

PSWN Program Analysis of Fire and EMS Communications Interoperability

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This effort was coordinated through the use of an Integrated Program Team (IPT). An IPT coordinates partnerships between the PSWN Program and its stakeholders to achieve program objectives. An IPT is comprised of diverse officials who have expertise relating to specific program issue areas.

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EXECUTIVE SUMMARY

Public safety agencies rely on effective radio communications to fight fires, provide emergency medical care, rescue accident victims, respond to natural disasters, and investigate criminal activity. Communications interoperability allows different public safety agencies to communicate with each other, on demand and in real time. Without such interoperability between fire departments, emergency medical providers, law enforcement, and other public service organizations, both life and property are placed at risk.

This study, conducted by the Public Safety Wireless Network (PSWN) program, focuses on communications interoperability issues in the fire and emergency medical community. The goal of the study is to establish a quantitative baseline of information regarding fire and EMS communications interoperability. This information baseline is collected from a survey of the interoperability challenges facing fire and EMS agencies throughout the country. The survey of fire and EMS agencies is a companion effort to the 1997 National Institute of Justice (NIJ)-sponsored survey of law enforcement interoperability.

The PSWN program mailed surveys to a stratified random sample of local and state fire and EMS agencies nationwide. A total of 1,045 agencies returned the survey, an overall response rate of 31 percent. Responding agencies were categorized as follows:

- Agency Type
 - Local fire departments
 - Local EMS agencies
 - Airport and harbor fire/EMS departments (“special” agencies)
 - State forestry agencies
 - State EMS agencies
 - State fire marshals
- Agency Size
 - Fewer than 25 uniformed personnel
 - 25-49 uniformed personnel
 - 50-99 uniformed personnel
 - 100-249 uniformed personnel
 - More than 250 uniformed personnel
- Professional Status
 - Career departments
 - Volunteer departments
 - Combined departments

Findings are organized into four categories: current wireless communications environment, interoperability experiences and requirements, interoperability shortfalls, and interoperability knowledge and training. State agencies are analyzed separately to profile their unique mission-based communications needs and state-wide responsibilities. The findings are broadly representative of agencies nationwide.

Current Wireless Communications Environment

Fire and EMS agencies primarily operate analog, conventional land mobile radio (LMR) systems on high-band VHF frequencies. A majority of these agencies participate in some form of shared communications, most commonly with other agencies within their jurisdiction. Agencies identified dead spots, interference, insufficient equipment, outdated equipment, and channel congestion as the most serious problems related to the operation of their LMR systems. The agencies using trunked LMR systems reported fewer problems with channel congestion. Agencies also use a variety of technologies (e.g., pagers, cellular phones, mobile data terminals, mobile laptop computers) to augment their LMR systems, and are planning to complement their LMR capabilities in the future with increased use of wireless data communications services, such as cellular data and global positioning.

Existing local LMR systems are, on average, nearly 10 years old, with state agencies having considerably older LMR infrastructures. Many agencies rely on systems that have exceeded the customary 8- to 10-year service life. More than half of all agencies plan to upgrade or replace their system within the next 10 years. The use of digital and trunked systems will nearly double as agencies upgrade their systems, as will the demand for 800 MHz frequencies. The current and projected future use of these modern technologies is more prevalent in larger agencies.

Interoperability Experiences and Requirements

The need for interoperability is extremely common for all local fire and EMS agencies, regardless of size or type. Most agencies interact daily or weekly with other local public safety organizations. In addition to day-to-day interoperability, local agencies need to interoperate occasionally with state and federal organizations for mutual aid or task force operations. State forestry agencies interoperate daily with other public safety agencies at all levels of government. However, state EMS agencies and state fire marshals do not have extensive interoperability requirements since the majority of their communications concern administrative or regulatory matters rather than emergency response.

Most fire and EMS agencies currently operate at least one radio channel dedicated solely for communicating with other agencies. However, a majority of agencies, especially the larger ones, experience difficulties interacting with surrounding jurisdictions. Many agencies indicate that limited interoperability has, at some time, hampered their ability to respond to a call. Agencies are most confident in their ability to interoperate with those jurisdictions with which they have more frequent contact. Very few local agencies are confident in their ability to interoperate with state or federal public safety agencies. These agencies expressed moderate to poor confidence in their ability to interoperate during the less frequent mutual aid or task force situations.

Interoperability Shortfalls

Fire and EMS agencies of all types and sizes face similar challenges to interoperability. Paramount among these is the lack of funding. Agencies with limited funding are more likely to have severe problems with their LMR systems. These include not enough channels; not enough

talk groups; frequency interference; insufficient equipment; and outdated equipment. They are generally less confident in their ability to handle interoperability situations. Operations in different frequency bands is a key problem for the fire and EMS community, particularly for larger agencies. Agencies operating in the less-used low-band VHF and low-band UHF frequencies experience more interoperability problems due to the minimal use of those frequency bands by most fire and EMS agencies.

There is no clear consensus among fire and EMS agencies regarding the extent to which political or turf issues, and the lack of adequate planning, are obstacles to interoperability. Political or turf issues, and a lack of adequate planning, are severe obstacles for one in three agencies, including a majority of EMS agencies. The remaining agencies are evenly split on the severity of these obstacles. Agencies are also divided over the need for date-certain mandates for interoperability that could help to alleviate some of these problems. Different system architectures (conventional versus trunked) and different communications modes (analog versus digital) are not generally viewed as severe obstacles to interoperability. They are more likely to pose problems for that minority of agencies making use of modern technologies.

Interoperability Knowledge and Training

Fire and EMS agencies, including those planning to replace their LMR systems, are unfamiliar with current initiatives related to wireless communications and interoperability. Agencies have almost no knowledge of standards development initiatives and are only slightly more familiar with spectrum issues. Yet agencies indicate that interoperability issues will be extremely important for them as they purchase their next LMR system, and at least one-third indicate they are likely to adopt Project 25 standards for their next LMR system. Agencies rely on equipment manufacturers and other government agencies (e.g., neighboring jurisdictions) as their primary source of information when planning the purchase of wireless communications technology.

Most fire and EMS agencies participate in joint training exercises with other public safety entities that involve the use of communications equipment. Joint training exercises are widely conducted among local agencies, but only occasionally with state and federal agencies. Agencies that participate in joint training activities involving the use of communications equipment are more confident in their ability to handle interoperability situations.

Policy Implications

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. Policy implications that arise from these findings include:

- Fire and EMS agencies require extensive interoperable communications to accomplish their missions. However, the confidence of fire and EMS agencies in their ability to achieve interoperability is limited to coordination with other agencies

with which they interact daily. There is a need for improved coordination among all levels of government to achieve interoperability.

- Most fire and EMS agencies are experiencing serious problems with interoperability. There is a critical need for funding to upgrade and modernize public safety communications systems and to address these interoperability problems.
- 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. Additional spectrum is required as well as improved planning and management of interoperability spectrum.
- Fire and EMS agencies are generally supportive of standards and plan to adopt them in the next system. However, they 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.

These policy implications are consistent with those identified by National Partnership for Reinventing Government (NPRG), which called for the establishment of an intergovernmental wireless communications network. The PSWN program recognizes that improving communications interoperability is a multi-dimensional challenge, and is working to address and resolve each of these issue areas. Ultimately, public safety and government officials will likely use the findings of this study to plan for and foster improved fire and EMS communications interoperability.

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SECTION 1: PROJECT BACKGROUND

Public Safety Communications Interoperability

High-profile incidents such as the Oklahoma City bombing, the crash of TWA Flight 800, and more recently, the Florida wildfires, dramatically illustrate the need for improved communications interoperability among public safety agencies. Communications interoperability allows different agencies to communicate with each other, on demand and in real time. Whether responding to catastrophic accidents and natural disasters, or conducting the more routine operations of emergency medical services and fire suppression, public safety agencies consistently encounter the requirement for multi-agency responses. Such joint responses require effective and interoperable communications to enable public safety agencies to protect lives and property.

The September 1993 National Performance Review (NPR) report, *Reengineering Through Information Technology*, recognized the need for improving public safety communications capabilities, including the need to achieve interoperability across different public safety radio systems. More recently, the 1997 NPR *Access America* report addressed the importance of interoperability and specifically identified five challenges to achieving interoperability – coordination, spectrum, standards, security, and funding. Through the NPR, now known as the National Partnership for Reinventing Government (NPRG), the Public Safety Wireless Network (PSWN) program was established to plan and foster interoperability among local, state, and federal public safety wireless communications networks.

The study that is the subject of this report was conducted by the PSWN program to identify issues that affect the ability of the fire and emergency medical services (EMS) community to achieve communications interoperability. A goal of this effort is to provide enough detailed information to support policy development and decision making regarding interoperability issues of this community. As such, the study explores issues identified by the NPRG and the PSWN program, and attempts to quantify these issues and the extent to which they affect the fire and EMS community. This study is a companion effort to one completed by the National Institute of Justice (NIJ) on law enforcement communications interoperability. Results from the fire and EMS study have been analyzed separately and are addressed in this report, but will be combined with those of the law enforcement study to establish a broader and integrated assessment of public safety communications interoperability issues.

Impact of the PSWAC Report

Many of the definitions for key terms related to interoperability and used for this study were based on the definitions provided in the *Public Safety Wireless Advisory Committee (PSWAC) Final Report*. (See Appendixes A and B, respectively, for complete listings of acronyms and definitions used in this report.) The PSWAC, established jointly by the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), provided advice and recommendations on the specific wireless communications

requirements, through the year 2010, of public safety agencies. The interoperability subcommittee of the PSWAC defined *interoperability* as “an essential communication link within public safety and public service wireless communications systems which permits units from two or more different agencies to interact with one another and to exchange information according to a prescribed method in order to achieve predictable results.” In addition, the *PSWAC Final Report* described three different types of interoperability:

- *Day-to-day interoperability*, which is the most commonly encountered and is typically associated with areas of concurrent jurisdiction where agencies monitor each other’s routine traffic. Such interoperability minimizes the need for dispatcher-to-dispatcher interaction to arise in the exchange of information among units in the field.
- *Mutual aid interoperability*, which often involves multiple agencies under conditions that allow for little planning for the specific event. This type of communications is called tactical, and when responders are on the scene, typically involves the use of portable radios.
- *Task force interoperability*, which usually involves communications among agencies representing several units and/or levels of government under conditions that do allow for planning. This type of communications usually involves the use of portable and/or covert equipment, often requires extensive close-range communications, and due to the nature of the communications traffic involved, long-range transmission is undesirable.

Furthermore, the interoperability experiences and shortfalls explored as part of this study draw from the typical obstacles to interoperability identified by the PSWAC:

- *Diversity of spectrum resources*. Local, state, and federal public safety agencies use a total of 10 frequency bands that range from 30 megahertz (MHz) to over 800 MHz. No single commercial grade radio can operate in all of the frequency bands.
- *Lack of channels available for interoperability*. Few channels have been designated and made available to satisfy interoperability requirements. In some cases, this situation arises from inadequate planning or an overriding need to utilize all available channels to satisfy routine operational demands.
- *Human and/or institutional factors*. The reluctance of some agencies to allow their units to join another system, agency concerns over maintaining independent communications with their own personnel, or constraints of human memory, such as the ability of operators to remember channel assignments, are obstacles.
- *Lack of common communications mode*. Different systems may be unable to communicate because they use different transmission and signaling technologies or proprietary technologies provided by different manufacturers.
- *Different coverage areas*. Coverage areas of systems do not completely overlap, limiting communications between units on their respective systems.

- *Limitations of current commercial services.* Commercial services lack certain characteristics that are deemed critical to public safety applications (e.g., availability, reliability, security, coverage), precluding use for interoperability.
- *Lack of a common plan.* There is no adequate nationwide mutual aid plan and incident command system to facilitate the required degree of interoperability.

Relevance of Interoperability to the Fire and EMS Community

The missions and responsibilities of different public safety organizations affect the extent to which they are involved in interoperability situations. However, it is accepted that a majority of agencies, regardless of size or mission, interact regularly with other public safety agencies. Consequently, a general understanding of the interoperability needs of all members of the public safety community is imperative for policy makers, public safety leaders, radio system managers, and the public safety community in general.

Although interoperability issues of the law enforcement community have been well-documented by both the *PSWAC Final Report* and the NIJ study, the wireless communications environment and the interoperability needs of the fire and EMS community have often been overlooked until this study. The lack of interoperability data for this community is significant because the combined local and state fire and EMS public safety community, nearly twice the size of the overall law enforcement community, comprises more than 36,000 agencies and 1.5 million uniformed personnel.¹ Of these agencies, 80 percent are fire departments, 19 percent are EMS agencies, and the remaining 1 percent are specialized departments (i.e., airport or harbor fire and EMS departments) or state organizations.

As illustrated by Exhibit 1, which shows the distribution of these agencies throughout the United States, the density of fire and EMS agencies varies widely. This variation is due not only to the relative size of the populations being served, but also to the number of independent political subdivisions throughout the nation and the geographic basis on which volunteer departments are organized.

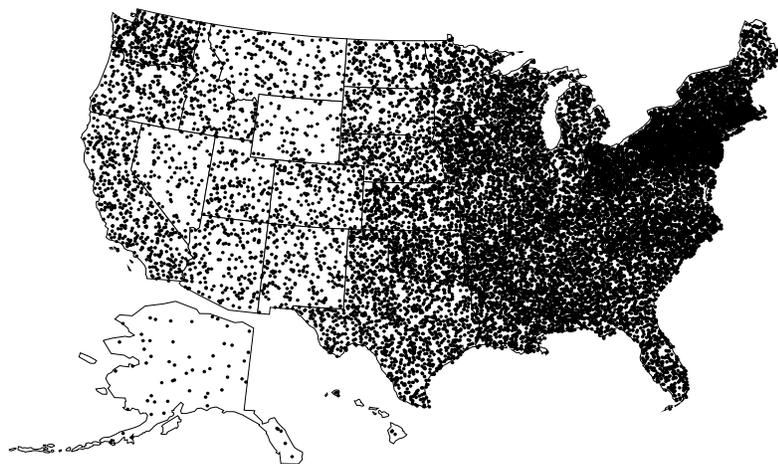


Exhibit 1

Fire and EMS Agencies in the United States

Approximately 96 percent of the fire and EMS agencies in the United States employs fewer than 100 uniformed personnel, with the vast majority of agencies (86%) employing fewer than 50 uniformed personnel. Exhibit 2 depicts the number of agencies with fewer than 100 personnel.

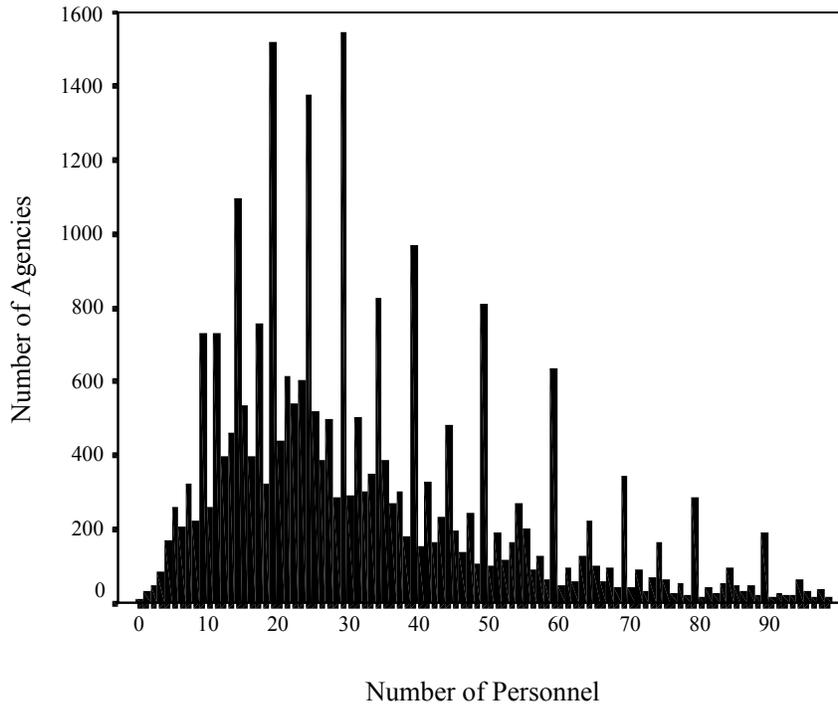


Exhibit 2
Number of Uniformed Personnel Per Agency

Fire and EMS Interoperability Study

The PSWN program surveyed fire and EMS organizations, at the local and state levels of government, throughout the United States to better understand and profile the communications interoperability challenges facing this segment of the public safety community. Specific characteristics of local and state fire and EMS agencies surveyed, as well as responding agencies, are provided in Section 2, Study Methodology. Agencies were asked to provide information about their wireless communications systems and operations, especially regarding their ability to handle a variety of interoperability situations. The goal of the study was to establish a quantitative baseline of information regarding fire and EMS communications interoperability.

Four objectives drove the study:

- Identifying the current and planned wireless communications capabilities of fire and EMS agencies;

- Determining the nature and extent of current fire and EMS communications interoperability experiences and requirements;
- Identifying the nature and extent of interoperability shortfalls experienced by fire and EMS agencies; and
- Determining the knowledge and training level of fire and EMS personnel related to current interoperability initiatives.

Although there is a degree of similarity between the interoperability needs of the fire and EMS community to that of the public safety community as a whole, this study has not attempted to quantify its results to represent the needs of the entire public safety community. However, as mentioned previously, this study is a companion effort to the law enforcement study completed by the NIJ. Results from this study will be combined with those from the law enforcement study to provide an overall assessment of communications interoperability encountered by the public safety community.

SECTION 2: STUDY METHODOLOGY

Beginning in March 1998, surveys were distributed to 3,398 fire and EMS organizations. Surveys were addressed to the fire chief, EMS chief, or agency director, with instructions to have the survey completed by the individual in their department who is the most knowledgeable about wireless communications with other departments. The survey was distributed through three mailings.ⁱⁱ Agencies were sent reminder postcards shortly after the distribution of the second and third mailings. The data collection effort, which concluded in September 1998, yielded an overall response rate of 31 percent. Exhibit 3 provides a timeline of the survey distribution, including the issue dates of an announcement postcard and reminder postcards issued with the second and third mailings.

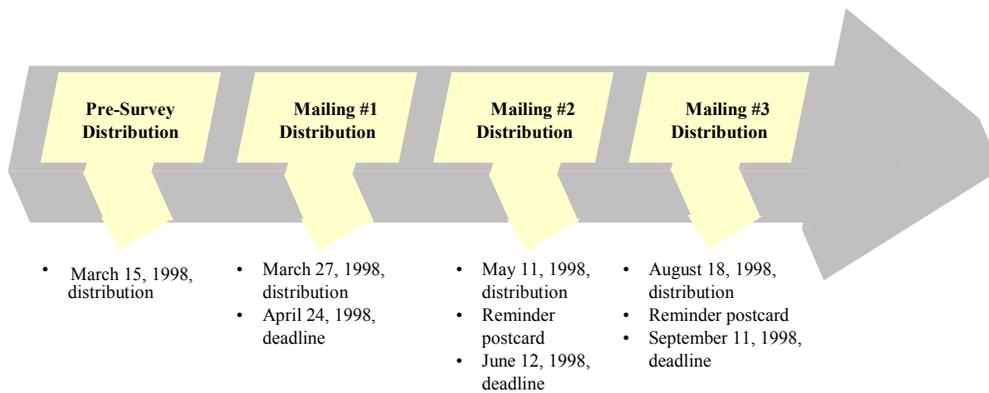


Exhibit 3
Timeline of Survey Distribution

Sample and Survey Instrument Development

The sample population used in the fire and EMS study was derived in a similar fashion as that used in the NIJ law enforcement study. First, the *1997 National Directory of Fire Chiefs and Emergency Departments* was consulted to create a stratified random sample based on seven predetermined categories. The stratification used in this process was large fire departments, small fire departments, large EMS departments, small EMS departments, airport and harbor departments (i.e., special agencies), state fire marshals, and state EMS directors. The size distinctions made in the case of both the fire and EMS departments resulted from preliminary research which concluded that large departments, that is, those having 100 or more personnel, were more likely to experience interoperability problems than those with fewer than 100 personnel, which defines a small agency. The state foresters segment, identified at a later date, was added to the third distribution wave.

Exhibit 4 provides a comparison of the population and the sample size and shows response rates for each segment. It is important to note, however, that large fire and EMS departments

represent a small minority of the overall fire and EMS community (less than 4%). Consequently, the sampling of large departments would not be sufficient for a detailed analysis of their interoperability experiences and needs. Therefore, 100 percent of large departments were included in the sample. This was also the case for the state EMS directors, the state fire marshals, and the state foresters. A 5 percent sampling rate was used for the small fire and EMS sample segments, and a 33 percent sampling rate was used for special agencies.

Sample Segment	Segment Population	Sample Size	Surveys Returned	Response Rates
Fire Departments – 100 or more (LV)	1,112	1,112	439	39.5%
Fire Departments – 99 or less (SV)	28,200	1,377	362	26.3%
	29,312	2,489	801	32.2%
EMS Departments – 100 or more (LV)	309	309	79	25.6%
EMS Departments – 99 or less (SV)	6,596	334	76	22.8%
	6,905	643	155	24.1%
Special (Airport and Harbor) Agencies (LV)	317	105	30	28.6%
State Fire Marshals (SV)	51	51	20	39.2%
State EMS Directors (SV)	51	51	16	31.4%
State Foresters (LV)	59	59	23	39.0%
Total Distributed		3,398		
Total Returned			1,045	30.8%

Exhibit 4

Distribution of Segment Population, Survey Sample Size, and Survey Return Rates

In addition to using similar sampling procedures, the PSWN program also used the survey instrument created by the NIJ as the basis for the fire and EMS questionnaire. The reliability of this survey instrument was tested by the NIJ and deemed “a dependable instrument to be used with other groups interested in measuring the status of interoperability among public safety organizations.”ⁱⁱⁱ However, the PSWN program and the NIJ recognized that the fire and EMS community was distinctly different from the law enforcement community. Consequently, the survey tool was amended to reflect the differences between the communities. In addition, two versions of the fire and EMS questionnaire were developed — a short version (SV) and a long version (LV).^{iv} (See Appendixes C and D, respectively, for copies of the short and long version of the questionnaire.) The short version, which was targeted at agencies with fewer than 100 employees, was intended to increase the response rate from smaller departments that may have limited technical knowledge pertaining to the land mobile radio (LMR) system infrastructures. The short version eliminated some of the more detailed questions relating to current and planned use of communications equipment, infrastructure, and technologies.

Bias and Error Analysis

To document the soundness of the compiled fire and EMS interoperability data, statistical tests were performed to assess the accuracy of the data. These tests included an examination of potential bias and the derivation of a maximum statistical error. Bias analyses were conducted to

assess potential differences between survey respondents and nonrespondents. Individual agencies responding to a survey represent their individual interests and situations; they do not necessarily represent the broader interests of the fire and EMS community. The biases introduced by respondents as they relate to the broader community, which includes non-respondents to the survey, are commonly evaluated to understand the extent to which generalizations to the broader population may be skewed.

To determine if the final responses were biased, a random sample of 35 fire departments that did not respond to the survey was selected, contacted by phone, and asked a series of nine questions taken directly from the printed survey.^v On the basis of the question type, statistical tests were performed to determine the significance of variances in responses from fire departments to the printed surveys and responses to the telephone survey. For dichotomous questions (i.e., yes-no), chi-square analysis was used to compare agency responses, while independent t-tests were used on agencies responses to the ordinal questions (i.e., ratings from 1 to 5). The results indicated that no statistically significant differences existed among the responses to the survey; thus no bias was evident.

A similar bias study was conducted to assess potential bias from differences among respondents to the different survey distribution waves. Such a study was needed to determine if responses were influenced by the use of two different cover letters. Survey responses of the first two survey distribution waves were grouped together because they included a PSWN program cover letter and compared with responses of the third distribution wave, which were distributed with a community-targeted cover letter. No bias was evident. (See Appendix E for a more detailed explanation of the bias studies.)

The maximum statistical error of the survey provides an indication of the likelihood that responses occurred by chance. This calculation is important in establishing the credibility of the results presented. On the basis of the standard error derived for each question, the total sample of 1,045 responses yields a maximum statistical error of ± 5 percent at the 95 percent confidence level.^{vi} Consequently, it is very unlikely that results achieved were due to chance alone.

From the outset, the goal of the study was to achieve a baseline understanding of the interoperability needs of the fire and the EMS communities. Although the survey responses provide a strong knowledge base, the proportion of agency sizes and types that exist in the final response population are not representative of the broader community. It is possible to correct for this by applying numerical weights to under- and over-represented categories to restore them to the proportions found in the total population. This weighting would minimize risk in making generalizations from the survey data to the fire and EMS population as a whole. A weighting analysis was conducted to determine its effect on overall survey response data. Descriptive statistics were run on weighted samples to determine their impact. Averages, percentages, and standard errors for questions changed only slightly, and the maximum statistical error remained at ± 5 percent at the 95 percent confidence level. Since the effect of weighting the sample was found to be minimal, the analysis provided in this report is based on the unweighted data. (See Appendix F for a more detailed discussion of the weighting analysis.)

Data Analysis

When the data collection period concluded, the responses were evaluated in terms of response quality. Because of the distinct operational requirements, low response rates and a high proportion of missing responses from the state agencies, it was determined that separate analyses of the state foresters, state EMS directors, and state fire marshals would offer a more accurate representation of these communities.

Local agencies, on the basis of their responses, were then classified first by agency type. The type groupings were fire departments, EMS departments, and special agencies (i.e., airport and harbor fire and EMS departments). The response rate for each agency type category was as follows: fire departments, 81 percent; EMS departments, 15 percent; and special agencies, 5 percent. These proportions are similar to the overall fire and EMS population. Where applicable, the fire departments were further separated into career and volunteer departments. Thirty-two percent of responding fire departments classified themselves as career compared with 51 percent who reported they were volunteer agencies.

Agency size was the second descriptive grouping in which responding local fire and EMS agencies were classified. After looking at the relative distribution of the number of non-administrative personnel that responses from local agencies provided, five size categories were established: agencies having fewer than 25 personnel, agencies with 25-49 personnel, agencies with 50-99 personnel, agencies with 100-249 personnel, and agencies reporting 250 or more personnel.

All questions were then analyzed in terms of overall response, response by agency size, and response by agency type. In addition, statistical tests were used to compare differences between agency sizes and types. For dichotomous questions (i.e., yes-no), chi-square analysis was used to compare agency responses, while independent t-tests were used on agencies responses to the ordinal questions (i.e., ratings from 1 to 5). Appendixes G through K provide the supporting data for the analyses, including the results of both types of statistical tests. All statistical tests were conducted at the 95 percent confidence level.

SECTION 3: LOCAL FIRE AND EMS — CURRENT WIRELESS COMMUNICATIONS ENVIRONMENT

A series of questions posed in the fire and EMS questionnaire addressed the current wireless communications environment for the community. Establishing a baseline understanding of the current environment is important for identifying opportunities for improvement. The following points provide a brief summary of the information gathered on the current wireless communications environment for local fire and EMS agencies.

- Almost all fire and EMS agencies use mobile (99%) and handheld (98%) radios for communications. They also rely on a variety of additional communications equipment to meet their communications requirements. The average fire and EMS agency uses six different types of communications equipment, all based on well-established technologies. In addition to mobile and handheld radios, agencies indicate widespread use of pagers, landline telephones, cellular phones, and fax equipment.
- The majority of fire and EMS agencies operate LMR systems that rely on basic technologies. Agencies predominately use analog systems (79%), conventional architectures (75%), and operate in the high-band very high frequency (VHF) (74%) spectrum. Additionally, a majority of fire and EMS agencies participate in a multi-agency or multi-jurisdictional shared communications arrangement.
- Regardless of system characteristics, 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. Agencies using trunked LMR systems report fewer problems with channel congestion. This lack of channels is compounded by an increasing demand to implement non-voice LMR capabilities, such as mobile data computing, imagery (still photos and live video), and geographic information systems (GIS). Meeting current mission requirements will necessitate increases in the average number of channels for fire and EMS LMR systems.
- The average age of the fire and EMS radio systems is 9.8 years, and more than a third of LMR systems have exceeded the typical 8- to 10-year service life. A majority (57%) of agencies plan to replace or substantially upgrade their LMR systems in the next 10 years. However, there is a lack of dedicated funding sources for the replacement or upgrade of fire and EMS LMR systems. Nearly one quarter of fire and EMS agencies do not know how they will fund their next LMR system. This funding uncertainty is more pronounced in smaller agencies and with fire departments that have volunteer personnel.
- Agencies must choose from a mix of new communications technologies to meet their mission requirements within their available fiscal resources. Although many agencies have not determined the characteristics of their next LMR system, planned fire and EMS LMR

systems will differ from the current ones. Digital technology will substantially replace analog technology (from 14% to 44%), the use of trunked systems architectures will double (from 20% to 45%), and the use of the 800 MHz frequency band will increase (from 26% to 43%). Additionally, agencies will increase their use of non-LMR communications services. These services include cellular digital packet data (CDPD), global positioning system (GPS), and personal communication services (PCS).

Several specific analyses follow that provide more detailed information and insights into the current wireless communications environment for local fire and EMS agencies. These analyses address responses to the following questions and inquiries posed by the questionnaire.

- Indicate the types of communications equipment used by your agency.
- Which of the following best describes your agency's communications arrangement?
- Identify the radio frequency band your agency currently uses.
- Identify the frequency bands your agency prefers for its next LMR system.
- Which best describes your current and preferred primary LMR base system — analog or digital?
- Which best describes your current and preferred primary LMR base system architecture — conventional or trunked?
- Does your agency use a paging system for emergency “alerting” of personnel? If so, what type?
- How serious are the following problems regarding your LMR system?
- How serious a problem is not enough channels?
- How many channels does your agency currently use? How many additional channels does your agency need?
- Approximately how old is your current LMR system?
- How does your agency plan to fund its next LMR system?
- What is the total number of mobile data terminals and/or laptop computers your agency estimates it will use by the end of 1999?
- Identify the types of wireless data communications (not voice) your agency currently uses and plans to use within the next 2 years.
- Indicate all other wireless communications services your agency uses or plans to use within the next 5 years.

