

PUBLIC

SAFETY

WIRELESS

NETWORK

PROGRAM

# PSWN PROGRAM

## INFORMATION BRIEF

# Fire and EMS Communications Interoperability

### Study Objectives

- Identify the current and planned wireless communications capabilities of fire and EMS agencies.
- Determine the nature and extent of current fire and EMS communications interoperability experiences and requirements.
- Identify the nature and extent of wireless communications interoperability shortfalls experienced by fire and EMS agencies.
- Determine the knowledge and training level of fire and EMS personnel related to current wireless communications interoperability initiatives.

**O**ur Nation's public safety workers — firefighters, emergency medical services (EMS) personnel, and police officers — do not work in isolation. Recent high-profile incidents such as bombings, plane crashes, and natural disasters have dramatically illustrated the need for public safety agencies to coordinate their response. Less visible to the public, but no less critical, is the coordination between agencies required to conduct the more routine operations of fire suppression and emergency medical care. To protect life and property, public safety personnel must be able to communicate with each other across agency and jurisdiction boundaries. The ability of agencies to do so, which is known as interoperability, depends on wireless radio communications.

This Public Safety Wireless Network (PSWN) program study explores the interoperability experiences of the fire and EMS community.<sup>1</sup> Interoperability issues facing the law enforcement community have been well documented in past initiatives.<sup>2</sup> However, the wireless communications environment and the interoperability needs of the fire and EMS community have largely been overlooked. This study quantifies the challenges faced by fire and EMS agencies when communicating with other public safety agencies. (See *Study Objectives*.)

The study was based on a survey that elicited the interoperability experiences of fire and EMS agencies from across the

nation. (See *Methodology* for a discussion of the sampling and analysis techniques used.) The survey sought to identify issues that affect the ability of the fire and EMS community to achieve communications interoperability. Included in the survey were questions regarding current and planned wireless capabilities, interoperability requirements, interoperability shortfalls, and interoperability knowledge and training levels. The full report, entitled the *PSWN Program's Analysis of Fire and EMS Communications Interoperability*, provides a more in-depth analysis of fire and EMS interoperability experiences and needs.

## Key Findings

- Eighty-eight percent of local fire and EMS agencies interoperate daily or weekly with other local public safety organizations. Interoperable communications is much less frequent between local and state or local and federal public safety agencies.
- Eighty-one percent of local fire and EMS agencies are confident in their current ability to handle interoperability situations. Agencies are most confident in handling day-to-day interoperability situations (76 percent) and least confident in handling task-force situations (35 percent).
- Local fire and EMS agencies rate funding limitations and the use of different frequency bands as the most severe obstacles to interoperability (68 percent and 51 percent, respectively).
- The majority of local fire and EMS agencies operate LMR systems that are old and rely on basic technologies. Agencies predominately use analog systems (79 percent) with conventional architectures (75 percent) and operate in the very high frequency (VHF) band (72 percent).
- A majority (57 percent) of local fire and EMS agencies plan to replace or substantially upgrade their LMR systems in the next 10 years. However, there is a lack of identifiable funding sources to accomplish these planned replacements.
- Based on fire and EMS agencies' preferences for their next LMR system, digital technology will substantially replace analog technology (from 14 percent to 37 percent), the use of trunked systems architectures will nearly double (from 20 percent to 39 percent), and the use of the 800 MHz frequency band will increase (from 26 percent to 43 percent).

(continued on page 3)

The survey results are broadly representative of fire and EMS agencies nationwide.<sup>3</sup> The quantitative information can be used to inform and support policy development and decision making regarding the challenges to achieving interoperability. For example, study findings are directly applicable to ongoing interoperability initiatives at the federal level, including those that address critical resource constraints such as spectrum and funding.

In January 1998, the Federal Communications Commission (FCC) reallocated an additional 24 MHz of spectrum for public safety use.<sup>4</sup> A portion of this spectrum has been designated to support nationwide interoperability among local, state, and federal agencies. Although this allocation nearly doubles the amount of spectrum currently available to meet the wireless communications needs of the state and local public safety community, it may not be readily available until 2006. Furthermore,

an additional 73.5 MHz of spectrum is still needed to ensure that public safety agencies can satisfy their wireless communications needs, taking full advantage of wireless data and other modern technologies.<sup>5</sup>

Also during 1998, Attorney General Janet Reno convened an interagency working group to establish an alternative funding mechanism for local and state public safety wireless communications systems. As a result, a federal grant program was proposed to provide funding and technical assistance to states for the planning of statewide public safety wireless communications systems and interoperability demonstration projects. The President's Fiscal Year 2000 budget contains \$80 million to support the planning for these statewide systems. However, recently developed estimates by the PSWN program suggest that the investment in existing public safety radio equipment nationwide is at least \$18.3 billion.<sup>6</sup> Additional funding sources at all levels of government are needed to

## Methodology

Beginning in March 1998, surveys were distributed to 3,398 fire and EMS organizations. Because a large portion of the fire and EMS community is made up of smaller volunteer departments, two versions (a long and a short) were developed. The short version contained fewer detailed questions than the long version and was sent to the smaller agencies. At the end of the data collection efforts in October 1998, a total of 1,045 surveys were returned (an overall response rate of 31 percent).

When analyzing the data, all questions were examined in terms of overall response rates, response rates by agency type, and response rates by agency size. The agency-type groupings were fire departments, EMS departments, and special agencies (i.e., airport and harbor fire and EMS departments). Where applicable, fire departments were further separated into career and volunteer departments. The five agency size classifications used, 1-24, 25-49, 50-99, 100-249, and 250 or more personnel, were based on respondents' indication of staffing levels. Separate analyses of the responding state agencies (state forestry agencies, state EMS agencies, and state fire marshals) were conducted due to their distinct operational requirements. The results of these analyses are summarized individually. (See *State Forestry Agencies*, *State EMS Agencies*, and *State Fire Marshals*.)

All data in this report are based on the respondent sample. Bias and error analyses were conducted, as were various statistical tests to evaluate differences among agency sizes and types. Although a degree of similarity exists between the interoperability needs of the responding fire and EMS community and that of the more than 37,000 fire and EMS agencies nationwide, this study does not represent the needs of the fire and EMS community as a whole. However, as determined from a weighting analysis, the study results are broadly representative of the local fire and EMS community and select state agencies.

advance the development of statewide and regional wireless communications systems and to improve interoperability among public safety agencies.

Additional policy implications arise from the interoperability experiences of fire and EMS agencies, such as the need for improved coordination among all levels of government and the development of standards. As the *PSWN Program Analysis of Fire and EMS Communications Interoperability* reveals, a number of policy issues require attention and resolution. It is through the active involvement of regulatory agencies, industry, elected officials, and most importantly, the state and local public safety agencies themselves, that interoperability can be achieved.

