



# National Institute of Justice

R e s e a r c h R e p o r t

## *State and Local Law Enforcement Wireless Communications and Interoperability: A Quantitative Analysis*

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**State and Local Law Enforcement  
Wireless Communications and Interoperability:  
A Quantitative Analysis**

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Rocky Mountain Region

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## Executive Summary

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Routine police work requires effective coordination and communication with other police agencies, fire departments, emergency medical services, and public service organizations. High-profile incidents—such as bombings, plane crashes, and natural disasters—test the ability of public safety and public service organizations to mount a well-coordinated response. Interoperability, the ability of different agencies to communicate across jurisdictions with each other, often depends on wireless communication systems.

This 1997 NIJ-sponsored study, conducted by the National Law Enforcement and Corrections Technology Center, focuses on interoperability issues in the law enforcement community. It is based on a mail survey of the interoperability experiences and needs of law enforcement agencies across the Nation. A follow-on study due to be completed in 1998 is currently underway to collect similar information from the fire, emergency medical, and emergency management communities.

Four basic questions drove the research:

1. What are the current and planned telecommunications capabilities of State and local law enforcement agencies?
2. What is the knowledge and training level of State and local law enforcement agencies related to telecommunication technologies, information sources, and interoperability policies or issues?
3. What is the nature and extent of law enforcement agencies' past and current interoperability experience and requirements?
4. What is the nature and extent of interoperability shortfalls experienced by law enforcement agencies?

### Methodology

A 10-page questionnaire was sent to all agencies that employ more than 100 sworn officers and to a stratified random sample of smaller agencies across the country. A total of 1,334 agencies responded to the questionnaire, an overall response rate of 48 percent. Agencies were categorized by size (the number of sworn officers served as the basis for six size categories) and type (local police, sheriff's departments, special police, and State police) for analyses. State agencies were analyzed separately. A bias analysis was conducted, as were analyses based on weighted data to correct for under- or overrepresented groups. All data in this report are based on the respondent sample. The sample is broadly representative of the Nation, although respondents were significantly *more* likely to have problems due to outdated equipment and were *less* confident in their ability to handle interoperability situations.

### Current and Planned Telecommunications Capabilities

Most agencies have conventional analog systems and operate in high VHF bands (73 percent), but information from agencies that were planning to replace or upgrade their systems within 10 years, 46 percent of total respondents, indicated several trends: (1) the number of agencies

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operating in 800 MHz will more than double, growing from 23 to 51 percent; (2) the number of agencies using digital systems will increase from 13 to 25 percent; and (3) the number of agencies using trunked systems will increase from 24 to 27 percent. Agencies with trunked systems reported fewer serious problems with channel congestion than agencies with conventional systems.

Agencies identified dead spots and outdated equipment as the most common and serious problems with their radio systems, followed by problems due to terrain/topography, insufficient equipment, frequency interference, insufficient channels, and fading. Static, battery problems, equipment size or weight, and insufficient talk groups were less common problems. More than half of all agencies (53 percent) indicated they needed additional voice-only channels and 30 percent indicated they needed additional data-only channels. Agencies that needed additional channels estimated an overall average need for 5.1 additional voice-only channels (a 40-percent increase) and 4.9 additional data-only channels (a 70-percent increase). State agencies and agencies with 500 or more sworn officers indicated the greatest need for additional channels, but overall, those that are planning to replace or upgrade their systems did not indicate big differences in the total number of channels needed in their next system. The use of wireless data technology (related to use of mobile data terminals and laptops) is increasing, as is the use of wireless technology services. Although the need for security measures is widely recognized, most agencies never use voice or data security measures. Use of such security measures is highly correlated to agency size and function.

### **Knowledge and Training**

As agency size increases, so does familiarity with initiatives related to interoperability in wireless communications. Agencies that participate in joint training activities that use communications equipment were significantly more confident in their ability to handle all types of interoperability situations. Agencies of all sizes and types rated manufacturers as the primary source of information when planning the purchase of communication technologies, and other government agencies as the second most important source. Seventy percent of agencies said consideration of interoperability issues and interoperability standards was important to their agency. Thirty-six percent said they were very likely to adopt Project 25 Interoperability Standards for their next system, 33 percent were somewhat likely, and 19 percent were unlikely.

### **Interoperability Experience and Requirements**

Interoperability is extremely common for agencies of all sizes and types, with 93 percent interoperating on a daily or weekly basis with local organizations, 63 percent interoperating with State-level organizations daily or weekly (only 15 percent interoperate with Federal organizations daily or weekly). Eighty-two percent of respondents have at least one radio channel solely dedicated to interoperating with other organizations. Seventy-four percent of respondents expressed a high level of confidence in their agencies' ability to establish radio links at the local level, 57 percent expressed confidence in the ability of their radio system to handle day-to-day interoperability, and 43 percent were very confident in their agency's overall ability to handle interoperability situations.

State agencies interact with the greatest number of Federal, State, and local agencies and are most likely to use formal written agreements. Most agencies use high band VHF to interoperate with other organizations, although larger agencies are more likely to use 800 MHz systems than

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smaller agencies. Agencies with 800 MHz systems were the most confident in their ability to interoperate with State and Federal organizations and in their ability to handle mutual aid or task force situations. Agencies of all sizes and most types indicated a preference for local, regional, and multijurisdictional interoperability planning: State agencies preferred State-level planning.

### **Interoperability Shortfalls**

Agencies of all sizes and types identified limitations in funding and different bands as the two biggest obstacles to interoperability. Agencies with funding problems rated both their radio system's ability and their agency's ability to handle different types of interoperability situations significantly lower than agencies that believed themselves to be adequately funded. They were also more likely to identify outdated equipment as a serious problem. State agencies (68 percent) and special police (60 percent) were the most likely to experience severe problems because of different frequency bands, although a large number of local police (51 percent) and sheriff's departments (47 percent) also indicated severe problems. Three out of ten agencies indicated severe obstacles due to lack of adequate planning. Different coverage areas, human and institutional limitations, and different communications modes (analog versus digital) adversely affect one in four agencies. The use of date-certain mandates to achieve interoperability received mixed reviews.

### **Discussion**

This study confirmed much of what has been generally believed about police use of wireless communications equipment and interoperability. It also revealed some surprises. Fragmented spectrum and funding were identified as serious interoperability obstacles, and problems with channel congestion and outdated equipment were quantified. The study revealed trends related to the shift from analog to digital systems, high VHF to 800 MHz, and increasing use of spectrum for data transmissions related to the use of MDTs and laptop computers. Surprises include the extent to which agencies already have channels dedicated for interoperability, their general level of confidence in handling routine local interoperability events, and the relatively modest requests for additional channels. Nonroutine events remain a challenge for most agencies. Willingness to adopt interoperability standards is linked to funding issues.

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## Glossary

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**Analog Modulation Technique**—Process whereby message signal, which is the analog of some physical quantity, is impressed on a carrier signal for transmission through a channel (e.g., FM).

**Cellular Digital Packet Data (CDPD)**—an open transmission control protocol/Internet protocol (TCP/IP) standard for cellular data communications. It offers the capability to use file transfer protocol (FTP) to send files (e.g., documents and images) over the air.

**Conventional Radio System**—Nontrunked, similar to telephone party-line in that the user determines availability by listening for an open channel.

**Coverage**—The geographic area included within the range of, or covered by, a wireless radio system. Two systems cannot be made compatible through patching unless the coverage areas overlap.

**Data Security**—Generic term designating methods used to protect data from unauthorized access (e.g., encryption).

**Digital Modulation Technique**—Technique for placing a digital data sequence on a carrier signal for subsequent transmission through a channel.

**Federal Communications Commission**—A board of Commissioners, appointed by the President, having the power to regulate wire and radio telecommunications in the United States.

**Frequency Division Multiple Access (FDMA)**—A channel access method in which different conversations are separated onto different frequencies. FDMA is employed in narrowest bandwidth, multiple-licensed channel operation.

**Gateway**—A type of network relay that attaches two networks to build a larger network. A translator of message formats and addresses, gateways typically make connections through a modem to other mail systems or services.

**Global Positioning System**—Based on 24 satellites orbiting earth at 11,000 miles.

**Interoperability Standards**—Established protocols that provide common interface.

**Laptop**—Small portable computer.

**Local Area Network**—A network of multiple interconnected data terminals or devices within a local area to facilitate data transfer. Most notable of LAN topologies are Ethernet, token ring, and FDDI.

**Mobile Data Terminal (MDT)**—Small computer-like system usually installed in a patrol car that allows the officer to receive and transmit a limited range of information between the officer and communications center.

**Mobile Satellite Service**—A service for land mobile radio systems that use satellites in a geosynchronous orbit to communicate with mobile units.

**Modulation Scheme**—The technical process used for transmitting messages through a wireless radio channel.

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**Mutual Aid Channel**—A national or regional channel that has been set aside for use only in mutual aid interoperability situations, usually with restrictions and guidelines governing usage.

**National Telecommunications and Information Administration**—The Federal agency responsible for domestic and international telecommunications policy.

**NPSPAC Guidelines**—National Public Safety Planning Advisory Committee’s nationwide public safety plan in the United States for the 821–824 MHz and 866–869 MHz bands.

**Pager**—One-way communications device in which the intended receiver is alerted to receive a message or return a phone call.

**Patch**—A control center subsystem that permits a mobile or portable radio on one channel to communicate with one or more radios on a different channel through the control center console.

**Personal Communication Services (PCS)**—Mobile radio technology used in cellular, advanced digital wireless services.

**Project 25 Standards**—A joint government/industry standards-setting effort to develop technical standards for the next generation of public safety radios, both voice and data.

**Public Safety Organization**—A Federal, State, or local organization that has been given, by law, the responsibility for protecting life, property, and natural resources (e.g., law enforcement agencies, fire departments, or emergency medical service providers).

**Public Service Organization**—A Federal, State, or local organization that helps furnish, maintain, and protect the infrastructures (e.g., highways and utilities) that promote the public’s safety and welfare.

**Refarming**—An FCC effort to develop a strategy for using private land mobile radio (PLMR) spectrum allocations more effectively so as to meet future communications requirements. This is to be accomplished primarily by dividing channel bandwidths (i.e., narrow banding).

**Relay**—Base station receiver that typically receives signals on one frequency processes and retransmits out on another frequency in order to extend talk out range.

**Scrambling/Digital Voice Scrambling**—A method of converting an input waveform to a digital representation, which is then encrypted and transmitted. The receiver decrypts the received data and regenerates the original analog signal.

**Spectrum**—The usable radio frequencies in the electromagnetic distribution. Specific frequencies have been allocated to the public safety community. They include:

Low VHF	25–50 MHz
High VHF	150–174 MHz
Low UHF	450–470 MHz
UHF TV Sharing	470–512 MHz
800 MHz	806–869 MHz

**Specialized Mobile Radio System (SMRS)**—A radio system in which licensees provide land mobile communications services in the 800 MHz and 900 MHz bands on a commercial basis.

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**Talk group**—A subgroup of radio users who share a common functional responsibility and, under normal circumstances, only coordinate actions among themselves and do not require radio interface with other subgroups.

**Time Division Multiple Access (TDMA)**—A channel access method in which different conversations are separated into different time slots. TDMA is employed in exclusive license use, moderate bandwidth applications.

**Trunked Radio System**—A system that integrates multiple channel pairs into a single system. When a user wants to transmit a message, the trunked system automatically selects a currently unused channel pair and assigns it to the user, decreasing the probability of having to wait for a free channel for a given channel loading.

**Voice Security**—Over the air audio that is unintelligible/inaccessible without appropriate means of decoding.

**Web site**—An Internet site. This document refers to the Department of Justice web site, which may be found at <http://www.ojp.usdoj.gov>

**Wide Area Network**—A network connecting local area networks from more than one site, such as between two buildings or two sites located at some distance from each other (e.g., in different cities).



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## Abbreviations

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AAR - American Association of Railroads  
APCO - Association of Public-Safety Communications Officials  
CDPD - Cellular Digital Packet Data  
DOJ - Department of Justice  
FCC - Federal Communications Commission  
FDMA - Frequency Division Multiple Access  
FLEWUG - Federal Law Enforcement Wireless Users Group  
GIS - Geographic Information System  
GPS - Global Positioning System or Satellite  
IACP - International Association of Chiefs of Police  
IMSA - International Mobile Signal Association  
ISC - Interoperability Subcommittee (of the Public Safety Wireless Advisory Committee)  
LAN - Local Area Network  
LMR/PLMR - Land Mobile Radio/Private Land Mobile Radio  
NABER - National Association of Business Education Radio  
NCIC - National Crime Information Center  
NIJ - National Institute of Justice  
NLECTC-RM - National Law Enforcement and Corrections Technology Center - Rocky Mountain Region  
NLETS - National Law Enforcement Teletype System  
NPSTC - National Public Safety Telecommunications Council  
NTIA - National Telecommunications and Information Administration  
PCS - Personal Communications Service  
PSWAC - Public Safety Wireless Advisory Committee  
SERS - Special Emergency Radio Service  
SMR - Specialized Mobile Radio  
TDMA - Time Division Multiple Access  
UTC - Utilities Telecommunication Council  
WAN - Wide Area Network  
WWW - World Wide Web

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## Section I: Project Description

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High-profile incidents such as the bombing of the Alfred P. Murrah Federal Center in Oklahoma City and the World Trade Center in New York City have brought attention to the need for improved communications interoperability. *Interoperability* is the ability of different agencies to communicate across jurisdictions with each other. Natural disasters such as tornadoes, earthquakes, hurricanes, and wild fires, particularly when they hit heavily populated areas, require a coordinated response from numerous public safety and public service organizations, as do disasters such as plane crashes, train derailments, and power outages. Even more routine situations, such as fairs, sports events, local festivals, visiting dignitaries, criminal- or drug-related investigations, car accidents, and fires require coordination between and across agencies. Such coordination requires planning, cooperation, and effective communications.

This study was conducted by the research staff of the National Law Enforcement and Corrections Technology Center - Rocky Mountain region (NLECTC-RM) and was designed to gather baseline data about wireless communications and interoperability. It was a nationwide quantitative study of law enforcement agencies' current and planned telecommunications equipment and infrastructure, interoperability knowledge and training, interoperability experience and requirements, and interoperability shortfalls. A major goal of the study was to provide information about interoperability issues in different sizes and types of law enforcement agencies across the Nation, with sufficient detail to support policy development and/or decisionmaking.

Some of the events related to this study:

- 1989 Project 25 collaborative initiative established to develop a suite of standards for analog and digital interoperability. The Steering Committee includes Federal, State, and local representatives.<sup>1</sup>
- 1992 Congress approves proposed rulemaking for refarming/auctioning off blocks of spectrum.
- 1993 National Performance Review raises concerns about the ability of the public safety community to keep pace with advances in technology; tasks Federal Law Enforcement Wireless Users Group (FLEWUG) to develop a plan for an intergovernmental, shared use, public safety wireless communications network that would carry public safety at least to the year 2010.<sup>2</sup>
- 1993 Study of Maryland Law Enforcement Telecommunications Interoperability<sup>3</sup> conducted for the Maryland State Police Bureau of Drug Enforcement and Communications Divisions identifies knowledge and equipment shortfalls.
- 1994 The Federal Communications Commission (FCC) begins refarming/auctioning off blocks of spectrum.
- 1995 The Public Safety Wireless Advisory Committee (PSWAC) is formed and establishes subcommittees to examine operational requirements, technical issues, interoperability, spectrum requirements, and transition issues.
- 1995 FCC Report and Order requires narrow-banding capability in all new radios.