INDICATE THE TYPES OF COMMUNICATIONS EQUIPMENT USED BY YOUR AGENCY.

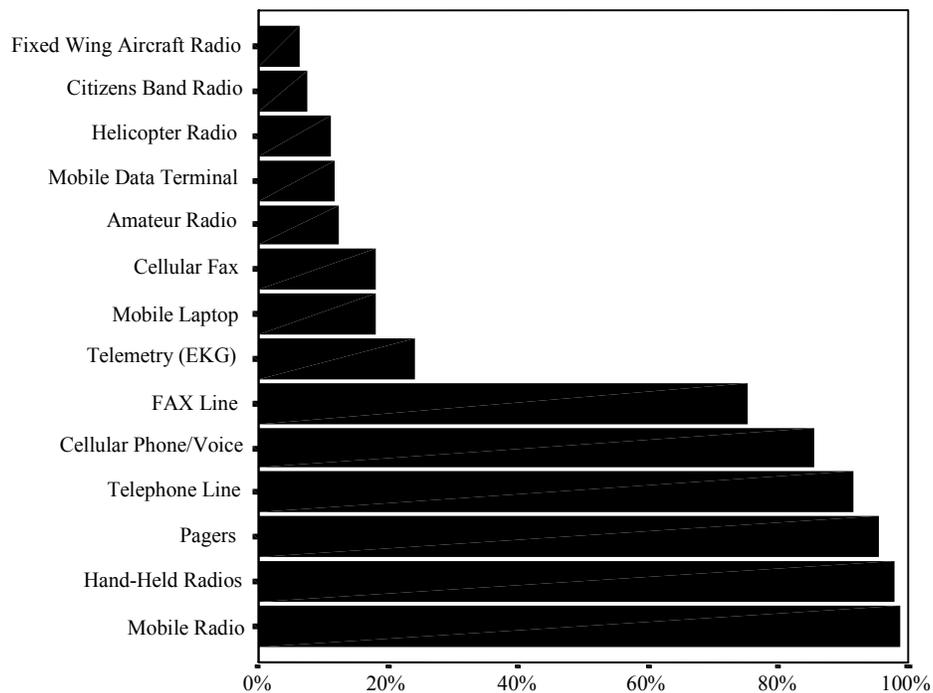


Exhibit 5

Communications Equipment Usage

Agencies use a multitude of communications equipment types but rely predominately on LMR radio communications.

Fire and EMS agencies were asked to indicate which types of communications equipment they use. Responding agencies indicate that mobile (99%) and handheld (98%) radios are the most commonly used communications equipment. Radios are closely followed by pagers and landline telephones at 95 percent and 92 percent, respectively.

All responding agencies report using more than one type of communications equipment. On average, agencies indicate that they use six different types of communications equipment. Aside from the four most common types previously mentioned, cellular phones (86%) and fax lines (75%) are the most commonly used forms of communications. As depicted in Exhibit 5, the remaining communications equipment types are utilized by fewer than 25 percent of agencies.

While radio, paging, and telephone equipment are used by almost all fire and EMS departments, the use of other types of communications equipment varies by agency size (See Appendix G, Table G-1 for supporting data). For example, for agencies with fewer than 25 personnel, the use of cellular phones is 63 percent, whereas the use of cellular phones is over 90 percent in agencies with 25 or more personnel. The use of advanced technologies (e.g., cellular fax, mobile data terminals and laptop computers, and EKG – telemetry) is more prevalent in larger agencies

(more than 100 personnel), while the use of citizen band radio is more prevalent in smaller agencies.

WHICH OF THE FOLLOWING BEST DESCRIBES YOUR AGENCY'S COMMUNICATIONS ARRANGEMENT?

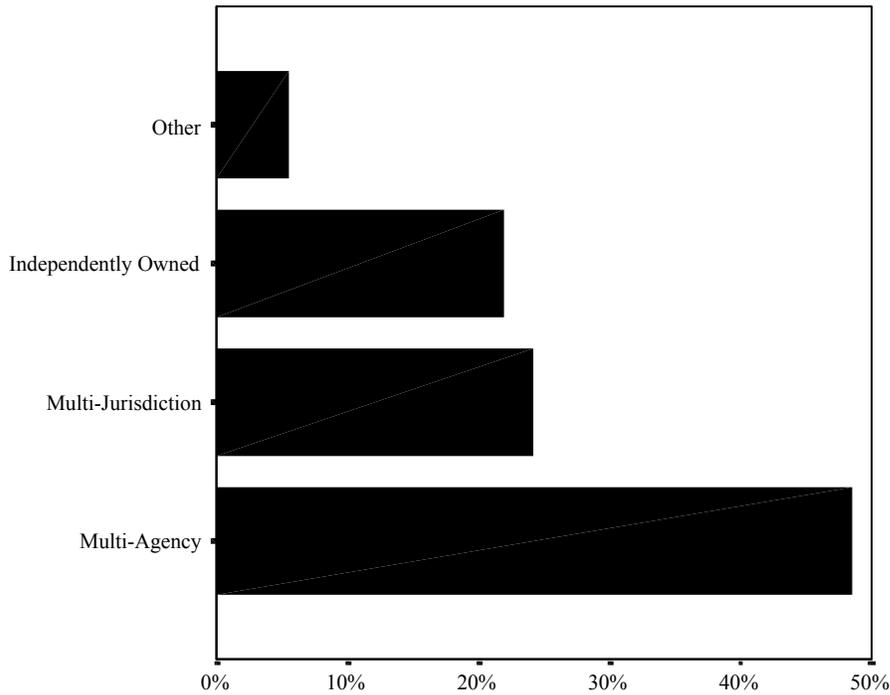


Exhibit 6

Communications Arrangement

A majority of agencies participate in a shared communications arrangement.

Seventy-three percent of fire and EMS agencies participate in a shared communications arrangement. Of these agencies, 49 percent participate in a communications arrangement among multiple agencies within their jurisdiction; and 24 percent participate in a multiple-agency, multiple-jurisdiction communications arrangement. Communications arrangements described as an “independently owned and operated communications center used exclusively by our department” represent 22 percent of responding agencies, of which 94 percent own their system, while 2 percent lease.

Comparisons across agency size, type, and terrain reveal several trends (See Appendix G, Tables G-2, G-3, and G-4 for supporting data). First, independently owned and operated communications arrangements are most prevalent (36%) in the largest agencies (250 or more personnel). Special agencies are also more likely to have independently owned and operated systems (43%) while fire departments are least likely (19%). However, fire departments with career personnel are more likely to participate in an independently owned and operated communications arrangement (32%) as compared with fire departments that rely on volunteer personnel (14%). Additionally, agencies operating areas with mountainous or heavily forested terrain are more likely to participate in a shared communications arrangement. In fact, 81 percent of these agencies participate in a multi-agency or multi-jurisdiction communications arrangement.

IDENTIFY THE RADIO FREQUENCY BAND YOUR AGENCY CURRENTLY USES.

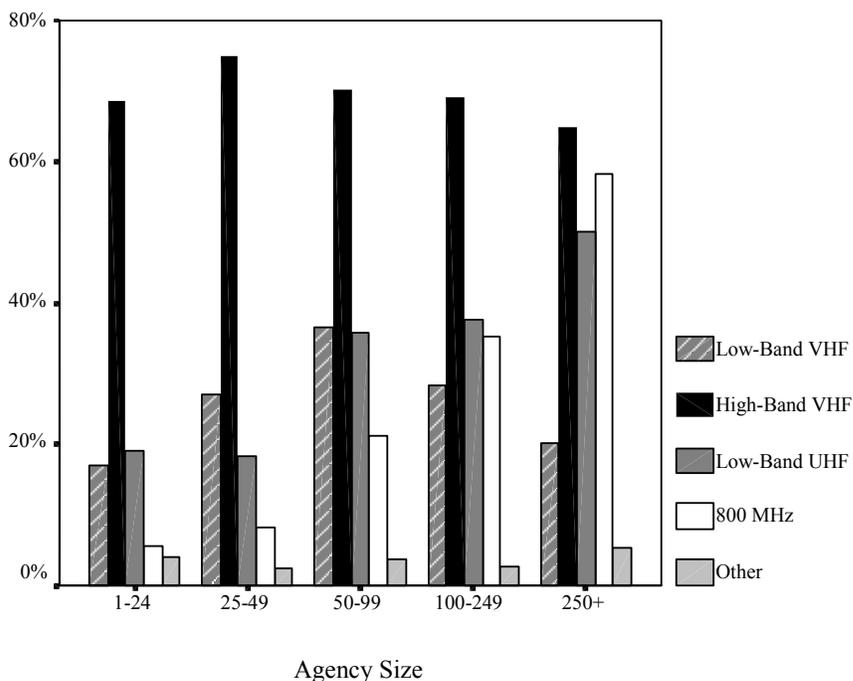


Exhibit 7
Current Radio Frequency Band

High-band VHF is the most commonly used frequency band among fire and EMS agencies.

Seventy percent of responding fire and EMS agencies operate at least one high-band VHF channel and nearly half (44%) of responding fire and EMS agencies report operating in more than one frequency band. The remaining frequency bands available for fire and EMS LMR systems are used by less than a third of agencies: 31 percent use low-band UHF, 26 percent use low-band VHF, and 25 percent use 800 MHz. In addition, 3 percent of respondents reported using “Other” bands.^{vii}

As illustrated by Exhibit 7, the use of the different frequency bands varies with agency size. Larger agencies (100 or more personnel) most commonly use the 800 MHz band. Fifty-eight percent of the largest agencies (250 or more personnel) use the 800 MHz frequency band compared with only 6 percent of the smallest agencies (fewer than 25 personnel). Additionally, the use of low-band UHF also increases with agency size. Fifty percent of the largest agencies use the low-band UHF frequency band, compared with 19 percent of the smallest agencies. The use of high-band VHF frequencies, however, remains nearly constant across all agency sizes.

The use of specific frequency bands also varies by agency type (See Appendix G, Table G-4 for supporting data). Use of the low-band UHF frequency band is more prevalent among EMS departments and special agencies than among fire departments. In addition, the use of the 800 MHz band is more common for special agencies than it is for fire and EMS departments.

Specifically, 36 percent of special agencies operate in the 800 MHz frequency band, compared with 24 percent of fire departments and 23 percent of EMS departments.

Further analysis of frequency band usage by fire departments reveals differences between those departments with career personnel and those with volunteers (See Appendix G, Table G-5 for supporting data). The use of the 800 MHz band is four times as common in career fire departments than it is in volunteer fire departments. Volunteer fire departments are more likely to use the low-band VHF frequency band compared with career fire departments.

In addition, agencies were asked to indicate the number of channels that they are currently using within each radio frequency band. Exhibit 8 cross references the average number of channels used to radio frequency band. Although high-band VHF was identified as the most common operational frequency, the highest average number of channels was reported in the 800 MHz band (15 channels) rather than high-band VHF (8 channels). Agencies reported the use of more channels in conventional systems than in trunked systems.

Radio Frequency Band	Average Number of Channels
800 MHz	15
High-Band VHF	8
Low-Band UHF	7
Low-Band VHF	6
Other	5

Exhibit 8
Average Number of Channels Currently Used by LMR Systems by Band

IDENTIFY THE FREQUENCY BANDS YOUR AGENCY PREFERS FOR ITS NEXT LMR SYSTEM.

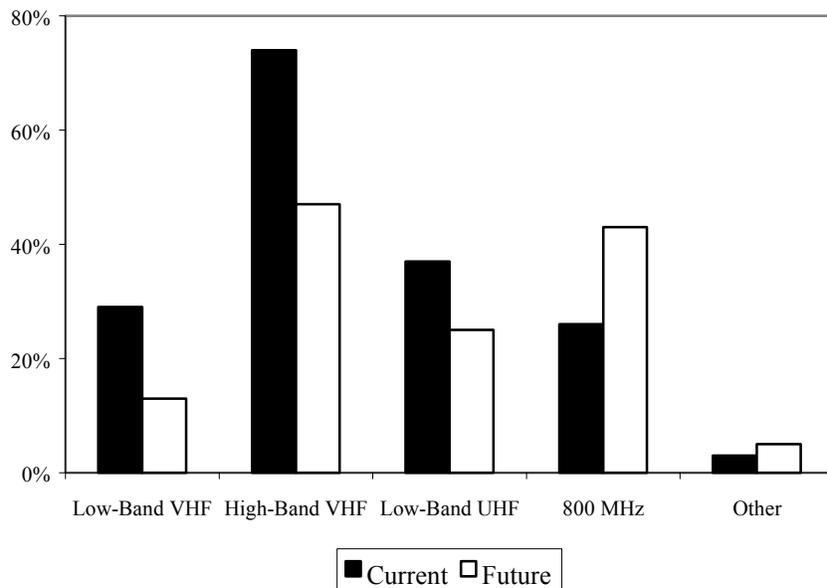


Exhibit 9
Current and Future Use of Radio Frequency Bands

Comparison of current and future radio frequency bands demonstrates an increasing demand for 800 MHz frequencies.

Fire and EMS agencies planning to upgrade their LMR systems within the next 10 years (57%) indicate a shift in frequency bands to be used in its next LMR system. The most notable trend is the migration of agencies to the 800 MHz band. Forty-three percent of agencies planning to upgrade their LMR systems expect to operate in the 800 MHz band, a projected increase of 17 percent from the 26 percent of agencies operating in 800 MHz now. Use of the three other primary frequency bands assigned to fire and EMS agencies will decrease. This projected increase in 800 MHz frequency use is consistent with the current lack of available spectrum in the other public safety frequency bands.

Although agencies are anticipating a migration to the 800 MHz band, the magnitude of the change varies by agency size. The largest percent change projected in frequency band use is for the largest agencies (250 or more personnel) currently using VHF, both high-band and low-band. These largest agencies indicate a projected decrease in the use of the high-band VHF frequencies from 71 percent to 31 percent and for low-band UHF frequencies, a decrease from 55 percent to 31 percent. Additional notable projected decreases include those of mid-size agencies (50-99 personnel). Their use of low-band VHF will decrease from 41 percent to 14 percent.

WHICH BEST DESCRIBES YOUR CURRENT AND PREFERRED PRIMARY LMR BASE SYSTEM — ANALOG OR DIGITAL?

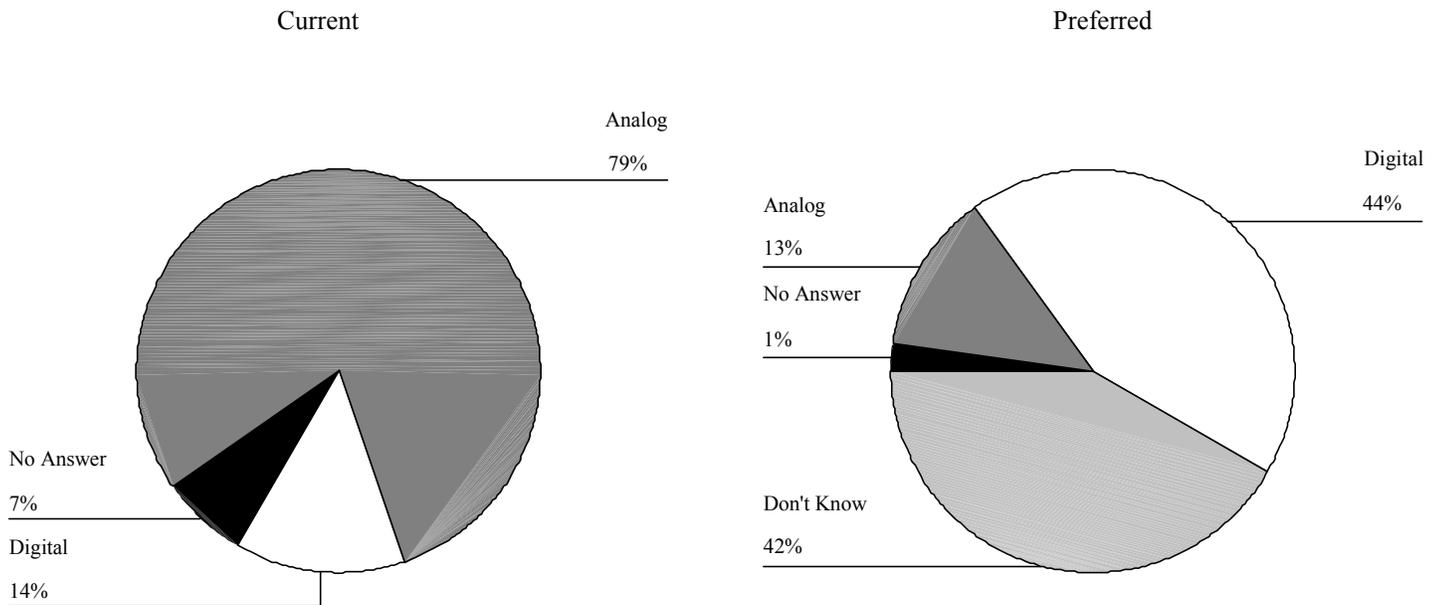


Exhibit 10

Current and Preferred Use of LMR Base System

Existing systems predominately rely on analog technology; however, the preferred technology for future LMR systems is digital.

For existing systems, 79 percent of fire and EMS agencies describe their primary LMR system as using analog technology. Although many respondents (42%) did not know whether they preferred analog or digital technology for their next LMR system, the preference for digital technology among those agencies planning to replace their systems (44%) is more than three times that of analog technology (13%). After taking into account those agencies that already operate digital systems, as well as the projected use of agencies that plan to migrate from analog technology to digital technology within the next 10 years, it is projected that the overall use of digital technology will increase from the current 14 percent to 37 percent.

The prevalence of digital technology in current systems is relatively equal across fire (14%) and EMS (17%) agencies (See Appendix G, Table G-7 for supporting data). However, the use of digital technology is more pronounced (24%) for special agencies. Additionally, the preference for digital technology for future systems is related to agency size, ranging from 27 percent for current systems in agencies with fewer than 25 personnel to 63 percent for systems in agencies with 250 or more personnel (See Appendix G, Table G-8 for supporting data).

WHICH BEST DESCRIBES YOUR CURRENT AND PREFERRED PRIMARY LMR SYSTEM ARCHITECTURE — CONVENTIONAL OR TRUNKED?

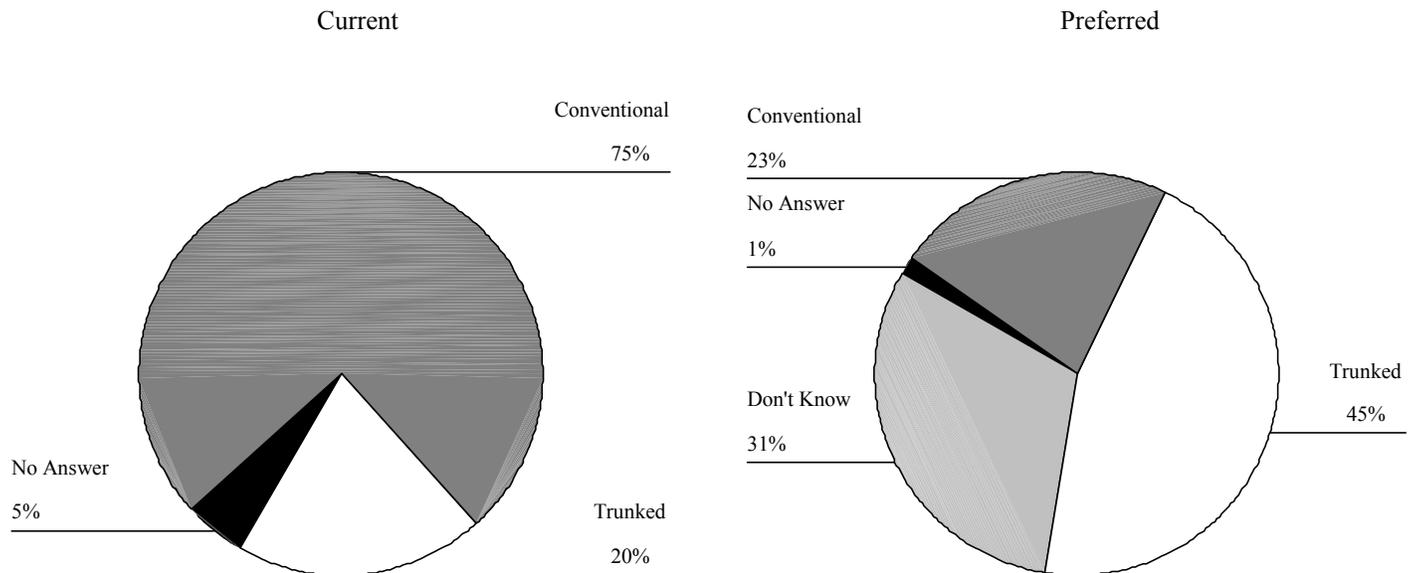


Exhibit 11

Current and Preferred Use of LMR System Architecture

While three-quarters of existing fire and EMS LMR systems are conventional, the preference for future LMR systems is trunked.

Conventional systems, which require a user to wait for an open channel before transmitting, are used by 75 percent of fire and EMS agencies. In contrast, trunked systems, which allow for the more efficient use of spectrum by automatically routing users to an open channel, are used by 20 percent of fire and EMS agencies.

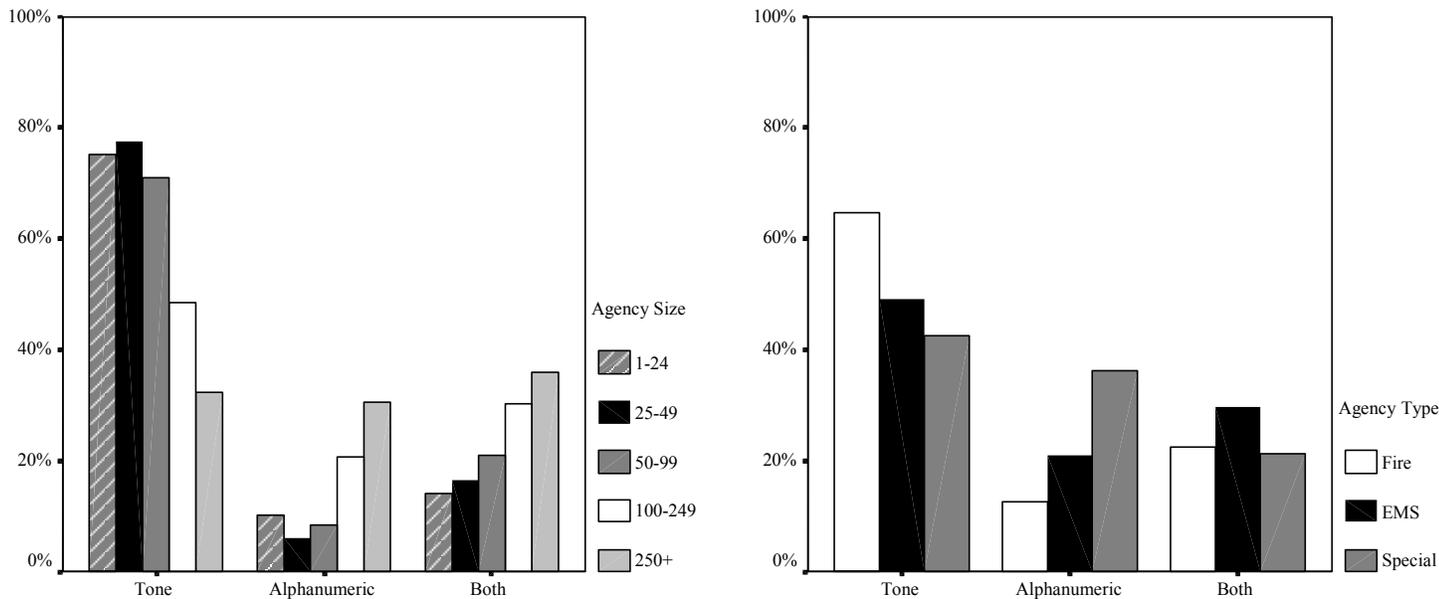
Fire and EMS departments are similar in their reliance on conventional architectures for current systems (79% and 83%, respectively) (See Appendix G, Table G-9 for supporting data). In addition, the majority of special agencies also predominately rely on conventional systems (64%). As expected, larger agencies are more likely to use trunked systems to accommodate their traffic requirements. Only 12 percent of agencies with 25 or fewer personnel use trunked systems compared with 39 percent of agencies with 250 or more personnel.

Although many respondents (31%) did not know whether they preferred a conventional or trunked system architecture for their next LMR system, the preference for trunked systems among those agencies planning to replace their systems (45%) is nearly two times that of conventional system (23%). After taking into account those agencies that already operate trunked systems, as well as the projected use of agencies that plan to migrate from conventional to trunked systems within the next 10 years, it is projected that the overall use of trunked architectures will increase from the current 20 percent to 39 percent. Projected use of trunking

increases for agencies of all sizes, with larger agencies continuing to rely on trunked systems more than smaller agencies (See Appendix G, Table G-10 for supporting data).

This preference for trunked architectures in the future is more pronounced for agencies that currently employ trunked architecture. Of the agencies expressing an architecture preference for their next LMR system, 38 percent with a conventional architecture in their current system prefer a trunked architecture for their next system. However, of the agencies expressing an architecture preference in their next system, all of the agencies currently using a trunked architecture indicate a preference for trunking in their next system as well.

DOES YOUR AGENCY USE A PAGING SYSTEM FOR EMERGENCY “ALERTING” OF PERSONNEL? IF SO, WHAT TYPE?



A majority of fire and EMS agencies use paging for emergency alerting of personnel, but the type of paging varies.

Paging for emergency alerting of personnel is used by 88 percent of fire and EMS agencies and is more prevalent in EMS (91%) and fire departments (88%) than in special agencies (75%) (See Appendix G, Table G-11 for supporting data). Smaller agencies (fewer than 100 personnel) are more likely to use paging for emergency alerting of personnel (90%), compared with 84 percent for agencies with 100 or more personnel. Volunteer and combination fire department (96%) are much more likely to use paging than those departments that rely exclusively on career personnel (71%) (See Appendix G, Table G-12 for supporting data).

Sixty-one percent of agencies use tone and/or voice paging, 15 percent use alphanumeric paging, and 24 percent use both tone and alphanumeric paging. Comparisons across agency sizes reveal several patterns (See Appendix G, Table G-13 for supporting data). For example, tone and/or voice paging is more common in the smallest agencies (fewer than 25 personnel), while larger agencies are more likely to use alphanumeric paging. Specifically, 76 percent of the smallest agencies use tone and/or voice paging, compared with only 33 percent of the largest agencies (250 or more personnel). The use of alphanumeric paging in the smallest agencies (14%) is nearly half that of the largest agencies (27%).

Differences in paging type also occur among different types of agencies. Tone and/or voice paging is more prevalent in fire departments (65%) than it is in special agencies (42%) and EMS departments (49%). Tone and/or voice paging is especially prevalent in volunteer fire departments (83%), compared to combination (53%) and career (34%) fire departments. Special agencies use alphanumeric paging at nearly three times the rate of fire departments (36% compared with 13%). In addition, the use of both tone and alphanumeric paging is more

common in EMS departments (30%) than it is in fire departments (23%) and special agencies (21%).

Agencies were also asked to rate their satisfaction with their paging system. Eighty-six percent of fire and EMS departments are satisfied (rating of 3, 4, or 5) with their paging system, while 14 percent are not. Special agencies expressed the most dissatisfaction (26%, rating of 1 or 2) – nearly twice the rate of dissatisfaction expressed by fire departments and EMS departments (See Appendix G, Table G-14 for supporting data).

HOW SERIOUS ARE THE FOLLOWING PROBLEMS REGARDING YOUR LAND MOBILE RADIO SYSTEM?

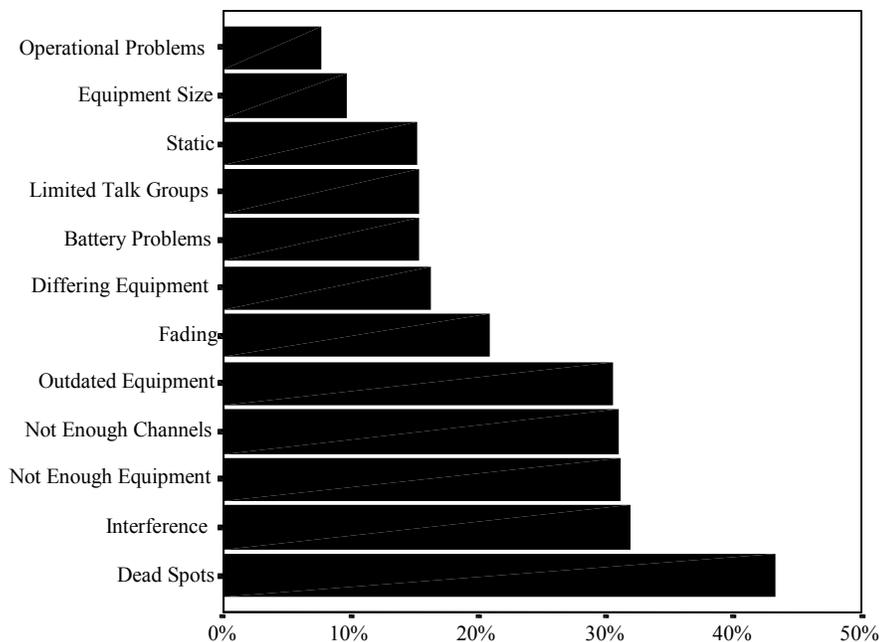


Exhibit 13

Percent of Agencies Rating Problems as Severe

Dead spots are the most serious problem agencies experience with their LMR system.