## FINDINGS

The findings of this study demonstrate that interoperability is an essential communications requirement for fire and EMS agencies. Challenges to interoperability faced by this community are pervasive and consistent with those experienced by the law enforcement community. To best describe the interoperability challenges facing local fire and EMS agencies, the findings are organized into five sections: Interoperability Needs, Interoperability Experiences and Require-

ments, Interoperability Obstacles, Wireless Communications Environment, and Interoperability Knowledge.

### Interoperability Needs

To define the extent to which fire and EMS agencies require interoperable communications, agencies were asked to indicate their interoperability requirements based on: frequency of interaction with other public safety agencies, types of interoperability experienced, and the effect of interoperability on mission performance. The findings verify that there is an almost universal need for interoperability among local fire and EMS agencies. Most agencies interoperate with other local public safety organizations on a daily or weekly basis. Interoperability with organizations at the state and federal levels is also required, but occurs less frequently. In addition, fire and EMS agencies require various types of interoperability (day-to-day, mutual aid, and task force) to effectively perform their missions. Not surprisingly, the inability of agencies to interoperate limits the effectiveness of their response to emergency situations.

**Frequency of Interaction.** Interoperability among public safety organizations is common for local fire and EMS agencies. Eighty-eight percent interoperate with other local organizations on a daily or weekly

### Types of Interoperability

**Day-to-day interoperability** involves coordination during routine public safety operations. Interoperability is required, for example, when firefighters from around a county join forces to battle a structural fire or when public safety agencies must work together to rescue accident victims.

**Mutual aid interoperability** involves a joint and immediate response to catastrophic accidents or natural disasters from numerous groups of public safety personnel. It requires tactical communications under conditions that

allow for little planning for the specific event. Airplane crashes, bombings, forest fires, earthquakes, and hurricanes are all examples of mutual aid events.

**Task force interoperability** involves local, state, and federal agencies coming together for an extended period of time to address a public safety problem. Task forces lead the extended recovery operations for major disasters, provide security for major events, and conduct operations in response to prolonged criminal activity.

## Key Findings

(continued from page 2)

- **Regardless of system characteristics, local fire and EMS agencies are experiencing similar problems with their LMR systems. These problems include system coverage (dead spots), interference, and outdated equipment. Agencies also indicate they have an insufficient amount of equipment and not enough channels to meet current mission requirements.**
- **Overall, local fire and EMS agencies are unfamiliar with current initiatives relating to wireless communications and interoperability. Agencies have almost no knowledge of standards development initiatives, availability of the 700 MHz band, or the NPSPEC channels and guidelines. They are only slightly more aware of FCC licensing and refarming issues.**
- **A majority of local fire and EMS agencies are optimistic about their ability to handle interoperability in the future. Agencies that view funding and planning as severe obstacles to interoperability are less confident in their future abilities to interoperate.**
- **State fire marshals and state EMS agencies do not have critical interoperability requirements, as their missions typically do not require frequent communications across jurisdictions.**
- **State forestry agencies have substantial interoperability requirements with all levels of government.**
- **Similarly to local fire and EMS agencies, a majority of state forestry agencies rate limitations in funding and the use of different frequency bands as severe obstacles to interoperability.**

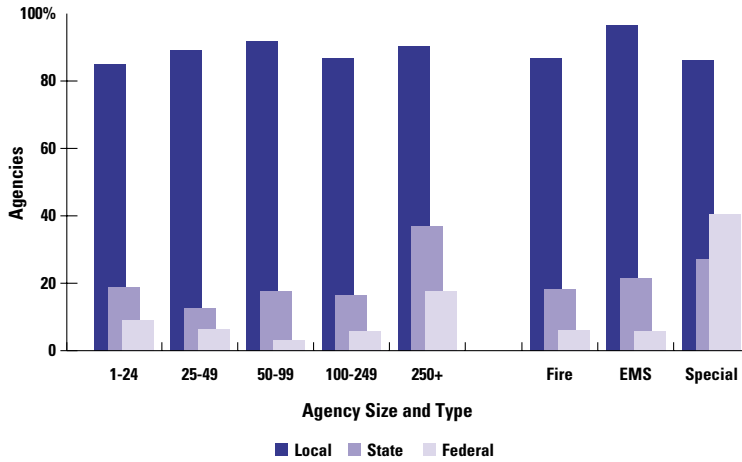


**“As time goes on, more incidents than ever demand interoperability.**

**Right now, all of my major incidents require contact with state patrol, county deputies, and local fire districts.”**

**EXHIBIT 1**

**Percentage of Agencies Experiencing Daily or Weekly Interoperability Events with Local, State, and Federal Organizations**



basis. Interaction with state organizations is less common, with 19 percent of fire and EMS agencies interoperating on a daily or weekly basis with state agencies. Interoperability with federal agencies is also required but far less common. Seventy-two percent of agencies indicate they never interoperate with federal agencies. (See Exhibit 1.) Larger agencies report more frequent interoperable communications with other public safety organizations than smaller agencies. In addition, fire and EMS agencies that operate at airports and harbors are the most likely to interoperate on a daily or weekly basis with state or federal organizations (27 percent with state organizations and 41 percent with federal organizations).

**Types of Interoperability.** A majority of local fire and EMS agencies (74 percent) require day-to-day interoperability with neighboring local public safety agencies. Day-to-day interoperability with state and federal public safety entities is much less common (21 percent and 17 percent, respectively). When local agencies require interoperability with state agencies, it is usually as part of a mutual aid response. Task force interoperability, while infrequent, occurs most often between local and federal public safety entities.

**Lack of Interoperability.** Forty-three percent of local fire and EMS agencies indicate that a lack of interoperability has affected their ability to communicate with agencies in surrounding jurisdictions. The problem is more common in larger agencies. In addition, 30 percent of fire and EMS agencies relate that the lack of wireless communications interoperability has, at some time in the past, hampered their ability to respond. Of all agency types, EMS departments are the most adversely affected by a lack of interoperability, with 53 percent indicating that it has limited their response capabilities.

**Interoperability Experiences and Requirements**

To understand the impact of interoperability issues on fire and EMS operations, agencies were asked to respond to a series of questions regarding their experiences with interoperability. Overall, agencies are confident in their current ability to handle situations that call for interoperable communications. As expected, agencies are most confident in their ability to interoperate with those jurisdictions with which they have more frequent contact. An agency’s ability to interoperate can depend on factors that go beyond the technical capabilities of the communications system. Several factors, such as whether agencies use plain English or a code system to communicate and whether agencies feel that they are properly trained for interoperable communications, influence the degree of confidence agencies have.