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1996 Phase I of Project 25 is completed.

1996 PSWAC final report is submitted to the FCC and NTIA.<sup>4</sup>

1997 National Public Safety Telecommunications Council (NPSTC) is formed to follow up on the recommendations made by PSWAC.<sup>5</sup>

1997 FCC and NTIA form Public Safety Communication Joint Working Group, a partnership to coordinate public safety spectrum allocation and to promote and help establish standards.<sup>6</sup>

The nationwide investment in land mobile radio (LMR) systems and supporting infrastructures for most public safety and public service interoperability is already substantial. As agencies replace aging equipment and adopt new technologies, the amount of money invested in telecommunications equipment will continue to grow. But spectrum is a limited resource that will become increasingly valuable as commercial uses proliferate, and public safety requests for additional spectrum represent a substantial resource investment for the country. Decisions of such magnitude benefit from research and informed public debate. The purpose of this research was to explore issues identified by the Public Safety Wireless Advisory Committee, provide quantitative data from State and local law enforcement agencies across the Nation, and to quantify the nature and extent of current use and anticipated needs for wireless communications, particularly as they relate to interoperability.

Data were collected from a stratified representative sample of all State and local agencies across the Nation, to quantify and better understand the nature and the extent of the law enforcement community's public safety interoperability needs and related issues. A number of technology, spectrum, and operational issues were also addressed in this study due to their relationship to interoperability. It is hoped that the information collected for this research and presented in this report is sufficiently detailed to be useful to those who make policy and/or purchase decisions regarding wireless communications for all sizes and types of agencies.

### ***Interoperability Defined***

Many of the key definitions used for this study were based on those developed by the Public Safety Wireless Advisory Committee (See Appendix A). The Interoperability Subcommittee defined *interoperability* as “*an essential communication link within public safety and public service wireless communication 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.*”<sup>7</sup> PSWAC identified three different types of interoperability: day-to-day, mutual aid, and task force. *Day-to-day missions* are the most commonly encountered and are typically associated with areas of concurrent jurisdiction where agencies need to monitor each other's routine traffic. *Mutual aid missions* often involve multiple agencies under conditions that allow little prior planning for the specific event. The third interoperability type, *task force operations*, usually involve communications among agencies representing several units and/or layers of government under conditions that do allow for prior planning.

Interoperability is not restricted to communications among and between law enforcement agencies. It includes communications between a variety of public safety and public service organizations, at a variety of levels (Federal, State, and local). The data reported here are based on written responses to a questionnaire that was sent to a scientifically selected sample of State

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and local law enforcement agencies across the country. Although the questionnaire was sent to law enforcement agencies only, some of the write-in responses revealed that there were several questionnaires that were forwarded to combined law enforcement, fire, and emergency medical service communications centers. Respondents were encouraged to think of interoperability in broad terms and the questionnaire included examples of public safety and public service organizations from the Federal, State, and local levels. Interoperability shortfalls and equipment problems were identified through a review of the literature, primarily the PSWAC report and articles in the APCO Bulletin, *Public Safety Communications*, a variety of other journals featuring issues related to public safety communications, and conversations with a law enforcement advisory group that worked with the NLECTC-RM research team.

### ***Need for Interoperability***

Law enforcement agencies' ability to carry out their legal mandates is increasingly dependent upon reliable, timely communications that allow them to coordinate operations with other organizations. Although PSWAC recommended the use of commercial services for nonmission-critical communications, agency-controlled and -operated wireless communications systems remain an integral part of both inter- and intra-agency communications. As noted in its final report:

*The ability of Public Safety agencies to communicate is vital to the safety and welfare of the citizens they represent. Whether a vehicle accident, crime, plane crash, special event or any other Public Safety activity, one of the major components of responding to and mitigating a disaster is wireless communications. These wireless communications systems are critical to Public Safety agencies' ability to protect lives and property and the welfare of Public Safety officials.*

*In an era where technology can bring news, current events, and entertainment...to the farthest reaches of the world, many police officers, firefighters, and emergency medical service personnel working in the same city cannot communicate with each other. Congested and fragmented spectral resources, inadequate funding for technology upgrades, and a wide variety of governmental and institutional obstacles result in a critical situation which, if not addressed expeditiously, will ultimately compromise the ability of Public Safety officials to protect life and property.<sup>8</sup>*

Effective and efficient wireless communications are ultimately dependent on radio frequency availability and/or compatibility. PSWAC concluded in its final report, “*unless immediate measures are taken to alleviate spectrum shortfalls and promote interoperability, Public Safety agencies will not be able to adequately discharge their obligation to protect life and property in a safe, efficient, and cost effective manner.*”<sup>9</sup> PSWAC asked the FCC to allocate additional spectrum for the exclusive use of public safety agencies.<sup>10</sup> The radio frequencies that have been set aside for public safety use are primarily in four areas of the spectrum and range from low band VHF (25–50 MHz) to 800 MHz (806–869 MHz). As a result, no universally available or affordable radio can handle all possible combinations. Research that was conducted for the Operational Subcommittee of PSWAC concluded, “*The highest rated feature was the need to operate across frequency bands (e.g., VHF to 800 MHz).*”<sup>11</sup> Communications across bands is possible through “patching” but the process has serious limitations and complications. Public safety agencies currently use just about 23 MHz of spectrum.<sup>12</sup> As an initial response, the FCC has recently allocated 24 MHz in the 746–806 MHz range for public safety use. Exhibit 1

summarizes the frequency bands used by the public safety community and illustrates the location of the additional allocation.

	Low VHF		High VHF		Low UHF T-Band		746-806 MHz	800 MHz	
	25–50 MHz		150–174 MHz		450–470 MHz		24 MHz Allocated	806–869 MHz	

**Exhibit 1: Radio Spectrum Used for Public Safety**

There are many mutual aid channels that have been set up on a regional or statewide basis, and there are also two nationwide interoperability channels: in high band VHF (the National Law Enforcement Emergency Channel 155.475 MHz); and, in 800 MHz (the Interagency Tactical Channels<sup>13</sup> in 866–868 MHz).

**Emerging Interoperability Issues**

The PSWAC Interoperability Subcommittee reviewed several high-profile incidents, analyzed how interoperability requirements were met, and concluded that several factors could under certain circumstances become an obstacle to interoperability.<sup>14</sup> This study explored the extent to which agencies experience each of the following factors as an obstacle:

**The diversity of spectrum resources**—With a total of 10 radio bands that range from 30 MHz to over 800 MHz, and no single radio capable of operating in all of the bands used by different agencies, agencies may not be able to communicate with each other simply because their radios operate on different frequencies.

**The lack of channels available for interoperability**—This could be due to inadequate planning, pressure to utilize all available channels for routine operational demands, or simply that channels have not been designated specifically for interoperability.

**Human and/or institutional factors**—Limitations or constraints in human memory, agency concerns over maintaining a communications link with their own personnel, or agency reluctance to allow personnel to join other systems may interfere with interoperability.

**The lack of a common communications mode**—Interoperability suffers when units from different systems, even those operating in the same band, cannot communicate because of different transmission or signaling techniques (e.g., analog versus digital or proprietary systems provided by different manufacturers).

**Different coverage areas**—If the coverage areas for different systems do not completely overlap, there may be areas where communications across or between agencies is extremely difficult or impossible.

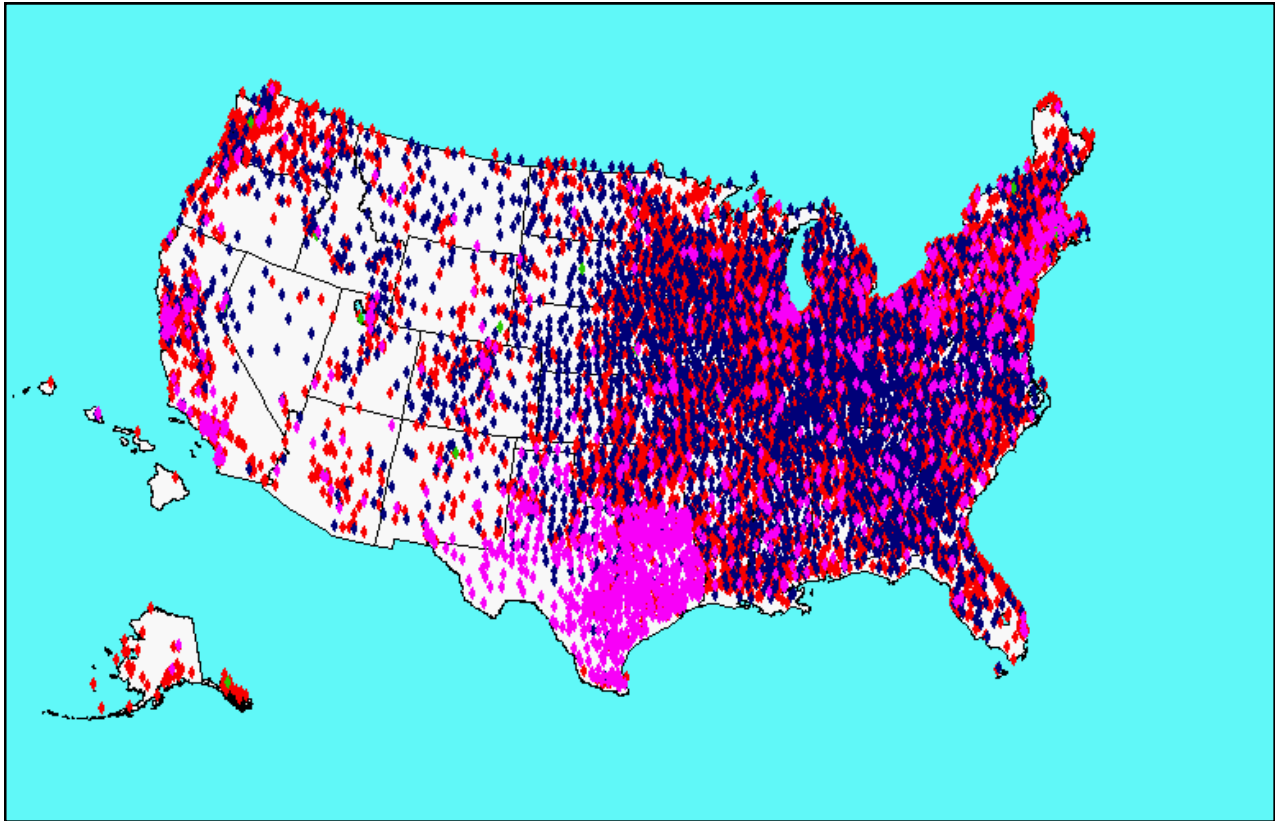
**Limitations of current commercial systems**—Since some of the characteristics that are deemed critical to public safety applications are not currently available in commercial services, such services may not be widely used for interoperability.

**The lack of a common plan**—There is no nationwide mutual aid plan and incident command system to facilitate interoperability.<sup>15</sup>

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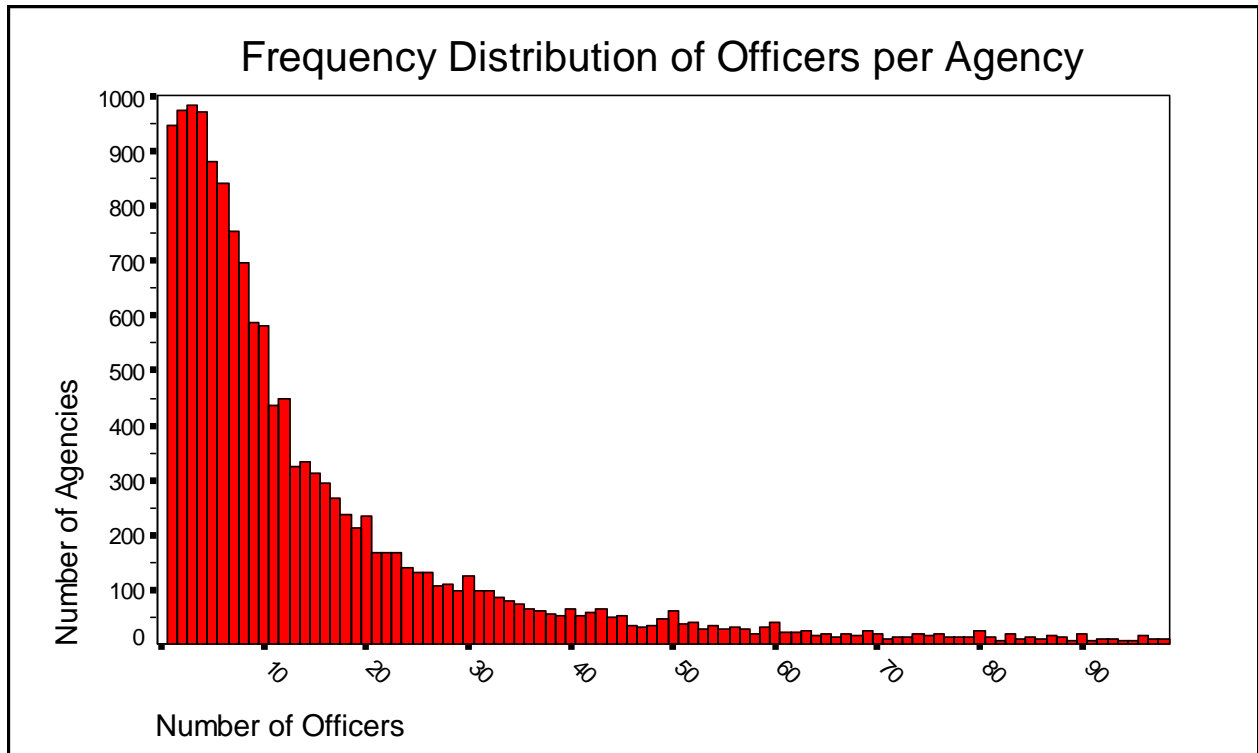
### **Relevance to Law Enforcement**

The roles of different types of law enforcement agencies influence the extent to which they are involved in interoperability situations, the nature and frequency of such interoperability events, and the kind of organizations with which they interoperate. It is sufficient here to note that the vast majority of all sizes and types of agencies interact on a regular basis with other law enforcement agencies, and with other public safety and public service organizations in their communities. Exhibit 2 shows the distribution of more than 17,000 law enforcement agencies (not including medical examiners and coroners) in the United States. Approximately 95 percent of these agencies employ fewer than 100 sworn officers.



**Exhibit 2: Law Enforcement Agencies in the United States**

Exhibit 3 shows the size distribution of agencies with less than 100 sworn officers. The vast majority (75 percent) employ fewer than 25 sworn officers. Although there are fewer agencies with more than 100 sworn officers, they employ about 60 percent of the total police force in the Nation. The largest agencies serve metropolitan populations (New York City Police employs 37,465 sworn officers and 9,148 nonsworn personnel) or States (California Highway Patrol employs 6,218 sworn officers and 2,976 nonsworn personnel). There are approximately 140 agencies that employ 500 or more sworn officers, 29 of which are State police.<sup>16</sup>



**Exhibit 3: Frequency Distribution of Officers Per Agency**

This report is based on information collected from a survey that was sent to law enforcement agencies.<sup>17</sup> While there is a degree of similarity in the need for interoperability within and between all public safety agencies, this study has not attempted to quantify the extent to which the results of the survey are applicable to other public safety organizations, or to public service providers. A follow-on study due to be completed in 1998 is currently underway to collect similar information from the fire, emergency medical, and emergency management communities.