Fire and EMS agencies experience all types of problems with their LMR systems; however, dead spots are by far the most prevalent. Dead spots are the areas that are within the expected range of a radio signal, but in which the signal is not detectable and therefore cannot be received. Common causes of dead spots include depressions in the terrain and physical structures. Forty-four percent of agencies indicate that dead spots are a serious problem (rating of 4 or 5). Dead spots are also more of a problem for EMS departments (53%) compared with special agencies (40%) and fire departments (43%) (See Appendix G, Table G-15 and G-16 for supporting data). In addition, dead spots are more of a problem for LMR systems in jurisdictions with a heavily forested (57%) or mountainous terrain (51%) and are less of a problem for LMR systems in jurisdictions with a relatively flat terrain (40%) (See Appendix G, Table G-17 for supporting data).

Interference is rated as a serious problem by 33 percent of agencies. Interference is extraneous energy, from natural or man-made sources, that impedes the reception of desired signals. More agencies with analog systems indicate interference is a serious problem (36%) than agencies using digital technology (20%). Additionally, agencies with systems operating in both high-band and low-band VHF frequencies (36%) and low-band UHF frequencies (30%) are twice as

likely to experience serious interference problems as agencies with systems operating in the 800 MHz frequency band (16%).

Problems with equipment (outdated and/or not enough equipment) and not enough channels are also serious problems for 3 out of 10 agencies. For smaller agencies (fewer than 25 personnel), outdated and not enough equipment is a serious problem for 35 percent and 38 percent of agencies, respectively. This is compared with only 33 percent of the largest agencies (250 or more personnel) that rate these two problems as severe. In addition, fire departments that rely on volunteer personnel indicate that limited equipment is more of the problem than fire departments that rely on career personnel (51% and 30%, respectively).

There is little difference in the nature of the problems experienced by older systems (more than 5 years old) and newer systems. The system problems are, however, more serious for older systems. For example, 48 percent of agencies with systems greater than 5 years old indicate dead spots as a serious problem, compared with 38 percent for agencies with systems 5 years old or newer.

HOW SERIOUS A PROBLEM IS NOT ENOUGH CHANNELS?

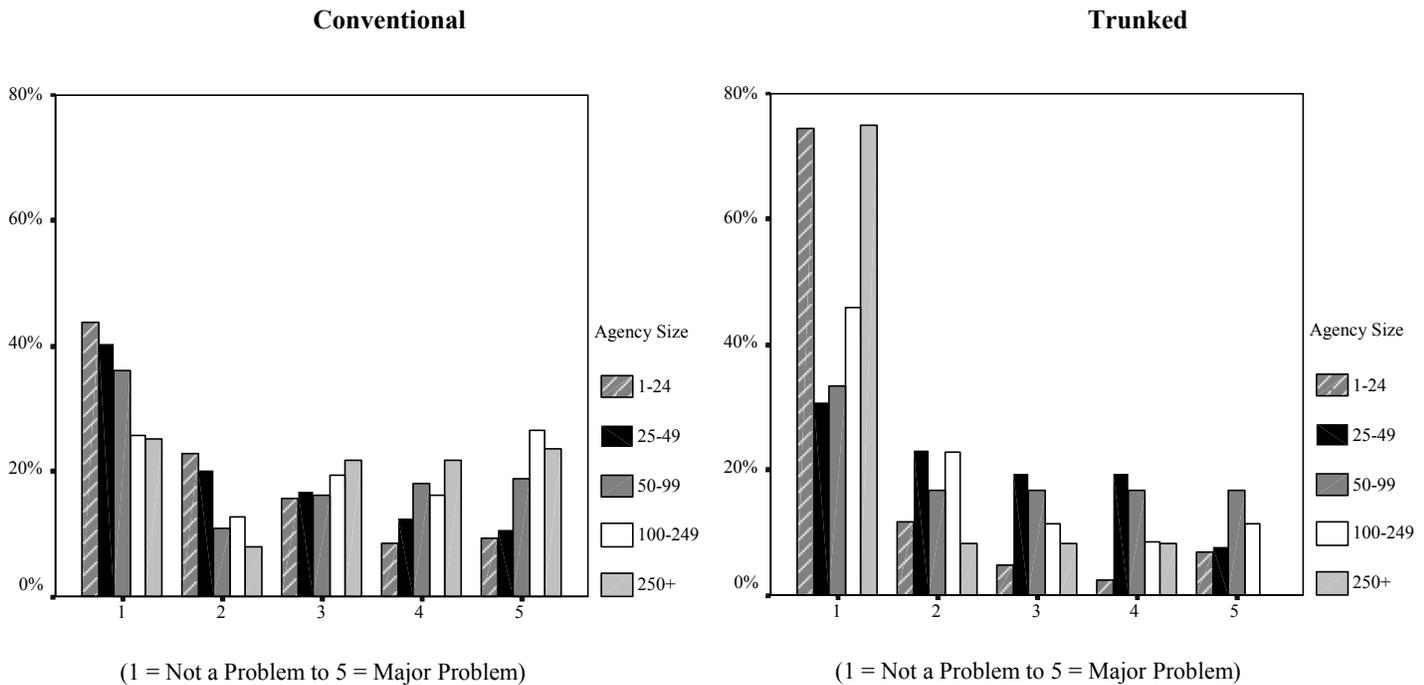


Exhibit 14
Not Enough Channels as a Problem

Larger agencies are more likely to experience channel congestion than smaller agencies.

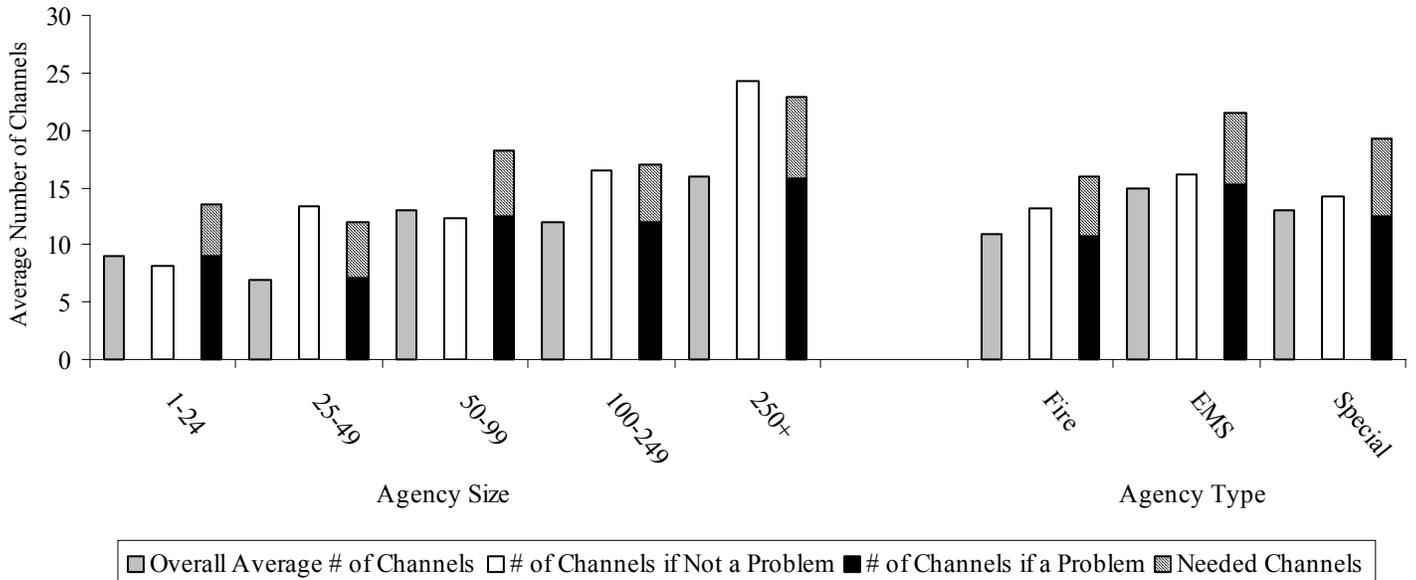
Fire and EMS agencies were asked to rate the extent to which not enough channels (i.e., channel congestion and/or channel availability) is a problem for their LMR system. Nearly half (48%) of fire and EMS agencies indicate that not enough channels is a moderate or serious problem (a rating of 3, 4, or 5). These agencies are less confident in their overall ability to handle communications interoperability, including day-to-day, mutual aid, and task force situations, than agencies that rate the limited number of channels as a minor or nonexistent problem (rating of 1 or 2).

Of the agencies that rate not enough channels as a serious problem (rating of 4 or 5), 88 percent have conventional systems. Conversely, agencies with trunked LMR systems report fewer problems related to channel congestion. In addition, 37 percent of all agencies using conventional systems indicate that they do not have enough channels, compared with 15 percent of the agencies using trunked systems. As shown in Exhibit 14, larger agencies are more likely to experience channel congestion than smaller agencies.

Channel congestion is also less problematic for LMR systems using the 800 MHz frequency band compared with systems using the other three primary public safety bands. However, of the agencies currently operating in the 800 MHz band, 73 percent with conventional systems

consider not enough channels a problem, compared to 28 percent of agencies with trunked systems.

HOW MANY CHANNELS DOES YOUR AGENCY CURRENTLY USE? HOW MANY ADDITIONAL CHANNELS DOES YOUR AGENCY NEED?



Overall, responding 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. It is important to note, however, that a majority of agencies participate in some type of shared communications arrangements. 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.

EMS agencies generally use more channels (15 channels) to support their operations than do fire departments (11 channels) or special agencies (13 channels). EMS channel use appears to be related to the requirements these agencies have for communications with a multitude of public safety and emergency care providers. EMS agencies communicate on average with 24 other agencies, whereas fire departments interact with 17 other agencies.

As expected, the number of channels used by fire and EMS agencies increases with agency size. As shown in Exhibit 15, agencies with fewer than 25 personnel use an average of 9 channels, while slightly larger agencies (25-49 and 50-99 personnel) use 7 and 13 channels, respectively. Agencies with 100-249 personnel use an average of 12 channels, while the largest agencies (250 or more personnel) use 16 channels, nearly twice as many channels as the smallest agencies.

On average, agencies with insufficient channel capacity estimate a need for an additional five channels. This need remains relatively constant regardless of agency size or type, with the largest agencies (250 or more personnel) indicating a need for the most additional channels (7 channels). In general, agencies expressing a need for channels currently have fewer channels available than those agencies with sufficient channel capacity. This differential is most dramatic for large agencies. Agencies with 100-249 personnel that have sufficient capacity report having 16 channels available, compared with only 12 channels available to agencies that report

insufficient capacity. Similarly, the largest agencies (250 or more personnel) that have sufficient capacity have 24 channels, while those that need channels currently have only 16 channels.

However, the data also suggests that there is not necessarily an optimal number of channels for agencies of different sizes and types. Of those agencies that indicate a need for more channels, both the small agencies (fewer than 25 personnel) and the mid-size agencies (50-99 personnel) estimate a total need that far exceeds the number of channels available to similar size agencies with sufficient capacity. For example, the smallest agencies without channel congestion problems have an average of eight channels, while agencies with congestion already have an average of nine channels and express a need for five more channels. In addition, all three agency types express a need for channels that exceeds the total number of channels used by agencies with sufficient capacity. This response may be due to the fact that agencies were not asked to justify additional channels but simply to estimate the number of additional channels needed.

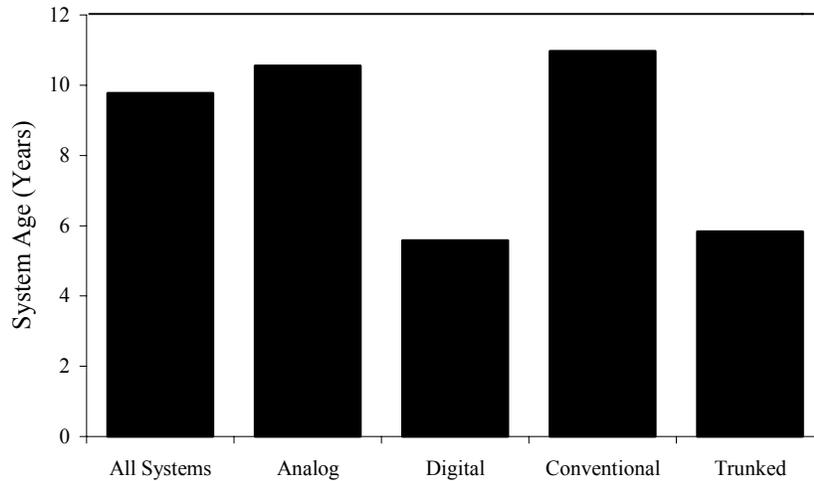
APPROXIMATELY HOW OLD IS YOUR CURRENT LAND MOBILE RADIO SYSTEM?

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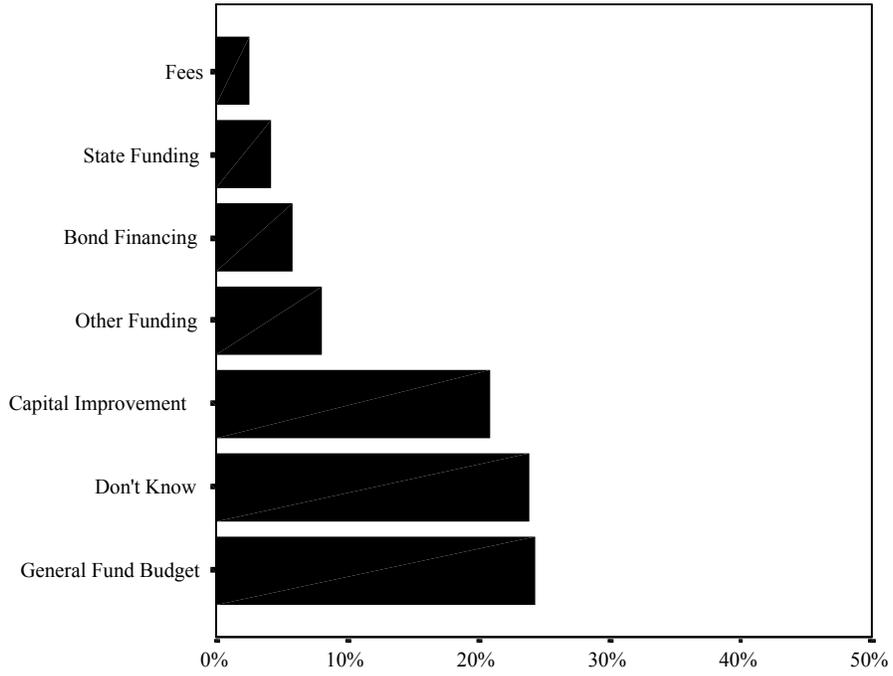
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System age is similar across agency types, but varies with agency size. Smaller agencies tend to have slightly newer LMR systems. For agencies with fewer than 50 personnel, 41 percent of the systems are more than 10 years old, and for agencies with 100 or more personnel, 48 percent of the systems are more than 10 years old.

HOW DOES YOUR AGENCY PLAN TO FUND ITS NEXT LAND MOBILE RADIO



SYSTEM?

Exhibit 17
Funding of Next LMR System

Smaller agencies and volunteer fire departments are less likely to know how they will fund their next LMR system.

Most fire and EMS agencies (87%) plan to rely on a single funding source for their next LMR system, with less than 4 percent planning to use three or more funding sources. As shown in Exhibit 17, general fund budget appropriations are the most common funding source (24%), with capital improvement funds the next most common source (21%). Volunteer fire departments rely more heavily on other funding sources than on traditional public financing mechanisms (general fund appropriations, capital improvement funds, bond financing). Though only 4 percent of agencies will rely on state funding for their next LMR system, reliance on state funding is more prevalent in EMS departments (7%), volunteer fire departments (6%), and agencies that participate in a multi-agency, multi-jurisdiction shared LMR system (6%).

However, when fire and EMS agencies were asked how they plan to fund their next LMR system, 23 percent did not respond. This lack of response may reflect widespread uncertainty regarding future funding sources. Agencies answering the question reflect similar uncertainty, as 24 percent could not identify a funding source. Together, nearly half of fire and EMS agencies surveyed do not yet have plans for how they will fund their next LMR system.

The uncertainty of responding fire and EMS agencies about funding sources differs across several factors, including agency size, agency type, and communications arrangements (See Appendix G, Tables G-18 and G-19, respectively, for supporting data). Small agencies are more likely to be uncertain about funding sources. In fact, nearly one-half (45%) of the smallest agencies (fewer than 25 personnel) do not know how they will fund their next LMR system, compared with 13 percent of large agencies (250 or more personnel).

Among agency types, special agencies are less likely to have problems identifying funding sources (16%) than fire and EMS departments (24%, and 26%, respectively). However, comparing fire department types, volunteer fire departments are nearly twice as uncertain about the source of funding for their next LMR system (32%) as fire departments operating with career personnel (17%) are (See Appendix G, Table G-20 for supporting data). In addition, agencies that participate in multi-agency, multi-jurisdiction communications arrangements have a greater uncertainty (30%) as to how they will fund their next LMR system compared with agencies that have an independently owned and operated communications system (19%).

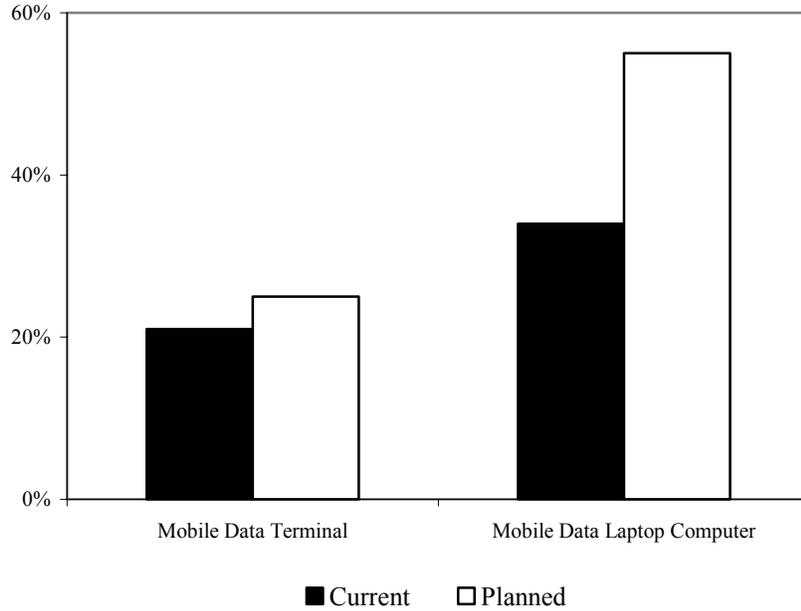
WHAT IS THE TOTAL NUMBER OF MOBILE DATA TERMINALS AND/OR LAPTOP COMPUTERS YOUR AGENCY ESTIMATES IT WILL USE IN YEAR 1999?
viii

Exhibit 18

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IDENTIFY THE TYPES OF WIRELESS DATA COMMUNICATIONS YOUR AGENCY CURRENTLY USES AND PLANS TO USE WITHIN THE NEXT 2 YEARS.^{ix}

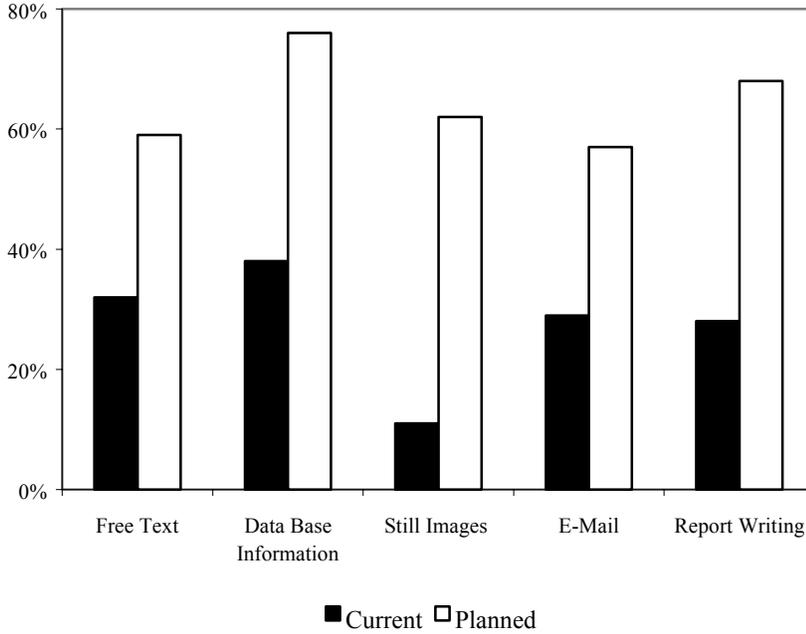
Exhibit 10

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For all types and EMS agencies from 84 percent in wireless data

Current use (Table G-21) of agencies use wireless data

Differences in special agencies wireless e-mail wireless data



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2,

INDICATE ALL OTHER WIRELESS COMMUNICATIONS SERVICES YOUR AGENCY USES OR PLANS TO USE WITHIN THE NEXT 5 YEARS.^x

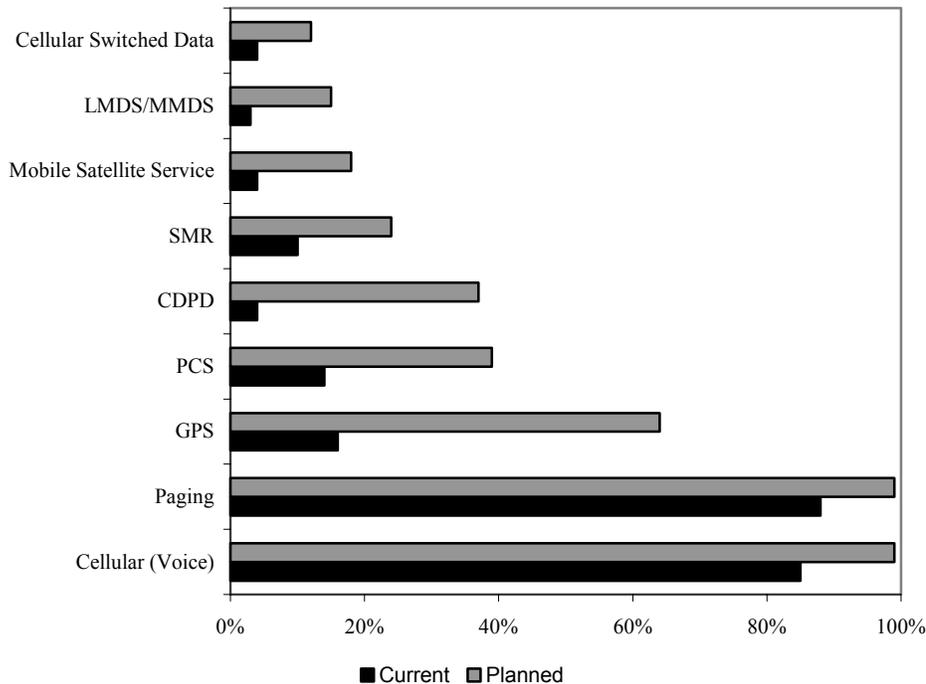


Exhibit 20

Current and Planned Use of Wireless Communications Services

Over the next 5 years there will be a significant increase in the use of wireless services and technologies.

Although a majority of agencies already use cellular voice (85%) and paging (88%) services, within the next 5 years, fire and EMS agencies anticipate an increased use of other wireless communications services, such as global positioning system (GPS), personal communications services (PCS), and cellular digital packet data (CDPD).

GPS is a satellite-based navigation service that allows users to locate their position. The use of GPS will increase from 16 percent to 64 percent of agencies within the next 5 years. PCS is a digital service and allows for enhanced features such as voice mail, call waiting, call forwarding, paging, and data services. PCS use will increase from 14 percent to 39 percent of agencies within the next 5 years. CDPD divides information into “packets” of data that are transmitted over a cellular network. The use of CDPD will increase from 4 percent to 37 percent of agencies within the next 5 years.

The current and planned use of wireless services also varies by agency size (See Appendix G, Table G-23 and G-24, respectively, for supporting data). Agencies with 250 or more personnel

are more likely to currently use and plan to use wireless services. For example, 20 percent of agencies with 250 or more personnel currently use GPS, compared with 13 percent for agencies with 100-249 personnel. Furthermore, within the next 5 years, 59 percent of agencies with 250 or more personnel will use GPS compared with 47 percent for agencies with 100-249 personnel. As previously noted within the analysis of communications equipment types, the current use of certain communications services by fire and EMS agencies may be related to funding constraints experienced by smaller agencies and the unavailability of a commercial infrastructure to support certain communications services in rural areas. The use of specific communications services is also related to agency mission. For example, EMS departments are more likely to use cellular (voice) communications services than fire departments or special agencies.

The smallest increase in the use of specific wireless services will be cellular voice and paging, since they are already used heavily. Within the next 5 years, however, cellular voice and paging will be almost universal, with 99 percent of fire and EMS agencies using or planning to use these wireless services.

Other wireless communications services with planned increases in use by fire and EMS agencies within the next 5 years include local multi-point distribution service (LMDS) or multi-point multi-channel distribution service (MMDS) (from 3% of agencies to 15%), mobile satellite service (from 4% to 14%), and cellular switched data (from 4% to 12%).

Agencies' current and planned use of wireless services varies with their concern for funding the upgrade of their LMR system. Agencies that rate funding as a serious concern (rating of 4 or 5) for their agency in upgrading their land mobile radio system are also less likely to currently use or plan to use wireless services. For example, funding is a serious concern for 79 percent of agencies not using CDPD, but funding is a serious problem for only 56 percent of fire and EMS departments currently using CDPD.

Agencies that rate outdated equipment as a serious problem with their current LMR system are more likely to plan for the use of wireless services within the next 5 years. For example, 46 percent of fire and EMS departments that plan to use cellular switched data communications within the next 5 years rate outdated equipment as a serious problem with their LMR system plan compared; however, only 31 percent of all agencies plan to use cellular switched data communication.

SECTION 4:

LOCAL FIRE AND EMS — INTEROPERABILITY EXPERIENCES AND REQUIREMENTS

Interoperability is defined as the ability of public safety personnel to communicate with other agencies, on demand and in real time. It includes communications between a variety of public safety and public service organizations, at all levels of government. Interoperability also encompasses different types of mission-critical operations – day-to-day, mutual aid, and task force. Information on fire and EMS agencies’ interoperability experiences and requirements provides data needed to understand the impact of interoperability issues on fire and EMS operations. To gain this understanding, fire and EMS agencies were asked to respond to a series of questions regarding their experiences with interoperability. These questions address the extent to which limited interoperability hinders operations, the nature of interoperability requirements, and the general level of confidence in handling various interoperability situations. The following points provide a brief summary of the information gathered on interoperability experiences and requirements for fire and EMS agencies.

- Almost half of fire and EMS agencies indicate that a lack of radio interoperability affects their ability to interact with agencies in surrounding jurisdictions. In addition, nearly one-third of agencies indicate that limited interoperability has, at some time, hampered their ability to respond to a call. Larger agencies are slightly more affected by the lack of interoperability than smaller agencies.
- Overall, 81 percent of fire and EMS agencies are confident in their current ability to handle interoperability situations. Three-quarters of agencies express high confidence (rating of 4 or 5) in their ability to establish radio links with other local public safety organizations, but very few agencies are confident in their ability to establish links with state (31%) and federal (13%) public safety organizations. Agency confidence in their ability to handle different types of interoperability also varies. A majority of agencies are confident in their ability to handle day-to-day (76%) and mutual aid (63%) situations, but they are much less confident in their ability to handle task force situations (35%).
- The need for interoperable communications is quite frequent at the local level. Nearly 90 percent of responding agencies interoperate with other local public safety organizations on a daily or weekly basis. With state and federal public safety agencies, however, interoperable communications is much less frequent, with a majority of local agencies never interoperating with federal entities. Agencies that interoperate with other organizations at any level on a daily or weekly basis are more confident in their ability to handle different types of interoperability situations.
- Many fire and EMS agencies (80%) report having at least one radio channel designated solely for communicating with other organizations. Over one-third of responding agencies operate on frequencies in multiple bands for interoperability purposes. High-band VHF is by far the most commonly used frequency band for interoperable communications; but the use of 800 MHz for interoperability increases with agency size.

- The majority of agencies report using plain English, rather than some form of code, as their primary radio language when communicating with other agencies. In addition, most fire and EMS agencies have intergovernmental communications agreements for mutually defined calls for service with neighboring jurisdictions. Agency responses indicate that the existence of these agreements contributes to higher confidence levels in their ability to handle different types of interoperable communications.

Several specific analyses follow that provide more detailed information and insights into the interoperability experiences and requirements of local fire and EMS agencies. These analyses address responses to the following questions and inquiries posed by the questionnaire.

- Does the lack of wireless radio interoperability affect your department's ability to interact with other agencies in surrounding jurisdictions?
- Rate the ability of your agency's radio system to effectively handle the three types of interoperability (day-to-day, mutual aid, and task force).
- Rate the ability of your agency to establish a radio link with other public safety organizations.
- How often does your agency have interoperable radio communications with public safety and/or public service organizations at the local, state, and federal levels?
- What radio frequencies does your agency use to interoperate with other public safety and public service organizations?
- What is the primary radio language used by your agency when communicating with other organizations?
- Does your agency have intergovernmental communications agreements with neighboring jurisdictions for mutually defined calls for services or disasters?

DOES THE LACK OF WIRELESS RADIO INTEROPERABILITY AFFECT YOUR DEPARTMENT'S ABILITY TO INTERACT WITH OTHER AGENCIES IN SURROUNDING JURISDICTIONS?