**Ability to Establish Radio Links.** Local fire and EMS agencies are more confident in their ability to use their radio systems to establish radio links with local public safety organizations (76 percent) than with state or federal agencies.<sup>7</sup> Forty-three percent of fire and EMS agencies express strong confidence in the ability of their system to link with state organizations, and 13 percent

**“Lack of interagency communications between fire and EMS was creating lapses in consistent information flow to and between responding units. In many cases, this information had a direct impact on the patient care provided.”**

express the same confidence in regard to federal organizations. Agency responses indicate that the more often an agency inter-operates with other agencies, the more confident it is in its ability to establish links with those agencies. Confidence levels are higher for agencies using newer radio systems and advanced technologies.

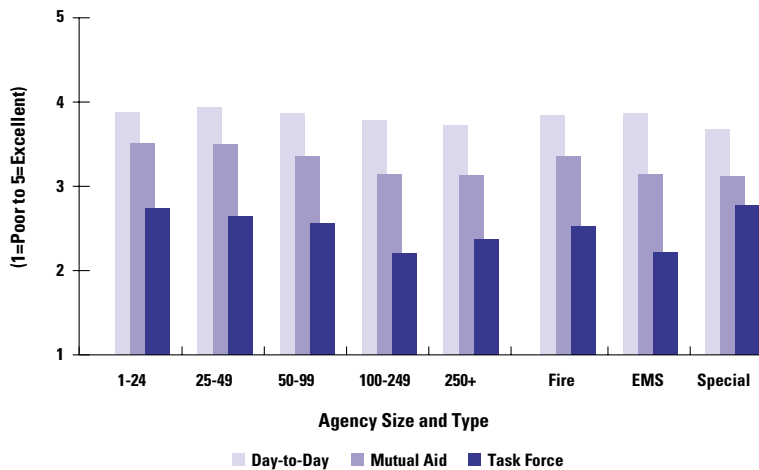
**Ability to Handle Interoperability**

**Situations.** Eighty-one percent of local fire and EMS agencies are confident in their current ability to handle situations requiring interoperability, but their confidence levels vary with the type of situation: day-to-day, mutual aid, and task force. Of these types, agencies are most confident in handling day-to-day interoperability situations (76 percent). Fire and EMS agencies express moderate confidence about handling mutual aid situations (63 percent) and are least confident about task force operations (35 percent). (See Exhibit 2.) Smaller agencies express more confidence in their ability to handle interoperability situations than larger agencies even though they perform such operations less frequently.

**Improvements to Interoperability.** Factors that may improve an agency’s confidence in dealing with interoperability situations include; the radio languages used to communicate, the existence of intergovernmental agreements, and the use of joint training. Agencies that use plain English (82 percent), rather than a code system (15 percent), to communicate with other organizations express more confidence in their ability to handle day-to-day interoperability. Additionally, agencies with intergovernmental agreements (88 percent) with neighboring jurisdictions for mutually defined calls for service are more confident in their overall ability to handle interoperable communications than agencies without such agreements. A majority of fire and EMS agencies (79 percent) participate in joint training exercises with other organizations. These joint training exercises most often involve local level organizations

**EXHIBIT 2**

**Rating of Agency Ability Compared to System Ability to Handle Different Types of Interoperability Situations**



(76 percent), and occasionally include state (30 percent) and federal (14 percent) agencies. Seventy-six percent of the responding agencies believe their training has at least moderately prepared them to handle communications interoperability situations. These same agencies express more confidence in their ability to do so than agencies that do not participate in joint training exercises.

**Interoperability Obstacles**

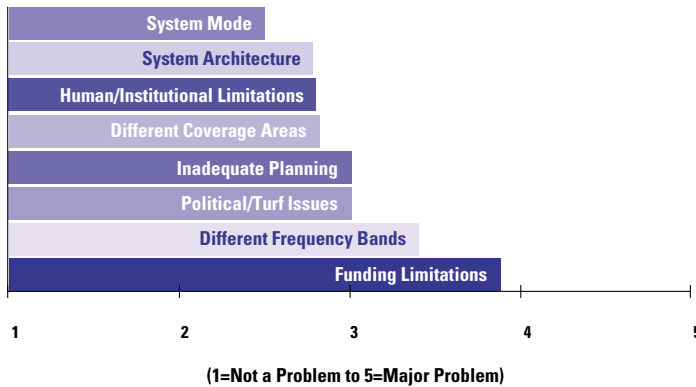
Regardless of their confidence levels, local fire and EMS agencies experience similar obstacles that impede effective interoperable communications. The survey information reinforces the prevailing wisdom about obstacles to interoperability, as identified through other initiatives such as the Public Safety Wireless Advisory Committee (PSWAC).<sup>8</sup> The survey results also served to quantify the occurrences of these obstacles in fire and EMS communications. Among the wide variety of difficulties, local fire and EMS agencies indicate the most severe obstacles arise from funding limitations, the necessity of operating in different frequency bands, political or turf issues, and inadequate planning. (See Exhibit 3.)



**“Cost! The majority of public safety agencies have limited resources for communications equipment.”**

**EXHIBIT 3**

**Obstacles to Interoperability**



**Funding Limitations.** Two-thirds (68 percent) of local fire and EMS agencies rate funding limitations as the most severe obstacle to interoperability. Results are consistent across all size groupings, but funding limitations are less of a concern for airport and harbor fire and EMS agencies than for fire departments and EMS departments. Agencies that experience funding limitations report more difficulties with their radio communications. These agencies are also less confident in their ability to handle all three types of interoperability.

**Operations in Different Frequency Bands.** More than half (51 percent) of local fire and EMS agencies rate the use of different frequency bands as a severe obstacle to interoperability. An additional 21 percent rate it as a moderate problem. This obstacle is more problematic for large agencies (66 percent) than small agencies (37 percent). The problems encountered by agencies due to the use of different bands vary by frequency band. Several agencies (38 percent) operate in more than one frequency band, but the majority (72 percent) use at least one channel in high-band VHF. Agencies using this band report the use of different operating bands as less of an obstacle to interoperability than agencies operating in other bands.

**Political or Turf Issues.** Thirty-nine percent of local fire and EMS agencies rate political or turf issues as a severe obstacle. An additional 23 percent rate it as a moderate problem. Political or turf issues are more problematic for EMS departments (46 percent) than for fire departments (39 percent) and for airport and harbor fire and EMS agencies (33 percent). Career fire departments are more likely to view these issues as a problem than volunteer fire departments. Larger agencies report more severe problems with political or turf issues than smaller agencies. Unfortunately, efforts to establish working relations with neighboring jurisdictions, such as joint training exercises and shared communications agreements, do little to mitigate the severity of political or turf issues as an obstacle to interoperability.

