	-	-	-	-	-	-	**5,685**
Uninterruptable Power System	1,688	1,723	-	-	-	-	-	-	-	-	-	-	**3,411**
Total Radio System	**30,989**	**31,649**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**62,638**
Recurring Costs													
Communications Circuits	57	174	237	243	248	253	258	264	269	275	281	287	**2,847**
Maintenance	1,265	3,877	5,279	5,392	5,507	5,624	5,744	5,866	5,991	6,119	6,250	6,383	**63,297**
Total Recurring Costs	**1,322**	**4,051**	**5,517**	**5,634**	**5,754**	**5,877**	**6,002**	**6,130**	**6,261**	**6,394**	**6,531**	**6,670**	**66,144**
Total System Cost	**32,311**	**35,700**	**5,517**	**5,634**	**5,754**	**5,877**	**6,002**	**6,130**	**6,261**	**6,394**	**6,531**	**6,670**	**128,782**

Table C-7
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Small, Conventional, 800 MHz Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	24	25	-	-	-	-	-	-	-	-	-	-	**49**
Channel Bank	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Communications Circuits Installation	5	5	-	-	-	-	-	-	-	-	-	-	**9**
Console Dispatch Position Equipment	30	31	-	-	-	-	-	-	-	-	-	-	**61**
Console System Central Electronics	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Engineering Design Services	83	85	-	-	-	-	-	-	-	-	-	-	**169**
Major Site Upgrades	666	680	-	-	-	-	-	-	-	-	-	-	**1,346**
Master Site Equipment	430	439	-	-	-	-	-	-	-	-	-	-	**869**
Microwave Radio w/Antenna	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Minor Site Upgrades	108	110	-	-	-	-	-	-	-	-	-	-	**218**
New Site Acquisition	444	453	-	-	-	-	-	-	-	-	-	-	**897**
Project Management	31	32	-	-	-	-	-	-	-	-	-	-	**63**
Receiver Multicoupler	18	18	-	-	-	-	-	-	-	-	-	-	**36**
Repeater	270	276	-	-	-	-	-	-	-	-	-	-	**546**
RF Control Station Equipment	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Simulcast Repeater Site Equipment	90	92	-	-	-	-	-	-	-	-	-	-	**182**
System Staging, Installation, & Optimization	209	213	-	-	-	-	-	-	-	-	-	-	**422**
Training	10	11	-	-	-	-	-	-	-	-	-	-	**21**
Transmitter Combiner	36	37	-	-	-	-	-	-	-	-	-	-	**73**
Trunking Site Controller	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Uninterruptable Power System	90	92	-	-	-	-	-	-	-	-	-	-	**182**
Total Radio System	**2,599**	**2,655**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5,254**
Recurring Costs													
Communications Circuits	12	37	51	52	53	54	55	56	57	59	60	61	**607**
Maintenance	113	346	472	482	492	502	513	524	535	547	558	570	**5,655**
Total Recurring Costs	**125**	**384**	**522**	**533**	**545**	**556**	**568**	**580**	**593**	**605**	**618**	**632**	**6,263**
Total System Cost	**2,724**	**3,038**	**522**	**533**	**545**	**556**	**568**	**580**	**593**	**605**	**618**	**632**	**11,517**

Table C-8
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Medium, Conventional, 800 MHz Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	90	92	-	-	-	-	-	-	-	-	-	-	**182**
Channel Bank	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Communications Circuits Installation	17	17	-	-	-	-	-	-	-	-	-	-	**34**
Console Dispatch Position Equipment	80	82	-	-	-	-	-	-	-	-	-	-	**162**
Console System Central Electronics	50	51	-	-	-	-	-	-	-	-	-	-	**101**
Engineering Design Services	260	266	-	-	-	-	-	-	-	-	-	-	**526**
Major Site Upgrades	2,498	2,551	-	-	-	-	-	-	-	-	-	-	**5,048**
Master Site Equipment	430	439	-	-	-	-	-	-	-	-	-	-	**869**
Microwave Radio w/Antenna	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Minor Site Upgrades	405	414	-	-	-	-	-	-	-	-	-	-	**819**
New Site Acquisition	1,665	1,700	-	-	-	-	-	-	-	-	-	-	**3,365**
Project Management	98	100	-	-	-	-	-	-	-	-	-	-	**197**
Receiver Multicoupler	68	69	-	-	-	-	-	-	-	-	-	-	**136**
Repeater	1,688	1,723	-	-	-	-	-	-	-	-	-	-	**3,411**
RF Control Station Equipment	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Simulcast Repeater Site Equipment	338	345	-	-	-	-	-	-	-	-	-	-	**682**
System Staging, Installation, & Optimization	651	665	-	-	-	-	-	-	-	-	-	-	**1,316**
Training	33	33	-	-	-	-	-	-	-	-	-	-	**66**
Transmitter Combiner	135	138	-	-	-	-	-	-	-	-	-	-	**273**
Trunking Site Controller	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Uninterruptable Power System	338	345	-	-	-	-	-	-	-	-	-	-	**682**
Total Radio System	**8,881**	**9,070**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**17,952**
Recurring Costs													
Communications Circuits	46	139	190	194	198	202	207	211	216	220	225	230	**2,278**
Maintenance	391	1,198	1,632	1,667	1,702	1,739	1,776	1,813	1,852	1,892	1,932	1,973	**19,567**
Total Recurring Costs	**437**	**1,338**	**1,822**	**1,861**	**1,900**	**1,941**	**1,982**	**2,025**	**2,068**	**2,112**	**2,157**	**2,203**	**21,844**
Total System Cost	**9,318**	**10,408**	**1,822**	**1,861**	**1,900**	**1,941**	**1,982**	**2,025**	**2,068**	**2,112**	**2,157**	**2,203**	**39,796**