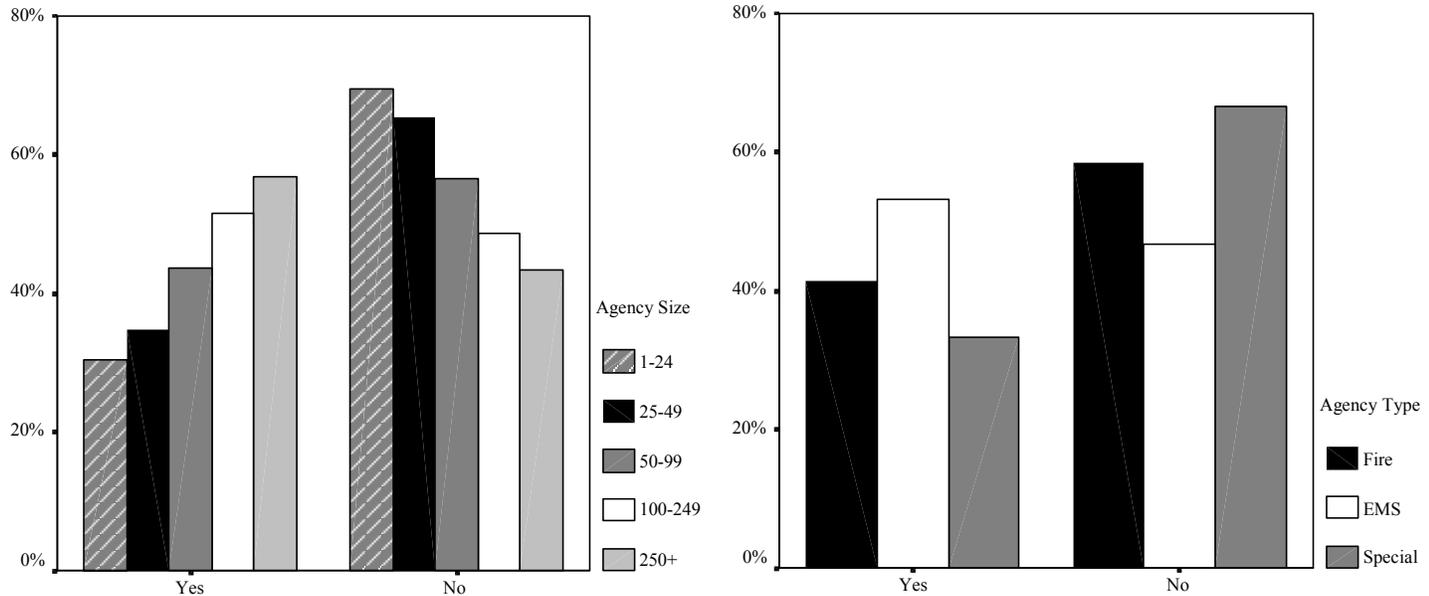


Exhibit 21

Interaction with Other Agencies Affected by a Lack of Interoperability

The lack of wireless radio interoperability has affected almost half of the responding fire and EMS agencies' ability to communicate with neighboring jurisdictions.

Forty-three percent of responding agencies indicate that the lack of interoperability has affected their ability to communicate with agencies in surrounding jurisdictions. In addition, 30 percent of responding agencies indicate that the lack of wireless communications interoperability has, at some time, hampered their ability to respond to a call.

EMS agencies appear to be the most affected, with 53 percent of these respondents indicating that the lack of interoperability had affected their ability to communicate. Forty-one percent of responding fire departments and 33 percent of special agencies also indicate that their ability to communicate with surrounding jurisdictions has been affected. Communications by career and volunteer fire departments with neighboring jurisdictions are equally affected by the lack of interoperability.

Lack of interoperability appears to have had more of an effect on larger agencies. Over half (53%) of the larger agencies (100 or more personnel) indicate that their ability to communicate with neighboring jurisdictions has been affected by the lack of interoperability. Forty-four percent of mid-size agencies (50 to 99 personnel) have been affected, while only about one-third (33%) of the smaller agencies (fewer than 50 personnel) have been affected.

Responses indicate that those agencies that have been affected by the lack of interoperability are less confident in their ability to handle various interoperability situations (See Appendix H, Table H-1, H-2, and H-3 for supporting data). Nearly a quarter (22%) of agencies affected by a lack of interoperability have serious concerns (rating of 1 or 2) with their ability to accomplish day-to day interoperability, compared with 47 percent of agencies that have not been affected (rating of 3, 4, or 5).

Agencies provided a variety of comments illustrating problems that arise from a lack of interoperability:

- *Different radio bands mean different radios for every band. As one band-aid measure, we must pass radios back and forth on emergency incidents. This seriously hampers the ability to coordinate fire resources while en route.*
- *Many frequencies and different bands exist in this area. This combined with lack of coverage and overcrowded frequencies continually hampers multi-agency response.*
- *Fifty percent of contiguous and surrounding jurisdictions are on different bands. This causes multiple relays of all messages.*
- *Lack of inter-agency 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 patient care provided.*

RATE THE ABILITY OF YOUR AGENCY’S RADIO SYSTEM TO EFFECTIVELY HANDLE THE THREE TYPES OF INTEROPERABILITY.

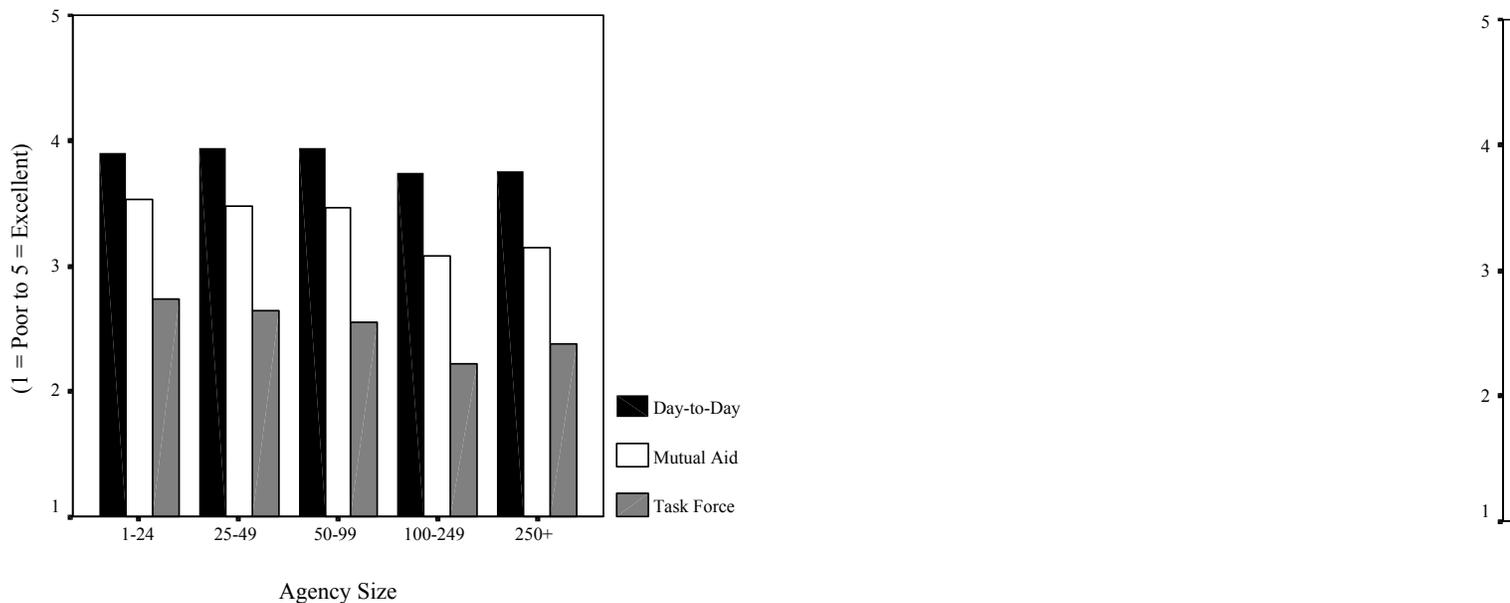


Exhibit 22
Agency Ability to Handle Different Types of Interoperability Situations

Fire and EMS agencies are confident in the ability of their radio systems to handle day-to-day interoperability situations.

Agencies were asked to assess their confidence in their ability to interoperate with other organizations. Agencies were asked to rate: (1) their agency’s overall ability to handle interoperability situations, and (2) the ability of their agency’s radio system to effectively handle day-to-day, mutual aid, and task force operations. Each question used a 5-point rating scale where 1 equals poor and 5 equals excellent. Ratings of 4 or 5 are considered as an indication of high confidence, whereas ratings of 3 are interpreted here as a moderate level of confidence. Ratings of 1 or 2 are considered an indication of serious concern.

Eighty-one percent of responding fire and EMS agencies express confidence (ratings of 3, 4, or 5) in their agency’s overall ability to handle interoperability situations today. Confidence varies greatly, however, depending on the type of interoperability required. Fire and EMS agencies are more confident in the ability of their radio system to handle day-to-day interoperability situations than they are for mutual aid or task force operations. Seventy-six percent of agencies express confidence in the ability of their radio system to handle day-to-day interoperability situations and are slightly less confident (63%) in their ability to handle mutual aid situations. Only 35 percent of agencies express confidence in their ability to handle task force situations, with a majority (65%) expressing low confidence levels (rating of 1 or 2).

Agency confidence in handling day-to-day interoperability is consistent across agency type, but fire departments are slightly more confident in handling mutual aid situations, and special agencies are slightly more confident in handling task force situations. Smaller agencies (fewer than 100 personnel) are also slightly more confident in their ability to handle all three types of interoperability situations than larger agencies. In addition, agencies with systems 5 years old or less and agencies using trunked systems are significantly more confident in their ability to handle all three types of interoperability situations than agencies using older systems and agencies using conventional radio systems (See Appendix H, Table H-4 for supporting data).

RATE THE ABILITY OF YOUR AGENCY TO ESTABLISH A RADIO LINK WITH OTHER PUBLIC SAFETY ORGANIZATIONS.

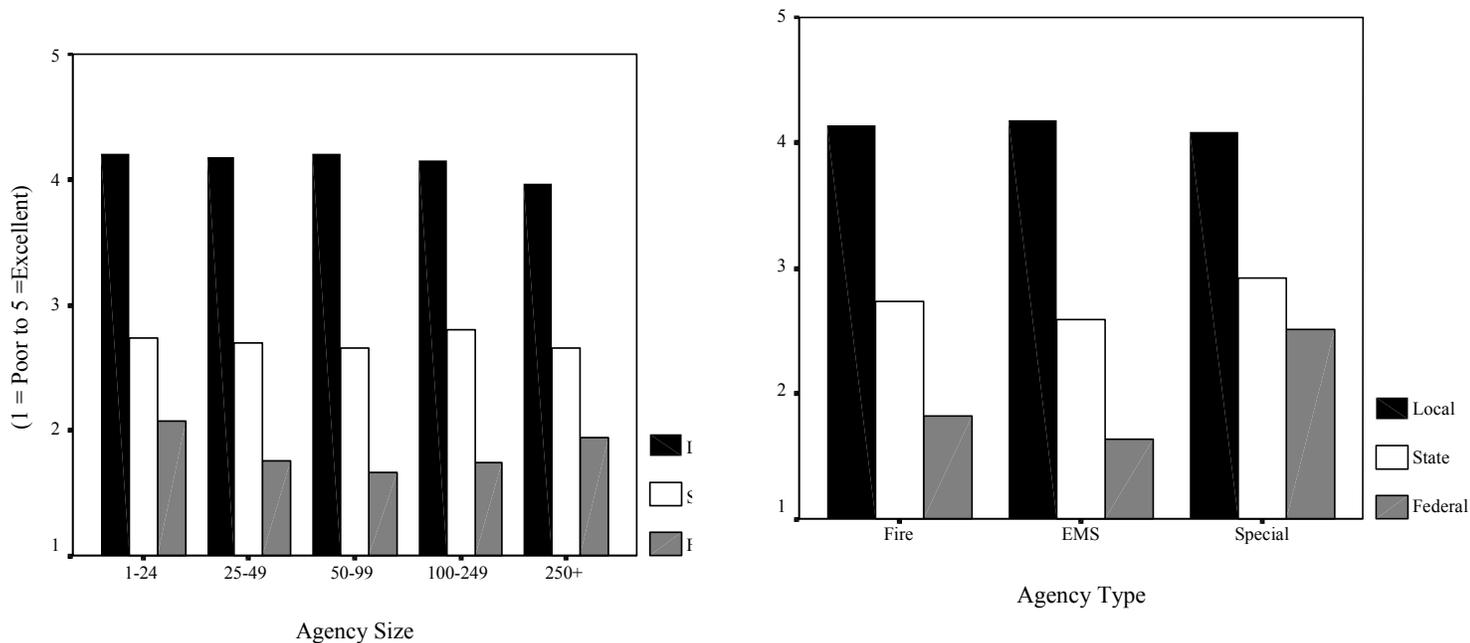


Exhibit 23
Ratings of Agency Ability to Establish Radio Links

Fire and EMS agencies are confident in their ability to establish radio links at the local level, but not with state or federal public safety organizations.

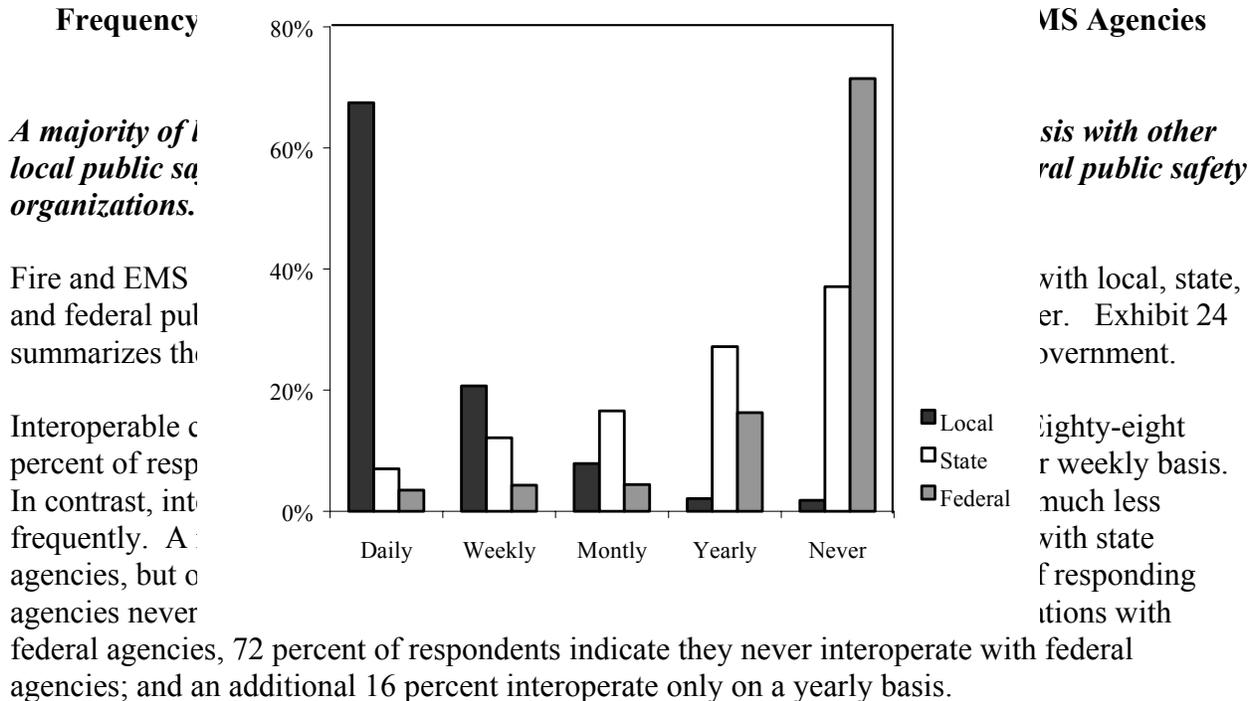
Agencies were asked to rate their ability to establish radio communications links with local, state, and federal public safety organizations. It should be noted that the method for establishing the radio link was not specified in the survey question. The reliability, quality, and security of radio links can range from simply swapping hand-held radios and installing multiple radios in emergency response vehicles to creating temporary system patches through a dispatch center. Establishing a radio link does not necessarily equal establishing interoperable communications. Seventy-six percent of fire and EMS agencies express high confidence (rating of 4 or 5) in their agency’s ability to establish radio links with local public safety organizations. In contrast, a majority of agencies (74%) report poor confidence (rating of 1 or 2) in their ability to establish links with federal public safety organizations and are divided over their ability to establish links with state organizations. Twenty-six percent express moderate confidence (rating of 3) in their ability to link with the state level, while 31 percent express high confidence; and 43 percent express poor confidence.

Neither agency type nor agency size appears to affect confidence levels for establishing radio links at the local or state levels. However, special agencies are slightly more confident in their

ability to establish links at the federal level. Agencies with systems 5 years old or less are slightly more confident in their ability to establish radio links with organizations than agencies with older systems. For example, local agencies with systems 5 years old or less provided an average confidence rating of 4.32 in establishing links with other local public safety organizations, while local agencies with systems older than 5 years old provided an average confidence rating of 4.02. Local agencies with systems 5 years old or less were similarly more confident in establishing links with state and federal organizations (3.03 and 2.00, respectively) than those agencies with older systems (2.56 and 1.71, respectively). Additionally, agency confidence in establishing links at any level significantly improves agency ratings for the overall ability to handle interoperability situations (See Appendix H-11 for supporting data).

HOW OFTEN DOES YOUR AGENCY HAVE INTEROPERABLE RADIO COMMUNICATIONS WITH PUBLIC SAFETY AND/OR PUBLIC SERVICE ORGANIZATIONS AT THE LOCAL, STATE, AND FEDERAL LEVELS?

Exhibit 24



Slight variations in the occurrence of interoperable communications exist depending on agency size and type (See Appendix H, Table H-5, H-6, and H-7 for supporting data). Larger agencies generally report more frequent interoperable communications with public safety organizations at all levels of government than smaller agencies. EMS agencies have the most frequent interoperable communications with local agencies. Specifically, 97 percent of responding EMS departments interoperate with local agencies daily or weekly, compared with 87 percent of fire departments and 86 percent of special agencies. However, special agencies are more likely than fire or EMS departments to interoperate with state or federal organizations. Twenty-seven percent of responding special agencies interoperate with state agencies daily or weekly, and 41 percent of special agencies interoperate with federal agencies daily or weekly basis.

Agency confidence in establishing links with each level of government varies with how frequently agencies are involved in interoperability situations. Fire and EMS agencies that indicate daily or weekly interoperable communications with other agencies report higher confidence ratings in their ability to establish links with those agencies. For example, of the fire and EMS agencies that express high confidence in their ability to establish links at the local level, 90 percent report frequent (daily or weekly) interactions with other local level public safety organizations (See Appendix H, Table H-8 for supporting data). By comparison, 60 percent of agencies with less frequent interaction (monthly, yearly, or never) express high confidence in their ability to establish radio links with other local level agencies. The same trend is apparent in the expressed ability of agencies to establish links at the state and federal level (See Appendix H, Table H-9 and H-10, respectively, for supporting data). Additionally,

agencies that are confident in their ability to establish links with each level of government (rating of 4 or 5) are significantly more likely to be confident in their ability to handle all types of interoperability (See Appendix H, Table H-11 for supporting data).

WHAT RADIO FREQUENCIES DOES YOUR AGENCY USE TO INTEROPERATE WITH OTHER PUBLIC SAFETY AND PUBLIC SERVICE ORGANIZATIONS?

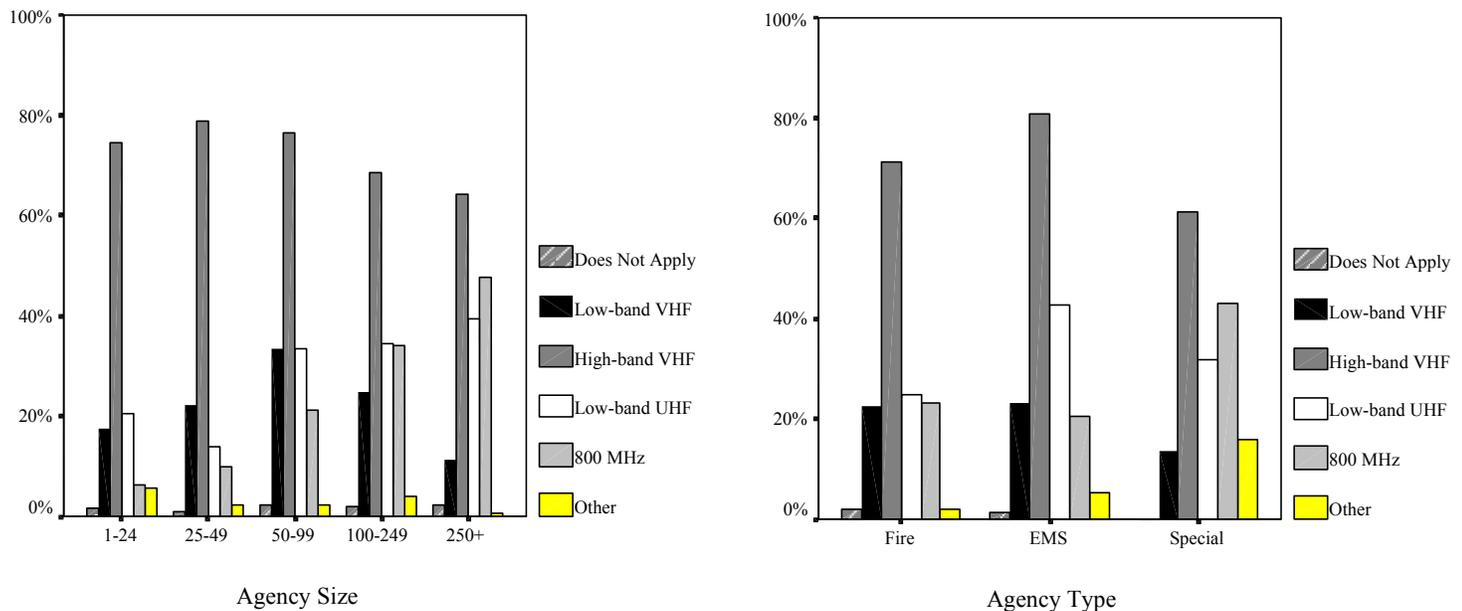


Exhibit 25

Radio Frequencies Used for Interoperability

High-band VHF is the most commonly used frequency band for interoperable communications.

Responding fire and EMS agencies indicate that high-band VHF is by far the most commonly used (72%) frequency band for interoperability. Twenty-eight percent of agencies use low-band UHF, and 24 percent use the 800 MHz band for interoperable communications.

Many agencies (38%) use multiple frequency bands for interoperability purposes, including more than 50 percent of responding EMS agencies. Larger agencies are also more likely to use multiple bands for interoperability. Nearly 50 percent of agencies with 50 or more personnel use multiple bands, compared with between 25 percent of the smaller agencies (fewer than 50 personnel).

Although high-band VHF is the most commonly used frequency for interoperability, the use of 800 MHz for interoperability increases with agency size. Only 12 percent of agencies with fewer than 100 employees use 800 MHz for interoperable communications, compared with 34 percent of agencies with 100 to 249 personnel and 48 percent of agencies with 250 or more personnel. The use of low-band UHF frequencies for interoperability is also more prevalent among the larger agencies.

The frequencies used for interoperable communications also vary with agency type. Special agencies indicated the most frequent use of 800 MHz (43%), compared with fire and EMS

agencies (20% and 23%, respectively). The majority (81%) of EMS agencies use high-band VHF; however, a significant number (43%) also use low-band UHF to interoperate.

Overall, fire departments interoperate using high-band VHF (71%). There are differences, however, between career and volunteer departments (See Appendix H, Table H-12 for supporting data). Career fire departments interoperate primarily on the high-band frequencies. Sixty-four percent of career fire departments interoperate using high-band VHF, and another 48 percent use 800 MHz. In addition, 14 percent use low-band VHF and 37 percent use low-band UHF. Volunteer fire departments also interoperate primarily using high-band VHF (69%); however, they are much more likely to also use the low-band frequencies. Thirty-two percent use low-band VHF, 19 percent use low-band UHF, and only 7 percent use 800 MHz.

Agency write-in responses reveal that many agencies are faced with migrating to 800 MHz systems to maintain interoperability with neighboring jurisdictions that have already transitioned to 800 MHz:

- *We are currently switching to a county-wide 800 MHz system that will put all public safety agencies in the county on the same system.*
- *Prior to January 1998...we had no compatibility with other agencies and no talk frequencies. We have just replaced that system with a trunked 800 MHz system.*
- *Neighboring EMS systems have migrated to other voice radio bands, primarily 800 MHz trunking...we will not have access to their new communications system until we implement our new system.*

WHAT IS THE PRIMARY RADIO LANGUAGE USED BY YOUR AGENCY WHEN COMMUNICATING WITH OTHER ORGANIZATIONS?

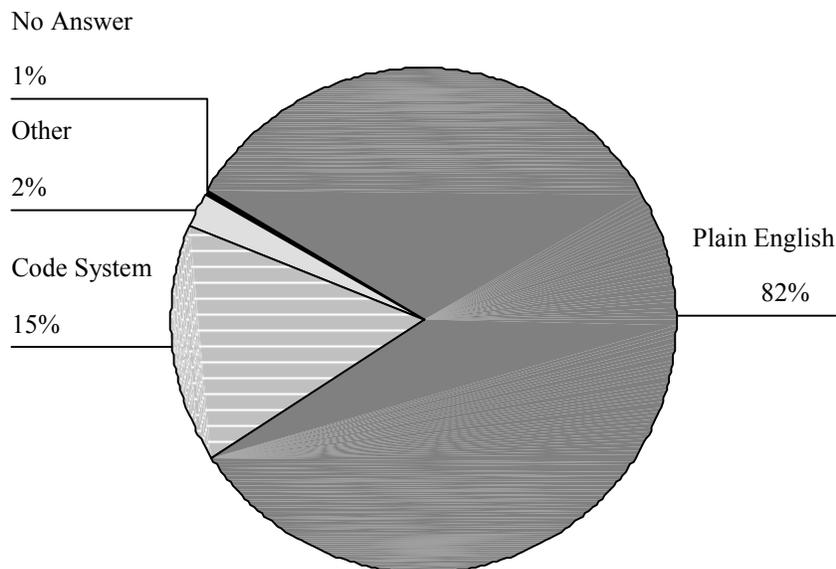


Exhibit 26

Radio Language Used for Interoperability

Most agencies have a dedicated channel for interoperable communications and use plain English as their primary radio language when communicating with others.

Of the more than three-quarters (79%) of fire and EMS agencies have at least one radio channel designated solely for communicating with other organizations, 82 percent use plain English for communications between their agencies and other organizations, while only 15 percent use a code system. EMS agencies are more likely to use code systems (20%) than other agency types are. (See Appendix H, Table H-13 for supporting data). Within fire departments, volunteer fire departments report higher use of code for interoperable communications (18%) than career fire departments (11%). Additionally, the smallest agencies (fewer than 25 personnel) report the highest use (19%) of code systems.

Seventy-six percent of fire and EMS agencies indicate that the use of different radio languages does not hinder communications with other agencies (rating of 1 or 2), and only 9 percent of agencies indicate that the use of different languages does hinder effective communications (rating of 3, 4, or 5). In fact, agencies that use plain English to communicate with other organizations are significantly more confident in their ability to handle day-to-day and mutual aid interoperability than agencies using code systems are (See Appendix H, Table H-14 for supporting data).

DOES YOUR AGENCY HAVE INTERGOVERNMENTAL COMMUNICATIONS AGREEMENTS WITH NEIGHBORING JURISDICTIONS FOR MUTUALLY DEFINED CALLS FOR SERVICES OR DISASTERS?

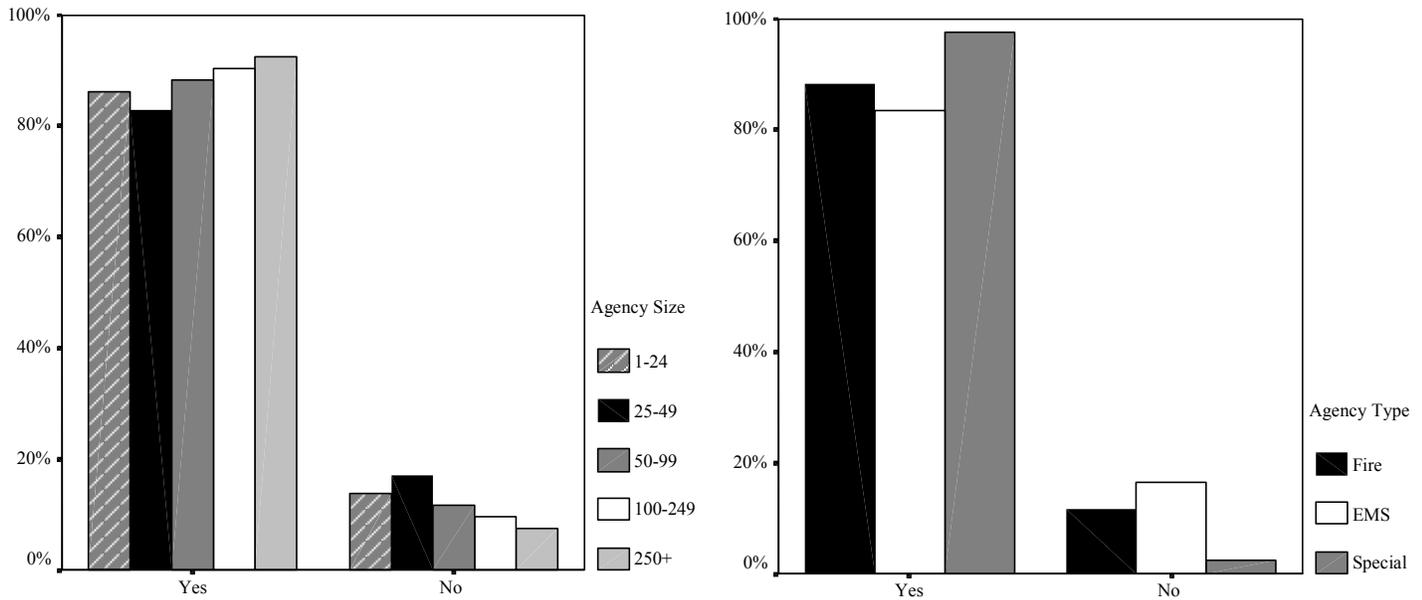


Exhibit 27

Percent of Agencies with Intergovernmental Communications Agreements

Nearly all fire and EMS agencies have some type of intergovernmental communications agreements.