**Inadequate Planning.** Thirty-six percent of local fire and EMS agencies rate inadequate planning as a severe obstacle to interoperability. An additional 30 percent rate it as a moderate problem. Agencies that rate this factor as a severe obstacle have less confidence in their ability to effectively handle interoperability situations. These agencies also have less confidence in their ability to establish radio communications links with local, state, and federal organizations. However, survey results indicate that agencies participating in joint training exercises with other agencies are less likely to experience problems with inadequate planning.

**Additional Obstacles.** There are other less serious obstacles to interoperability. Twenty-nine percent of agencies rate problems associated with different coverage areas as a severe problem, while forty percent indicate it is not a problem. Human and institutional limitations, defined as limitations or constraints in human memory, agency concerns over maintaining communications links with their own personnel, or agency reluctance to allow personnel to join other systems, were also viewed as a less serious impediment. Twenty-four percent of

**“Different departments are on different frequencies, making communications difficult to impossible.”**

agencies rate human and institutional limitations as a severe problem and 37 percent indicate it is not a problem.

Often times, interoperability is hampered due to technological differences in radio communications systems. However, local fire and EMS agencies indicate that the technical diversity of their systems minimally affects their ability to achieve interoperability. Almost half of agencies do not view the use of different system architectures (conventional or trunked) or the use of different communications modes (analog or digital) as obstacles to interoperability (45 percent and 42 percent, respectively).

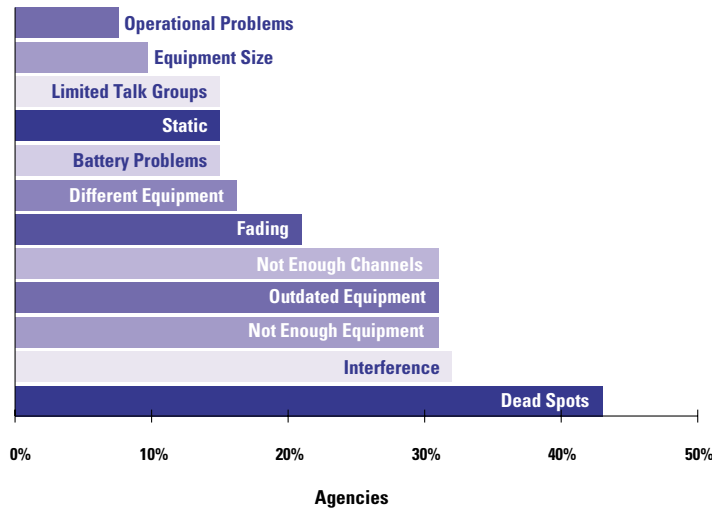
**Mandates for Interoperability.** There is a slight preference (52 percent) among responding agencies for date-certain state or federal mandates to ensure interoperability. However, 21 percent of agencies did not answer the question, so no clear conclusions may be drawn. Agency support for mandates does increase with agency size. Also, a clear majority of EMS departments favor date-certain mandates, but fire departments are evenly split on the issue. Support for mandates is lowest (45 percent) among volunteer fire departments. Written responses hint at the concerns regarding date-certain mandates. The general content of the written responses focused on the need for funding if such a mandate were applied.

**Wireless Communications Environment**

To best address interoperability issues, an understanding of the current wireless communications environment and the future direction of this environment is needed. To assess the direction of fire and EMS wireless communications, fire and EMS agencies were asked to identify the problems they experience with their land mobile radio (LMR) system and their current and planned use of specific wireless technologies. In addition, as funding is key to developing future LMR systems, agencies were asked to indicate funding sources.

**EXHIBIT 4**

**Problems with Existing Land Mobile Radio Systems**



Agencies currently experience numerous problems with their LMR systems. (See Exhibit 4.) These range from technical issues, such as dead spots and interference, to operational issues such as a limited number of available channels. Fire and EMS agencies currently operate older, more basic technology. The plans of agencies that will upgrade their LMR systems in the next 10 years reveal that the future wireless communications environment will

**State EMS Agencies**

State EMS agencies provide administrative and regulatory oversight of local EMS agencies and pre-hospital health care providers located within their state boundaries. Most state EMS agencies develop and enforce licensing requirements for ambulances; develop certification requirements for EMS care providers, such as paramedics and emergency medical technicians (EMTs); coordinate the distribution of grant funds; and serve as a training resource for local EMS operations.

State EMS agencies do not have a direct role in public safety emergency response and thus have a limited need for interoperability. Most state EMS agencies use an LMR system regularly to communicate within their agency as well as with local jurisdictions. However, a majority of the radio traffic concerns administrative matters. These radio systems are generally quite old and rely on conventional analog technology. While results from responding state EMS agencies indicate they do not have an explicit need for radio interoperability, they do feel strongly about the importance of interoperability for the local providers with whom they work.



**“In the past, egos and agency attitudes have inhibited the best use of public safety personnel to respond to everything from small to large incidents. We need to be responsible to the public.”**

### **State Fire Marshals**

State fire marshal agencies provide a variety of fire and public safety services in their respective states. These services can vary greatly by state, depending on prevailing state policies, local fire marshal capabilities, and organizational affiliations. Most state fire marshals responsibilities are administrative or regulatory in nature. Many localities rely heavily on state fire marshals for assistance with fire investigations. However, state fire marshals do not generally respond to fires unless requested by a public safety agency. Even though they do not have a direct role in public safety emergency response, most state fire marshals use an LMR system for routine communications within their agency and with local jurisdictions, as necessary. These radio systems, unlike those of state EMS agencies, are generally newer and include diverse technologies. State fire marshals tend to interoperate with local fire departments via radio, but well after fires have been extinguished. Additionally, state fire marshals indicate they frequently need to interoperate with local law enforcement agencies during the course of their investigations.

### **State Forestry Agencies**

State forestry agencies have wide-ranging responsibilities for promoting and protecting the natural resources located within their individual state boundaries. Most state forestry agencies provide nature conservation planning and training as well as a host of natural resource management services. Additionally, state forestry agencies are responsible for preventing and suppressing wildfires in forests throughout their states. Significant portions of the responding state forestry agencies’ resources are dedicated to addressing these fire-related responsibilities. As state forestry agencies often partner with both federal and local agencies to perform their public safety missions, they have extensive statewide radio communications infrastructure.

Although the information gathered from state forestry agencies is not as comprehensive as the information collected from local fire and EMS agencies, it does provide a glimpse into the interoperability experiences and needs of this segment of state agencies.