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## Section II: Scope and Methodology

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The information summarized in this report is based on agency responses to a 10-page, 268-item questionnaire (Appendix A). All agencies that employ more than 100 sworn officers were included in the sample and a stratified random sample of the remainder was selected to guarantee representation of all agency types and sizes from across the country. A total of 1,334 agencies responded to the questionnaire, an overall response rate of 48 percent.

Agencies were classified into four categories for analyses: (1) State agencies, which are the primary general purpose agency that provides law enforcement services throughout a given State; (2) local law enforcement agencies, which are operated by municipal or county governments; (3) sheriffs; and (4) special police, which include campus or university police, drug and alcohol enforcement units, parks and wildlife or conservation units, and other special units. The category of special police includes statewide police agencies that are *not* the State's primary general-purpose police agency.

Respondents were asked to provide information about their agency's current use of communications technology, especially wireless technology, for routine operations and interoperability situations, as well as the nature of their experience with day-to-day, mutual aid, and task force interoperability. Agencies were also asked to assess the ability of their organization and of their radio systems to handle a variety of interoperability situations. Four basic questions drove the research:

1. What are the current and planned telecommunications capabilities of State and local law enforcement agencies?
2. What is the knowledge and training level of State and local law enforcement agencies related to telecommunications technologies, information sources, and interoperability policies or issues?
3. What is the nature and extent of law enforcement agencies' past and current interoperability experience and requirements?
4. What is the nature and extent of interoperability shortfalls experienced by law enforcement agencies?

The questionnaire was piloted in October of 1996. Initial questionnaires were sent to 2,765 agencies in February 1997, followed by two additional mailings and postcard reminders. The final sample consisted of the following:



Agency Type/Size	Total N	Sample Sent	Sample Received	Response Rate
Local Police:	12,506	1,683	823	49%
100 or more	486	486	313	64%
99 or less	12,020	1,197	510	43%
Sheriff:	3,085	806	382	48%
100 or more	271	271	153	57%
99 or less	2,814	535	229	43%
Special Police:	1,715	225	89	40%
100 or more	63	63	41	65%
99 or less	1,652	162	48	30%
State	51	51	40	78%
<b>TOTAL</b>	<b>17,357</b>	<b>2,765</b>	<b>1,334</b>	<b>48%</b>

*Note: All State agencies and all agencies with more than 100 sworn officers were sent questionnaires. A stratified random sample was selected for agencies with less than 100 sworn officers (20 percent of sheriffs, 10 percent of all others).*

#### **Exhibit 4: Response Rates by Agency Type and Size**

Agencies were asked to have the survey completed by the individual most knowledgeable about their communication systems and to obtain assistance from other personnel as needed.<sup>18</sup> It is characteristic of survey research that those who choose to respond are by definition volunteers, which means they tend to be a more interested and educated sample than the population as a whole, as well as more motivated to express their needs. This study is subject to the limitations of survey research in general and agency self-administered mail surveys specifically. One of the most important limitations is due to the fact that agency responses to a written survey may differ depending on *who* within the agency fills out the survey.<sup>19</sup>

All data were analyzed by agency type (State, sheriff, local, special police), and size classifications (based on number of sworn officers as indicated in Exhibit 4). Statistical tests were used to compare differences between agency sizes and types.<sup>20</sup> Statistics were run to assess the reliability of the questionnaire and specific question sets (questions that asked for ratings, questions that asked for a yes/no response, and questions that asked for a specific number). Instrument reliability and internal consistency are high (0.90/0.85/0.84, respectively on the three question sets). The total sample of 1,334 yields a maximum statistical error of  $\pm 4$  percent at the 95-percent confidence interval.<sup>21</sup>

#### **Bias analysis**

To assess the extent to which the final responses might be biased, a random sample (consisting of 155 of the agencies that did not return the questionnaire) was selected using the original sample selection process. A telephone survey was conducted to assess the differences between respondents and nonrespondents and better understand how the information that was gathered

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might reflect those differences. Ten questions from the written survey were selected for the telephone survey. A copy of the specific questions and additional details may be found in Appendix B. Data collected from the telephone survey were used only to assess bias<sup>22</sup> and were not included in the results summarized in this report.

There were no significant differences in the extent to which phone respondents were experiencing problems with channel congestion or frequency interference, the designation of a radio channel solely for communicating with other organizations, their familiarity with Project 25 Standards, or their knowledge of FCC refarming efforts. The percentage of agencies that were planning to replace or substantially upgrade their LMR system was comparable to the written survey agencies, and ratings of the importance of interoperability when making their next purchase decision were not significantly different. There were two significant differences, however, between the phone sample and the sample that responded to the written survey. Most notably, (1) the respondents to the phone survey were significantly less likely to rate outdated equipment as a major problem, and (2) respondents rated their agencies' significantly higher on their overall ability to handle interoperability situations. In other words, respondents to the written survey were *more* likely to view their equipment as outdated and they were *more* conservative in rating their agencies' ability to interoperate. The differences are significant at the 99-percent confidence level (0.001) but some of the bias may be due to the different methodologies (written versus telephone).<sup>23</sup> See Appendix C.

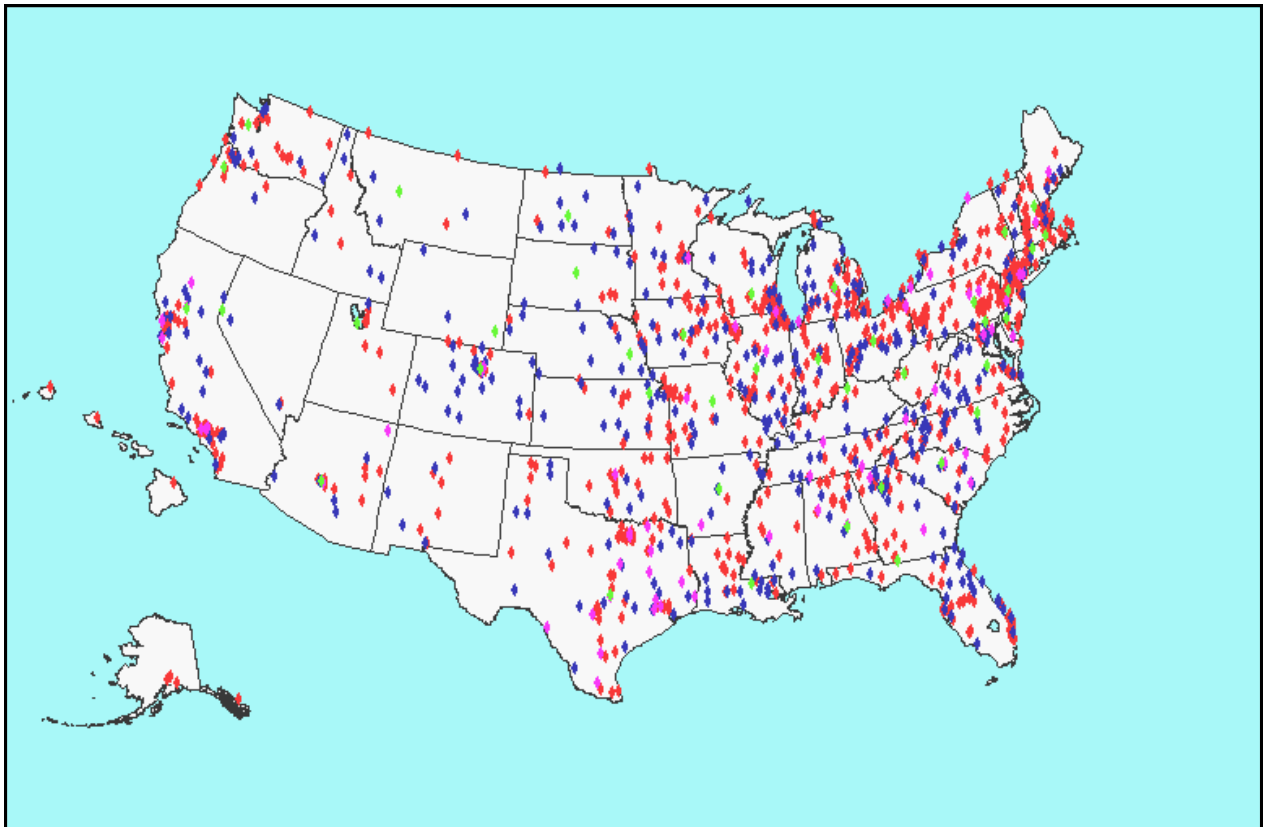
The goal of this study was to understand law enforcement interoperability needs at a national level, but with loss of subjects due to nonresponse, the intended proportions may not occur in the final sample. To correct for this, it is possible to apply numerical weights to under- and overrepresented categories to restore them to the proportions found in the total population. The assumption is that the weighted data are then more representative of the population as a whole, and inferences are more believable. The risk is in assuming that the opinions and ideas expressed by the under-sampled groups accurately reflect those of the corresponding group nationwide. Descriptive statistics were run on weighted samples to determine their impact. Averages and percentages changed very little, statistical error changed slightly, but *maximum* error did not. The largest differences occurred in questions requiring a fill-in response, such as "How many channels does your agency currently use?" Since weighting resulted in very small differences, the data reported here are from the unweighted respondent sample. A more thorough discussion of the weighting analyses and the weighting factors that were used may be found in Appendix D.

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## Section III: Findings

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Law enforcement agencies are often in situations that require close contact and coordination with other organizations, especially other public safety or public service organizations such as fire departments or emergency medical services. The agencies that responded to this survey are representative of the diversity of the law enforcement community. They vary greatly in size, in the type of law enforcement work they do, the size of the populations they serve, and the geographic areas within their jurisdictions. All State agencies employ more than 100 sworn officers, and play a unique role within their State (although the roles are different from State to State). Since they have unique communications needs, they were analyzed as a separate group. Exhibit 5 shows the distribution of survey respondents.



**Exhibit 5: Geographic Distribution of Survey Respondents**

### ***Telecommunications Equipment and Infrastructure***

Mobile radios, whether hand-held or vehicle-mounted, are basic law enforcement communications equipment. Citizen's Band and Amateur radios are most likely to be used by State agencies and sheriff's departments, but all sizes and types of agencies use cellular phones

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and pagers. Sharing frequencies and/or infrastructure is very common, and most agencies that share radio systems are actively involved in the decisionmaking related to the system.

Four out of five agencies (81 percent) currently use analog systems, 13 percent use digital. Forty-six percent plan to replace or upgrade their land mobile radio (LMR) system within 10 years, and the proportion of agencies using digital will increase from 13 to 25 percent. The number of agencies using trunked systems will increase from 24 to 27 percent. Agencies with trunked systems reported fewer problems with channel congestion than did agencies with conventional systems.

Seventy-three percent of law enforcement agencies operate in high band VHF, but the number of agencies operating in 800 MHz will double over the next 10 years (from 23 to 51 percent). There were no significant differences between agencies with 800 MHz systems and those operating in other bands with respect to their confidence in the ability of their radios to handle routine, day-to-day local interoperability situations. However, there was a difference in confidence in their ability to establish radio links with State and/or Federal organizations and in their ability to handle mutual aid and/or task force operations (agencies with 800 MHz systems were more confident).

Forty-three percent of agencies rated dead spots and outdated equipment as serious problems with their LMR systems. Thirty-seven percent of respondents indicated serious problems due to topography/terrain, with agencies that have mountains or many highrise buildings in their jurisdiction the most likely to have problems with dead spots. Problems with mobile radio systems do not necessarily translate into problems with interoperability, but given that limitations in funding was rated as the most severe obstacle to interoperability, the problem of outdated equipment was selected for more detailed analysis. The normal processes for systematically replacing aging equipment appear to be stalled somewhat, as a larger number of agencies have outdated systems (43 percent indicated serious problems due to outdated equipment, compared to 35 percent that are not having problems). Most of the agencies that are having problems with older equipment are already planning to replace or upgrade their radio system within the next 10 years. Agencies with older equipment were *less* likely to have trunked systems and *more* likely to indicate problems with channel congestion.

Ninety-one percent of respondents have channels dedicated to voice-only transmissions. Twenty-seven percent have channels for data-only, although fewer channels are dedicated to data transmission than to voice. Nineteen percent of respondents have channels that are used alternately for voice and data. As a result of increasing use of wireless data technology (related to use of mobile data terminals and laptops), the estimated need for additional data-only channels show the greatest *rate* of increase, even though the greatest overall need is for more voice-only channels.

Channel congestion has been linked to interoperability problems and Public Safety Wireless Advisory Committee (PSWAC) requests for additional public safety frequencies, so the data from agencies that indicated they did not have enough channels were analyzed in some detail. Agencies' current and preferred uses of voice-only and data-only channels were analyzed to determine the extent of problems with channel congestion. More than half (53 percent) of all respondents indicated they needed additional voice-only channels, and 30 percent indicated they needed additional data-only channels. Agencies that said they needed more channels (53 percent of the respondents) were asked to estimate the number of additional channels they needed. These

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agencies indicated a need for an average of 5.1 additional voice channels per agency (a 40-percent increase) and an average of 4.9 additional data channels (a 70-percent increase).

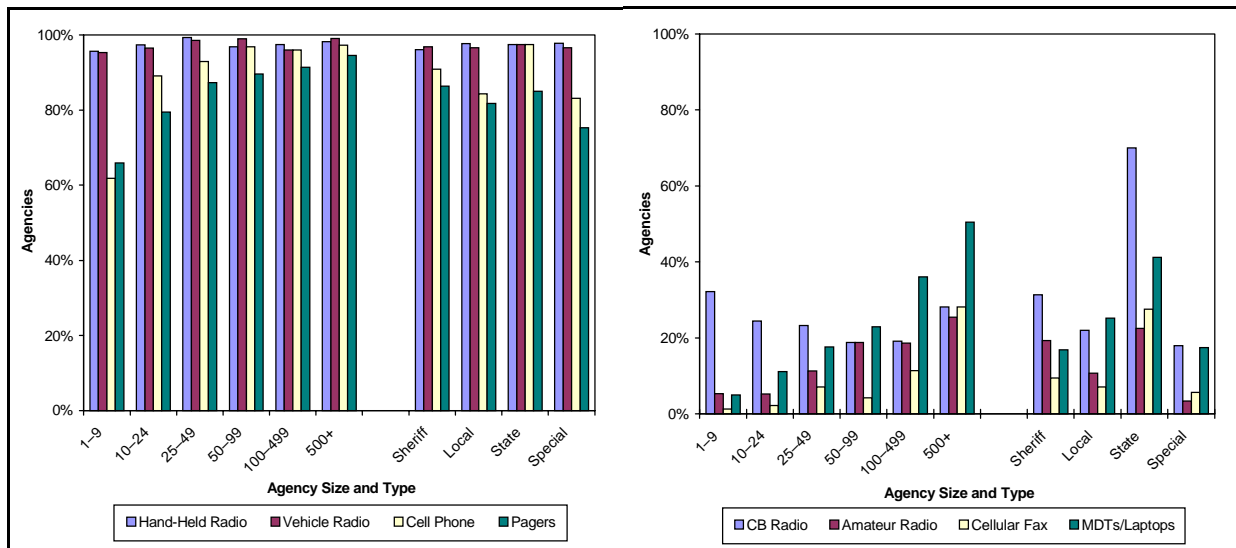
A comparison of agencies that were satisfied with the current number of channels with those that said they needed more channels revealed considerable agreement across agencies in the number of channels considered optimal for routine operations (including routine interoperability incidents). A similar pattern was not evident for data-only channels, perhaps because agencies are just beginning to dedicate channels for data transmission and they are less clear about how many data channels will be optimal. Agencies are also planning to increase their use of advanced technology services and wireless data applications that will require channels devoted to data transmissions, and have yet to find out how those applications will translate into the need for additional spectrum.