Eighty-eight percent of respondents have intergovernmental agreements for radio communications with neighboring jurisdictions for mutually defined calls for service. Almost all of the special agencies (98%) have intergovernmental agreements with neighboring jurisdictions, as do 88 percent of fire departments and 83 percent of EMS agencies.

The percentage of agencies with intergovernmental agreements increases as agency size increases. Ninety-one percent of larger agencies (100 or more personnel) have intergovernmental agreements with neighboring jurisdictions, compared with 88 percent of mid-size agencies (50-99 personnel) and 85 percent of the smaller agencies (fewer than 50 personnel).

Agencies that interoperate with other public safety organizations daily or weekly, regardless of level of government, have a higher percentage of intergovernmental agreements than those agencies that interoperate with other agencies less frequently (See Appendix H, Tables H-15, H-16, and H-17, respectively, for supporting data). Agencies with intergovernmental

communications agreements are also significantly more confident in their overall ability to handle interoperable communications than agencies without agreements (See Appendix H, Table H-18 for supporting data). When asked to rate their confidence in their ability to handle interoperability situations, agencies with interoperability agreements reported an average confidence of 3.43, while those without agreements reported an average confidence of 2.98. Agencies with intergovernmental agreements are also significantly more confident that their training programs prepare them to handle interoperability situations.

SECTION 5: LOCAL FIRE AND EMS — INTEROPERABILITY SHORTFALLS

The *PSWAC Final Report* identified several potential obstacles to interoperability. These obstacles were coupled with issue areas identified in *Access America: Reengineering Through Information Technology*, (*Action Item 06 - Establish The Intergovernmental Wireless Public Safety Network*) and ongoing PSWN program efforts to develop a comprehensive list of potential obstacles to interoperability. Using this list, fire and EMS agencies were asked to rate how serious each obstacle is in terms of affecting their ability to interoperate. The following points provide a brief summary of the information gathered on interoperability obstacles and shortfalls experienced by local fire and EMS agencies.

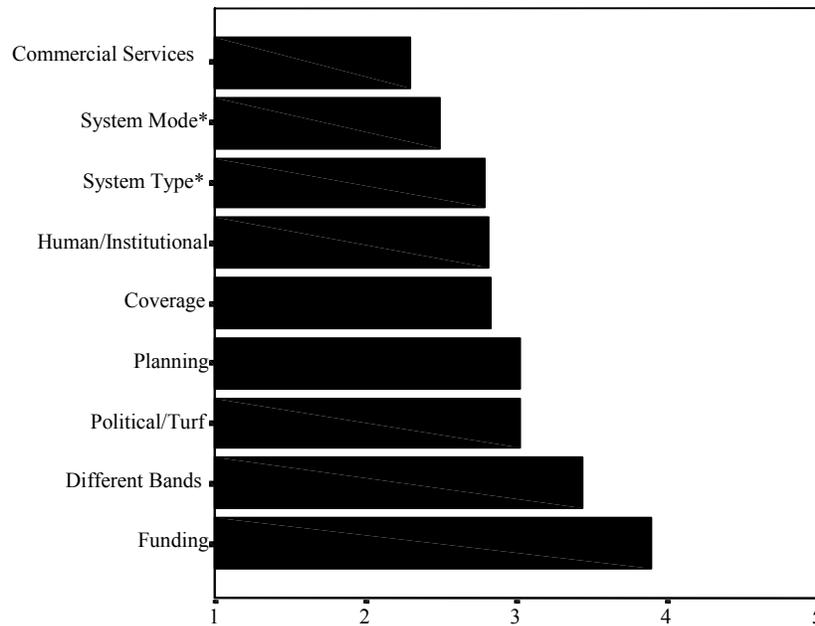
- All agencies, regardless of size and type, experience similar obstacles to interoperability; but, the severity of these obstacles differs depending on agency type. EMS agencies generally view obstacles as more severe problems than do fire departments or special agencies. Variations between career and volunteer fire departments also exist. Additionally, the perceived severity of each obstacle relates to agency size.
- Funding limitations and the use of different frequency bands are severe obstacles to interoperability for more than half of fire and EMS agencies (68% and 51%, respectively). The agencies that indicate limited funding as a severe obstacle are more likely to have severe problems with their LMR systems, including not enough channels, not enough talk groups, frequency interference, not enough equipment, and outdated equipment. In addition, these agencies are less confident in their ability to establish radio communication links with other local, state, and federal public safety organizations. Fire and EMS agencies operating in low-band VHF and low-band UHF rate different operating bands as more of an obstacle to interoperability, while agencies operating in high-band VHF and the 800 MHz band rate different operating bands as less of an obstacle.
- There is variability among fire and EMS agencies on the extent to which political or turf issues or human and institutional limitations are obstacles to interoperability. Just over one-third of agencies rate both issues as moderate problems, while the remaining agencies are evenly split on the severity of the obstacles. EMS agencies are significantly more likely to experience political or turf problems. Additionally, career fire departments are more likely to see political or turf problems as an obstacle than volunteer departments are. Agencies' perceptions about political or turf issues and human and institutional limitations as obstacles to interoperability increase as agencies are required to communicate with a larger number of agencies.
- A lack of adequate planning and problems with different coverage areas are severe problems for approximately one-third of responding agencies (36% and 30%, respectively). As expected, agencies that participate in joint training are less likely to have problems with planning. Fire and EMS agencies that operate within mountainous or forested terrain are more likely to have problems associated with different coverage areas.

- Three additional obstacles, which are operating in different system modes (analog versus digital), using different system architectures (conventional versus trunked), and limitations imposed by using commercial services, are not perceived as impediments to interoperability by a majority of responding fire and EMS agencies. Commercial service limitations are more of a problem for the smaller agencies.
- In addition to rating obstacles, agencies were asked to express their views on the establishment of state or federal mandates with date-certain timelines to ensure interoperability. Although agency responses are evenly split (52% percent supporting mandates and 48% opposing), distinctions by agency type are evident. A majority of EMS departments and special agencies are in favor of establishing mandates. Fire departments are evenly split, but career fire departments are more likely to favor date-certain mandates than volunteer fire departments are.
- Regardless of the obstacles agencies experience, a majority express increasing confidence in their ability to handle interoperability in the future. Today, almost half of agencies are confident (rating of 4 or 5) in their overall ability to handle interoperability situations, compared with 12 percent 5 years ago. Two-thirds of agencies are confident in their future abilities. Agencies that view funding and planning as severe obstacles to interoperability are less confident in their future abilities to interoperate.

Several specific analyses follow that provide more detailed information and insights into the interoperability shortfalls of local fire and EMS agencies. These analyses address the responses to the following questions and inquiries posed by the questionnaire.

- Based on your agency’s experience, indicate the severity of each of the following obstacles to interoperability:
 - Limitations in funding?
 - Different bands?
 - Political/turf issues?
 - Lack of adequate planning?
 - Different coverage areas?
 - Human and institutional limitations?
 - Different communication architecture types (conventional versus trunked)?
 - Different communication modes (analog versus digital)?
 - Limitations of commercial services?
- Rate your agency’s overall ability to handle communications interoperability situations 5 years ago, today, and 5 years into the future.
- As new technologies are introduced and digital communications mature, do you think there should be federal or state mandates with “date-certain” timelines to ensure interoperability?

BASED ON YOUR AGENCY’S EXPERIENCE, INDICATE THE SEVERITY OF EACH OF THE FOLLOWING OBSTACLES TO INTEROPERABILITY.



(1 = Not a Problem to 5 = Major Problem)

*System mode refers to analog versus digital communications modes and system type refers to conventional versus trunked system architectures.

Exhibit 28

Obstacles to Interoperability

Lack of funding and the use of different frequency bands are the two biggest obstacles to interoperability.

Fire and EMS agencies were given a list of potential obstacles and asked to rate the severity of each one as an impediment to interoperability based on their experience. Each obstacle used a 5-point rating scale where 1 equals not a problem and 5 equals a major problem. Ratings of 4 or 5 are considered as an indication of a severe obstacle, whereas ratings of 3 are interpreted here as a moderate obstacle. Ratings of 1 or 2 are considered an indication of a minor or nonexistent obstacle. Responding agencies rate limitations in funding and the use of different frequency bands as the two biggest obstacles. These two issues cause severe problems (rating of 4 or 5) for a significantly larger percentage of agencies than any of the other issues. Specifically, 68 percent of respondents classify funding as a severe problem; and 51 percent cite the use of different bands as a severe obstacle. In contrast, issues concerning commercial services were rated as severe by only 18 percent of respondents. Exhibit 28 and Exhibit 29, respectively, provide the relative ratings of the obstacles and the percentage of agencies that viewed each issue as a severe obstacle (See Appendix I, Table I-1 for supporting data).

Obstacles to Interoperability	Percentage of Respondents with a severity ranking of 4 or 5	Overall Average
Limitations in funding	68	3.88
Different bands	51	3.40
Political or turf issues	40	3.01
Lack of adequate planning	36	3.01
Different system architecture (conventional vs. trunked)	33	2.78
Different coverage areas	30	2.82
Different communications modes (analog vs. digital)	25	2.50
Human and institutional limitations	24	2.80
Limitations on commercial services	18	2.31

Percentages indicate the portions of agencies that rated the issue a 4 or 5 on a 5-point scale where 1 = Not a Problem and 5 = Major Problem.

Exhibit 29

Percentage of Responding Agencies That Consider Obstacles to Interoperability as Severe

Each obstacle is analyzed separately in the subsequent pages of this section. The percentage of agencies, segmented by both agency size and type, which provided each of the ratings on the 5-point scale is depicted graphically for each obstacle. Trends are highlighted based on these percentages, as well as the average ratings provided by each segment.

Agencies of all sizes and types experience similar obstacles to interoperability; however, analyzing responses in terms of agency size reveals several notable trends (See Appendix I, Table I-2 for supporting data). As agency size increases, so do concerns with the use of different frequency bands, political or turf issues, human and institutional limitations, and different system architecture types (conventional versus trunked systems). In addition, the largest agencies (250 or more personnel) also indicate a slightly higher concern with coverage areas as an obstacle. On the other hand, the smallest agencies (fewer than 25 personnel) are more likely to rate limitations in commercial services as an obstacle to interoperability than larger agencies are.

The seriousness of interoperability obstacles also differs depending on agency type. Special agencies are less concerned with limited funding as an obstacle to interoperability than fire or EMS departments are. On the other hand, EMS departments are more concerned with political/turf issues and a lack of adequate planning than fire departments or special agencies are.

Regardless of agency size or type, the lack of funding theme dominated written comments. Examples of the written comments provided by respondents include:

- *Who's going to foot the bill?*
- *Cost! The majority of public safety agencies have limited resources for communications equipment.*
- *Funding is the big issue. The federal and state agencies have big budgets and access to big funds – local agencies are limited and work with limited funds.*

Comments were also made on the use of different bands and political/turf issues as obstacles.

Examples include:

- *We have had border incidents where 4 or 5 agencies were responding and couldn't communicate because they were using 150 MHz, 800 MHz conventional systems, and 800 MHz trunked systems between the police/fire units.*
- *We are one of a handful of agencies still in the low-band VHF spectrum. On mutual aid assignments, communications with other agencies in different spectrum bands is a major problem.*
- *In the past, egos and agency attitudes have inhibited the best use of personnel. We need to be responsible to the public.*

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF LIMITATIONS IN FUNDING AS AN OBSTACLE TO INTEROPERABILITY.

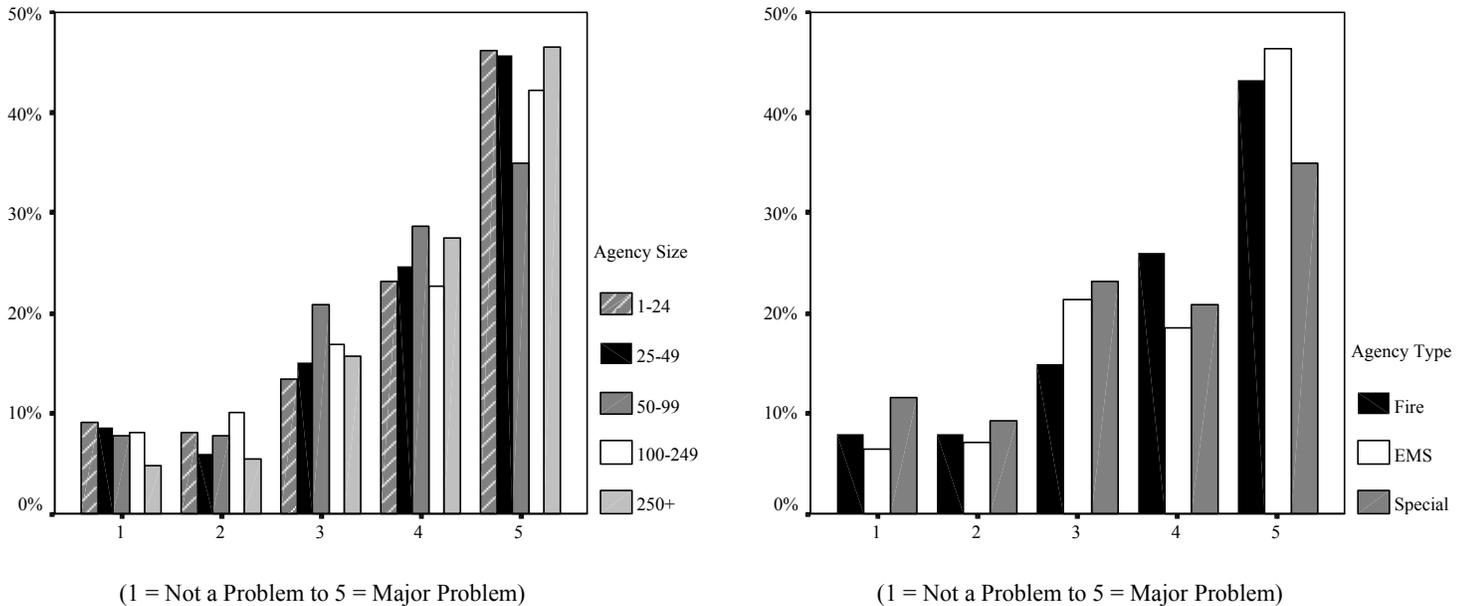


Exhibit 30
Extent to Which Limitations in Funding Are an Obstacle to Interoperability

Two-thirds of agencies view limitations in funding as a severe obstacle to interoperability.

Sixty-eight percent of fire and EMS agencies rate limitations in funding as a severe obstacle to interoperability (ratings of 4 or 5) (see Exhibit 29). The ratings provided by agencies of all types and sizes are generally consistent, as illustrated in Exhibit 30; but variations do exist. While only a third of mid-size agencies (50-99 personnel) indicated funding was a severe obstacle, almost half of both smaller and larger agencies rated funding as a severe obstacle. In addition, limited funding is less of a concern for special agencies (3.58 on a 5-point scale) than it is for fire or EMS departments (3.89 and 3.91, respectively). Among fire departments, career agencies are slightly more likely to view funding as a problem than volunteer agencies (3.90 and 3.84, respectively). (See Appendix I, Table I-3 for supporting data).

Agency perceptions of funding problems were compared to their perceived ability to handle interoperability and problems associated with their LMR systems. As expected, there are significant differences between agencies that view funding as a severe obstacle to interoperability and those that indicate it is a minor or nonexistent problem (rating of 1 or 2). (See Appendix I, Table I-4 for supporting data.)

Local agencies that experience funding problems are less confident in their ability to effectively handle all three types of interoperability. They are also less confident in their ability to establish radio communications links with all levels of public safety/service organizations. In addition,

agencies that report funding as a severe obstacle to interoperability rate problems with not enough channels, not enough talk groups, frequency interference, not enough equipment, and outdated equipment as severe problems in their land mobile radio systems, while agencies that view funding as a minor or nonexistent obstacle to interoperability do not.

Limitations in funding have no appreciable effect on an agency's plan to upgrade its land mobile radio system within the next 10 years. No significant differences are found between agencies that rate funding as a severe obstacle to interoperability and those that indicate it is a minor or nonexistent problem in regard to their plans for system upgrade or replacement. Although agencies view funding limitations as a severe obstacle, they still are proceeding with plans to replace their current systems.

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF THE USE OF DIFFERENT BANDS AS AN OBSTACLE TO INTEROPERABILITY.

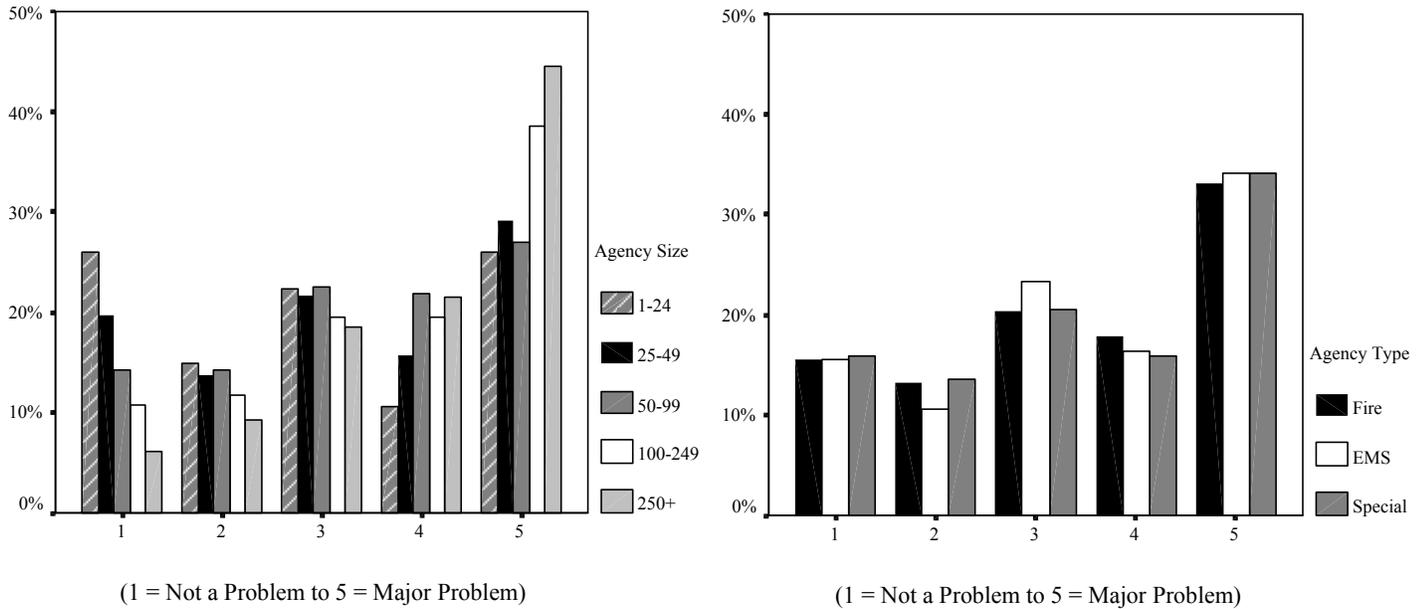


Exhibit 31
Agencies Indicating the Use of Different Bands as an Obstacle to Interoperability

Over half of the agencies indicate that the use of different frequency bands is a severe obstacle to interoperability.

The use of different frequency bands is a severe obstacle (rating of 4 or 5) to interoperability for 51 percent of responding fire and EMS agencies (see Exhibit 29). An additional 21 percent rate it as a moderate problem (rating 3). As detailed earlier, agencies communicate with other local jurisdictions on a daily or weekly basis, and often do so using multiple bands. Consequently, a large majority of fire and EMS agencies regularly confront problems with interoperability arising from the use of different bands.

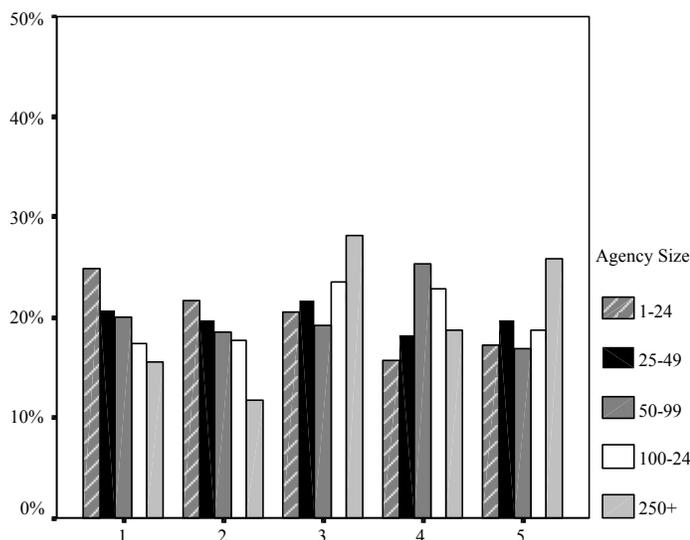
Comparisons across agency size reveal that as the number of personnel increases, so does the severity of the problem (see Exhibit 31). In fact, larger agencies (100 or more personnel) are significantly more likely to experience severe interoperability problems due to operation in different bands than small agencies (less than 50 personnel). Specifically, 66 percent of larger agencies rate the use of different bands as a severe obstacle to interoperability compared with 37 percent of small agencies. Agencies, regardless of type, experience similar problems with different frequency bands.

Agencies' problems due to the use of different bands vary with frequency band (See Appendix I, Table I-5 for supporting data). Fire and EMS agencies operating in low-band VHF and UHF rate the use of different operating bands as more of an obstacle to interoperability than do agencies operating in high-band VHF and 800 MHz. This finding may be attributable to the

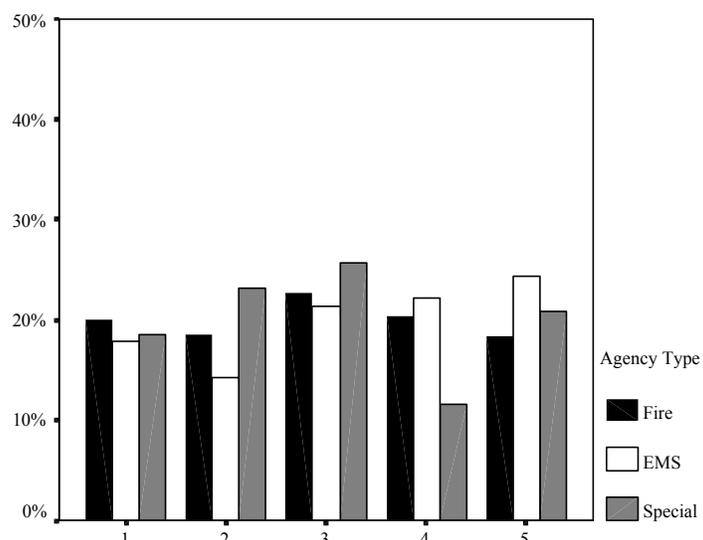
current prevalence of high-band VHF systems (see Exhibit 7) and the trend toward 800 MHz systems (see Exhibit 9).

Additionally, local agencies operating in the 800 MHz band are more confident in their ability to conduct mutual aid and task force operations. They are more confident in their ability to establish radio communications links with all levels of public safety/service organizations. In addition, agencies operating in the 800 MHz band rate problems with their land mobile radio systems as less severe, reflecting the fact that systems operating in the 800 MHz band tend to be newer and use modern technology. However, they are more likely to view different system architectures (conventional versus trunked) as an obstacle to interoperability.

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF POLITICAL OR TURF ISSUES AS AN OBSTACLE TO INTEROPERABILITY.



(1 = Not a Problem to 5 = Major Problem)



(1 = Not a Problem to 5 = Major Problem)

Exhibit 32

Political or Turf Issues as an Obstacle to Interoperability

Agencies are split over whether or not political/turf issues are an obstacle to interoperability.

There is variability among the fire and EMS respondents as to the extent to which political or turf issues hinder interoperability. Twenty-three percent of fire and EMS agencies rate political or turf issues as a moderate obstacle to interoperability (rating of 3). The remaining 76 percent of agencies are split evenly between viewing these issues as a minor or nonexistent obstacle (38 percent rating 1 or 2) or a severe obstacle (39 percent rating 4 or 5) (see Exhibit 29). A few trends are evident when comparing responses from different agency types. Almost half of EMS departments view political or turf issues as a severe problem (46%), while 39 percent of fire departments rate political or turf issues as a severe problem. Career fire departments are slightly more likely to view political or turf issues as a problem than volunteer fire departments are (40% of career departments compared with 37% of volunteer departments).

Differences also exist based on agency size. The severity of political or turf issues as an obstacle to interoperability increases as the number of agency personnel increases. Forty-five percent of large agencies (250 or more personnel) rate political or turf issues as a severe problem (rating of 4 or 5), compared with 42 percent of mid-size agencies (50-99 personnel) and 33 percent of small agencies (fewer than 25 personnel).

It is generally known that political and turf problems can arise within or between agencies involved in collaborative efforts. Working relationships or variations in familiarity with

technology may lessen that problem. However, responses from fire and EMS agencies indicate that participation in joint training exercises with communications equipment appears to have little to no effect on their determination of political or turf issues as an obstacle to interoperability. In addition, involvement in shared communication agreements did not affect views of political or turf problems.

However, agency views on the impact of political or turf issues change depending on their perceptions regarding adequate planning and limitations in funding. Of the agencies that experience severe problems from limitations in funding, 62 percent also believe that political or turf issues are a serious impediment to interoperability. The same is true of agencies that experience severe problems from inadequate planning (See Appendix I, Tables I-4 and I-6 for supporting data).

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF LACK OF ADEQUATE PLANNING AS AN OBSTACLE TO INTEROPERABILITY.

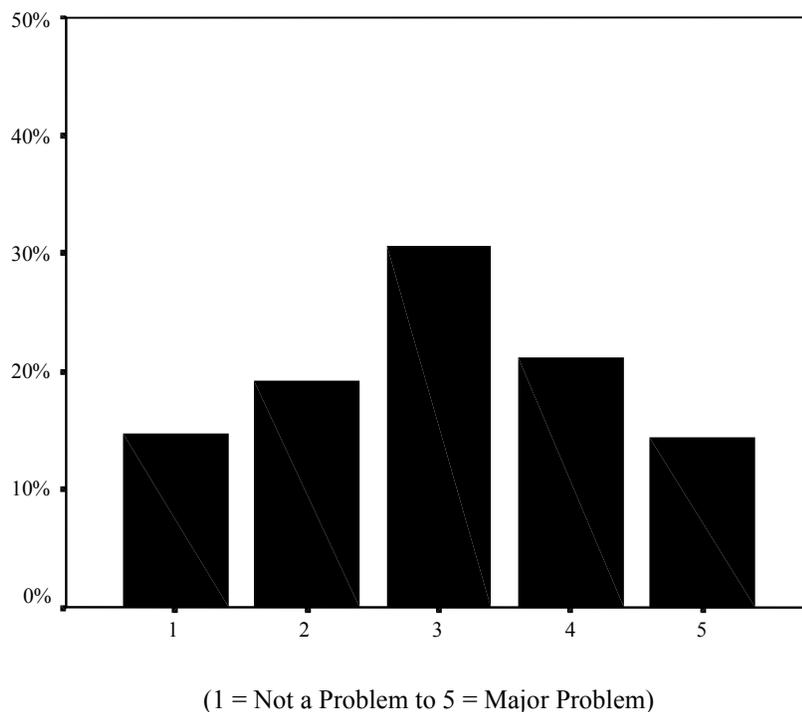


Exhibit 33

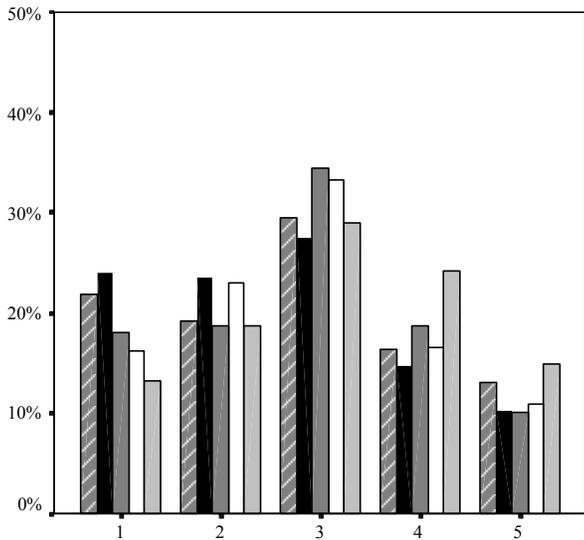
Lack of Adequate Planning as an Obstacle to Interoperability

A lack of adequate planning hinders interoperability for more than a third of agencies, regardless of type or size.