Highlights include:

- Forty-five percent of state forestry agencies report that their ability to interoperate is very good.
- State foresters interoperate daily or weekly with all levels of public safety.
- State foresters are most confident in their ability to interoperate with other state agencies.
- Limitations in funding (79 percent) and the use of different frequency bands (75 percent) are the two biggest obstacles to interoperability for state foresters.
- Eighty-five percent of state forestry agencies are against establishing “date-certain” mandates to ensure interoperability.
- Eighty-three percent of state forestry agencies use LMR systems that are 10 years or older.
- Responding agencies primarily use conventional analog systems; however, the majority of planned replacements or upgrades will be to digital trunked systems.
- While state forestry agencies use multiple bands for interoperability, all have at least one interoperability channel in high-band VHF.
- State foresters are more familiar with public safety communications initiatives than their local counterparts.

be significantly different. Agencies will be operating newer, state-of-the-art technology. In addition, agencies will be utilizing more commercial services to complement their LMR systems.

**Existing LMR Systems.** Local fire and EMS agencies share a variety of common concerns regarding their LMR systems. Dead spots in signal coverage are by far the most prevalent issue.<sup>9</sup> In fact, 44 percent of agencies indicate that dead spots are a serious problem. Agencies whose jurisdictions are heavily forested or encompass mountainous terrain are more likely to experience difficulties with dead spots than agencies with relatively flat terrain.

Interference is rated a serious problem by 33 percent of the agencies.<sup>10</sup> This issue is more prevalent for fire and EMS agencies operating analog technology (36 percent) than for agencies using digital technology (20 percent). In addition, agencies operating in the 800 MHz band experience fewer difficulties with interference than agencies operating in the other public safety frequency bands.

Equipment issues (outdated and/or not enough equipment) are also serious for 32 percent of agencies, and are more of a concern for smaller agencies than for larger agencies. In addition, fire departments that rely on volunteer personnel indicate that equipment is more of an issue than fire departments that rely on career personnel (51 percent and 30 percent, respectively).

Nearly one-third of agencies rate not enough channels as a serious problem with their LMR system. Agencies using trunked systems are much less likely to experience channel congestion than those using conventional systems. Overall, fire and EMS agencies currently use an average of 12 channels; this includes channels used in all frequency bands for both voice and data applications.<sup>11</sup> Agencies with insufficient channel capacity estimate more than a 40 percent increase in channels (5) is needed to meet their current mission requirements. Larger agencies estimate a need for more channels.



**“Many frequencies and different bands exist in this area. This, combined with lack of coverage and overcrowded frequencies, continually hampers multi-agency response.”**

**Replacement of Outdated LMR Systems.**

The average age of fire and EMS LMR systems is 9.8 years, almost at the end of the typical 8- to 10-year service life of LMR systems. About one-third (30 percent) of agencies operate systems that have exceeded their typical service life. Consequently, it is no surprise that more than half (57 percent) of the fire and EMS agencies plan to replace or substantially upgrade their LMR systems within the next 10 years. For these agencies, the average age of their LMR systems is 11.5 years, almost 2 years past the system’s expected service life. Larger agencies tend to operate older systems as compared to smaller agencies, and thus are more likely to be planning a replacement or upgrade to their systems in the near future.

Most fire and EMS agencies (87 percent) plan to rely on a single funding source to fund the purchase of their next LMR system. General fund budget appropriations are the most common funding source (24 percent), followed by capital improvement funds (21 percent). Volunteer fire departments tend to not rely on these traditional mechanisms, but instead on other funding sources (e.g., grants, bake sales, raffles, donations). Despite funding being instrumental to the development of LMR systems, nearly half of the fire and EMS agencies express uncertainty regarding future funding sources or do not yet have plans for how they will fund their next LMR system. Regardless of limitations in funding, agencies report that they continue to pursue plans to upgrade their LMR systems within the next 10 years.

**Evolving LMR Technologies.** Agencies’ plans for their next LMR systems reflect an environment that will be greatly different. Currently, fire and EMS agencies primarily operate analog (79 percent), conventional (75 percent) LMR systems on high-band VHF frequencies (72 percent). Only a quarter (24 percent) of the agencies participate in a shared communications arrangement with agencies in other

EXHIBIT 5

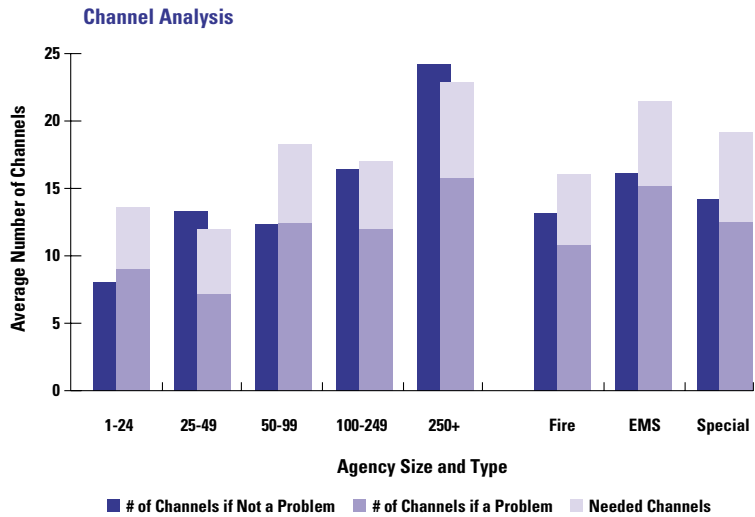
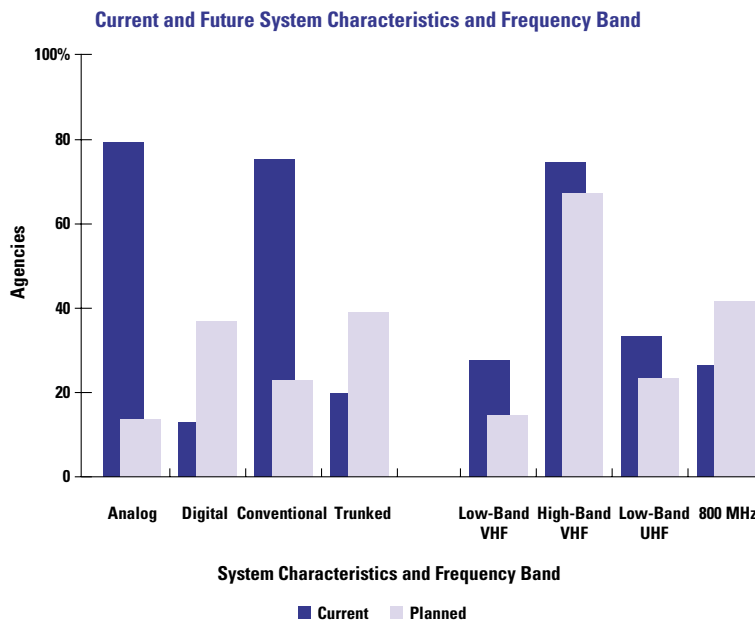