Agencies that were planning to replace or upgrade their LMR systems (46 percent of all respondents) were asked to estimate the TOTAL number of channels they would need in their next system. They estimated an average of 13.7 voice-only channels and 4.9 data-only channels for their next system. State agencies and agencies with 500 or more sworn officers were the most desperate for additional channels, but most of those that plan to replace or upgrade were not expecting big differences in the total number of channels in their next system.

The use of mobile data terminals (MDTs) and laptops increases with agency size. The use of MDTs is increasing in smaller agencies but leveling off or declining in large agencies, while plans for additional use of laptop computers reveal a dramatic increase across the board. According to the results of this study, the number of agencies using free-text and data base information on their MDTs/laptops will double in the next 2 years. The wireless transmission of still images, fingerprints, and video is highly desirable and many agencies plan to adopt them within the next 2 years (if budgets permit). Advanced wireless technology services are also highly desirable. Cellular phones are already used by 87 percent of agencies and more plan to begin using them within the next 5 years. About 40 percent of all agencies expect to use a global positioning system (GPS) within 5 years.

Large agencies and State agencies are the most likely to use security measures of all kinds, with digital encryption being the most common form of security protection for voice and/or data security. Most agencies said they *never* use voice or data security. There is a discrepancy between the number of agencies that say voice and data security are essential to their operations and the number that use either on a regular basis, but there appears to be a growing awareness of the need as well as an increasing use of both voice and data security measures.

Question: Indicate the types of communication equipment used in your agency.



### Exhibit 6: Use of Selected Communications Equipment

#### Mobile radios are essential communications equipment.

As the graphs in Exhibit 6 illustrate, law enforcement use of communications equipment falls into two general categories, equipment that is essential to, and used by, virtually *all* law enforcement agencies, and equipment that is essential to the operations of, and used by, a significantly smaller number of agencies. The use of wireline telephone and FAX is so widespread that it is not even included in the graph to the left. Handheld and vehicle-mounted radios are almost as common as telephones, and the results of this study suggest it will not be long before the use of cellular phones and pagers will be as common as the use of wireless radio.

The graph to the right highlights some of the differences that exist between different sizes and types of agencies with respect to their use of CB Radio, Amateur Radio, Cellular FAX, and MDTs and/or laptop computers. State agencies, which serve different functions in different States, but in many States are the highway patrol, are the most likely to use CB Radios, followed by sheriff's departments and then local police. The smallest agencies, many of them serving rural communities, are a little more likely to use CB radios than all but the largest agencies. The use of MDTs and laptops is clearly related to agency size, although agencies of all sizes and types are increasing their use of wireless data equipment. Cellular FAX is used almost exclusively by State agencies and agencies with 500 or more sworn officers.

Question: Does your agency SHARE radio frequencies with other organizations? AND Does your agency SHARE the infrastructure for its land mobile radio base system with other organizations?

Agency Type and Size	Percent That Share		Infrastructure Components		Decisions	
	Frequencies (% share)	Infrastructure (% share)	Transmitters (average #)	Repeaters (average #)	Extensively involved (percent)	
<i>Type:</i>						
Local	67	58	3	8	60	
Sheriff	84	75	5	11	83	
Special	61	46	21	14	56	
State	78	72	71	78	89	
<i>Size:</i>						
1	1–9	92	72	1	1	38
2	10–24	74	65	2	3	44
3	25–49	69	57	2	2	47
4	50–99	68	58	2	5	85
5	100–499	58	58	7	12	78
6	500 +	65	60	32	54	88

\* Agencies that indicated either a 4 or 5 on a scale of 1–5 (where 1 = not at all and 5 = extensively involved).

### Exhibit 7: Sharing Frequencies and Infrastructure

#### Most agencies share frequencies and/or infrastructure with other organizations.

Most agencies own rather than lease their primary LMR systems, and it is common to share frequencies and/or infrastructure. Agencies with fewer than 10 sworn officers are *most* likely to share frequencies and/or infrastructure with other organizations, while agencies with 100–499 sworn officers are the *least* likely to share frequencies (58 percent) and special police are least likely to share infrastructure (46 percent). All size categories of agencies with 25 or more sworn officers are quite similar in the extent to which they share infrastructure, ranging from 57–60 percent. Exhibit 7 presents information about the typical infrastructure (the average number of transmitters and repeaters) for different sizes and types of agencies. A relatively small number of agencies reported the use of relays (10 percent) or gateways (5 percent). As expected, State agencies that serve large geographic areas, and large agencies that are more likely to serve metropolitan communities with highrise buildings, have more infrastructure components. Agency involvement in decisionmaking is a function of both agency size and type.

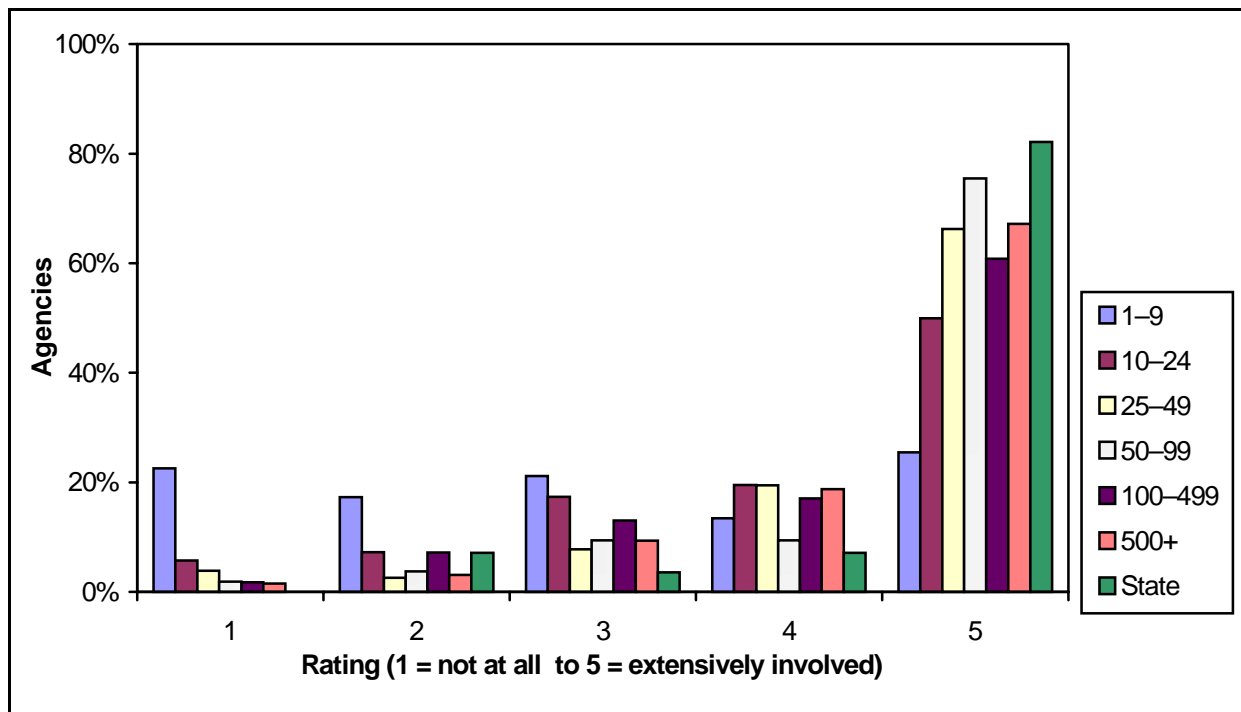
Written comments indicated that shared frequencies and/or infrastructure could create interoperability problems as well as solve them, as illustrated by the following statements from agencies that use shared systems:

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- *[Our] 800 MHz radio system has 4600 SERS and 28 agencies. It has worked well for interoperability because it is reliable and the jurisdictions all participate in the planning. The system is managed by the Telecommunications Department, which also manages a combined, consolidated E-911/Fire/Law/EMS dispatch center. This has facilitated interoperability.*
  - *We are a small suburban agency that leases equipment from the County Sheriff's Department along with many other metropolitan suburbs, our dispatch is by the County. We have a user's advisory board to address issues of natural concern. We are currently developing a regional system... County will be the dispatch provider.*
  - *[Our] Department of public safety is a combined police-fire department. Our officers do both disciplines and both police and fire dispatching is done from the same dispatch center.*
  - *[We are] only able to talk with agencies on our current system. Agencies not on 800 have no contact.*
  - *By the fall we should be in a new facility [running] a joint communications center (fire and police) and new radio equipment. Exciting times with lots of changes. Only real problem is leaving other agencies behind.*



Question: Does your agency *SHARE* the infrastructure for its land mobile radio base system with other organizations?

AND If so, how involved is your agency in the decisionmaking process related to the operation of the system? (1 = not at all to 5 = extensively involved)



**Exhibit 8: Extent of Involvement in LMR Decisionmaking (for Agencies that Share LMR Infrastructure)**

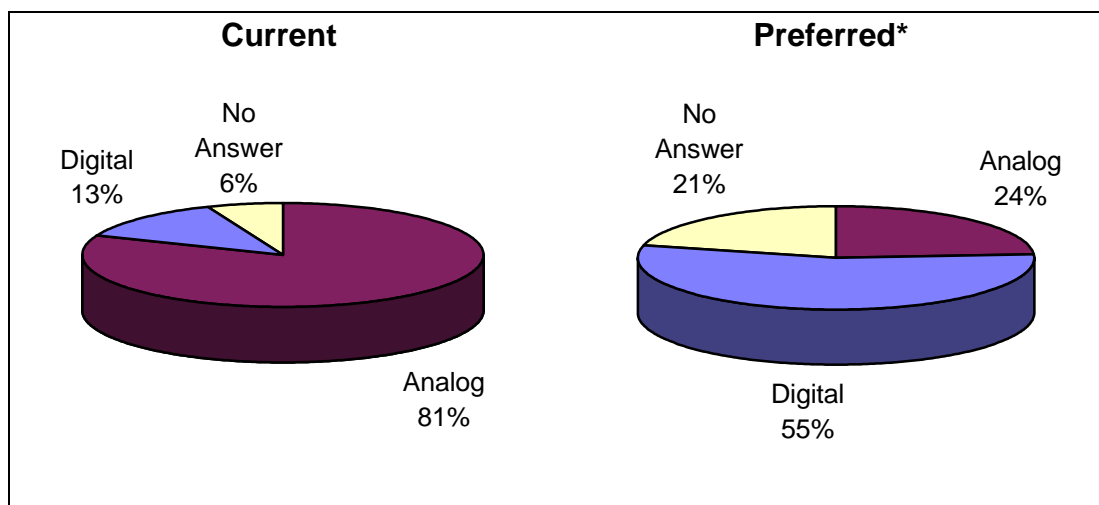
**The majority of agencies are actively involved in LMR decisionmaking.**

Most agencies are actively involved (rating of 4 or 5 on a 5-point scale) in decisionmaking related to the operation of their LMR systems, although agencies with fewer than 10 sworn officers tend to be less involved. Twenty percent of the smallest agencies indicated they are not at all involved in the decisionmaking for their radio systems. Most agencies with 500 or more sworn officers (88 percent) indicated they are actively involved, compared to 38 percent of agencies with less than 10 sworn officers. Most State agencies are *extensively* involved (rating of 5 on 5-point scale) in the decisionmaking related to their radio system. The extent to which agencies rated their involvement is summarized in Exhibit 8. Each bar on the graph indicates the percentage of agencies in each size category that rated their agency involvement from a 1 (not at all involved) to a 5 (extensively involved).

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Question: Which best describes your PRIMARY land mobile radio base system?

If you have plans to replace or upgrade your system, what is your agency's preference for its next system?



\* Preferences of agencies with plans to replace or upgrade within 10 years (46 percent of all respondents).

#### Exhibit 9: Current and Preferred Use of Analog/Digital LMR Systems

##### Analog is still most common but most agencies prefer digital.

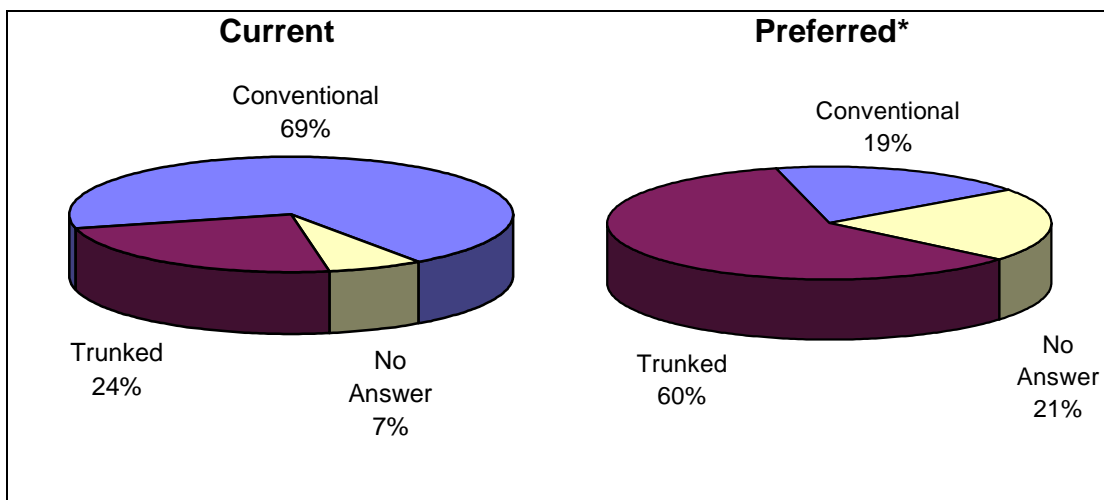
Eighty-one percent of respondents reported the use of analog systems (17 percent have 800 MHz). Only 13 percent of all respondents reported digital systems. Exhibit 9 summarizes current use of analog and digital systems and the preferences indicated by the 46 percent of agencies that are planning to replace or upgrade their systems within the next 10 years. One State agency reported using a digital trunked system, and two others indicated they were in the process of moving to digital.

Write-in comments indicated there are a variety of factors that result in agencies' decisions to move to digital technology or remain with analog. An agency that recently purchased a digital system noted, "For our department, this conversion is a \$4 million option. In fact, due to the differing digital technologies already in use in [our] area, analog voice may be a better state/Federal option." Another police department decided on analog technology: "This County recently upgraded its VHF conventional radio system with a \$6 million 800 MHz simulcast trunked analog radio system. Due to our mountainous terrain, an analog system provides superior performance."

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Question: Which best describes your PRIMARY land mobile radio base system?

If you have plans to replace or upgrade your system, what is your agency's preference for its next system?