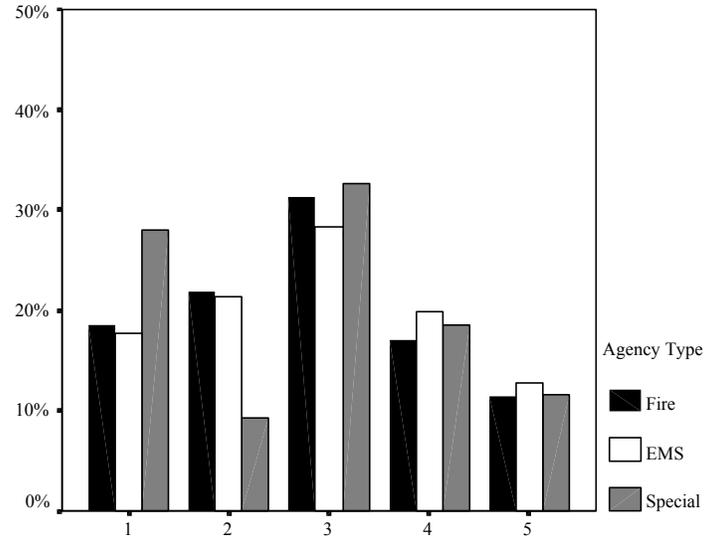
Thirty-six percent of fire and EMS agencies report a lack of adequate planning as a severe obstacle (rating of 4 or 5) to interoperability (see Exhibit 29). As illustrated by Exhibit 33, an additional 30 percent rate it as a moderate or occasional problem (rating of 3).

Comparing agencies that rate a lack of planning as a severe obstacle with those that do not reveals several trends (See Appendix I, Table I-6 for supporting data). Agencies that rate the lack of adequate planning as a severe obstacle have significantly less confidence in their ability to effectively handle interoperability situations, including day-to-day, mutual aid, and task force operations. In addition, these agencies also have significantly less confidence in their ability to establish radio communications links at the local, state, and federal levels than those agencies that do not perceive adequate planning as an obstacle. Agencies planning to replace their systems in the next 10 years view a lack of adequate planning as a more severe obstacle. However, agencies that participate in joint training exercises that involve communications are less likely to experience problems with interoperability due to a lack of adequate planning.

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF DIFFERENT COVERAGE AREAS AS AN OBSTACLE TO INTEROPERABILITY.



(1 = Not a Problem to 5 = Major Problem)



(1 = Not a Problem to 5 = Major Problem)

Exhibit 34

Different Coverage Areas as an Obstacle to Interoperability

Different coverage areas complicate interoperability for a quarter of the agencies.

Forty percent of fire and EMS agencies indicate that problems associated with different coverage areas are minor or nonexistent obstacles to interoperability (rating of 1 or 2). However, 29 percent of agencies view problems with different coverage areas as severe (rating of 4 or 5) (see Exhibit 29). As depicted by Exhibit 34, these results are consistent regardless of agency type and size.

Agencies that report having mountainous or heavily forested terrain view different coverage areas as more of a problem than do agencies with other topography/terrain groupings (See Appendix I, Table I-7 for supporting data). In addition, agencies that believe problems associated with different coverage areas are a severe obstacle are also more likely to view political or turf issues as a severe obstacle to interoperability (See Appendix I, Table I-8 for supporting data).

BASED ON YOUR AGENCY’S EXPERIENCE, INDICATE THE SEVERITY OF HUMAN AND INSTITUTIONAL LIMITATIONS AS AN OBSTACLE TO INTEROPERABILITY.

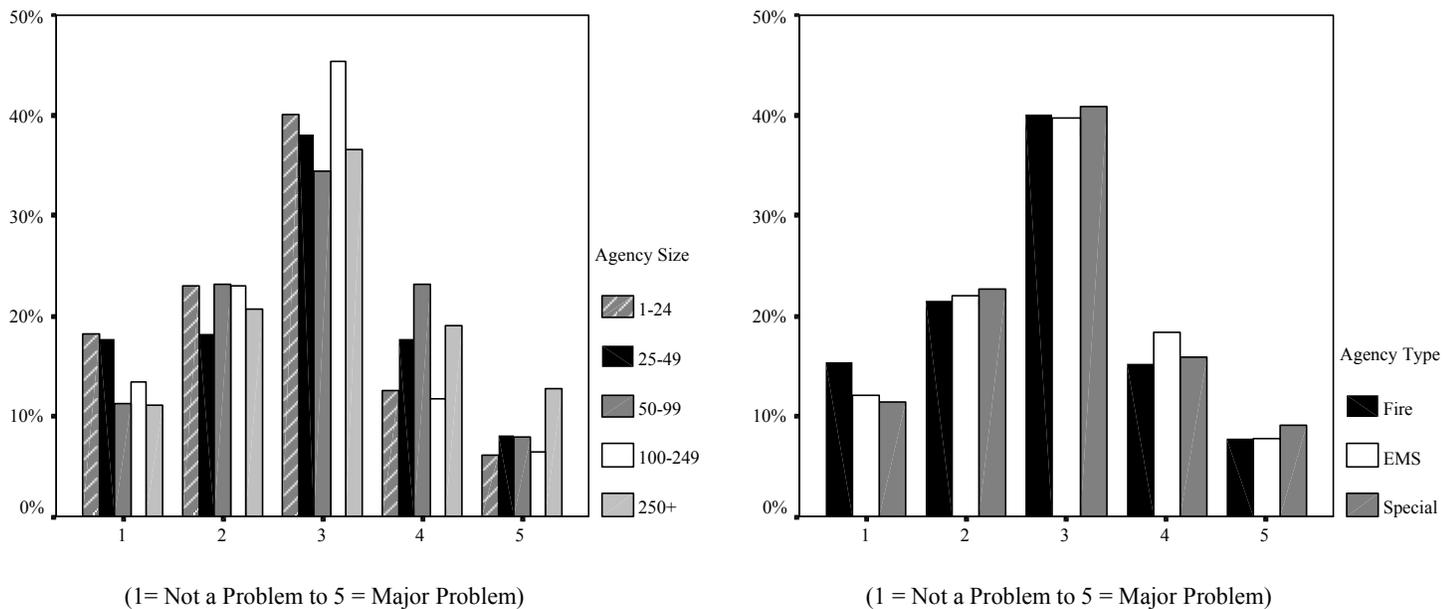


Exhibit 35
Human and Institutional Limitations as an Obstacle to Interoperability

Human and institutional limitations are a moderate problem.

Human and institutional limitations are defined in the *PSWAC Final Report* 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.^{xi} A majority of responding agencies view human and institutional limitations as a moderate or occasional obstacle (40%), regardless of agency size or type. An additional 37 percent indicate that human and institutional limitations are a minor or nonexistent obstacle to interoperability (rating of 1 or 2), while only 24 percent rate indicate it is a severe obstacle (rating of 4 or 5) (see Exhibit 29).

Differences in the perception of the severity of the problem varies by agency size. As fire and EMS agency size increases, so do concerns over human and institutional problems as an obstacle to interoperability. The largest agencies (250 or more personnel) are more likely to consider human and institutional limitations a serious obstacle to interoperability than small agencies (fewer than 25 personnel).

In addition to agency size, it is important to consider under what conditions agencies might be faced with human and institutional limits. Management and control issues can potentially arise when agencies interoperate with one another. The likelihood of fire and EMS agencies rating human and institutional limitations as an obstacle to interoperability increases in proportion to the number of agencies with which they are required to communicate at all three levels of government (local, state, and federal) (See Appendix I, Tables I-9, I-10, and I-11 for supporting

data). For example, of the agencies that communicate with one to five local agencies, only 20 percent believe that human and institutional limitations hamper interoperability. Comparatively, of the fire and EMS agencies that communicate with more than 20 local agencies, 27 percent feel that human and institutional limitations are a severe obstacle to interoperability. Similar trends are evident if the agencies communicate with federal or state agencies. However, problems that the responding agencies are experiencing with human and institutional limitations do not appear to be related to whether an agency has a shared communications arrangement (See Appendix I, Table I-12 for supporting data).

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF DIFFERENT SYSTEM ARCHITECTURES AS AN OBSTACLE TO INTEROPERABILITY.

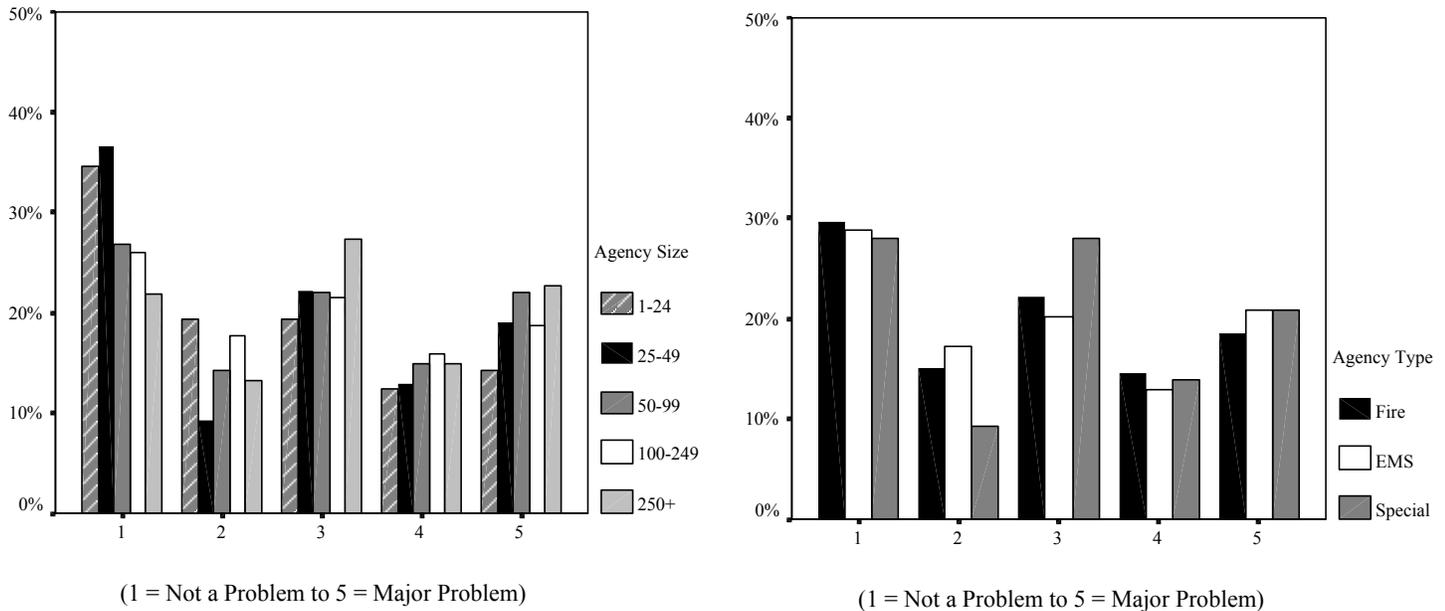


Exhibit 36
Different Communications System Architectures as an Obstacle to Interoperability

The use of different system architectures is not generally viewed as a severe obstacle to interoperability.

Only one-third of responding fire and EMS agencies indicate that the use of different communications system architectures (conventional versus trunked) is a severe obstacle to interoperability (rating 4 or 5) (see Exhibit 29). As illustrated by Exhibit 36, 45 percent of agencies view these differences as a minor or nonexistent obstacle (rating of 1 or 2); and 22 percent believe it is a moderate problem (rating of 3).

Comparisons of fire and EMS agencies across agency size and type indicate a few distinctions. The largest agencies (250 or more personnel), which are three times as likely to have trunked systems, are significantly more likely to view the use of different system architectures as an obstacle (38%) than small agencies are (fewer than 25 personnel, which are at 27%). In addition, special agencies are more likely to perceive the use of different communications system architectures as a moderate obstacle (rating of 3) to interoperability (28%) than fire departments or EMS agencies (22% and 20%, respectively).

Differences also exist between fire and EMS agencies based on their current and anticipated next system architecture type. Agencies currently operating trunked systems (20% of respondents) are significantly more likely to rate problems associated with different system types as an obstacle to interoperability (average of 3.02) than agencies using conventional systems (average

of 2.72). Nonetheless, when asked about what system architecture they will use for their next system, respondents prefer trunked systems by more than a 2 to 1 margin.

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF DIFFERENT COMMUNICATIONS MODES (ANALOG VERSUS DIGITAL) AS AN OBSTACLE TO INTEROPERABILITY.

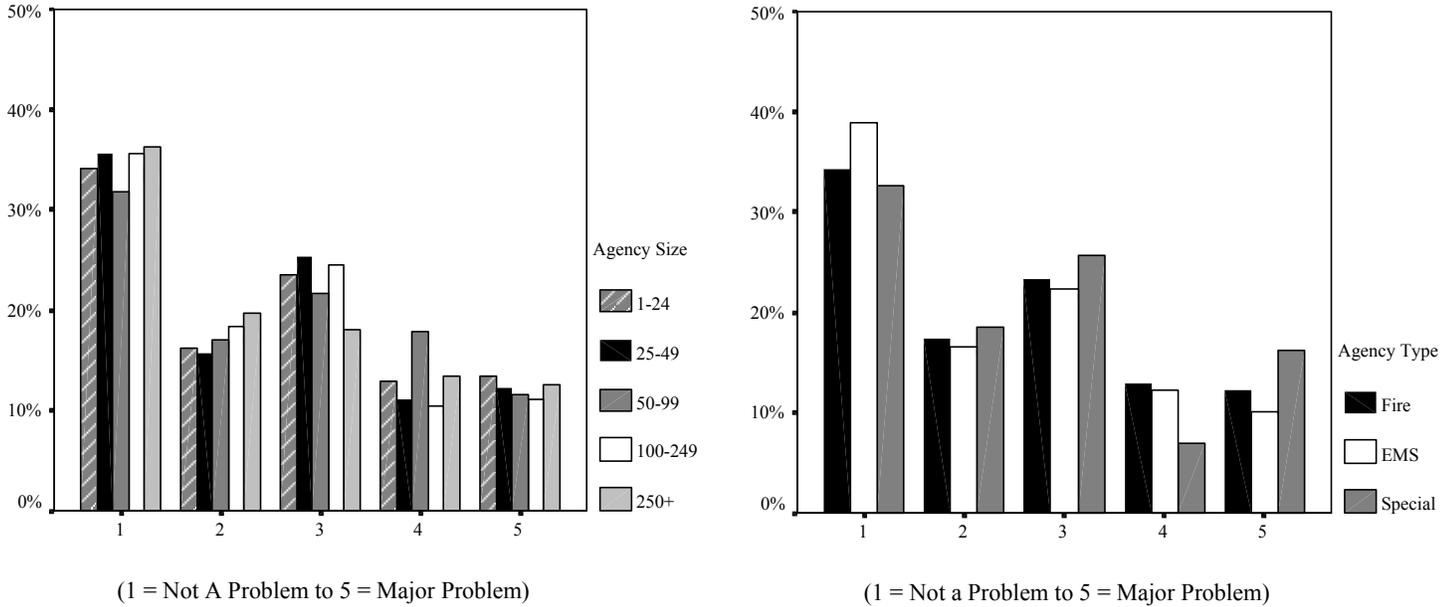


Exhibit 37

Different Communications Modes as an Obstacle to Interoperability

The use of different communications modes is not a problem for a majority of agencies.

Less than one quarter (24%) of fire and EMS agencies, regardless of agency size or type, view the use of different communications modes (analog versus digital) as a severe obstacle to achieving interoperability (rating of 4 or 5). Of responding agencies, 42 percent experience only minor or nonexistent problems (rating of 1 or 2); and 23 percent believe it is a moderate problem (rating of 3). Overall, 16 percent of agencies currently using digital systems rate different modes as a severe obstacle compared to 26 percent of agencies using analog systems.

Although 79 percent of responding agencies report using analog modes in their current system, agencies are four times as likely to prefer digital technology over continued analog use in their next land mobile radio system. This preference holds whether or not agencies view different communications modes as an obstacle.

BASED ON YOUR AGENCY'S EXPERIENCE, INDICATE THE SEVERITY OF LIMITATIONS OF COMMERCIAL SERVICES AS AN OBSTACLE TO INTEROPERABILITY.

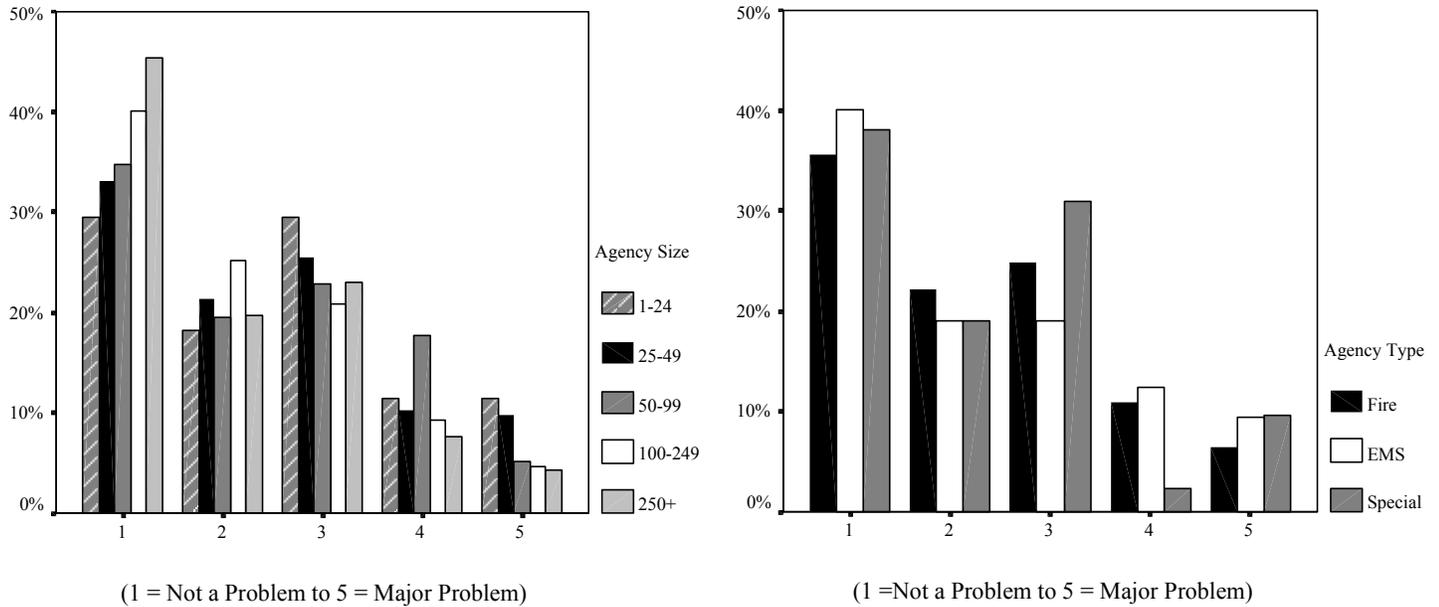


Exhibit 38

Limitations of Commercial Services as an Obstacle to Interoperability

Limitations of commercial services are not perceived as obstacles to interoperability.

Only 19 percent of responding fire and EMS agencies view limitations in commercial services as a serious obstacle to interoperability (rating of 4 or 5) (see Exhibit 29). Fifty-seven percent of agencies do not view commercial service limitations as a problem (rating of 1 or 2), while 24 percent experience moderate problems (rating of 3). Responses are consistent regardless of agency type or agency communications arrangements; but smaller agencies (fewer than 25 personnel) are slightly more likely to rate limitations in commercial services as an obstacle.

DO YOU THINK THERE SHOULD BE STATE OR FEDERAL MANDATES WITH “DATE CERTAIN” TIMELINES TO ENSURE INTEROPERABILITY?

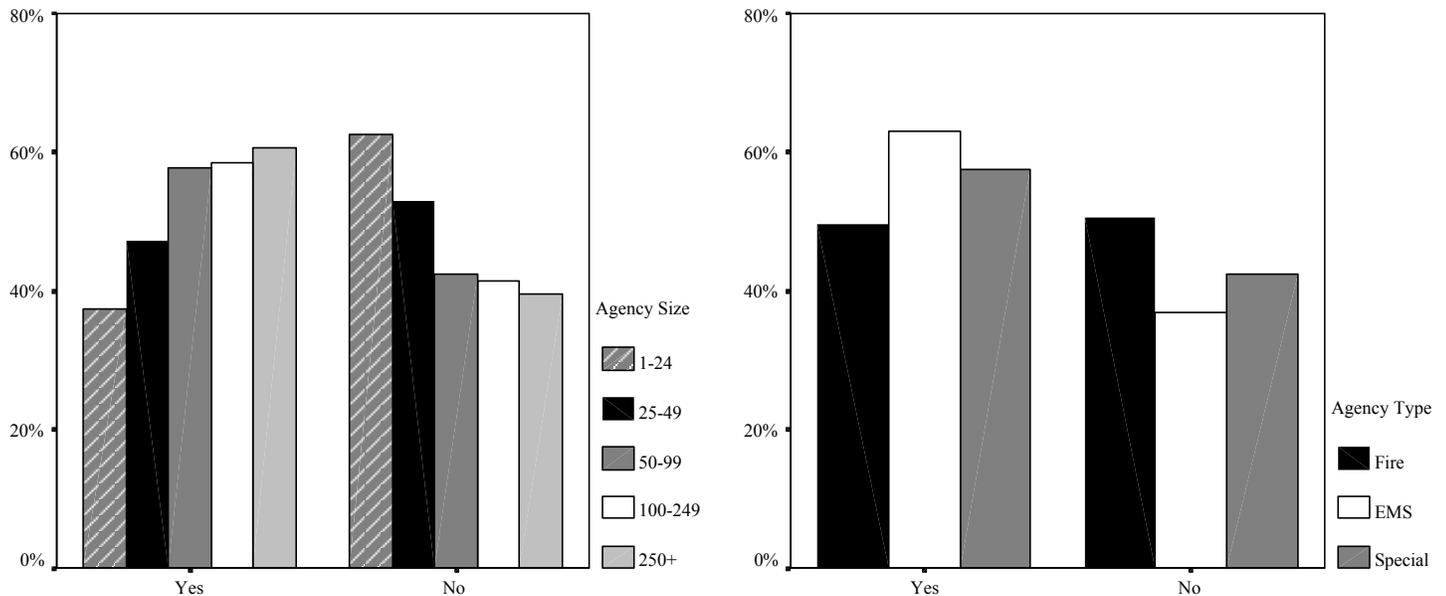


EXHIBIT 37
Agencies’ Opinions on State or Federal Mandates

Agencies are divided over the need for state or federal date-certain mandates to ensure interoperability.

Of responding fire and EMS agencies, 52 percent are in favor of establishing state or federal mandates, while 48 percent of agencies are opposed to them. However, 21 percent of the agencies participating in the survey did not answer the question. Consequently, no clear consensus is apparent.

An examination of agency support across the varying size categories reveals that the percentage of agencies supporting date-certain state or federal mandates increases with agency size. Specifically, 37 percent of the smallest agencies (fewer than 25 personnel) are in favor of establishing mandates compared with 61 percent of the largest agencies (250 or more personnel). This trend is illustrated in Exhibit 39.

Differences in support are also evident depending upon agency type. A clear majority of EMS departments and special agencies favor date-certain mandates (63% of EMS agencies and 58% of special agencies). However, fire departments are evenly split on the issue with 50 percent in favor of establishing mandates and 50 percent opposed. A closer inspection of the fire departments reveals differences depending on the type of fire department (i.e., career versus volunteer) (See Appendix I, Table I-13). Fifty-nine percent of fire departments with career personnel support establishing mandates, while support drops to 45 percent among volunteer fire departments.

The topic of mandates spurred strong feelings from both viewpoints. Half of the fire and EMS agencies surveyed provided written comments concerning the introduction of mandates with date-certain timelines. Funding is most often identified as a limitation to compliance with interoperability mandates. Although the written comments directly cite funding as an impediment to establishing date-certain federal or state mandates, no significant differences exist between those agencies that believe limitations in funding are a severe problem and those that do not (See Appendix I, Table I-4 for supporting data). A second major theme among the written comments is the lack of adequate planning as a serious constraint. Again, there are no significant differences in the responses of agencies that perceived lack of adequate planning as a serious problem versus those who did not (See Appendix I, Table I-6 for supporting data).

Examples of the written comments:

- *Funding is the key issue. Without federal assistance most agencies can't comply.*
- *Mandates assume adequate funding. If they fund the changes – mandate away.*
- *Federal mandates are necessary to improve compliance. Similarly, federal assistance is necessary to help purchase equipment.*
- *It is a good idea, but only if guaranteed funding sources are identified.*
- *Cost. We are volunteers. \$ is not in great supply. If the government mandates it then they should pay for it!*
- *We have enough federal mandates to deal with in our life.*
- *Without a mandate the politics and funding issues will allow the agency with the loudest voice or most money to dominate. Equally important would be to give direction to the smaller and less affluent agencies. National planning with regional coordination of frequencies is needed!*
- *Federal and state deadlines and bureaucracies hinder progress at times.*

ESTIMATE YOUR AGENCY'S OVERALL ABILITY TO HANDLE INTEROPERABILITY SITUATIONS 5 YEARS AGO, TODAY, AND 5 YEARS INTO THE FUTURE.

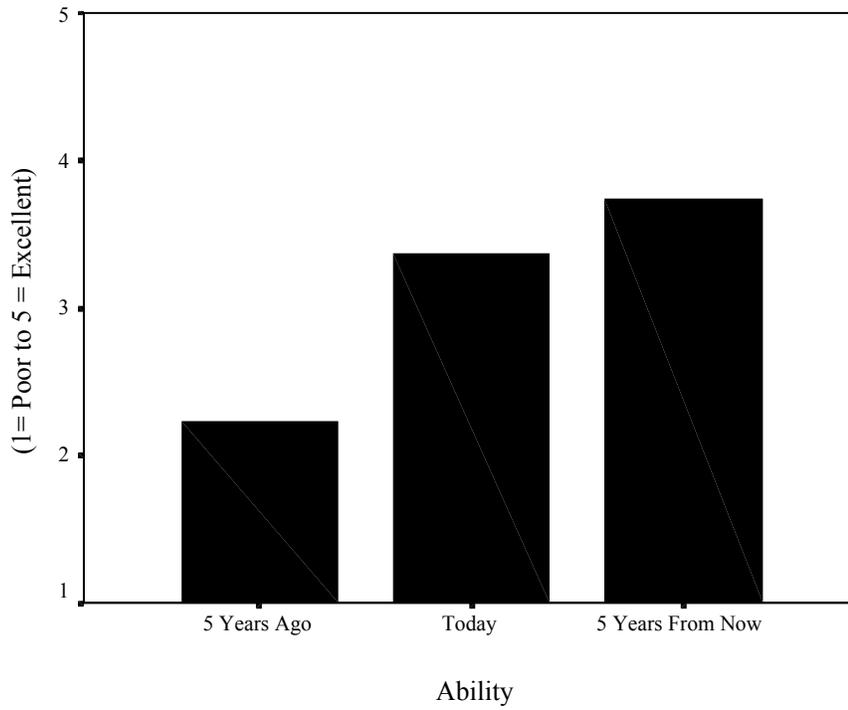


Exhibit 40

Agencies' Estimates of Ability to Handle Interoperability Situations 5 Years Ago, Today, and 5 Years From Now

Regardless of size or type, agencies expect improved interoperability in the future.

Fire and EMS agencies' confidence in their ability to handle interoperability situations has increased over the past 5 years and is expected to continue to rise over the next 5 years. Sixty-five percent of responding agencies express strong confidence (rating of 4 or 5) in their ability to handle interoperability 5 years from now. Comparatively, 48 percent of agencies have strong confidence in their current ability. This is a dramatic increase from the 13 percent of agencies that expressed strong confidence levels in their ability 5 years ago. Agencies' growing confidence in their ability to interoperate is consistent regardless of agency size or type (See Appendix I, Table I-14 for supporting data).

This generally optimistic outlook may be related to the fact that 57 percent of respondents have plans to replace or substantially upgrade their land mobile radio systems within the next 10 years. However, regardless of agencies' plans for their next land mobile radio system, respondents express similar confidence levels in their future ability to handle interoperability situations (See Appendix I, Table I-15 for supporting data). Current confidence levels are affected neither by the existence of intergovernmental communications agreements with neighboring jurisdictions for mutually defined calls for service or disasters nor by participation in joint training exercises. (See Appendix I, Table I-16 and I-17, respectively, for supporting data).

Yet, significant differences in confidence levels exist between agencies that view limitations in funding or lack of adequate planning as minor or nonexistent obstacles to interoperability (ratings of 1 or 2) and those that rate them as severe obstacles (ratings of 4 or 5). Fire and EMS agencies that do not see limitations in funding or the lack of adequate planning as a hindrance express significantly more confidence in their future ability than agencies rating either of the two potential obstacles as severe to impeding interoperability (See Appendix I, Tables I-4 and I-6, respectively, for supporting data).

SECTION 6:
LOCAL FIRE AND EMS — INTEROPERABILITY KNOWLEDGE AND TRAINING

Knowledge and training can heighten the ability of fire and EMS agencies to handle interoperability situations or overcome interoperability shortfalls. To assess knowledge levels, agencies were asked to rate their familiarity with recent initiatives affecting wireless communications technology. Agencies were also asked to describe the nature of their communications training and rate the effectiveness of training and its impact on their overall preparedness to handle interoperability situations. Information on these topics is of interest to policymakers and others who are working towards improving public safety wireless communications. The following points provide a brief summary of the information gathered on communications knowledge and training of local fire and EMS agencies.

- Three-quarters of fire and EMS agencies participate in joint training exercises that involve the use of communications equipment. Joint training exercises are widely conducted with local agencies and occasionally with state and federal agencies. Regardless of the level of participation, agencies that participate in joint training exercises are confident that training has prepared them to handle interoperability situations.
- Overall, agencies are unfamiliar with current initiatives relating to wireless communications and interoperability. Agencies have almost no knowledge of standards development initiatives and are only slightly more familiar with FCC licensing and refarming. This includes those agencies that are currently planning to replace or substantially upgrade their land mobile radio systems. However, familiarity with interoperability issues does increase with agency size. Although the vast majority of agencies are unfamiliar with Project 25 standards (82%), at least one-third indicate that they are likely to adopt Project 25 standards for their next LMR system.
- Agencies were also asked to rank the importance of various information sources for their agencies. All sizes and types of agencies rely on equipment manufacturers as their primary source of information when planning for the purchase of communications technologies. Information from other government agencies is a second important source. Larger agencies tend to use a variety of external sources, while smaller agencies used fewer sources.