Table C-9
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Large, Conventional, 800 MHz Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	240	245	-	-	-	-	-	-	-	-	-	-	**485**
Channel Bank	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Communications Circuits Installation	45	46	-	-	-	-	-	-	-	-	-	-	**92**
Console Dispatch Position Equipment	150	153	-	-	-	-	-	-	-	-	-	-	**303**
Console System Central Electronics	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Engineering Design Services	625	638	-	-	-	-	-	-	-	-	-	-	**1,263**
Major Site Upgrades	6,660	6,802	-	-	-	-	-	-	-	-	-	-	**13,462**
Master Site Equipment	430	439	-	-	-	-	-	-	-	-	-	-	**869**
Microwave Radio w/Antenna	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Minor Site Upgrades	1,080	1,103	-	-	-	-	-	-	-	-	-	-	**2,183**
New Site Acquisition	4,440	4,535	-	-	-	-	-	-	-	-	-	-	**8,975**
Project Management	234	239	-	-	-	-	-	-	-	-	-	-	**474**
Receiver Multicoupler	180	184	-	-	-	-	-	-	-	-	-	-	**364**
Repeater	4,500	4,596	-	-	-	-	-	-	-	-	-	-	**9,096**
RF Control Station Equipment	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Simulcast Repeater Site Equipment	900	919	-	-	-	-	-	-	-	-	-	-	**1,819**
System Staging, Installation, & Optimization	1,562	1,595	-	-	-	-	-	-	-	-	-	-	**3,157**
Training	78	80	-	-	-	-	-	-	-	-	-	-	**158**
Transmitter Combiner	360	368	-	-	-	-	-	-	-	-	-	-	**728**
Trunking Site Controller	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Uninterruptable Power System	900	919	-	-	-	-	-	-	-	-	-	-	**1,819**
Total Radio System	**22,535**	**23,015**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**45,550**
Recurring Costs													
Communications Circuits	121	372	507	517	528	540	551	563	575	587	600	612	**6,074**
Maintenance	1,000	3,062	4,170	4,259	4,350	4,443	4,537	4,634	4,733	4,834	4,937	5,042	**50,001**
Total Recurring Costs	**1,121**	**3,434**	**4,677**	**4,777**	**4,878**	**4,982**	**5,089**	**5,197**	**5,308**	**5,421**	**5,537**	**5,655**	**56,075**
Total System Cost	**23,655**	**26,449**	**4,677**	**4,777**	**4,878**	**4,982**	**5,089**	**5,197**	**5,308**	**5,421**	**5,537**	**5,655**	**101,625**