*\*Preferences of agencies with plans to replace or upgrade within 10 years (46 percent of all respondents).*

#### **Exhibit 10: Current and Preferred Use of Conventional versus Trunked LMR Systems**

##### **Most new LMR systems will be trunked.**

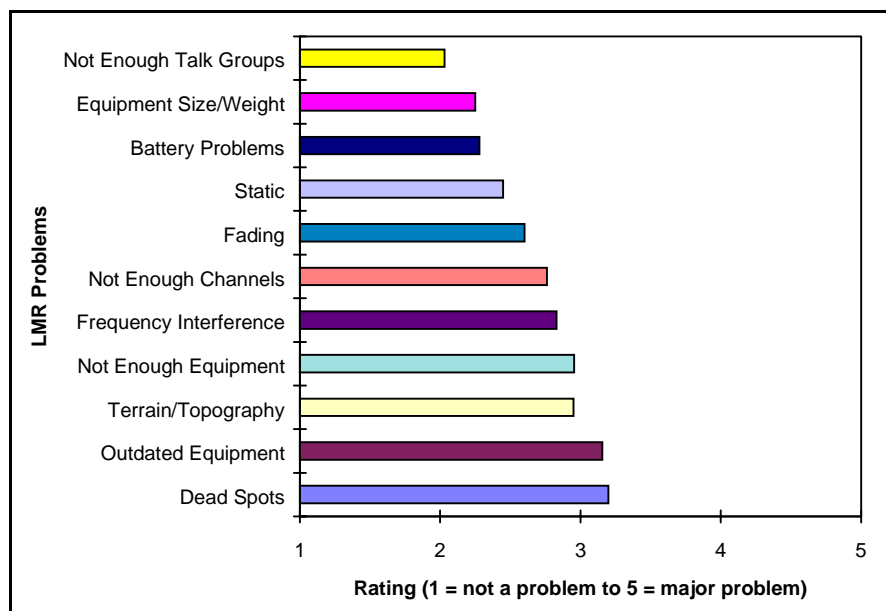
Trunking, the technology that allows for more efficient use of spectrum by automatically routing users to an open channel, is used by 24 percent of agencies overall, *most* often by large agencies (32 percent of agencies with 50–499 sworn officers, 55 percent of agencies with 500 or more sworn officers). Although most agencies (69 percent) have conventional radio systems, many of those that are planning to replace or upgrade their current system were most likely to indicate a preference for trunking their next system. Large agencies that are planning to replace their current system were most likely to indicate a preference for trunking. A larger percentage of the smallest agencies (20 percent of agencies with 1–9 sworn officers) have trunked systems than do agencies with 10–49 sworn officers. Five of the State agencies currently use a trunked system and most (90 percent) indicated a preference for trunking in their next system. Among agencies that are currently using trunked systems and plan to replace or upgrade their systems, 75 percent prefer trunking in their next system, 2 percent prefer conventional, and 20 percent were unsure. In contrast, among agencies that are currently using conventional systems, 56 percent indicated a preference for trunking, 24 percent prefer conventional, and 21 percent were unsure. Overall, the proportion of agencies using trunked systems will increase from 24 to 27 percent.

Trunking alleviates channel congestion but does not solve all interoperability problems, as noted by the respondent who wrote, *“The nature of trunked radio systems coupled with the industry’s inability to share trunking schemes breeds lack of interoperability. We experience extreme difficulty communicating beyond our County’s borders in every situation.”* The reader is referred to the discussion about channel congestion, comparing agencies with trunked versus conventional systems on page 24.

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*Question: How serious are the following problems regarding your land mobile radio base system?*

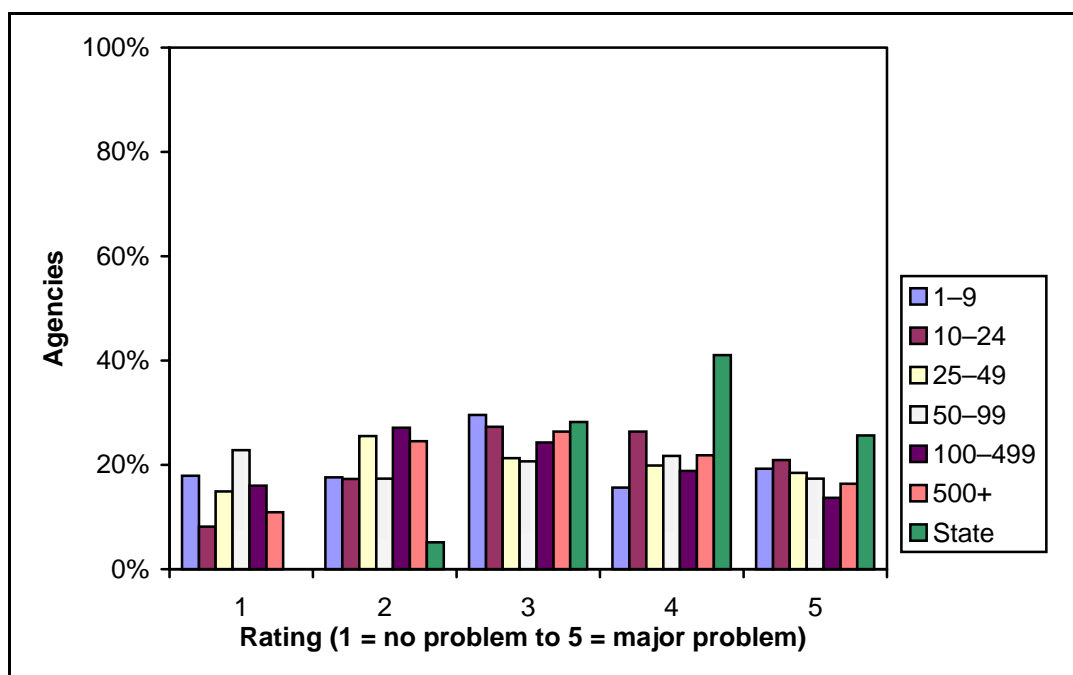
*AND To what extent does topography/terrain hinder the effectiveness of your land mobile radio base system?*



### **Exhibit 11: Problems With LMR Systems**

As the primary communication equipment for all sizes and types of agencies, an effective LMR system is essential to effective communications for routine internal operations as well as interoperability across agencies. Agencies were asked to rate the seriousness of some common problems regarding their LMR system. The issues and average ratings are summarized in Exhibit 11. Ratings of 4 or 5 are interpreted to indicate a serious, ongoing problem, whereas ratings of 3 are interpreted here as a moderate or infrequent problem. Dead spots and outdated equipment were identified as the most serious problems for the largest number of agencies, with 43 percent of respondents indicating ratings of 4 or 5. Thirty-seven percent indicated serious problems with topography/terrain and insufficient equipment. Respondents that indicated serious problems due to topography/terrain were agencies with mountains or many highrise buildings in their jurisdiction. Approximately a third indicated serious problems with frequency interference (32 percent) and channel congestion (34 percent), and 26 percent indicated problems with fading. Twenty percent of respondents were experiencing serious problems with static, and 15 percent indicated serious problems due to batteries, equipment size/weight, or lack of enough talk groups. In every category except battery problems, State agencies were the most likely to indicate serious problems. See Table I in Appendix E for more detail.

Question: To what extent does topography/terrain hinder the effectiveness of your land mobile radio base system?

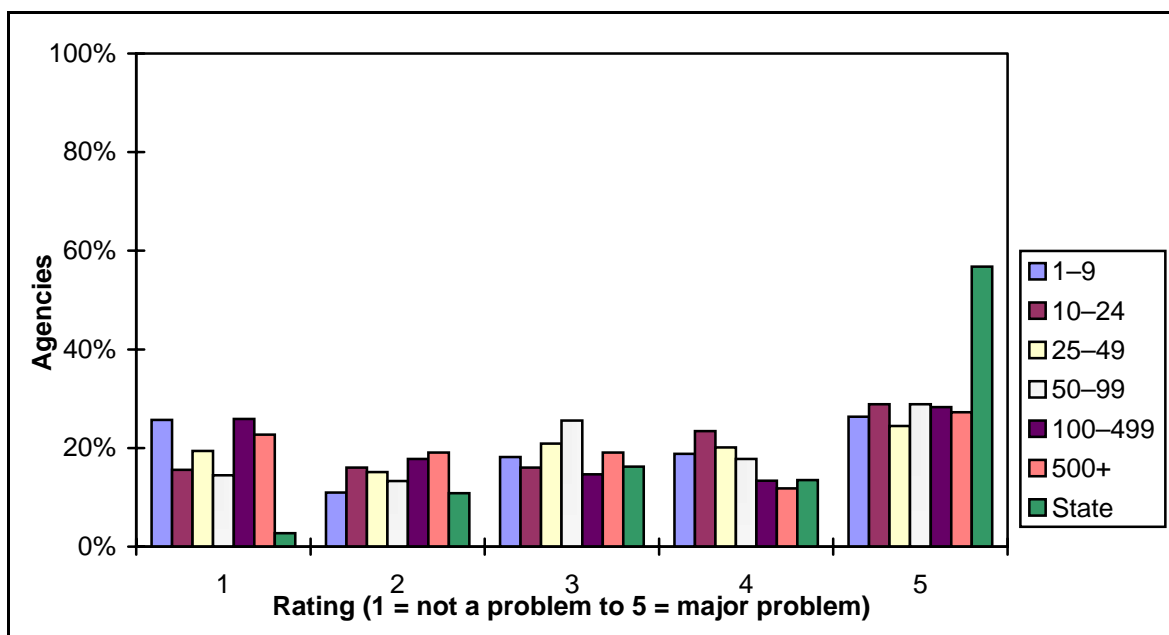


**Exhibit 12: Ratings of Topography/Terrain as a Problem for LMR Effectiveness**

**Topography/terrain limits LMR effectiveness for 62 percent of respondents.**

Respondents were asked about the presence of mountains, rolling hills, and/or the presence of many highrise buildings. They were also given “relatively flat” and “coastal or intracoastal waterways” as possible descriptors of topography/terrain. Most agencies indicated that topography/terrain hindered the effectiveness of their land mobile radio system to some extent (3 or more on a 5-point scale where 1 = no problem and 5 = major problem). Those that rated topography or terrain as a serious problem (4 or 5) were either large metropolitan agencies (with many highrise buildings), and/or they were located in mountainous regions. Agencies that rated terrain as a serious problem also reported dead spots as a serious problem. As expected, State agencies, represented by the bar on the far right of each cluster, were more likely to report problems resulting from topography/terrain. They work across larger geographic regions and are more likely to encounter *all* of the problems being experienced by smaller agencies within their jurisdiction.

Question: How serious a problem is outdated equipment regarding your land mobile radio system?



**Exhibit 13: Extent to Which Outdated Equipment Limits LMR Effectiveness**

Severity of Problem	Average Age of LMR System	% Giving Response	% Plan to Replace
1 = not a problem	6.0	21%	26%
2	7.6	14%	38%
3	9.2	17%	49%
4	10.9	16%	55%
5 = major problem	14.7	27%	69%

**Exhibit 14: Average Age of LMR Systems and Replacement/Upgrade Plans**

**State agencies are most likely to have a major problem with outdated equipment.**

The relatively flat profile in Exhibit 13 suggests the existence of a systematic process for replacing LMR systems as they age. Although that may be generally true, the data also reveal a somewhat larger proportion of agencies working with outdated equipment. Agency ratings were strongly correlated with the average age of their systems, and many agencies with older equipment are already planning to replace/upgrade their systems within the next 10 years.

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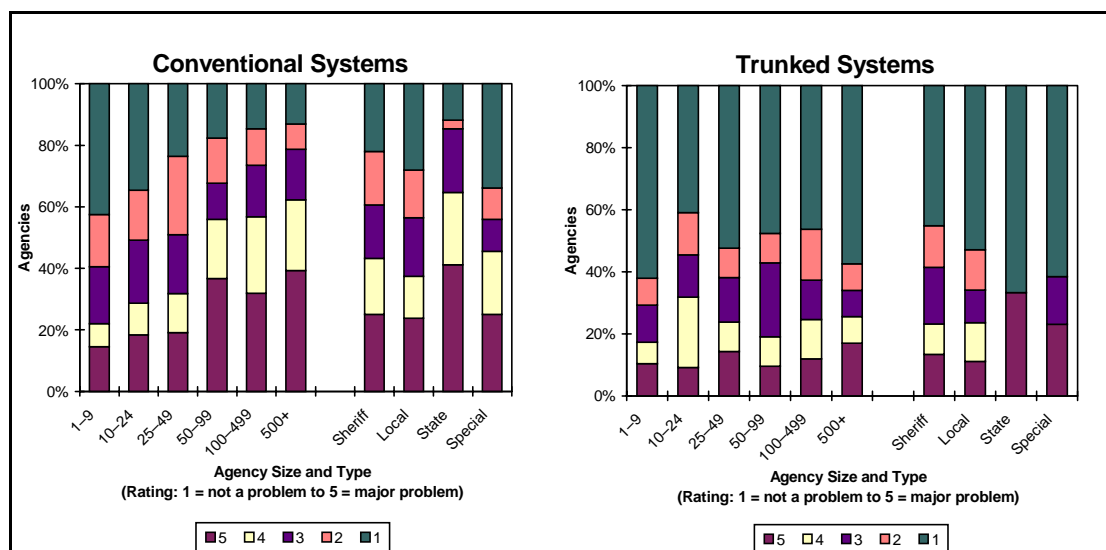
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State agencies were the most likely to rate outdated equipment as a serious problem, with 65 percent of them rating the issue as a 4 or 5. State agencies also tend to have the oldest equipment (average age of 15 years compared to 9 years for local police agencies) as well as the largest (and most expensive) systems. Three quarters of the responding State agencies (75 percent) have plans to replace or upgrade their systems within the next 10 years.

Thirty percent of respondents indicated they are working with relatively new radio systems (1 to 5 years old), and those agencies were significantly more confident in their ability to handle day-to-day, mutual aid, and task force situations than agencies working with older systems.

Almost half of all respondents (46 percent) plan to replace or upgrade their systems within the next 10 years, about a third of them (29 percent) before the end of the century, and less than one-fifth (18 percent) in the year 2000 or later. Agencies that have plans to replace or upgrade their equipment have significantly older equipment (average age 13 years) than agencies that are not in the planning process (average age 8 years), and they were much more likely to report serious problems with channel congestion (50 percent with ratings of 4 or 5, compared to 20 percent of agencies that are not planning to replace or upgrade). See Exhibit 13 and Exhibit 14. Based on their written comments, some agencies are working with equipment that would qualify as “*antique*” while others are working with state-of-the-art equipment. Labeling any technology as outdated is a very subjective rating, however, as one respondent noted, “*Current today, antiquated tomorrow.*” See Appendix E for additional information about relationships between age of equipment and the factors mentioned here.

Question: How serious is “not enough channels”?



Note: The bars have been stacked so that the agencies that reported no problems are on the top. Only three State agencies have trunked radio systems.

### Exhibit 15: Extent to Which Channel Availability Is a Problem: Conventional versus Trunked

#### Trunked systems relieve channel congestion.

The graphs in Exhibit 15 compare the responses related to channel congestion for agencies that have trunked systems with the responses of agencies that have conventional systems. Each bar summarizes the proportion of responses within each size and type category for each rating on the 5-point scale. Although the phrase “not enough channels” was used in the questionnaire, it is discussed here as channel congestion and/or channel availability. Agencies that have trunking were clearly experiencing fewer problems related to channel congestion, although trunking does not completely eliminate the problem.