Several specific analyses follow that provide more detailed information and insight into the communications knowledge and training of local fire and EMS agencies. These analyses address the responses to the following questions and inquiries posed by the questionnaire.

- **How familiar is your agency with the following initiatives promoting public safety communications?**
- **How important is each source of information to your agency when planning for the purchase of communications technologies?**

- **How likely is it that your agency will adopt Project 25 Interoperability Standards for its next land mobile radio system?**
- **Does your agency participate in joint training exercises with other organizations that involve the actual use of communication equipment?**
- **How well do you believe your agency's training has prepared your staff to handle communications interoperability situations?**

HOW FAMILIAR IS YOUR AGENCY WITH THE FOLLOWING INITIATIVES PROMOTING PUBLIC SAFETY COMMUNICATIONS?

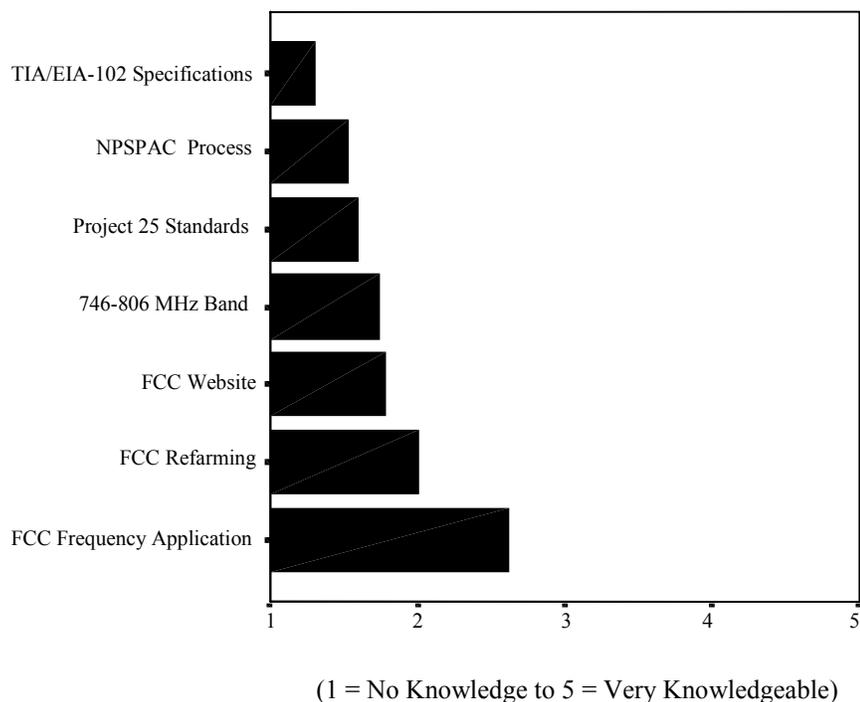


Exhibit 41

Familiarity with Current Wireless Communications and Interoperability Initiatives

Agencies are unfamiliar with current initiatives affecting public safety communications.

Fire and EMS agencies were asked to rate their familiarity with a list of initiatives related to wireless communications and interoperability. Exhibit 41 illustrates the extent to which agencies are familiar with the various initiatives. Overall, agencies are fairly unfamiliar with all initiatives.

Fire and EMS agencies have limited knowledge of radio spectrum issues such as FCC frequency application processes (average rating of 2.60) and refarming (average rating of 2.00). Knowledge of the National Public Safety Planning Advisory Committee (NPSPAC) guidelines for 800 MHz spectrum allocations is very poor (average rating of 1.50). Similarly, agencies have almost no knowledge of standards development initiatives such as TIA/EIA-102 specifications (average rating of 1.31) or proposed Project 25 standards (average rating of 1.60).

Familiarity with recent initiatives increases with agency size (See Appendix J, Table J-1 for supporting data). This is particularly evident regarding familiarity with Project 25 standards and FCC refarming efforts. Smaller agencies (fewer than 50 personnel) rated their familiarity with these initiatives as an average of 1.22 and 1.58, respectively. Mid-size agencies (50-99 personnel) rated their familiarity with the same initiatives as an average of 1.34 and 1.93, and

large agencies (100 or more personnel) rated their familiarity as an average of 2.07 and 2.47, respectively. In addition, agencies currently operating in the 800 MHz band are more knowledgeable of recent wireless communications initiatives than agencies operating in other radio frequency bands. Specifically, agencies operating in 800 MHz indicate more knowledge of Project 25 standards (average of 2.24 versus 1.43 for those operating in other bands), FCC refarming efforts (2.50 versus 1.88), and NPSPAC (2.07 versus 1.36).

Knowledge of these recent initiatives remains poor even if an agency is planning to replace or substantially upgrade its LMR system. Of those agencies planning a system upgrade or replacement, 90 percent report little or no knowledge (rating of 1 or 2) about TIA/EIA-102 specifications; and more than 70 percent report the same knowledge level concerning Project 25 standards, the NPSPAC process, the FCC Web site, and the FCC spectrum allocation in the 746-806 MHz band.

HOW IMPORTANT IS EACH SOURCE OF INFORMATION TO YOUR AGENCY WHEN PLANNING FOR THE PURCHASE OF COMMUNICATIONS TECHNOLOGIES?

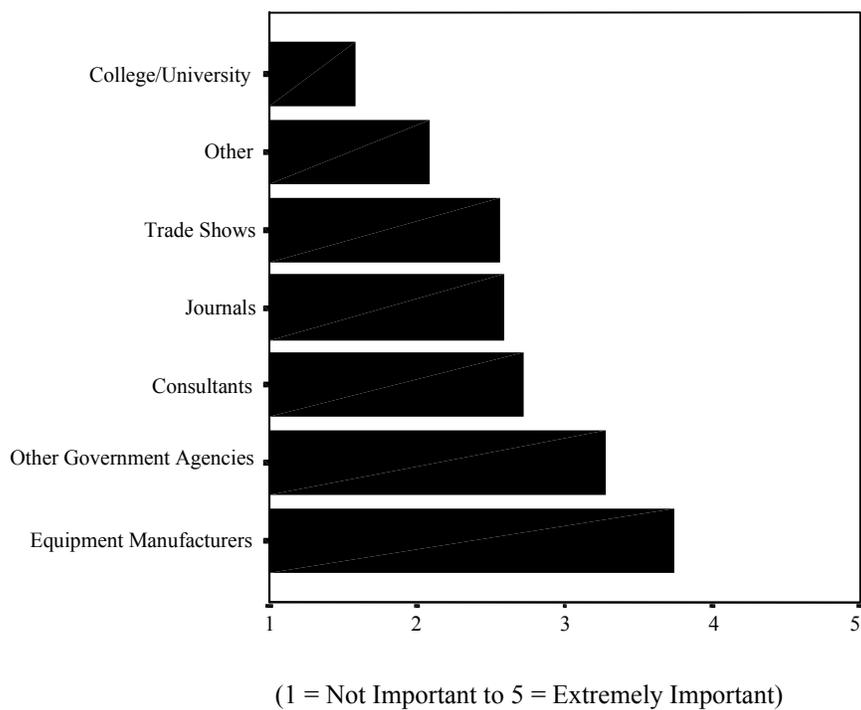


Exhibit 42

Importance of Information Sources When Purchasing Communications Technology

Equipment manufacturers and other government agencies are the most commonly used sources of information.

Exhibit 42 depicts the average rated importance of a variety of information sources used by fire and EMS agencies when making decisions related to the purchase of new communications technologies. Equipment manufacturers are the most important (average rating of 3.70) source of information among all responding agencies.

The reliance on information from equipment manufacturers increases as agency size increases (See Appendix J, Table J-2 for supporting data). The largest agencies (250 or more personnel) indicate the greatest use (82%) of equipment manufacturers as an important source of information (rating of 4 and 5). Just over half (52%) of the smallest agencies (fewer than 25 personnel) also rely on equipment manufacturers for information.

Special agencies view equipment manufacturers as a slightly more important source of information than fire and EMS agencies do. Seventy-three percent of special agencies indicate that equipment manufacturers are a very important source of information when purchasing communications technology, as compared with 66 percent of fire departments and 59 percent of EMS departments.

Other government agencies was rated the second most important information source (average rating of 3.31) for fire and EMS agencies when purchasing communications technologies. There were slight variations in the rating of importance based on agency type. Special agencies had the highest rating of importance, with an average of 3.69, followed by fire departments (3.32) and EMS departments (3.12). The importance of other government agencies as a source of information also increased with agency size. Larger agencies (100 or more personnel) gave other government agencies an average rating of 3.47, compared with a 3.31 for mid-size agencies (50-99 personnel) and 3.13 for smaller agencies (fewer than 50 personnel).

Ratings of importance for all other information sources were below a 3 (moderately important); however, there were some patterns worth noting. The largest agencies (250 or more personnel) were significantly more likely to include independent consultants, journals, and trade shows as important sources of information than smaller agencies, while smaller agencies (fewer than 25 personnel) rated colleges and universities as more important sources of information than agencies of other sizes.

HOW LIKELY IS IT THAT YOUR AGENCY WILL ADOPT APCO PROJECT 25 INTEROPERABILITY STANDARDS FOR ITS NEXT LAND MOBILE RADIO SYSTEM?^{xii}

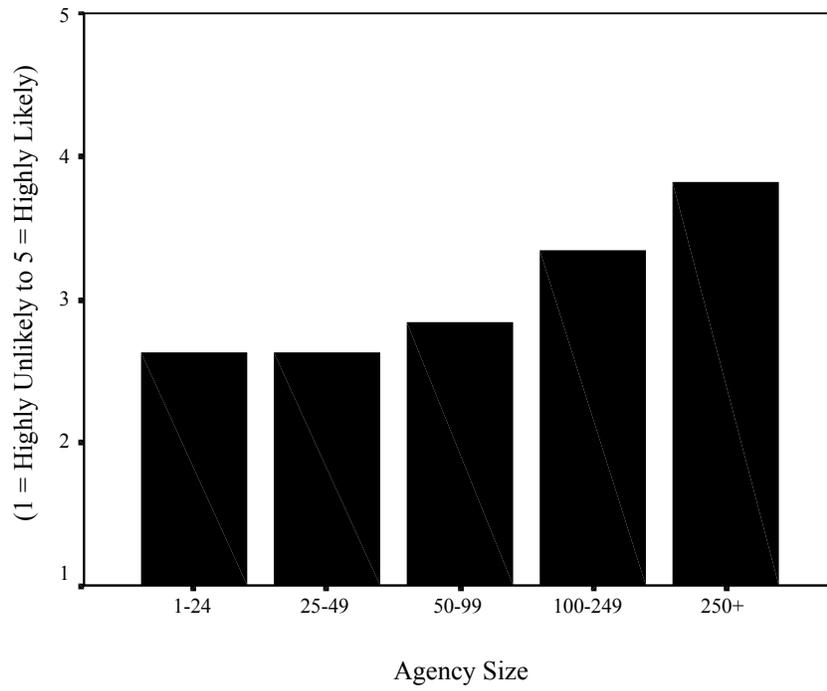


Exhibit 43

Likelihood of Adopting Project 25 Interoperability Standards

Nearly one-third of agencies will likely adopt Project 25 Interoperability Standards for their next LMR system.

Thirty percent of fire and EMS agencies indicate that they will likely adopt the Project 25 standards for their next system (rating of 4 or more). Another 42 percent are moderately likely (rating of 3), while only 28 percent are unlikely to adopt the Project 25 standards (rating of 1 or 2).

The likelihood of adopting Project 25 standards increases as agency size increases (See Appendix J, Table J-3 for supporting data). Forty-eight percent of the larger agencies (100 or more personnel) responded that they will likely adopt Project 25 standards for their next land mobile radio system, compared with 25 percent of mid-size agencies (50-99 personnel) and 16 percent of the smaller agencies (fewer than 50 personnel). The likelihood of adopting Project 25 standards does not vary by agency type.

Thirty-six percent of the agencies planning to replace or substantially upgrade their land mobile radio system within the next 10 years indicated they were likely (rating of 4 or 5) to adopt Project 25 standards. Nonetheless, the vast majority (76%) of these same agencies also indicate that they are unfamiliar with the Project 25 standards (rating of 1 or 2) (See Appendix J, Table J-4 and J-5 for supporting data). This discrepancy suggests that agencies are planning to implement standards-based systems regardless of their familiarity with the particular standard.

DOES YOUR AGENCY PARTICIPATE IN JOINT TRAINING EXERCISES WITH OTHER ORGANIZATIONS THAT INVOLVE THE ACTUAL USE OF COMMUNICATION EQUIPMENT?

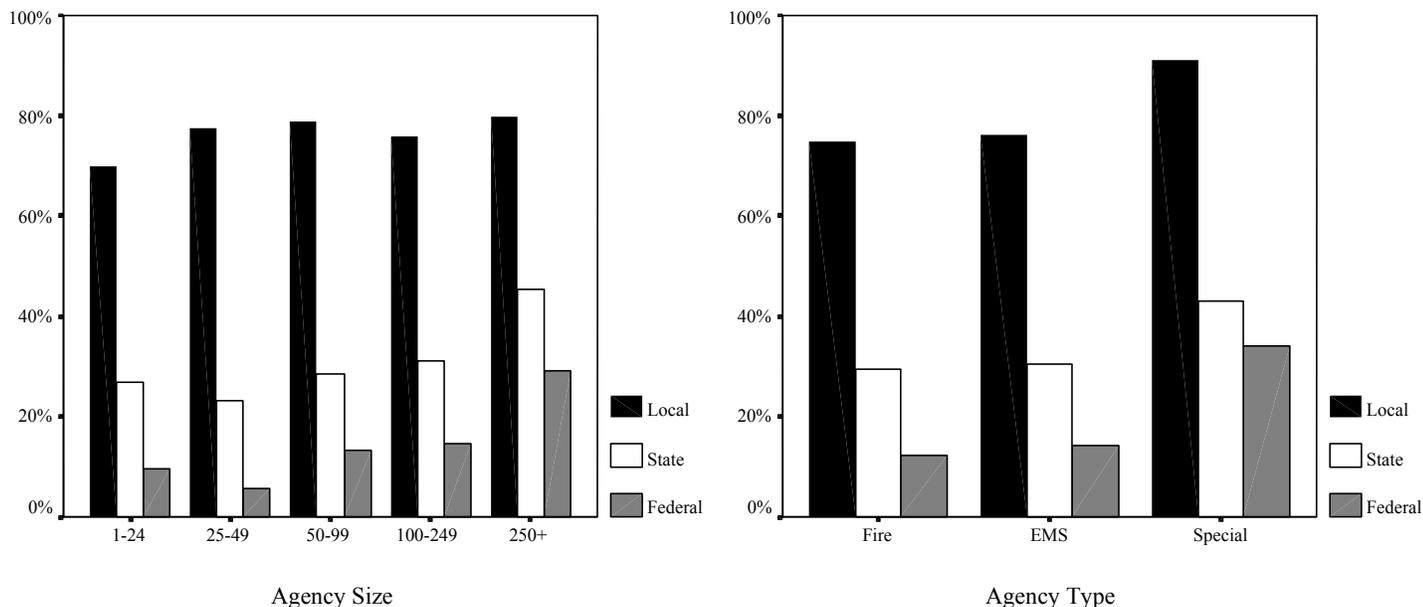


Exhibit 44

Agency Participation in Joint Training

Joint training exercises that use communications equipment are widely conducted at the local level.

Seventy-nine percent of respondents participate in joint training exercises with other organizations using communications equipment. These joint training exercises occur most often between local level organizations. Seventy-six percent of agencies indicate that they participate in joint training exercises with other local organizations, while 30 percent train with state organizations and 14 percent with federal public safety agencies.

Agency size does not influence participation in joint training exercises at the local level. However, larger agencies participate in more training exercises at the state and federal levels than smaller agencies do. Additionally, special agencies participate in more training exercises with organizations at all three levels of government than fire and EMS agencies do. This higher rate of participation may be a result of interoperability requirements. Responses indicate that agencies requiring more frequent interoperability with organizations at any level of government are also more likely to participate in joint training exercises.

HOW WELL DO YOU BELIEVE YOUR AGENCY'S TRAINING HAS PREPARED YOUR STAFF TO HANDLE COMMUNICATIONS INTEROPERABILITY SITUATIONS?

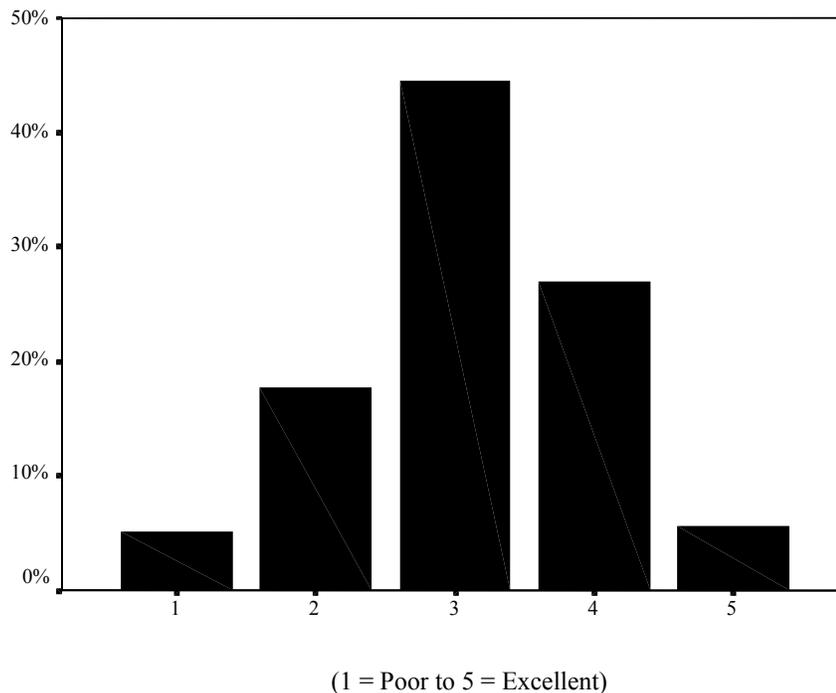


Exhibit 45

Preparedness to Handle Communications Interoperability Situations

Agencies believe their training has prepared them moderately well to handle communications interoperability situations.

Forty-four percent of fire and EMS agencies indicate that their training has prepared them moderately well (rating of 3) to handle communications interoperability situations. An additional 32 percent believe that they have been well prepared for interoperability situations (rating of 4 or 5). Exhibit 45 shows the relative percentages within each rating category. The overall rating of preparedness remains relatively constant (approximate rating of 3) across various agency sizes (See Appendix J, Table J-6 for supporting data). However, special agencies rated their training preparedness slightly higher than fire and EMS agencies.

Of those agencies that felt prepared (rating of 3 or more) to handle interoperability situations, 81 percent participate in joint training exercises with other organizations that involve the actual use of communications equipment (See Appendix J, Table J-7 for supporting data). Additionally, agencies that feel well prepared by their training are more confident in their ability to effectively handle different types of interoperability situations (See Appendix J, Tables J-8, J-9, and J-10 for supporting data). Seventy-two percent of those agencies that felt well prepared by their training were highly confident in their ability to handle day-to-day interoperability situations, compared with 52 percent of those agencies that did not feel well prepared. The same is true of confidence in their ability to handle mutual aid and task force situations (51% versus 32% and 28% versus 10%, respectively).

SECTION 7: 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 that extend from forest ecology management to pest management. State forestry agencies also are responsible for preventing and suppressing wildfires in forests throughout their states.

State forestry agencies frequently partner with federal and local agencies in performing their public safety missions. Most state forestry agencies work with federal agencies to distribute federal funds and equipment to local fire agencies. They also procure excess federal equipment to augment their own fire fighting equipment. Additionally, state foresters respond to fires in federal forests within their state. With local entities, foresters conduct fire and wildlife education (i.e., Smokey Bear), provide wildfire training, prescribe the appropriate use of fire, rehabilitate burned land through reseeded, and provide cooperative fire protection during wildfires. State forestry agencies frequently partner with rural fire departments to support local fire fighters in areas that do not have adequate fire protection coverage. Some state forestry agencies also respond to non-fire emergencies such as automobile accidents or drownings.

Twenty-four of the 51 state forestry agencies (47%) responded to the survey.^{xiii} The respondents represent a cross-section of state foresters nationwide, including a majority of those in the western United States. Significant proportions of the responding state foresters' resources are dedicated to addressing fire-related responsibilities. For responding state forestry agencies, over 35 percent of their non-administrative personnel are classified as fire fighters. Furthermore, these agencies respond to an average of more than 3,000 fire-related calls per year. State foresters have extensive statewide radio communications infrastructures to support their varied mission and corresponding communications requirements.

FINDINGS

Compared with other local and state fire agencies, state forestry agencies have unique communications needs based on their mission requirements and statewide responsibilities. Consequently, the responses from state foresters are analyzed separately. Findings are presented under the same four broad categories used to analyze local agency responses. State forestry findings are divided into the following four sections: current wireless communications environment, interoperability experience and requirements, interoperability shortfalls, and interoperability knowledge and training. However, due to limitations in the size of the data set, many of the more detailed analyses performed on local responses are not included. Similarities and differences between the local responses and the state foresters are highlighted where applicable.

Current Wireless Communications Environment

The average state forester's LMR system has exceeded its expected service life.

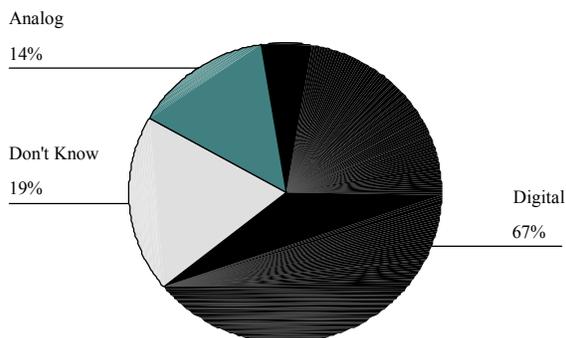
The average state forester's LMR system is 14.9 years old, far exceeding the typical 8- to 10-year life cycle of LMR systems. Eighty-three percent of the state systems are 10 years or older. The average system age for those state forestry agencies expecting to replace their system in the next 10 years is 15.2 years. Forty-five percent of state forestry agencies whose systems are 10 years or older indicate that their overall ability to interoperate is very good (ratings of 4 or 5). The remaining 55 percent are split with 40 percent rating their ability to interoperate as moderate (rating of 3) and 15 percent rating their ability to interoperate as poor (rating of 1 or 2).

Similarly to local agencies, most upgrades or replacements to state forestry LMR systems will be digital and trunked.

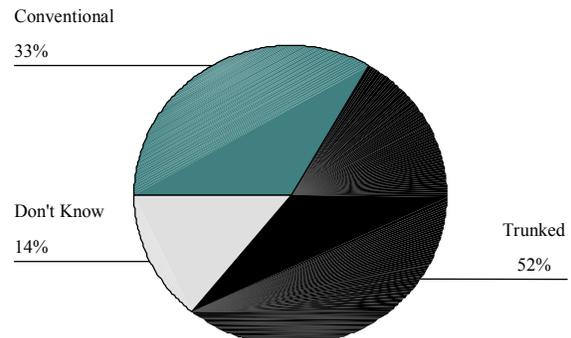
All (100%) of the 24 responding state forestry agencies currently use analog systems. However, as forestry agencies look to the future, most (88%) are anticipating a significant upgrade of their radio system in the next 10 years. Of these agencies, 67 percent prefer to upgrade to digital technology. Fourteen percent of respondents planning to upgrade indicated that they will remain with an analog system, while 19 percent have not decided on their desired system type.

Only one of the 24 responding state forestry agencies (4%) currently uses a trunked system architecture. This agency, which shares its infrastructure with other organizations, currently uses a trunked analog system and plans to upgrade their system to a digital trunked system. Of the agencies currently using conventional technology and planning to upgrade, 44 percent indicate they prefer trunking for its next system, 30 percent prefer conventional, and 13 percent are uncertain of their next system architecture. The percentage of agencies stating a preference for trunking are comparable to local agencies (52% compared with 45%) even though state forestry agencies currently operate fewer trunked systems (4% compared with 20%).

Analog vs. Digital Preferences*



Conventional vs. Trunked Preferences*



**Preferences of agencies with plans to replace or upgrade within 10 years (88% of responding state forestry agencies)*

Exhibit 46

State Forestry Agencies' Preferred System Types

State forestry agencies indicate a preference for high-band VHF, but different bands currently prove troublesome for interoperable communications.

A comparison of state foresters' current and preferred frequency bands reveals a strong desire by these agencies to remain in the high-band VHF range (See Appendix K, Tables K-1 and K-2 for supporting data). All of the responding state foresters (100%) currently have operations in the high-band VHF range. Due to operational requirements, many use multiple frequency bands. Thirty percent also have operations in low-band VHF, 30 percent operate in low-band UHF, and 13 percent have operations in the 800 MHz band.

The 88 percent of state foresters that are planning to upgrade their systems within the next 10 years prefer to operate in the same frequency bands. Again, a majority (83%) prefer to have operating channels in high-band VHF, while 23 percent indicated a desire for channels in low-band VHF, 17 percent in low-band UHF, and 21 percent in the 800 MHz band.

High-band VHF is also the most commonly used frequency band for interoperability. All (100%) of the responding state foresters have at least one interoperability channel in this band. Many of the agencies use multiple bands for interoperability, with the most common additional bands being low-band VHF (21%) and low-band UHF (17%). Only two agencies (8%) have the capability for interoperable communications in the 800 MHz band. Write-in comments describe the complexity of having interoperable requirements in multiple bands:

- *Structural fire units travel to forest fires with 800 MHz radios, leaving their support system behind. Forest [fire fighters] operate on high-band VHF.*
- *If the state system moves to 800 MHz we still need VHF to communicate locally and with federal agencies on wildfires in and out of the state.*

Interoperability Experience and Requirements

Most state forestry agencies interoperate with other jurisdictions at all levels of government on a daily or weekly basis.

State forestry agencies were asked how often they interoperate with jurisdictions at all levels of government (e.g., local, state, federal). Exhibit 47 shows the percentage of responding agencies that indicated a frequent need (rating of daily or weekly) for interoperability. The frequency of interoperability (particularly with federal and state agencies) is much higher for the state foresters than for local agencies. Approximately two-thirds of responding forestry agencies indicate a need to interoperate with federal public safety organizations daily or weekly. Only 8 percent of local agencies indicate daily or weekly interoperability with the federal level. Additionally, 79 percent of responding agencies have a daily or weekly need to interoperate with

both the state and local levels of government (local agencies indicate 19% and 88%, respectively).

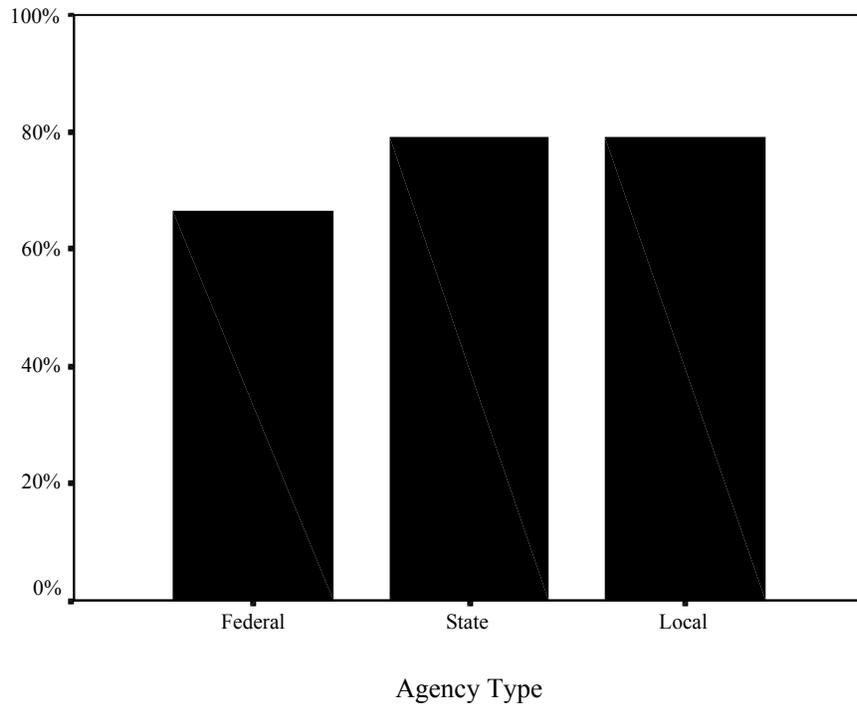


Exhibit 47

State Forestry Agencies' Interoperability Requirements on a Daily or Weekly Basis

Most state foresters are moderately confident in their ability to interoperate with other jurisdictions.

State forestry agencies were asked to rate the confidence in their ability to interoperate with all levels of government, with ratings on a scale from 1 to 5 (1=poor and 5=excellent). Ratings of 4 or 5 are considered as an indication of high confidence, whereas ratings of 3 are interpreted as a moderate level of confidence. Ratings of 1 or 2 are viewed as a serious concern. The average ratings for interoperability with each level of government are provided in Exhibit 48 (See Appendix K, Table K-3 for supporting data).

State foresters rate their overall ability to interoperate with federal level entities as moderate (an average rating of 3.38), but 21 percent have serious concerns (ratings of 1 or 2). The average rating for the ability to interoperate with local governments is slightly higher (average of 3.43); however, 21 percent again have serious concerns. The state foresters reported the most confidence in their ability to interoperate with other state agencies (average of 3.75), with approximately two-thirds of respondents having high confidence. This is similar to local agencies in that they are most confident in their ability to interoperate with agencies at the same level. However, the state agencies are more confident than locals in their ability to interoperate with other levels of government.