Table C-10
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Small, Trunked, 800 MHz Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	24	25	-	-	-	-	-	-	-	-	-	-	**49**
Channel Bank	88	89	-	-	-	-	-	-	-	-	-	-	**177**
Communications Circuits Installation	1	1	-	-	-	-	-	-	-	-	-	-	**2**
Console Dispatch Position Equipment	30	31	-	-	-	-	-	-	-	-	-	-	**61**
Console System Central Electronics	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Engineering Design Services	191	195	-	-	-	-	-	-	-	-	-	-	**386**
Major Site Upgrades	666	680	-	-	-	-	-	-	-	-	-	-	**1,346**
Master Site Equipment	750	766	-	-	-	-	-	-	-	-	-	-	**1,516**
Microwave Radio w/Antenna	307	314	-	-	-	-	-	-	-	-	-	-	**621**
Minor Site Upgrades	108	110	-	-	-	-	-	-	-	-	-	-	**218**
New Site Acquisition	444	453	-	-	-	-	-	-	-	-	-	-	**897**
Project Management	72	73	-	-	-	-	-	-	-	-	-	-	**145**
Receiver Multicoupler	18	18	-	-	-	-	-	-	-	-	-	-	**36**
Repeater	450	460	-	-	-	-	-	-	-	-	-	-	**910**
RF Control Station Equipment	15	15	-	-	-	-	-	-	-	-	-	-	**30**
Simulcast Repeater Site Equipment	90	92	-	-	-	-	-	-	-	-	-	-	**182**
System Staging, Installation, & Optimization	478	488	-	-	-	-	-	-	-	-	-	-	**965**
Training	24	24	-	-	-	-	-	-	-	-	-	-	**48**
Transmitter Combiner	36	37	-	-	-	-	-	-	-	-	-	-	**73**
Trunking Site Controller	450	460	-	-	-	-	-	-	-	-	-	-	**910**
Uninterruptable Power System	90	92	-	-	-	-	-	-	-	-	-	-	**182**
Total Radio System	**4,371**	**4,464**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8,835**
Recurring Costs													
Communications Circuits	3	9	13	13	13	13	14	14	14	15	15	15	**152**
Maintenance	180	552	752	768	785	801	818	836	854	872	890	909	**9,019**
Total Recurring Costs	**183**	**562**	**765**	**781**	**798**	**815**	**832**	**850**	**868**	**887**	**905**	**925**	**9,171**
Total System Cost	**4,554**	**5,026**	**765**	**781**	**798**	**815**	**832**	**850**	**868**	**887**	**905**	**925**	**18,005**

Table C-11
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Medium, Trunked, 800 MHz Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	135	138	-	-	-	-	-	-	-	-	-	-	**273**
Channel Bank	335	342	-	-	-	-	-	-	-	-	-	-	**677**
Communications Circuits Installation	9	9	-	-	-	-	-	-	-	-	-	-	**17**
Console Dispatch Position Equipment	80	82	-	-	-	-	-	-	-	-	-	-	**162**
Console System Central Electronics	50	51	-	-	-	-	-	-	-	-	-	-	**101**
Engineering Design Services	711	726	-	-	-	-	-	-	-	-	-	-	**1,437**
Major Site Upgrades	2,498	2,551	-	-	-	-	-	-	-	-	-	-	**5,048**
Master Site Equipment	750	766	-	-	-	-	-	-	-	-	-	-	**1,516**
Microwave Radio w/Antenna	1,087	1,110	-	-	-	-	-	-	-	-	-	-	**2,197**
Minor Site Upgrades	405	414	-	-	-	-	-	-	-	-	-	-	**819**
New Site Acquisition	1,665	1,700	-	-	-	-	-	-	-	-	-	-	**3,365**
Project Management	267	272	-	-	-	-	-	-	-	-	-	-	**539**
Receiver Multicoupler	68	69	-	-	-	-	-	-	-	-	-	-	**136**
Repeater	3,375	3,447	-	-	-	-	-	-	-	-	-	-	**6,822**
RF Control Station Equipment	40	41	-	-	-	-	-	-	-	-	-	-	**81**
Simulcast Repeater Site Equipment	338	345	-	-	-	-	-	-	-	-	-	-	**682**
System Staging, Installation, & Optimization	1,778	1,816	-	-	-	-	-	-	-	-	-	-	**3,594**
Training	89	91	-	-	-	-	-	-	-	-	-	-	**180**
Transmitter Combiner	270	276	-	-	-	-	-	-	-	-	-	-	**546**
Trunking Site Controller	1,688	1,723	-	-	-	-	-	-	-	-	-	-	**3,411**
Uninterruptable Power System	675	689	-	-	-	-	-	-	-	-	-	-	**1,364**
Total Radio System	**16,310**	**16,658**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**32,967**
Recurring Costs													
Communications Circuits	23	70	95	97	99	101	103	106	108	110	112	115	**1,139**
Maintenance	673	2,062	2,807	2,867	2,928	2,991	3,054	3,120	3,186	3,254	3,323	3,394	**33,660**
Total Recurring Costs	**696**	**2,131**	**2,902**	**2,964**	**3,027**	**3,092**	**3,158**	**3,225**	**3,294**	**3,364**	**3,436**	**3,509**	**34,798**
Total System Cost	**17,005**	**18,789**	**2,902**	**2,964**	**3,027**	**3,092**	**3,158**	**3,225**	**3,294**	**3,364**	**3,436**	**3,509**	**67,766**