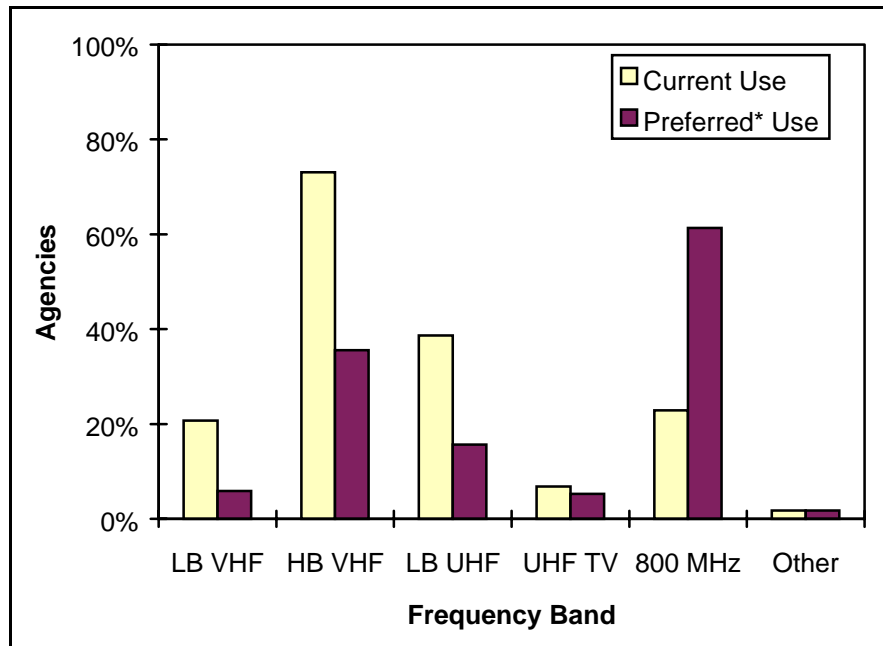
A comparison of agencies that are planning to replace or upgrade their systems within the next 10 years found no significant difference between agencies with trunked and conventional systems with regards to their estimated needs for additional voice-only, data-only, or alternate voice and data channels. A quarter of all respondents (23 percent) reported trunked systems, and 24 percent of them (about 5 percent of all respondents) reported serious problems with channel availability. Three times as many agencies use conventional systems, and 40 percent reported serious problems with channel congestion. Regardless of whether they have trunked or conventional systems, larger agencies are more likely to experience channel congestion than smaller agencies. State agencies were considerably more likely to rate channel availability as a major problem (58 percent rated it a 4 or 5, compared to 18 percent that rated it a 1 or 2) than other types of agencies.



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Question: Identify the radio frequencies your agency currently uses.

AND Identify the radio frequencies your agency needs for its NEXT land mobile radio base system.



*\*Preferences of agencies with plans to replace or upgrade within 10 years (46 percent of all respondents).*

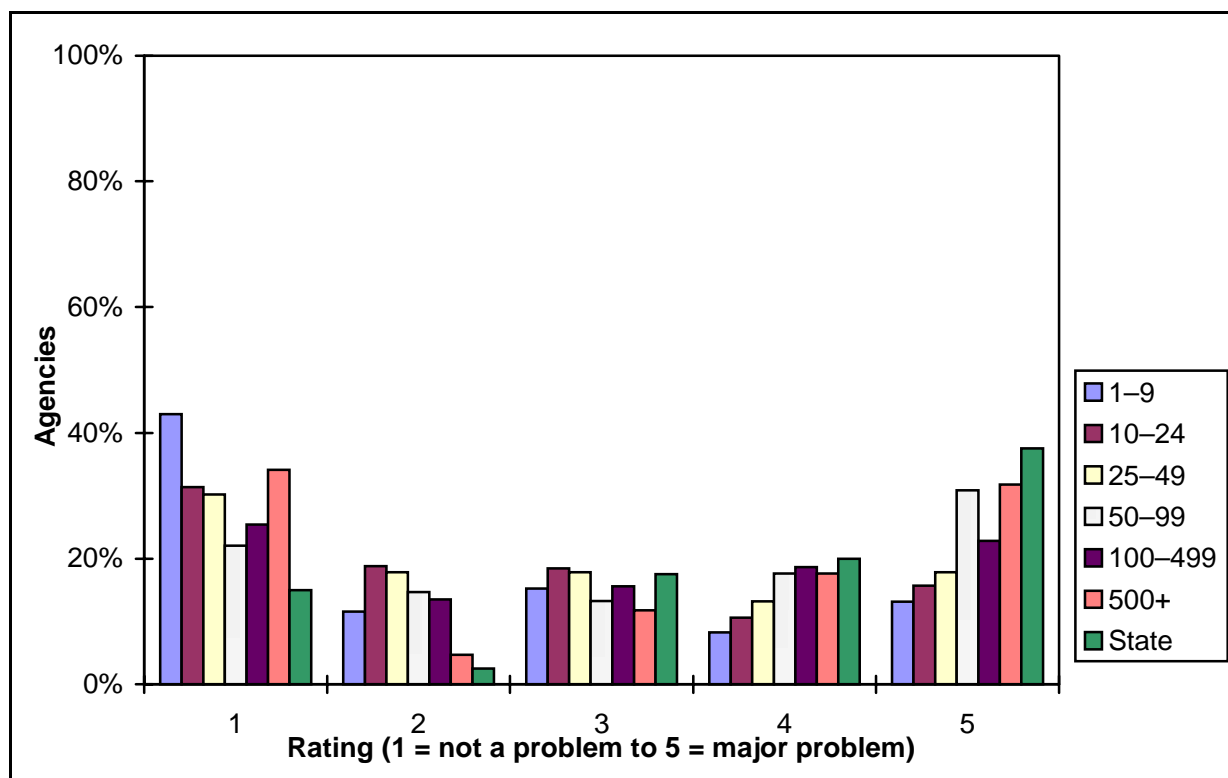
**Exhibit 16: Current and Preferred Use of Radio Frequencies for Agencies With Plans to Replace or Upgrade Their LMR System in the Next 10 Years**

**Comparison of current and preferred frequencies reveals shift to 800 MHz.**

The bar graph in Exhibit 16 summarizes current use and spectrum preferences indicated by the 46 percent of agencies that have plans to replace or upgrade their land mobile radio system within the next 10 years. The bars compare the percentage of these agencies that currently use voice-only channels in low band VHF, high band VHF, low band UHF, UHF-TV, 800 MHz and Other, with the percent of agencies that expect to operate in each bandwidth after they have replaced their current system. The only band that shows an increase is 800 MHz. As a result, the total number of agencies operating in 800 MHz will more than double, growing from 23 to 51 percent. Table II in Appendix E summarizes agency use of different frequency bands for interoperability.

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Question: How serious is the following problem regarding your land mobile radio system? Not enough channels?



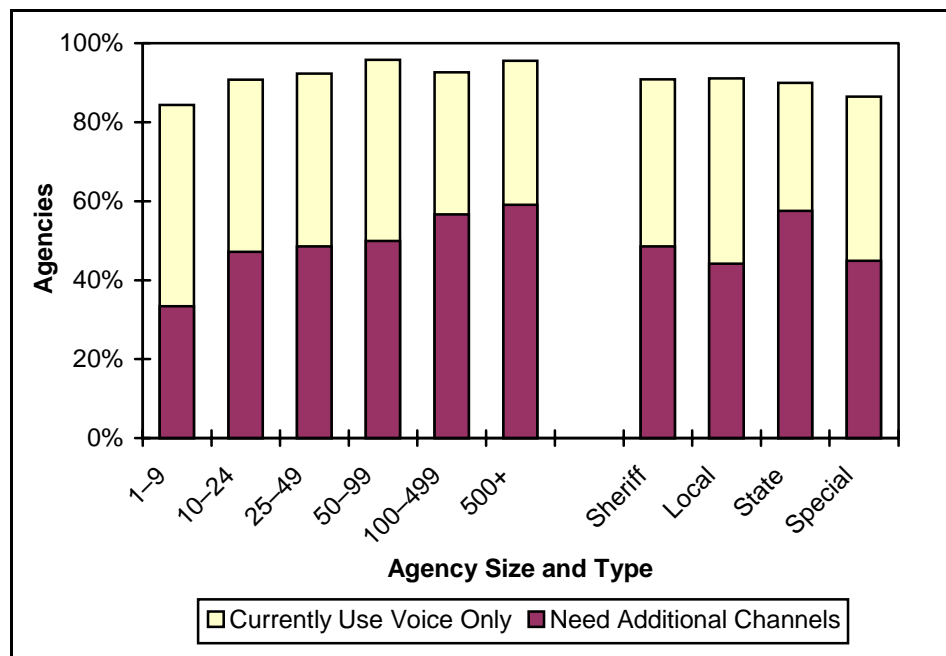
**Exhibit 17: Not Enough Channels**

Conclusions about the extent to which channel congestion is a national problem are dependent upon the inclusion or exclusion of agencies that gave a rating of 3 in the diagnosis. This analysis interprets a rating of 4 or 5 as a *serious* problem (on a 5-point scale where 1 = not a problem and 5 = major problem). A rating of 3 is interpreted as a moderate or infrequent problem. Thirty-six percent (36 percent) of all respondents said “not enough channels” was a *serious* problem, 17 percent rated it as a moderate or infrequent problem. If agencies that gave a rating of 3 are considered as having a serious problem (as opposed to an intermittent or moderate problem as we have assumed), 53 percent of all respondents are currently experiencing serious problems with channel congestion.

The distribution of responses in Exhibit 17 (i.e., high on both ends and low in the middle) suggests the possibility that the summary data were blending two or more distinctly different subgroups. When the data were analyzed based on whether or not agencies are using conventional or trunked systems, it became clear that trunked systems are alleviating channel congestion for many agencies (see the discussion accompanying Exhibit 15). Agencies with conventional systems are five times as likely to be experiencing problems with channel congestion as are agencies with trunked systems (44 percent of those rating 3 or more have conventional systems, 9 percent have trunked).

Question: Does your agency currently use voice-only channels?

AND Does your agency need additional voice-only channels?



**Exhibit 18: Percent of Agencies Currently Using Voice-Only Channels and Percent That Need Additional Voice-Only Channels**

#### **Need for additional channels is related to agency size.**

Agencies were asked to report the number of channels they currently use in low band, high band VHF, UHF, and 800 MHz. If channel congestion or “not enough channels” was a problem for them, they were asked to rate the seriousness of the problem. If agencies said “not enough channels” was a problem they were asked to estimate the number of additional channels they needed for voice-only, data-only, and/or alternate voice and data. The analysis of current and estimated needs for additional channels is organized into a discussion of current and anticipated needs for voice- and data-only channels and alternate voice and data channels. All analyses of agencies’ needs for additional channels are based on responses from two subgroups: (1) agencies that said “not enough channels” was a problem and estimated additional channels needed; and (2) agencies that plan to replace or upgrade their systems within the next 10 years and provided information about the total number of channels they expect to have in their next system.

The majority of channels are devoted to voice-only communications, but there is a growing number of agencies devoting an increasing number of channels to data-only transmissions. There also is a significant number of agencies that use alternate voice and data channels (i.e., sometimes they use the channel for voice, sometimes for data, a capability that is greatly enhanced by trunking). Overall, 97 percent of respondents reported the use of mobile radios, 91 percent reported the use of voice-only channels, 27 percent reported the use of data-only channels, and 19 percent reported the use of alternate voice and data channels (the percentages do not add up to 100 percent because agencies could report more than one type of channel usage). See Exhibit 18 through Exhibit 22 and Tables III and IV in Appendix E.

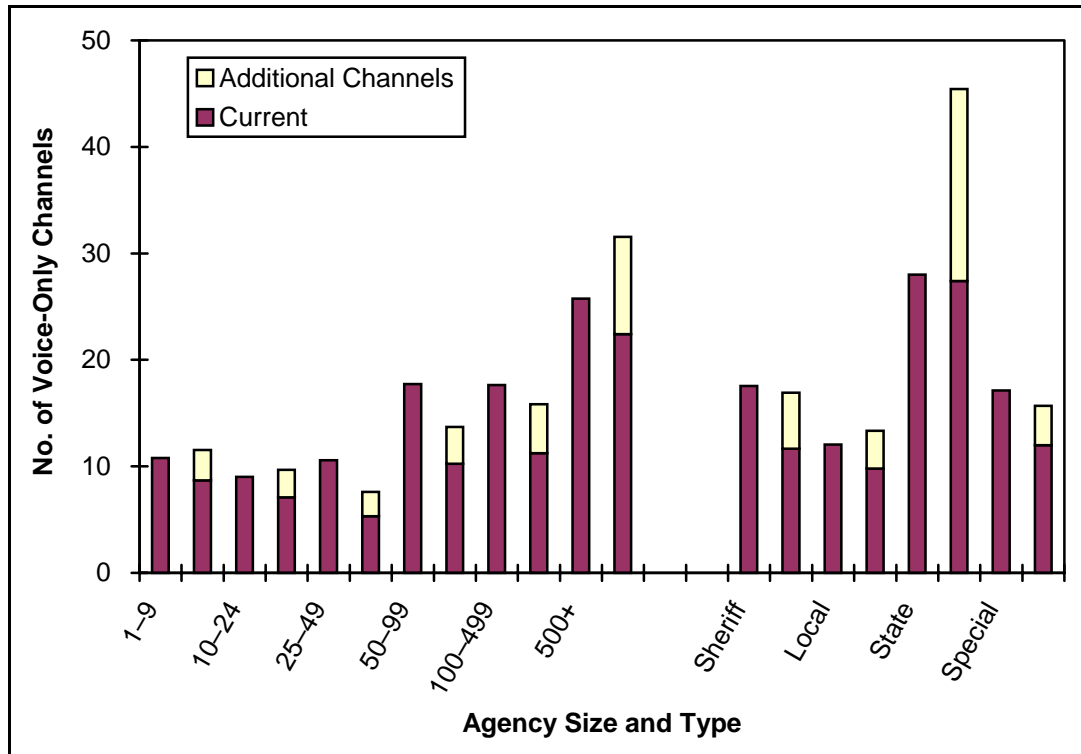
Agency Size/Type	Agency Size and Type							
	1-9	10-24	25-49	50-99	100-499	500+	State	TOTAL
Percent of all agencies that use voice-only channels	84%	91%	92%	96%	93%	96%	90%	91%
<b>Average number of voice-only channels</b>	<b>10.1</b>	<b>8.0</b>	<b>8.0</b>	<b>12.9</b>	<b>13.7</b>	<b>23.8</b>	<b>36.1</b>	<b>12.8</b>
Percent needing additional channels	40%	52%	53%	52%	61%	62%	67%	53%
<b>Average additional channels needed</b>	<b>2.8</b>	<b>2.6</b>	<b>2.3</b>	<b>3.4</b>	<b>5.4</b>	<b>9.2</b>	<b>24.2</b>	<b>5.1</b>
Percent increase in voice-only channels	28%	32%	28%	26%	39%	39%	67%	40%
Percent of users that plan to replace/upgrade system	26%	30%	37%	45%	50%	58%	60%	40%
<b>Average number of channels estimated for next system</b>	<b>10.1</b>	<b>8.8</b>	<b>10.3</b>	<b>7.3</b>	<b>13.1</b>	<b>24.1</b>	<b>32.4</b>	<b>13.7</b>

**Exhibit 19: Current Use Compared to Estimated Need for Additional Voice-Only Channels**

Agency Size/Type	Agency Size and Type							
	1-9	10-24	25-49	50-99	100-499	500+	State	TOTAL
Percent of all agencies that use data-only channels	16%	13%	16%	23%	39%	66%	23%	27%
<b>Average number of data-only channels</b>	<b>5.3</b>	<b>2.9</b>	<b>2.7</b>	<b>3.1</b>	<b>2.8</b>	<b>5.9</b>	<b>5.7</b>	<b>3.9</b>
Percent needing additional data-only channels	17%	27%	25%	37%	40%	40%	43%	30%
<b>Average additional channels needed</b>	<b>2.0</b>	<b>1.7</b>	<b>1.9</b>	<b>1.8</b>	<b>2.5</b>	<b>3.5</b>	<b>12.8</b>	<b>2.7</b>
Percent increase in data-only channels	35%	58%	71%	57%	87%	60%	225%	70%
Percent of users that plan to replace/upgrade system	15%	18%	22%	32%	46%	50%	50%	31%
<b>Average number of data channels estimated for next system</b>	<b>4.2</b>	<b>2.8</b>	<b>4.2</b>	<b>3.7</b>	<b>4.4</b>	<b>6.0</b>	<b>14.9</b>	<b>4.9</b>

**Exhibit 20: Current Use Compared to Estimated Need for Additional Data-Only Channels**

Question: How many voice-only channels does your agency currently use?  
 If you marked "not enough channels" as a problem, estimate the number of ADDITIONAL voice-only channels your agency needs.