EXHIBIT 6



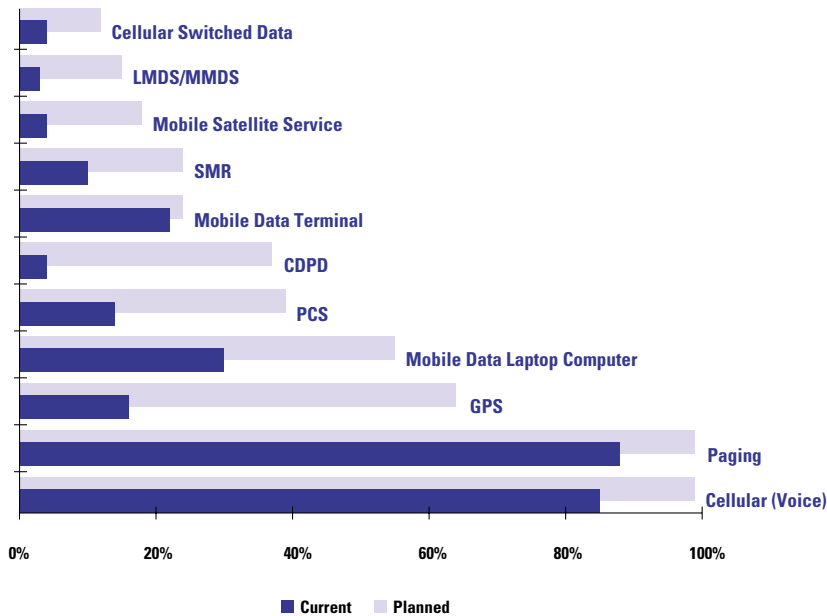
jurisdictions. Although more than one-third of agencies are undecided about the characteristics of their planned systems, a few trends are apparent regarding the future wireless environment. (See Exhibit 6.)



**“Not all agencies have the resources to keep up with the latest technology.”**

**EXHIBIT 7**

**Current and Planned Use of Wireless Data Communications**



The most prominent trend is the move towards digital technology, which will substantially replace analog technology. It is projected that the overall use of digital technology will increase from the current 14 percent to 37 percent. Second, the use of trunked systems will nearly double.<sup>12</sup> It is projected that the overall use of trunked architectures will increase from the current 20 percent to 39 percent. Larger agencies are more likely to use digital technology and trunked systems than smaller agencies.

**Radio Frequency Preferences.** Local fire and EMS agencies planning to replace or substantially upgrade their LMR systems indicate that use of 800 MHz frequencies will increase. Almost half of fire and EMS agencies planning to replace their LMR systems expect to operate in the 800 MHz band (43 percent). Agency use of the 800 MHz band will increase to 43 percent from the current 26 percent of agencies operating in 800 MHz.

**Additional Technology Use.**<sup>13</sup> Over the next 2 years, there will be a dramatic increase in the use of wireless data communications and additional wireless services to supplement LMR communications. By the end of 1999, the use of mobile data laptop computers (MDC) will have nearly doubled (from 30 percent to 55 percent). (See Exhibit 7.) Planned use of mobile data terminals (MDT) will also increase, but only slightly (from 22 percent to 24 percent). MDC and MDT usage will need to support a dramatic increase in the use of all types of wireless data communications. Planned increases in the types of wireless data communications range from an 84-percent increase for free text wireless data communications to more than a 400-percent increase in wireless data communications for still images, such as photos or maps. Over the next 5 years, agencies will also increase their use of wireless services and technologies. Already widely used, cellular voice and paging services will become almost universal (99 percent). The use of GPS services is expected to quadruple (from 16 percent to 64 percent); the use of PCS will almost triple (from 14 percent to 39 percent); and the use of CDPD will increase (from 4 percent to 37 percent). The planned use of other wireless communications services (LMDS, MSS, and cellular switched data) will slightly increase.

**Interoperability Knowledge**

Knowledge of current initiatives regarding public safety communications can heighten the ability of fire and EMS agencies to handle interoperability situations or overcome interoperability shortfalls. To assess their awareness of current interoperability initiatives, agencies were asked to rate their familiarity with FCC processes and procedures, as well as standards development initiatives. Overall, local fire and EMS agencies are unfamiliar with current initiatives related to wireless communications and interoperability. Nevertheless, agencies indicate that interoperability issues will be

**“The County Fire Department is about to install a new 800 MHz system. My concern is for mutual aid communications; our equipment will be incompatible.”**

extremely important as they purchase their next LMR system. In fact, many agencies are likely to adopt an interoperability standard for their next system.

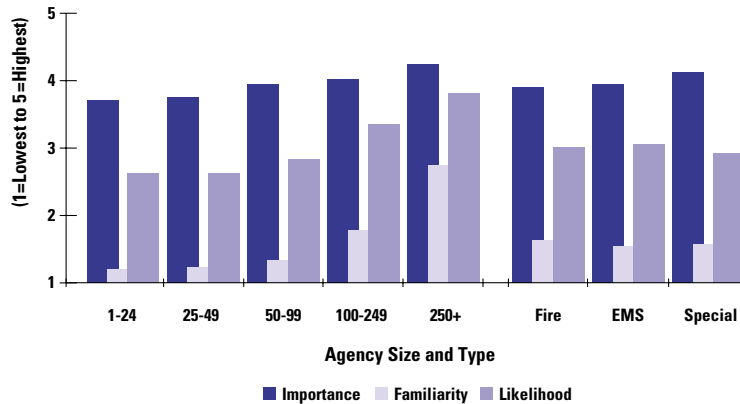
**Familiarity with Initiatives.** Local fire and EMS agencies have limited knowledge of all listed initiatives related to wireless communications and interoperability. Agencies were most familiar with radio spectrum issues, such as FCC frequency application processes and spectrum refarming.<sup>14,15</sup> Agencies have almost no knowledge of standards development initiatives such as TIA/EIA-102 specifications or proposed standards put forward under Project 25.<sup>16</sup> Agencies are neither familiar with the spectrum recently allocated to public safety services in the 746-806 MHz band nor the NPSPEC channels and guidelines.<sup>17,18</sup>

**Adoption of Project 25-based Standards.** Nearly one-third (30 percent) of agencies will likely adopt Project 25-based interoperability standards for their next LMR system. An additional 42 percent expressed some likelihood of adopting Project 25-based standards. Larger agencies are more likely to adopt Project 25-based standards than smaller agencies. (See Exhibit 8.) Surprisingly, agencies are planning to implement standards-based systems regardless of their familiarity with the particular standard. In fact, 36 percent of the agencies planning to replace their LMR system within the next 10 years are likely to adopt Project 25-based standards. However, of these same agencies, the vast majority (76 percent) indicate that they are unfamiliar with these standards.