The state foresters' confidence in their radio systems ability to perform different types of interoperability is moderate to good (See Appendix K, Table K-4 for supporting data). Agencies provided an average rating of 3.50 for their ability to perform day-to-day interoperability and 3.13 for mutual-aid situations. The ability to perform task force interoperability was lower (average of 2.83), in part due to the 38 percent of respondents who have serious concerns. The low rating may be related to the limited number of agencies that perform this type of interoperability. Only one respondent has been involved in a task force with federal agencies, one agency has been involved in task forces with the other state agencies, and two agencies have been involved in task forces with local agencies.

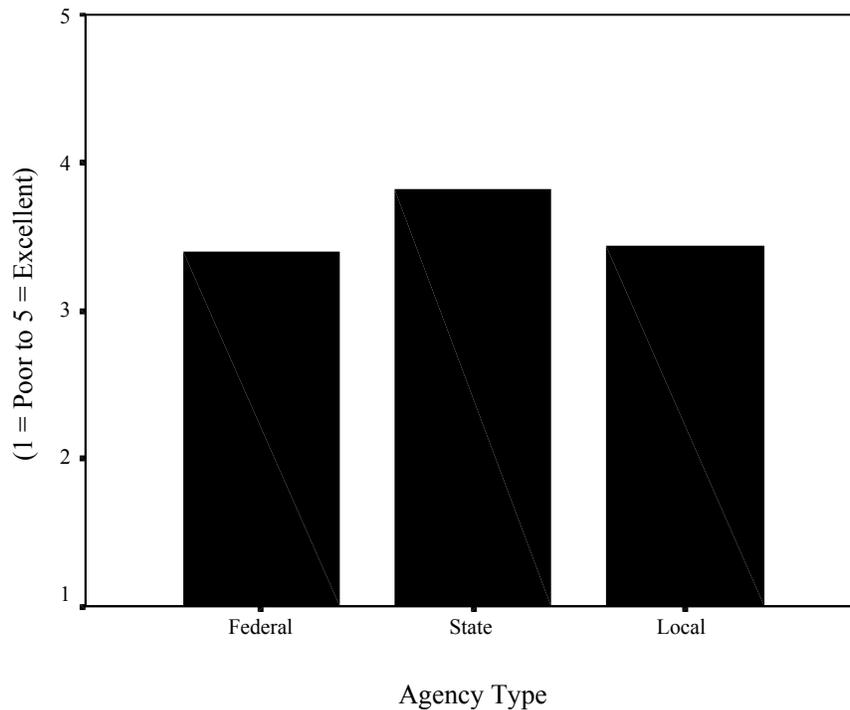


Exhibit 48

State Forestry Agencies' Confidence in Their Ability to Interoperate

The majority of state forestry agencies prefer statewide planning.

State foresters' preferences for planning reflect their perspective as a state agency (Exhibit 49). Two-thirds of the responding agencies desire interoperability planning at the state level with an additional 8 percent supporting multi-state regional planning. Seventeen percent express a preference for planning at the local level. One agency indicates that national planning would best serve its needs.

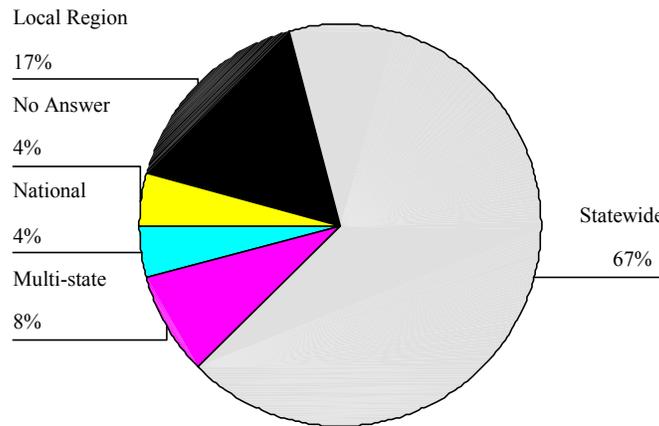
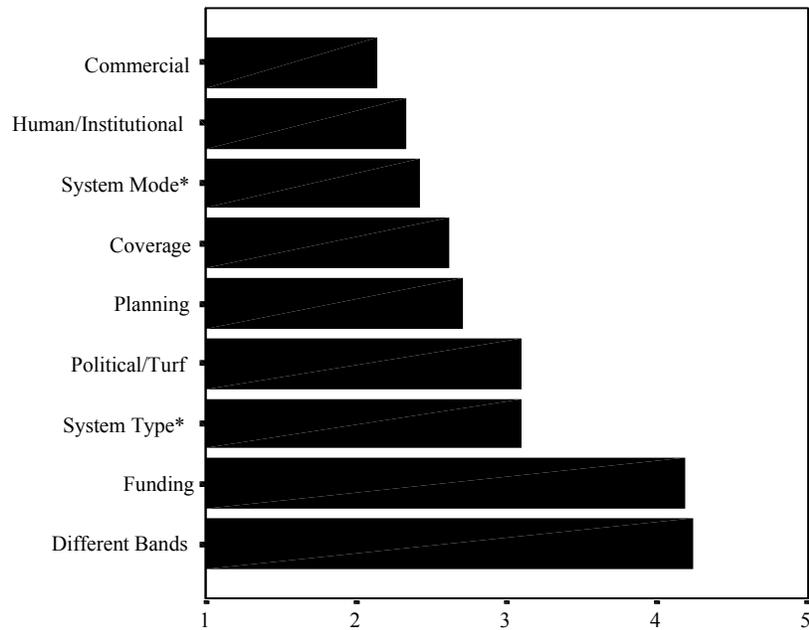


Exhibit 49
State Forestry Agencies' Preferences for Interoperability Planning

Interoperability Shortfalls

State forestry agencies and local fire and EMS agencies experience similar obstacles to interoperability.

State foresters were asked to rate the severity of several items as an impediment to interoperability, with ratings on a scale from 1 to 5 (1 = not a problem to 5 = a major problem). As with local agencies, limitations in funding and the use of different frequency bands are the two biggest obstacles. Exhibit 50 summarizes the average rating for each potential obstacle to interoperability (See Appendix K, Table K-5 for supporting data). More than 79 percent of respondents classified funding as a severe problem (ratings of 4 or 5), while 75 percent cited the use of different operating frequency bands as a severe problem. These are the only two problems whose average rating was in the severe problem range. The state foresters rate different system architectures (conventional versus trunked) as a more severe obstacle to achieving interoperability than local agencies do. Fifty-two percent of the state agencies indicate that this is a severe problem compared with 45 percent of local agencies, while 34 percent of agencies rated it as minor or nonexistent problem compared with 32 percent of local agencies. Despite viewing this issue as a problem, state forestry agencies prefer trunked systems for their next system.



(1 = Not a Problem to 5 = Major Problem)

**System mode refers to analog versus digital communications mode and system type refers to conventional versus trunked system architectures.*

Exhibit 50 Obstacles to Interoperability for State Forestry Systems

Funding limitations affect interoperability for more than three-quarters of state forestry agencies.

There are differences between the 8 percent of respondents indicating that funding is not a problem (ratings of 1 or 2) and the 79 percent of respondents indicating that funding is a severe problem. The agencies that indicate funding was not a problem have high confidence in their ability to interoperate (average of 4.50). These agencies currently operate conventional analog systems but plan to upgrade their systems in the next 10 years.

In contrast, the agencies that rate the lack of funding as a severe problem view their current ability to interoperate as moderate, with an average rating of 3.26. Of these agencies, 84 percent plan to replace their systems in the next 10 years. Currently, all of these agencies operate analog systems, 95 percent of which are conventional. In the future, 57 percent indicate that they want to upgrade to digital systems; and 36 percent would like to upgrade to trunking technology, while 32 percent indicate the desire to remain on conventional systems.

Three-fourths also indicate that different bands impede their ability to interoperate.

Seventy-five percent of state forestry agencies indicated that different bands are a serious obstacle to interoperability. Most of the responding state foresters have a majority (an average

of 14 channels) of their channels in the high-band VHF range; however, three responding agencies operate on channels in the 800 MHz band (an average of two channels per agency). All of the respondents with 800 MHz systems and 75 percent of the respondents with VHF systems rate different bands a major problem (rating of 4 or 5). Write-in comments further expose problems with operating communications systems in different bands:

- *Yes [we have] common frequencies between law enforcement and state wildland agencies. Fire types are often not compatible.*
- *The sheriff rides in the fire helicopter for law enforcement work. The fire helicopter can talk with fire folks and the sheriff uses a handheld to talk with law enforcement folks. [We] can't quickly and easily use each other's frequencies.*
- *When we use local fire departments as task forces on wildland fires, we can't communicate with them. [We] have to give them one of our radios.*

State foresters are overwhelmingly against “date certain” timelines to ensure interoperability.

Eighty-five percent of responding state foresters are against establishing “date certain” mandates for interoperability. Several agencies commented on the need for interoperability to be an internal decision, not mandated by the federal government. Largely, however, these agencies are concerned about sources of funding for any such mandate. There were several comments regarding the need for funding to make any mandates on interoperability a reality:

- *Funding is the problem. If state or federal governments mandate timelines [for interoperability] they need to provide the funding to meet set goals.*
- *Fiscal constraints may possibly negate any timeline.*
- *It is difficult for agencies to come up with the funding to meet date-certain timelines.*

Interoperability Knowledge and Training

A majority of state foresters are involved in joint training exercises.

Eighty-three percent of the responding agencies participate in joint training exercises involving the use of communications equipment. Training occurs most frequently (90% of respondents) with other state-level organizations but is followed closely by exercises with local agencies (85% of respondents) and federal agencies (80% of respondents). State forestry participation in joint training with all three levels is much more prevalent than the local agency training experiences. Agencies that participate in joint training are confident in their ability to interoperate with all three levels of government (local, state, and federal) giving them average ratings of 3.25, 3.80, and 3.40, respectively (See Appendix K, Table K-6 for supporting data). The same agencies also were also confident (average rating of 3.50) in their overall ability to interoperate.

Respondents were also asked to rate their agency's training in preparing them to handle communications interoperability situations. State forester responses closely mirrored the

responses of local agencies. Twenty-nine percent felt well prepared (ratings of 4 or 5), 54 percent felt moderately well prepared (rating of 3), and 17 percent felt poorly prepared (ratings of 1 or 2).

State foresters are more familiar with public safety communications initiatives than their local counterparts are.

State foresters were asked to rate their familiarity with initiatives related to wireless communications and/or interoperability. Exhibit 51 summarizes the average ratings of the extent to which agencies are familiar with the different initiatives. Like local agencies, the state foresters are most familiar with spectrum issues such as the frequency application process and refarming (See Appendix K, Table K-7 for supporting data). However, state forestry agencies are more familiar (average ratings of 3.83 and 3.75, respectively) with each of these initiatives than local agencies (average ratings of 2.63 and 2.03, respectively). State forestry agencies are only moderately familiar with Project 25 standards, yet more than 70 percent say they are likely to implement these standards in their next system. The state forestry agencies have the least knowledge about the new 700 MHz (764-806 MHz) public safety spectrum and TIA/EIA standards.

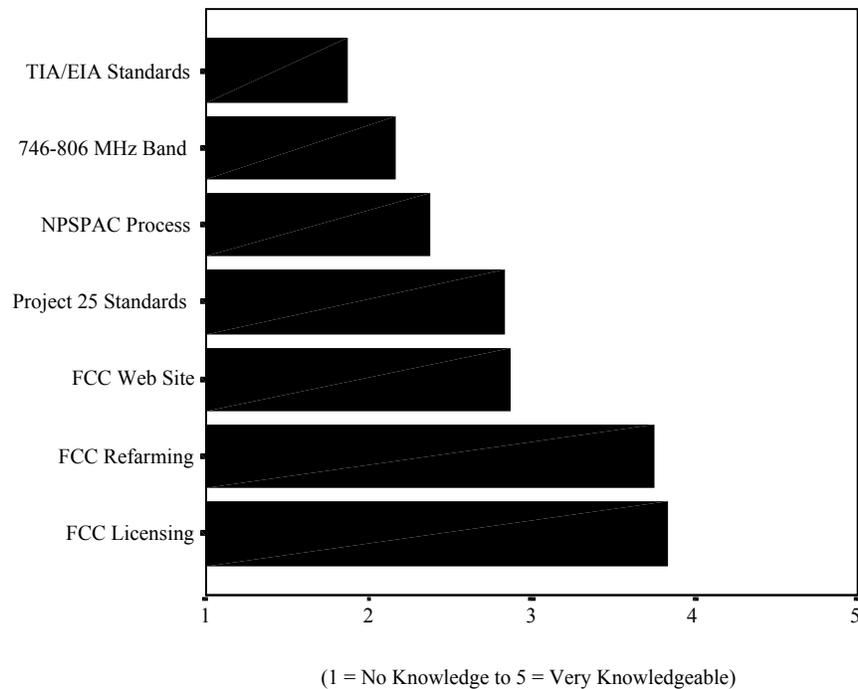


Exhibit 51
State Forestry Agencies’ Familiarity with Current Initiatives

Like local agencies, state forestry agencies use equipment manufacturers and other government agencies as their most important source of outside assistance.

State foresters were also asked to rate the sources of information their agency used when planning the purchase of communications equipment. The foresters were asked to rate a series of information sources on a scale from 1 to 5, with 1 being not important and 5 being extremely important. As with the local agencies, equipment manufacturers (average rating of 3.87) and other government agencies (average rating of 3.63) are the most important sources of information when purchasing communications technologies (See Appendix K, Table K-8 for supporting data). Fifty-four percent of respondents indicated that equipment manufacturers are a very important (ratings 4 or 5) source of outside information, while 50 percent indicated other government agencies are very important. Another important outside influence is professional trade conferences (average rating of 3.42). Conversely, responding state agencies rarely use local colleges and universities (average rating of 1.39) or independent consultants (average rating of 2.46) as outside sources of information.

SECTION 8: 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 (EMT); coordinate the distribution of grant funds; and serve as a training resource for local EMS operations. Additional EMS-related services provided to local and state agencies vary from state to state. State EMS agencies generally fall under the direction of the state health department.

Unlike state forestry agencies, state EMS agencies do not have a direct role in public safety emergency response and thus have a limited need for interoperable communications. State EMS agencies were included in the survey to better understand their current use of wireless technology and the extent of their interoperability requirements. Seventeen of the 50 state EMS agencies (34%) responded to the survey. Additionally, nine agencies (18%) returned non-participant slips indicating that the issue of interoperability does not apply to their agency. Write-in comments from survey respondents as well as nonparticipant agencies alluded to a lack of interoperability requirements in performing their mission:

- *This questionnaire does not apply to the functions of our agency.*
- *We are an EMS regulatory agency and do not provide EMS services. We license, inspect, and approve EMS providers.*
- *Our bureau has no operational status. We are an administrative bureau only.*

FINDINGS

The responses provided by state EMS agencies do not lend themselves to a quantitative analysis; however, their experiences with wireless telecommunications and their concerns regarding interoperability can be profiled. This information follows in four sections: current wireless communications environment, interoperability experience and requirements, interoperability shortfalls, and interoperability knowledge and training.

Current Wireless Communications Environment

Most state EMS agencies use an LMR system regularly to communicate within their agency as well as with local jurisdictions. A majority of radio traffic concerns administrative matters. However, one respondent indicated that their agency “does not utilize the radio” in its operation. The respondents who answered questions regarding their LMR systems primarily use conventional analog systems. Three-quarters of respondents have systems that are 18 or more years old.

Interoperability Experience and Requirements

State EMS agencies indicate that they play no emergency role in daily EMS operations; therefore, the need for radio interoperability is not critical to their agency's operation. It is possible that a state EMS agency would play a role in large-scale incidents such as natural disasters or mass-casualty incidents.

Results from responding state EMS agencies indicate that while they do not have an explicit need for radio interoperability, they do feel strongly about the importance of interoperability for the local EMS providers with whom they work. In fact, state EMS offices are responsible for developing ambulance equipment standards that may require them to dictate radio or communication standards as part of ambulance licensure requirements. State EMS agencies understand the working relationship of local EMS agencies and also understand that interoperability is critical to their operation.

Write-in comments included:

- *This is a state EMS agency – it does not respond to field emergencies unless of a disaster nature.*
- *Our agency does not operate a radio system but we are interested in this issue since we do EMS systems planning, ambulance requirements, etc.*
- *Interoperability [is] essential for mutual aid coordination.*

Interoperability Shortfalls

Although state EMS agencies do not have a need for interoperability with local jurisdictions, they commented extensively on the interoperability issue:

- *Interagency efficiency drastically reduced by incompatible operational frequencies.*
- *Coordinated responses inefficient. Agencies usually purchase individual radios for different uses.*
- *Unable to actively communicate and manage resources from multiple agencies.*
- *Having EMS on low-band UHF and everyone else on VHF causes problems and requires additional radios.*
- *[During an] area wide disaster – lack of interoperability and equipment forced use of borrowed cell phones and services.*

Interoperability Knowledge and Training

State EMS agencies are not familiar with current public safety interoperability issues. Limited knowledge of several critical areas was apparent from the responses of state EMS agencies. Less than a quarter of responding state EMS agencies were knowledgeable or very knowledgeable about Project 25 standards and even fewer respondents were knowledgeable with TIA/EIA-102 specifications. Similarly to state forestry agencies and local EMS departments, state EMS agencies are most familiar with FCC licensing processes.

SECTION 9: STATE FIRE MARSHALS

State fire marshal agencies are responsible for 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. The charter of most state fire marshals includes a variety of administrative and regulatory oversight functions. These functions commonly include fire prevention education to the general public; development and enforcement of hazardous materials regulations; development of fire prevention codes and review of plans for state buildings (e.g., sprinklers and exits); inspection and enforcement of state building codes; fire training for career and volunteer fire fighters; and the distribution of training funds to local fire departments. Additionally, most state fire marshals develop minimum training standards for each category of fire personnel (e.g., fire fighters, apparatus drivers, fire officers). Local fire departments must comply with these established training standards to receive state certification.

State fire marshals generally provide these services to local jurisdictions within their state. Several local governments have the capability to do their own fire investigations and training and therefore do not rely heavily on the state fire marshals. On the other hand, many local governments do not have a fire marshal and are dependent on the support of the state fire marshals, especially in cases of specialized fire investigations. In the case of a fire fatality, many states require that the state fire marshals assist in the investigation regardless of the local jurisdiction's resources.

Usually, state fire marshals do not respond to local jurisdiction fires unless requested by a local public safety agency. They also do not generally have a direct role in public safety emergency response. State fire marshal agencies were included in the survey to better understand their current use of wireless technology and the extent of their interoperability requirements. Seventeen of the 50 state fire marshal agencies (34%) responded to the survey. An additional two agencies (4%) returned nonparticipant slips indicating that the issue of interoperability does not apply to their operation. Write-in comments from survey respondents as well as nonparticipant agencies indicates that LMR communications are not required in performing their mission:

- *We are not an emergency response agency. We only use cell phones.*
- *This office does not have any radios, portables or mobiles, at this time.*

FINDINGS

Similarly to the state EMS agencies, the responses provided by state fire marshal agencies do not lend themselves to a quantitative analysis. Nevertheless, a brief profile of state fire marshal experiences with wireless telecommunications and their concerns regarding interoperability can be constructed. This information follows in four sections: current wireless communications environment, interoperability experience and requirements, interoperability shortfalls, and interoperability knowledge and training.

Current Wireless Communications Environment

Most responding state fire marshals use an LMR system regularly. They primarily use radios for routine communications with staff in their agency and to communicate with local jurisdictions, as it becomes necessary. Of the respondents who answered questions about their LMR systems, there was a diversity of system types (conventional versus trunked) as well as system modes (digital versus analog). Two-thirds of state fire marshals have a system that is less than 10 years old. This is in stark contrast to state forestry and state EMS agencies that, as noted previously, have much older systems.

Interoperability Experience and Requirements

State fire marshals need to communicate with local and state officials regularly. Nearly three-quarters of state fire marshals have a daily need to speak with other state officials and a similar number have a daily need to communicate with local jurisdictions. Because state fire marshals are generally not involved in the immediate emergency response to a fire, they tend to interoperate with local fire departments via radio after the fire has been extinguished. Additionally, state fire marshals indicate that they can find themselves in some situations where they must interoperate with local law enforcement agencies to obtain assistance when investigating the origins of a fire.

Interoperability Shortfalls

State fire marshals indicate that their routine interoperability requirements with the local jurisdictions are generally not due to emergency situations. Therefore, radio interoperability is not the most pressing issue these agencies face. Written comments provide insight to the problems they encounter and how they adjust to these problems when interacting with local jurisdictions:

- *In locating fire scenes we normally find other ways to communicate, but often our field investigators cannot communicate directly with [local] fire departments.*
- *Interoperability is addressed by using multiple means of communications including – analog pagers, 800 MHz band handheld radios and high-band mobile radios with statewide coverage.*
- *Interoperability is hampered by our inability to link UHF and VHF systems.*

Interoperability Knowledge and Training

The majority of responding state fire marshals are not familiar with most of the current public safety interoperability initiatives. State fire marshals have the least familiarity with spectrum allocation and standards development processes. Specifically, they have limited knowledge of spectrum issues such as the FCC licensing process, refarming, and the NPSPAC guidelines for 800 MHz spectrum allocations. State fire marshals also have limited knowledge of standards development initiatives such as TIA/EIA-102 or Project 25.

SECTION 10: DISCUSSION AND CONCLUDING COMMENTS

This study was initiated to better understand and quantify the communications interoperability challenges facing fire and EMS agencies within the public safety community. To date, a detailed assessment of these communities has not been undertaken, even though fire and EMS agencies constitute a significant portion of the public safety community as a whole and are nearly twice the size of the law enforcement community. The results from this study are broadly representative of the local fire and EMS community and select state agencies. The analyses contained in this report provide a quantitative baseline of the interoperability experiences and shortfalls of fire and EMS communities nationwide. The data cannot yield a detailed assessment for individual agencies, but it does enable trends to be discerned. Analyses by size and type of agency provide some insight into the differences that exist within the fire and EMS community.

Local fire and EMS agencies require extensive interoperable communications to accomplish their missions. Local agencies interoperate daily with other local public safety agencies. In addition to day-to-day interoperability, agencies need to interoperate occasionally with state and federal organizations for mutual aid or task force operations. State forestry agencies require extensive interoperable communications as the nature of their mission brings them in regular contact with public safety agencies from all levels of government. However, the majority of radio communications by state EMS agencies and state fire marshals concerns administrative matters rather than emergency response. Therefore, these agencies do not have extensive interoperability requirements.

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. Agencies indicate that interoperability issues will be extremely important for them when they upgrade or purchase their next LMR systems. Although most currently operate at least one channel dedicated solely for communicating with other organizations, fire and EMS agencies, especially the larger ones, experience difficulties interacting with agencies from surrounding jurisdictions. Even more problematic, limited interoperability has hampered the ability of many fire and EMS agencies to respond to a call. This critical impact on the safety and welfare of those in need of public safety assistance highlights the need for improved communications interoperability among the nation's public safety workers.

Fire and EMS agencies find ways to achieve interoperable communications despite challenges from coordination, spectrum, technology, and funding. Fire and EMS agencies are relatively confident in their current ability to interoperate, much more so than they were 5 years ago. This confidence seems to reflect that agencies have found resourceful ways to work around their communications interoperability problems. Agencies are more confident in their ability to interoperate with those agencies with which they have more

frequent contact. As such, local agencies are more confident in their ability to handle interoperable situations with other local public safety agencies, due in part to the relationships they have built with neighboring jurisdictions. In contrast, the need for communications between local agencies and state or federal agencies is much less frequent, and agency confidence in achieving interoperability with these levels of government is much lower.

Agencies that participate in training activities that use actual communications equipment and involve other public safety entities believe that training has better prepared them to handle interoperability situations. Most joint exercises are done with agencies at the local level; however, some agencies, particularly the larger ones, indicate that they also participate in training exercises with state and federal level public safety agencies.

Agencies are moving toward more advanced technologies to meet their communications needs. Fire and EMS agencies currently operate LMR systems that are old and use basic technology. The majority of agencies continue to operate outdated systems that are generally near the end of the 8- to 10-year life cycle. Most agencies operate analog, conventional systems in high-band VHF. Instead of continuing to operate basic and old technologies, agencies are planning to implement state-of-the-art communications systems within the next decade. Although many agencies have not determined the specific characteristics of their next LMR system, the future communications environment will see a dramatic shift towards digital technology, trunked systems, and use of the 800 MHz frequency band. Agencies currently using or implementing these state-of-the-art systems have considerably more confidence in their ability to handle interoperability situations than agencies using older technology.

Fire and EMS agencies are also using a variety of technologies to augment their LMR systems. These technologies provide additional mechanisms for agencies to access more advanced technologies without upgrading their LMR systems. Agencies use a variety of additional communications equipment, such as pagers, telephone lines, cellular phones, and fax machines. The use of mobile laptop computers is increasing, especially among the large agencies. Furthermore, agencies are planning to complement their LMR communications capabilities with increased use of wireless data communications and other wireless communications services such as CDPD, GPS, and PCS.

Agencies are faced with many difficult challenges to interoperability. Paramount among these is a lack of funding. Although these state-of-the-art-systems offer benefits to agencies, many fire and EMS agencies will be unable to upgrade or replace their existing LMR systems due to funding constraints. Funding is a common problem for fire and EMS agencies, regardless of an agency's size or type. Agencies that report funding problems are more likely to experience severe problems with their existing LMR systems and are generally less confident in their ability to handle interoperability situations. Insufficient fiscal resources limit progress towards improving public safety communications and should be a primary concern for public officials at all levels of government.

Operations in different frequency bands is also a key problem for the fire and EMS community, particularly for larger agencies. The planned use of the 800 MHz band will continue to grow as

spectrum becomes increasingly scarce in the lower frequency bands and spectrum adjacent to the 800 MHz band (764-776/796-806 MHz) is made available. Agencies operating in the less-used low-band VHF and low-band UHF frequencies experience more of a problem due to operations in different frequency bands than agencies operating in the more commonly used bands.

Differing technologies and system architectures are viewed as less problematic than previously mentioned obstacles. However, it remains uncertain whether the proliferation of newer technologies will enhance interoperability or magnify existing obstacles. The use of standardized equipment may greatly enhance interoperability. Fire and EMS agencies realize the benefits of standards-based communications systems and indicate a preference for adhering to Project 25 standards for their next LMR system.

Even more difficult to assess is the manner in which obstacles to interoperability, such as inadequate planning and political and institutional factors, will be resolved. Although these obstacles are rated as moderate for a majority of agencies, their long-term effects are unknown. The need for improved interoperability is critical for agencies' day-to-day operations; however, mandates for interoperability, which would help to alleviate some of these problems, have divided support. Although the methods by which interoperability will improve are unclear, the overall sense of improved confidence to handle interoperability situations in the future indicates a willingness on the part of the fire and EMS community to overcome existing obstacles.

The overall level of knowledge exhibited by the fire and EMS community regarding future wireless communications technologies and interoperability initiatives should also be of concern when projecting the future state of fire and EMS communications. Agencies have limited knowledge of FCC processes, new frequency allocations, and efforts to standardize radio equipment for improved interoperability. As such, agencies are forced to rely on equipment manufacturers and other government agencies as their main sources of information on communications technology. This narrow focus may lead to uninformed decision making and may potentially hinder interoperability in the future.

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. The data provides important information profiling the community as a whole, but government decisionmakers must independently assess these issues for their own systems and address the problems in a manner that properly suits their environment.

END NOTES

ⁱ Based on the *National Directory of Fire Chiefs and Emergency Departments* (1997), there are a total of 36,636 agencies: 29,312 fire departments; 6,905 EMS agencies; 317 airport and harbor fire departments; 51 state fire marshals; and 51 state EMS Directors. This directory does not include the 51 state forestry agencies.

ⁱⁱ The survey was re-mailed in May and August 1998, to agencies that did not respond previously. The state foresters segment was included only in the third distribution wave. For the third wave, cover letters from endorsing organizations (i.e., International Association of Fire Chiefs, National Association of State EMS Directors, or National Association of State Foresters) accompanied the survey.

ⁱⁱⁱ National Institute of Justice. *State and Local Law Enforcement Wireless Communications and Interoperability: A Quantitative Analysis*. January 1998, p. 98.

^{iv} The short version consists of a subset of questions from the long version and is an 8-page, 157-item questionnaire. The long version of the survey is a 12-page, 269-item questionnaire. Analyses are based on combined responses from both questionnaires, except where noted.

^v Because fire departments make up the majority of the overall fire/EMS community and only 1 percent of that overall population responded, the bias study was conducted on this segment. Data collected in the telephone interviews was used only to determine bias and was not included in the results summarized in the report.

^{vi} The maximum statistical error was derived by examining both the sample size and the variability of responses (to both dichotomous and ordinal questions) to determine the standard error of the mean response rate. The standard error of the means range from 1 percent to 5 percent depending on the question.

^{vii} “Other” includes bands used that are not designated specifically for public safety purposes.

^{viii} Only agencies with 100 or more personnel were surveyed for MDT and MDC usage.

^{ix} Only agencies with 100 or more personnel were surveyed for wireless data communications use.

^x Only agencies with 100 or more personnel were surveyed for communications services usage.

^{xi} *PSWAC Final Report*. September 1996, p. 47-78.

^{xii} Caution must be used in interpreting the responses to this question for several reasons. First, a significant number of respondents (26%) chose not to answer. This may be related to the lack of familiarity with Project 25, and that a choice of “don’t know” was not provided on the questionnaire. Second, this question has the highest difference in averages when the weighting analysis was conducted. Finally, since a rating of 3 was not defined in the question, an interpretation of agency responses depends upon how responses are clustered. For example, if a

response of 3 is considered positive (likely to adopt Project 25 standards), then nearly three-quarters of responding agencies would likely adopt Project 25 standards (rating of 3-5).

^{xiii} Eight of the 59 state forestry agencies included in the original sample were excluded from the analysis because they represent U.S. Territories.