**Exhibit 21: Comparison of Agencies With Enough Voice-Only Channels and Agencies With "Not Enough Voice-Only Channels" and Estimated Needs, by Agency Size and Type**

**Half need additional voice-only channels.**

The bar graph in Exhibit 21 compares agencies that *have* enough channels (answered 1 or 2 on 5-point rating scale) with agencies that indicated they *do not have* enough channels (answered 3, 4, or 5 on rating scale *and* filled in an estimate of the number of additional channels they needed). In each size category, the bar to the left represents the average number of channels available to agencies that have enough channels, the bar to the right represents the average number of channels available to agencies with insufficient channels *and adds the average number of channels they estimate they need*. More than half of all respondents (53 percent) that currently use voice-only channels indicated they needed additional voice-only channels. Agencies did not have to justify additional channels, they were just asked to indicate the number of additional channels they needed. Generally speaking, the percentage of agencies expressing a need for additional channels increases with the size of the agency, as does the number of additional channels desired. Although there are some differences between the two bars, the data suggest there is an optimal number of channels for agencies of different sizes and types. The difference between the two bars in the size category of 500 or more sworn officers may be due to the fact

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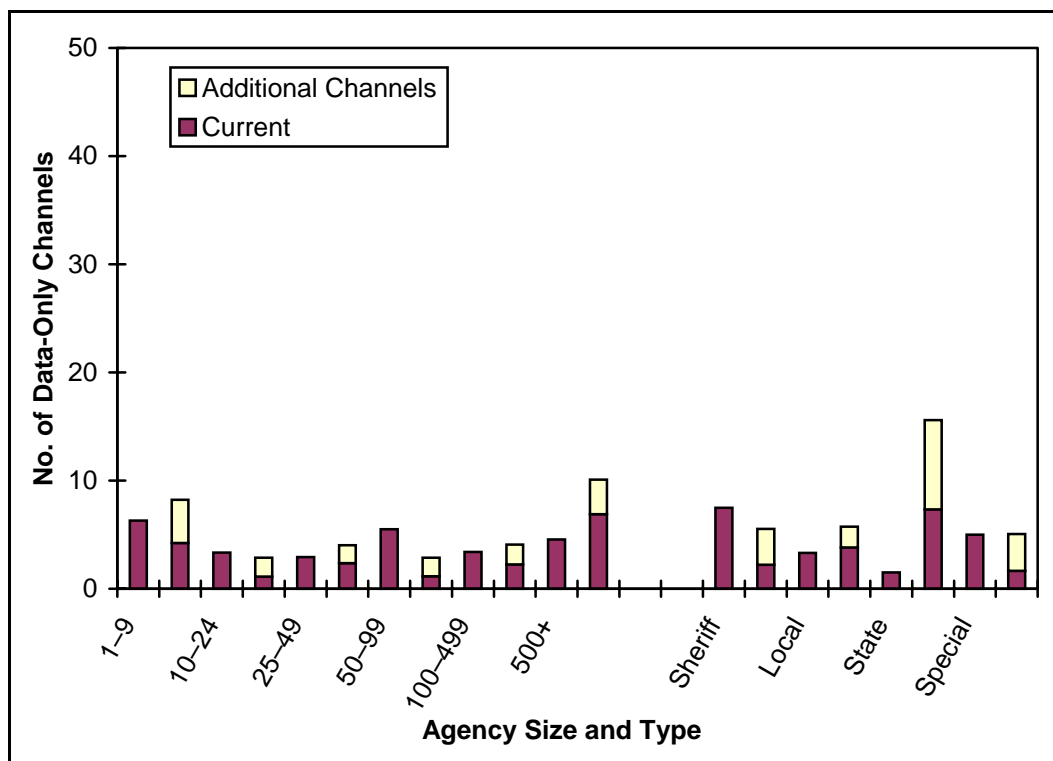
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that the category includes agencies that range in size from 500 to more than 35,000 sworn officers.

Sixty-seven percent of the responding State agencies indicated a need for an average of 24 additional channels. Averages for State agencies may be somewhat misleading since the two groups differ in size (a disproportionate number of the State agencies are represented in the bar to the right). Averages can be inflated if the needs of a large agency (e.g., the California Highway Patrol) far exceed the needs of smaller agencies (e.g., the North Dakota State Highway Patrol). See Table III in Appendix E.

Question: How many data-only channels does your agency currently use?

If you marked "not enough channels" as a problem, estimate the number of ADDITIONAL data-only channels your agency needs.



Note: Scale has been selected to facilitate comparison with voice-only channel needs in Exhibit 21.

### Exhibit 22: Comparison of Agencies With Enough Data-Only Channels and Agencies With "Not Enough Data-Only Channels" and Estimated Needs, by Agency Size and Type

#### More channels are being dedicated to data-only.

About 30 percent of all agencies indicated a need for additional data-only channels. Twenty-seven percent of respondents indicated they already use some channels for data-only. Two-thirds (67 percent) of the channels devoted to data are on 800 MHz systems (agencies with 100 or more sworn officers are more likely to have 800 MHz systems). Agencies with 500 or more sworn officers were the most likely to have multiple channels dedicated to data-only (an average of 4.5 channels). Although data-only channels represent a small percentage of all channels being used, the total number of channels being set aside nationally for that purpose is increasing (overall, by 70 percent), especially in larger agencies and State agencies. The need for data channels will increase as agencies implement their plans to adopt emerging, spectrum-hungry technologies. See Exhibit 20 and Exhibit 22 and Table IV in Appendix E.

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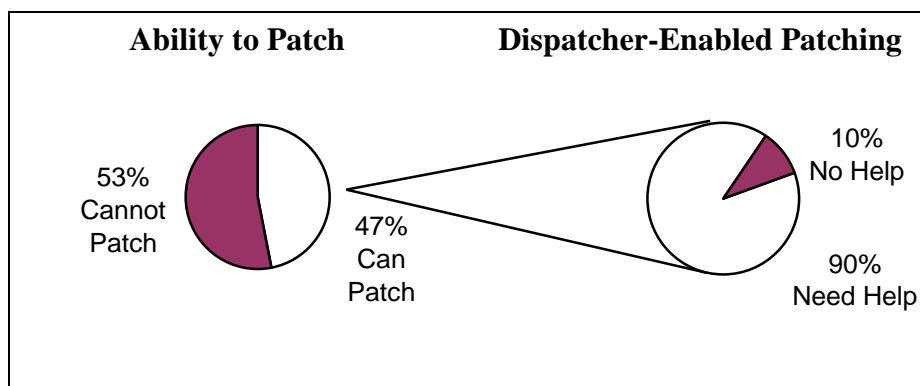
**Alternate voice and data channels offer flexibility.**

Large local police agencies and sheriff's departments are the most likely to use alternate voice and data channels, although a few agencies within all size and type categories have some channels that are used sometimes for voice and sometimes for data. Agencies could report more than one category (i.e., voice-only, data-only, and alternate voice and data). Trunked systems may be able to automatically route radio traffic to available channels, thus alternating between voice and data uses, whereas conventional systems are more likely to require channels dedicated for specific purposes. About 24 percent of respondents reported trunked systems, and 19 percent reported the use of alternate voice and data channels.



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Question: Does your agency have the ability to patch across channels?  
AND Is a dispatcher REQUIRED to set up and break down the patch?

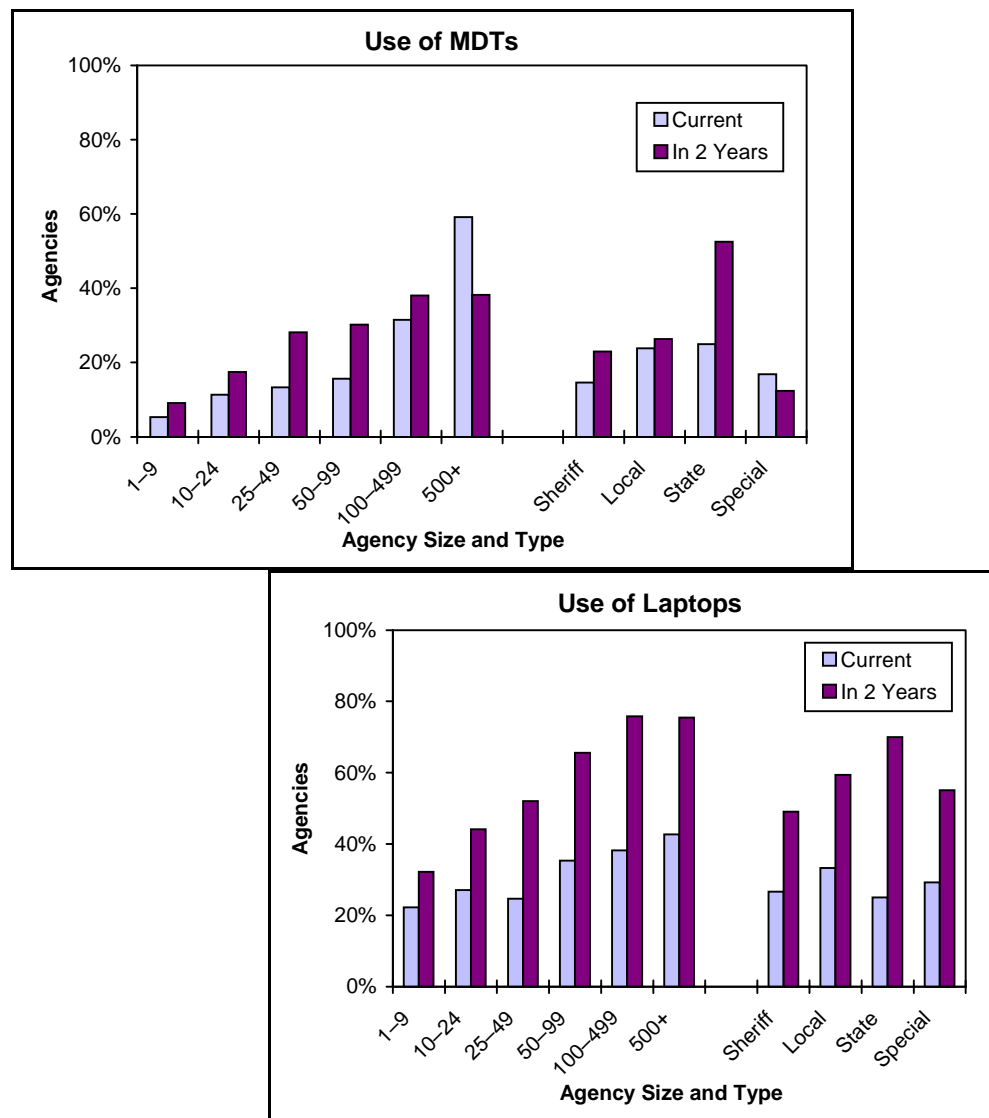


**Exhibit 23: Ability to Patch Across Channels and Percent That Requires Dispatcher to Patch Across Channels**

**Half can patch across channels.**

Almost half of the agencies (47 percent) said they could patch across channels. Ninety percent of the agencies that reported they could patch across channels need a dispatcher to set up and break down the patch. Agencies indicated they could handle a median of two simultaneous cross patches, but the maximum number of patches they said they could handle varied widely. Agencies were not asked about the nature of problems they might be encountering with patching, such as time delays, skipped portions within messages, and the unavailability of channels when a patch is in place; or about the extent to which patching was limited by the need for overlapping or congruent coverage areas.

Question: What is the TOTAL number your agency currently uses/estimates it will need in 1999?

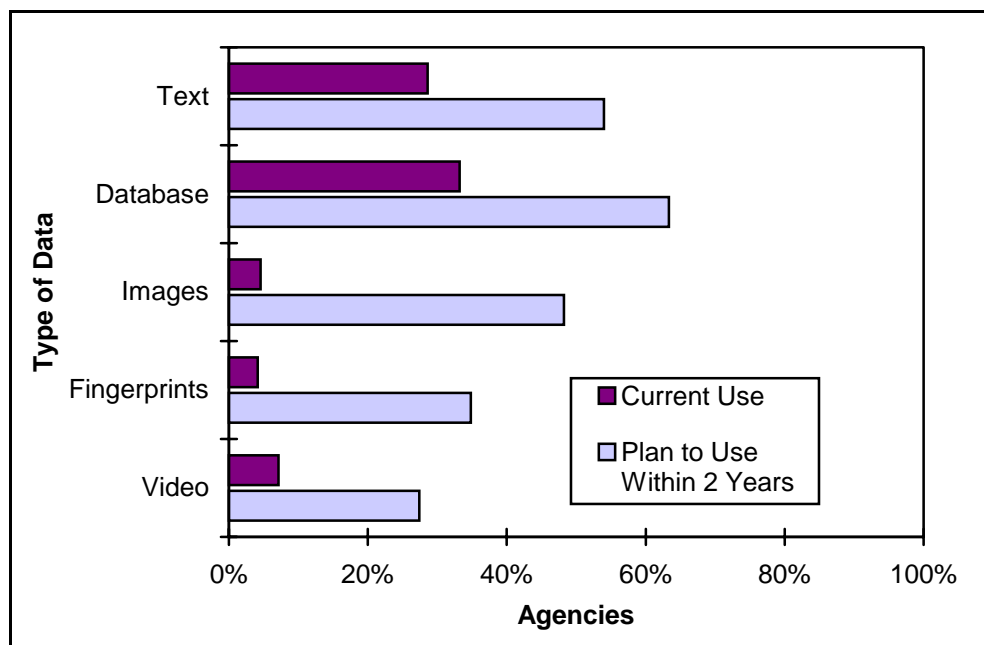


**Exhibit 24: Use of MDTs and Laptops**

**Laptops are replacing mobile data terminals, although use of both is growing.**

Approximately one-third of the respondents (36 percent) are currently using Mobile Data Terminals and/or laptop computers (9 percent report using both laptops and MDTs). Twenty-one percent of the agencies reported current use of MDTs, compared to 31 percent that plan to use them within 2 years, a 10-percent increase. In contrast, 26 percent of all respondents currently use laptops and 56 percent expect to use them within 2 years, a 30-percent increase. Exhibit 24 illustrates the comparative growth use and preference for laptops over MDTs. It also shows the extent to which the use of MDTs by larger agencies is leveling off or declining. Currently, 37 percent of all agencies with 100 or more sworn officers use MDTs (39 percent expect to be using them in 2 years), and 38 percent use laptops (75 percent expect to be using them within 2 years).