**Preferred Information Sources.** Agencies depend on various information sources to become knowledgeable about current technology. The most commonly used sources of information are equipment manufacturers and other government agencies. Smaller agencies are most likely to use colleges and universities for information. Regardless, fire and EMS agencies will need to expand

**EXHIBIT 8**

**Comparison of Importance Ratings of Interoperability Standards, Likelihood of Adopting Project 25-based Standards, and Agency Familiarity with Project 25-based Standards**



their information sources to become more familiar with initiatives affecting wireless communications and interoperability.

**Future Interoperability.** Although the methods for improving interoperability are unclear, agencies are optimistic about their future ability to handle situations that require interoperability. Sixty-five percent of agencies express high confidence in their future ability (5 years into the future) compared with 48 percent today. The positive outlook on their future ability reflects an overall sense of willingness on the part of the fire and EMS community to overcome the existing impediments to interoperability.

## CONCLUSION

Communications interoperability is a critical factor in the ability of fire and EMS agencies to provide a coordinated response. Fire and EMS agencies must be able to effectively communicate with other public safety agencies to provide immediate and coordinated assistance. However, such coordinated responses are often prevented due to numerous communications challenges. This study was initiated to better understand the challenges facing fire and EMS entities within the public safety community.

The results of this study are intended to provide reliable data that can be used by local, state, and federal government officials to illustrate the existing interoperability environment of the fire and EMS community. Findings are based on a broad portrait of nationwide experiences and trends, and should be useful for decision makers as they address the communications interoperability challenges faced by the public safety community. These findings indicate that fire and EMS agencies require extensive interoperable communications to accomplish their missions. However, most fire and EMS agencies are experiencing serious problems with interoperability. Policy implications that arise from these findings include:

- Fire and EMS agencies are not confident in their ability to achieve interoperability with other public safety agencies unless they interact with them on a daily basis. There is a need for improved coordination among all levels of government to achieve interoperability.
- Fire and EMS agencies lack the funding needed to upgrade or replace their wireless communications systems. There is a critical need for funding to advance the development of systems and improve interoperability among public safety agencies.

- Fire and EMS agencies face a variety of issues related to spectrum. There are serious interoperability problems that arise from the fragmentation of public safety spectrum. There is a need for additional spectrum. There is also a need for improved planning and management of interoperability spectrum.
- Fire and EMS agencies are generally supportive of standards and plan to adopt them in their next systems. However, the agencies have limited knowledge of current standards initiatives. There is a need to better educate and involve the fire and EMS community in the standards development process and other interoperability initiatives.

Some fire and EMS agencies have found ways to achieve interoperable communications despite limitations in technology and organizations. However, as the wireless communications environment moves towards more advanced technologies, it is not clear whether the proliferation of newer technologies will enhance interoperability or magnify existing obstacles.

As this study indicates, a number of issues require sufficient resolution by the public safety community and the broader set of public safety communications stakeholders, such as industry and regulatory agencies. With sufficient resolution of these issues, interoperability is achievable throughout the Nation.

The PSWN program recognizes that improving communications interoperability is a multi-dimensional challenge, and is working to address and help resolve each of these policy issues. Hopefully, public safety and government officials will rely on the findings of this study to justify, plan for, and foster improved fire and EMS communications interoperability throughout their jurisdictions.

## NOTES

<sup>1</sup> The PSWN program, a jointly sponsored endeavor between the Department of Justice and the Department of the Treasury, was created in 1996 through Vice-President Gore's National Partnership for Reinventing Government. The program is responsible for encouraging interoperability among wireless networks so that local, state, and federal public safety requirements can be addressed.

<sup>2</sup> Public Safety Wireless Advisory Committee (PSWAC) Final Report, September 1996 and Wireless Communications and Interoperability Among State and Local Law Enforcement Agencies, National Institute of Justice, January 1998.

<sup>3</sup> All data in this study are based on the respondent sample. As such, the results of the study should not be used to make inferences about individual agency experiences or to generalize to the fire and EMS community as a whole.

<sup>4</sup> FCC Proceeding, "In the Matter of Reallocation of Television Channels 60-69, the 746-806 MHz Band," Report and Order, ET Docket No. 97-157, released January 6, 1998.

<sup>5</sup> PSWAC Final Report, September 1996.

<sup>6</sup> Land Mobile Radio Replacement Cost Study, PSWN Program, June 1998.

<sup>7</sup> It should be noted that the method for establishing the radio link was not specified on the survey. The method of establishing a link can vary from simply swapping hand-held radios to creating temporary system patches through a dispatch center. Reliability, quality, and security will vary in accord with the method used.

<sup>8</sup> Through its deliberations, the PSWAC defined the typical obstacles to interoperability as the diversity of spectrum resources, lack of available channels, human and/or institutional factors, lack of a common communications mode, different coverage areas, limitations of current commercial services, and lack of a common national plan.

<sup>9</sup> Dead spots are areas that are within the expected range of a radio signal, but in which the signal is not detectable and therefore cannot be received.

<sup>10</sup> Interference is extraneous energy, from natural or man-made sources, that impedes the reception of signals.

<sup>11</sup> It is important to note, however, that a majority of agencies participate in some type of shared communications arrangement. Thus, agencies may have included the total number of channels used in the shared system as opposed to only the channels available to their specific agency.

<sup>12</sup> Trunking technology allows for more efficient use of spectrum by automatically routing users to an open channel.

<sup>13</sup> Only agencies with 100 or more personnel were surveyed for mobile computing and wireless data communications usage and communications services usage.

<sup>14</sup> State and local agencies seeking to use LMR frequencies must obtain a frequency license or a temporary frequency authorization granted by the FCC. For more information on the FCC frequency application process, visit the PSWN program web site at <http://www.pswn.gov>. The PSWN program developed a "how-to-guide," entitled State and Local Spectrum Management Processes Report, to help state and local entities with public safety missions obtain frequencies.

<sup>15</sup> Refarming is an FCC effort to develop an overall strategy for using spectrum in the private LMR allocations more efficiently to meet future communications requirements. For more information on refarming, visit the FCC web site at <http://www.fcc.gov>.