Table C-12
Required Infrastructure Costs for Traditional Procurement Alternative ($ Thousands)
Large, Trunked, 800 MHz Configuration

Cost Elements	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	Total
Radio System													
Antenna Assembly	360	368	-	-	-	-	-	-	-	-	-	-	**728**
Channel Bank	898	917	-	-	-	-	-	-	-	-	-	-	**1,814**
Communications Circuits Installation	34	35	-	-	-	-	-	-	-	-	-	-	**69**
Console Dispatch Position Equipment	150	153	-	-	-	-	-	-	-	-	-	-	**303**
Console System Central Electronics	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Engineering Design Services	2,213	2,260	-	-	-	-	-	-	-	-	-	-	**4,474**
Major Site Upgrades	6,660	6,802	-	-	-	-	-	-	-	-	-	-	**13,462**
Master Site Equipment	750	766	-	-	-	-	-	-	-	-	-	-	**1,516**
Microwave Radio w/Antenna	2,859	2,920	-	-	-	-	-	-	-	-	-	-	**5,778**
Minor Site Upgrades	1,080	1,103	-	-	-	-	-	-	-	-	-	-	**2,183**
New Site Acquisition	4,440	4,535	-	-	-	-	-	-	-	-	-	-	**8,975**
Project Management	830	848	-	-	-	-	-	-	-	-	-	-	**1,678**
Receiver Multicoupler	180	184	-	-	-	-	-	-	-	-	-	-	**364**
Repeater	13,500	13,788	-	-	-	-	-	-	-	-	-	-	**27,288**
RF Control Station Equipment	75	77	-	-	-	-	-	-	-	-	-	-	**152**
Simulcast Repeater Site Equipment	900	919	-	-	-	-	-	-	-	-	-	-	**1,819**
System Staging, Installation, & Optimization	5,533	5,651	-	-	-	-	-	-	-	-	-	-	**11,184**
Training	277	283	-	-	-	-	-	-	-	-	-	-	**559**
Transmitter Combiner	720	735	-	-	-	-	-	-	-	-	-	-	**1,455**
Trunking Site Controller	4,500	4,596	-	-	-	-	-	-	-	-	-	-	**9,096**
Uninterruptable Power System	2,700	2,758	-	-	-	-	-	-	-	-	-	-	**5,458**
Total Radio System	**48,733**	**49,772**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**98,505**
Recurring Costs													
Communications Circuits	91	279	380	388	396	405	413	422	431	440	450	459	**4,555**
Maintenance	1,992	6,104	8,313	8,490	8,671	8,856	9,044	9,237	9,434	9,635	9,841	10,050	**99,668**
Total Recurring Costs	**2,083**	**6,383**	**8,693**	**8,878**	**9,067**	**9,260**	**9,458**	**9,659**	**9,865**	**10,076**	**10,290**	**10,510**	**104,223**
Total System Cost	**50,817**	**56,156**	**8,693**	**8,878**	**9,067**	**9,260**	**9,458**	**9,659**	**9,865**	**10,076**	**10,290**	**10,510**	**202,729**

APPENDIX D: ACRONYM LIST

ACRONYMS

API	Application Program Interface
CAD	Computer-Aided Dispatch
CBD	Commerce Business Daily
CDMA	Code Division Multiplex Access
CMS	Central Management Service
EDACS	Enhanced Digital Access Communication System
EIA	Electronics Industry Association
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FDMA	Frequency Division Multiplex Access
FedSMR	Federal Specialized Mobile Radio
FIRST	Fund For Infrastructure, Roads, Schools, and Transit
IP	Internet Protocol
ISP	Illinois State Police
IT	Information Technology
LMR	Land Mobile Radio
MHz	Megahertz
MOU	Memoranda of Understanding
O&M	Operations and Maintenance
OIR	Office of Information Resources
OMB	Office of Management and Budget
P25	Project 25
PCS	Personal Communications Services
PSWAC	Public Safety Wireless Advisory Committee
PSWN	Public Safety Wireless Network
RF	Radio Frequency
RFI	Request for Information
RFP	Request for Proposals
SAA	Service and Access Agreement
SDR	Software-Defined Radio
SLA	Service Level Agreement
SLERN	Statewide Law Enforcement Radio Network
STO	State Technology Office
TIA	Telecommunications Industry Association
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
VHF	Very High Frequency