<sup>16</sup> The Telecommunications Industry Association (TIA) issues technology standards related to telecommunications. The E102 specifications are a series of TIA specifications based on Project 25 Standards for the next generation of public safety radios. Project 25 is a joint government/industry standards-setting effort to develop technical standards for the next generation of public safety radios, both voice and data. For more information on these standards initiatives, visit the TIA web site at <http://www.tiaonline.org>.

<sup>17</sup> Public safety services were reallocated 24 MHz of spectrum in the 700 MHz band on January 6, 1998. This spectrum was the largest amount of spectrum designated to public safety at one time.

<sup>18</sup> The National Public Safety Planning Advisory Committee (NPSPAC) was established by the FCC to ensure public safety involvement in the National Public Safety Plan governing the 821-824 and 866-869 MHz band. For more information on the NPSPAC process, please review the PSWN program's 800 MHz Study. This report assesses the relative merits of 800 MHz as an operating frequency band for public safety wireless communications, and includes a detailed analysis of the planning and management processes for 800 MHz.

## GLOSSARY

**Analog Modulation Technique:** A communications mode through which an analog representation of the information to be transmitted is impressed upon a carrier signal for transmission.

**Cellular Digital Packet Data (CDPD):** A wireless communications data service that divides information into data packets which are then transmitted over a cellular network.

**Channel:** A pair of frequencies mated together to provide, at a minimum, half duplex wireless communications.

**Conventional Radio System:** An LMR system architecture similar to a telephone party-line in that the user determines availability by listening for an open channel before transmitting.

**Digital Modulation Technique:** A communications mode that places a digital data sequence on a carrier signal for transmission.

**Global Positioning System (GPS):** A satellite-based navigation service that allows users to locate their position and in some cases, their velocity anywhere on the Earth.

**Land Mobile Radio (LMR):** A radio system that allows for wireless communications between base stations and land mobile stations (mobile, portable, or hand-held radios), or between land mobile stations.

**Local Multi-point Distribution Service (LMDS):** A fixed, point-to-multipoint, emerging technology that offers subscribers a variety of one- and two-way broadband services such as video conferencing, voice services, Local Area Network (LAN)/Wide Area Network services (WAN), telemedicine, remote access to LANs, video-on-demand, real-time multimedia file transfer, and wireless local loop-based services.

**Multi-point Multi-channel Distribution Service (MMDS):** Also known as wireless cable, a fixed, point-to-multipoint, subscription-based broadband television and data service that closely resembles traditional hard-wired cable television service. Operators use over-the-air microwave frequencies rather than coaxial or fiber optic cable to transfer video and high-speed data to customers.

**Mobile Data Terminal (MDT):** A wireless computer terminal installed in a vehicle that allows the user to receive and transmit information.

**Mobile Satellite Service (MSS):** MSS is the term used to describe telecommunication services delivered via satellite to or from mobile users. MSS extends mobile communications beyond the range constraints of terrestrial-based wireless systems and allows mobile-to-fixed and mobile-to-mobile voice and data communications worldwide.

**Personal Communications Services (PCS):** A digital wireless communications service that provides enhanced features such as voice mail, call waiting, call forwarding, paging, and data transmission.

**Rating Interpretations:** Survey questions requested agencies to rate the extent of a problem or confidence levels using a rating scale of 1 to 5. Interpretations of these ratings are as follows:

|               |                     |
|---------------|---------------------|
| <i>Rating</i> |                     |
| 1 or 2        | Minor or infrequent |
| 3             | Moderate            |
| 4 or 5        | Serious or high     |

**Specialized Mobile Radio (SMR):** A commercially operated radio system that provides land mobile communications services in the 800 MHz and the 900 MHz frequency bands.

**Spectrum:** Spectrum refers to the frequencies available for wireless communications transmissions. Specific radio frequencies that have been allocated to the public safety community include:

|               |             |
|---------------|-------------|
| Low-band VHF  | 25-50 MHz   |
| High-band VHF | 150-174 MHz |
| UHF           | 406-512 MHz |
| 700 MHz       | 746-806 MHz |
| 800 MHz       | 806-869 MHz |

**Trunked Radio System:** An LMR system architecture that automatically and dynamically assigns an available channel to users. The term trunking connotes sharing of a number of channels by a group of users.

## About the Public Safety Wireless Network Program

**T**he Public Safety Wireless Network (PSWN) Program, a jointly sponsored endeavor between the Department of Justice and the Department of the Treasury, was created in 1996 through Vice President Al Gore's National Partnership for Reinventing Government. The program is responsible for encouraging interoperability among wireless networks so that local, state, and federal public safety requirements can be addressed. The program strives to achieve the vision it shares with the public safety community — seamless, coordinated, and integrated public safety communications for the safe, effective, and efficient protection of life and property. Specifically, the program attempts to:

- Improve the coordination of public safety wireless communications
- Foster actions to support adequate radio frequency spectrum availability for use by public safety agencies
- Support the development of technical standards for public safety wireless communications systems
- Promote the inclusion of security measures in public safety wireless communications systems
- Identify alternative funding mechanisms for local, state, and federal public safety agencies to improve their wireless communications systems.

During its initial three years, the PSWN program has promoted partnerships among public safety agencies and has pursued case studies and pilot projects, analytical studies, and outreach efforts. Examples of these activities include:

- Hosting regional shared systems symposiums that bring together local, state, and federal public safety agencies to share information on wide-ranging issues such as regional planning, site acquisition, funding, and systems planning

- Providing input to FCC filings to better position public safety agencies to participate in shared systems and improve communications between local, state, and federal public safety agencies
- Developing “how to” guides on local, state, and federal spectrum management processes to assist radio managers in navigating frequency assignment procedures
- Conducting regional needs analyses that characterize mission requirements, determine a baseline of current radio systems infrastructure, and identify opportunities to improve system efficiency
- Evaluating and profiling commercial services to project how these services are likely to be deployed by public safety agencies and the implications for public safety operations
- Partnering with state and local agencies to establish pilot implementations of interoperable radio architectures in multiple regions of the country
- Participating in the test and demonstration of wireless data communications such as the National Crime Information Center (NCIC) 2000 wireless testbed
- Investigating security issues to understand and address the vulnerabilities and risks associated with evolving land mobile radio systems
- Profiling current funding mechanisms and suggesting alternative strategies to receive the requisite funding to replace or upgrade public safety communications systems
- Participating in a federal interagency group that developed a recommendation for a planning and demonstration grant program for statewide public safety radio systems development efforts.

Further information regarding PSWN program products and services can be found at <http://www.pswn.gov>.

AMBULANCE