Question: Regarding mobile data terminals and laptop computers, identify the types of WIRELESS DATA communication (not voice) your agency currently USES and PLANS TO USE within the next 2 years.

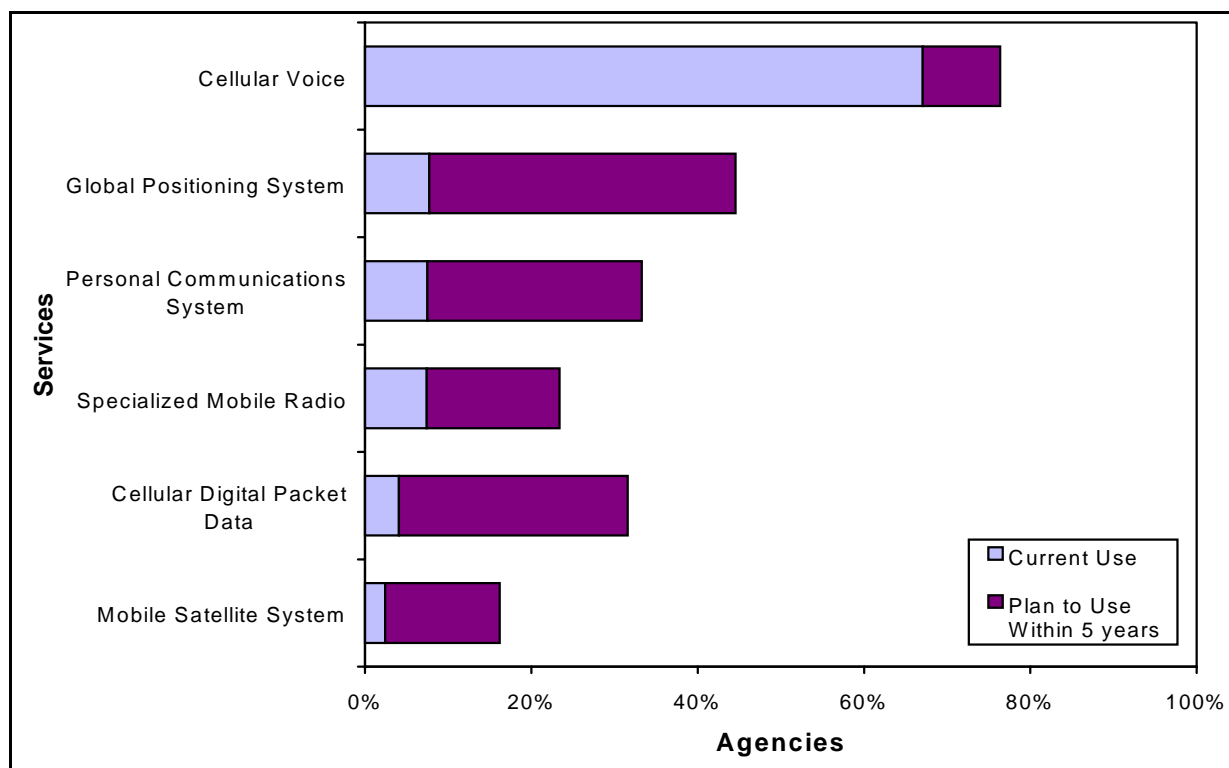


**Exhibit 25: Current and Planned Use of Wireless Data Applications**

**Agencies plan to expand use of wireless data applications.**

The respondents that currently use MDTs or laptops use them primarily for data base information and free text (e.g., reports and queries). A quarter of all agencies (24 percent) use wireless data base information, primarily agencies with 500 or more sworn officers (61 percent), and 21 percent of all agencies use free text (51 percent of agencies with 500 or more sworn officers). Approximately one-third of the agencies with 100–499 sworn officers have the same capabilities (32 percent, free text; 35 percent, data base information). The use of such advanced technology is far less common in smaller agencies (ranging from 4 percent of agencies that employ fewer than 10 sworn officers to 23 percent of agencies with 50–99 sworn officers). About 38 percent of the responding State agencies use free text and 50 percent use wireless data base information. The ability to transmit still images, video, or fingerprints, although highly desirable, is still relatively rare (no more than 5 percent in any size or type of agency). Many indicated they hope to adopt such technology within 2 years. Many agencies indicated a high level of need even though they were not currently using or even making plans to use the new technology applications.

Question: Indicate ALL services your agency USES or PLANS TO USE within the next 5 years.



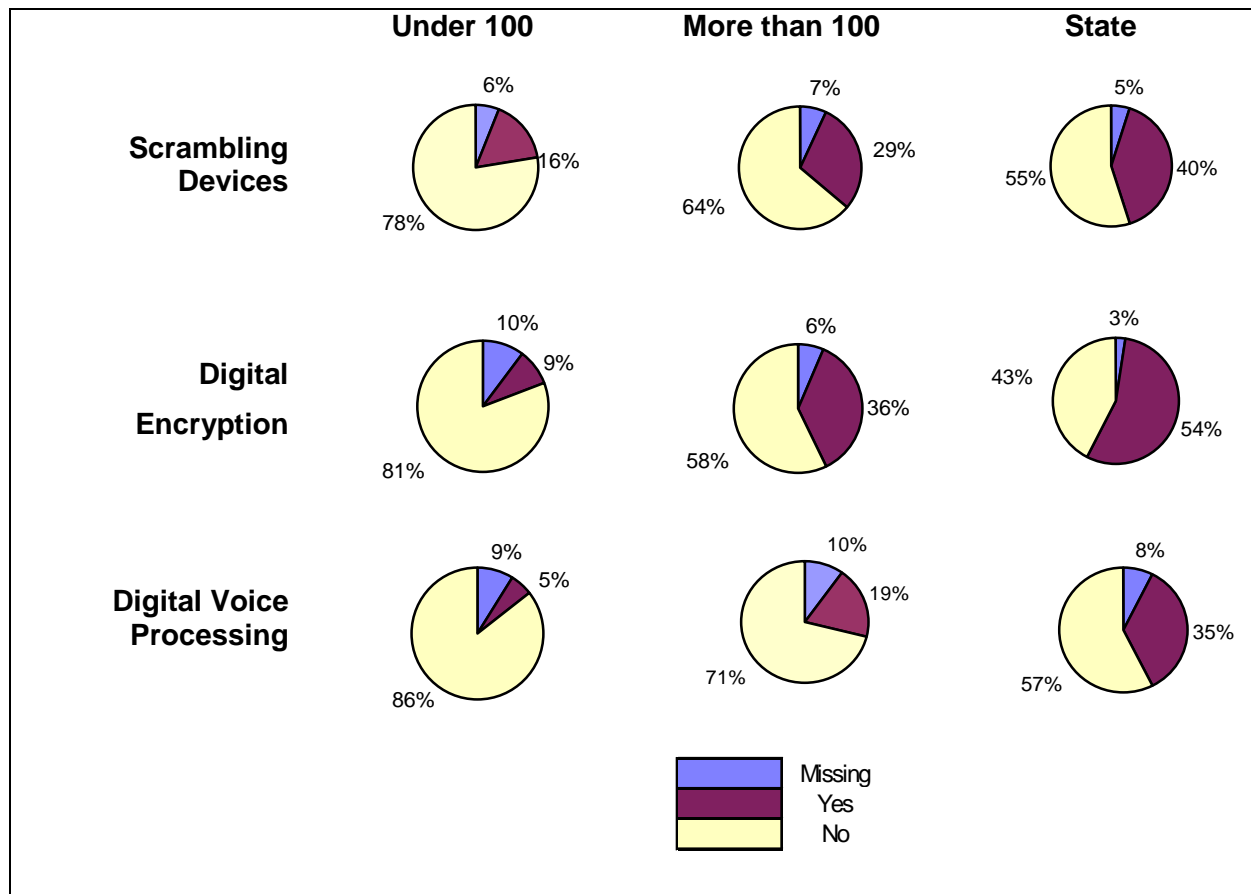
**Exhibit 26: Current and Planned Use of Advanced Technology Services**

**Use of advanced technology services will triple if budgets allow.**

Agencies were asked to indicate which of the following services they currently use or plan to use within the next 5 years: Cellular/Voice (C/V), Cellular Digital Packet Data (CDPD), Personal Communications Systems (PCS), Specialized Mobile Radio (SMR), Mobile Satellite Systems (MSS), and/or Global Positioning System (GPS). A majority of agencies already use C/V technology, but the use of other advanced technology services is much less common. GPS services are being anticipated by the greatest number of agencies (about 37 percent of all respondents, the actual percentages increase with agency size). Many of the agencies with 500 or more officers (28 percent) already use GPS and another 17 percent plan to begin within 5 years.

A significant number of all responding agencies indicated interest in Cellular Digital Packet Data (28 percent) and Personal Communications Systems (26 percent). State agencies indicated the greatest interest in adopting CDPD (45 percent of State agencies), PCS (35 percent), and GPS (25 percent). Specialized Mobile Radio services are already being used by 7 percent of responding agencies and 16 percent report plans to use them within 5 years. Mobile Satellite System use was low overall (2 percent), but more common among larger agencies (7 percent of agencies with 500 or more officers, 5 percent of agencies with 100–499 sworn officers). Exhibit 26 summarizes agencies’ current and planned use of advanced technology services.

Question: Does your agency currently use the following types of WIRELESS voice and or data security?



**Exhibit 27: Use of Voice/Data Security Measures by Agency Size and Type**

**State agencies and large agencies are most likely to use voice and data security measures.**

Three questions explored the extent to which agencies use security measures. One of the questions asked respondents to indicate whether or not they used specific measures for wireless voice and/or data security. Another asked them to indicate how essential voice and data security measures were to their agency. The third question asked for an indication of how frequently they used voice and/or data security measures. Generally speaking, most agencies indicated they *never* use voice (55 percent of all respondents) or data (65 percent of all respondents) security measures, although use increases with the size of the agency, and is relatively common practice for State agencies. Specific security measures that were explored included scrambling devices, digital encryption, and digital voice processing. Agencies that use laptops and/or MDTs were significantly more likely to view security measures as essential (rating of 4 or 5 on a 5-point scale) and use such measures on a daily or weekly basis compared to agencies that do not use MDTs/laptops. Exhibit 27 compares the use of security measures by police agencies with fewer than 100 sworn officers, 100 or more sworn officers, and State agencies.

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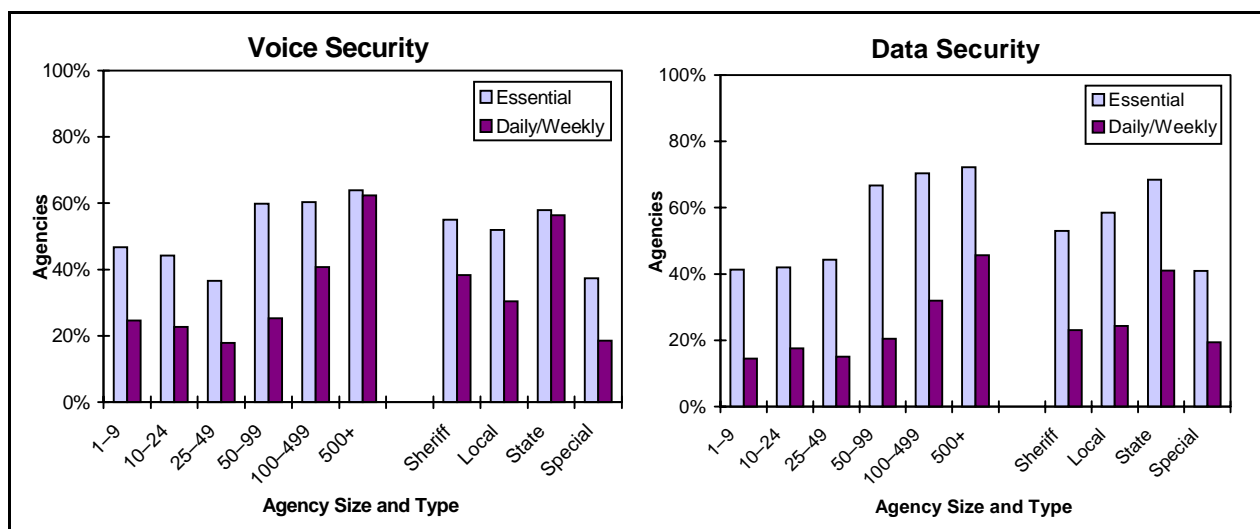
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*Scrambling devices:* State agencies (40 percent) are most likely to use scrambling devices, compared to sheriff's departments (27 percent), local police (20 percent), and special police (7 percent). Agencies that employ 100 or more sworn officers are about twice as likely to use scrambling devices as smaller agencies (29 percent of all larger agencies compared to 16 percent for all agencies with less than 100 sworn officers).

*Digital encryption:* State agencies (55 percent) are also the most likely to use digital encryption, compared to local police (21 percent), sheriffs (19 percent), and special police (14 percent). More than a third (36 percent) of agencies with 100 or more sworn officers use digital encryption, compared to only 9 percent of the smaller agencies.

*Digital voice processing:* Nineteen percent of agencies with more than 100 sworn officers indicated they used digital voice processing, compared to only 5 percent of the smaller agencies, and 35 percent of State agencies.

Question: How essential is WIRELESS voice and/or data security protection to your agency?



**Exhibit 28: Daily or Weekly Use of Voice and Data Security Measures Compared to Ratings of How Essential to Operations**

**Agencies rate voice and data security as essential but do not use them daily or weekly.**

The general questions about the importance of security measures (i.e., How *essential* is wireless voice and/or data security protection to your agency?), and frequency use (i.e., How *often* does your agency use wireless voice and/or data security protection?) resulted in some interesting contrasts. Although frequency use is not directly related to importance, agencies were more likely to rate security as essential than they were to indicate daily or weekly use of such measures. Overall, only 45 percent of respondents indicated they use voice security and 35 percent indicated they use data security measures. The percentage of agencies using voice and/or data security changes significantly with size. As Exhibit 28 shows, State agencies, sheriff’s departments and agencies with more than 100 sworn officers were most likely to view both voice and data security measures as essential to their operations. They were also more likely to use such measures on a daily or weekly basis. Although many agencies viewed data security measures as essential, a much smaller percentage use such measures on a daily or weekly basis. Only the agencies with 500 or more sworn officers and State agencies gave comparable ratings with regard to the importance and regular use of voice security measures, although not for data security measures.

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## ***Knowledge and Training***

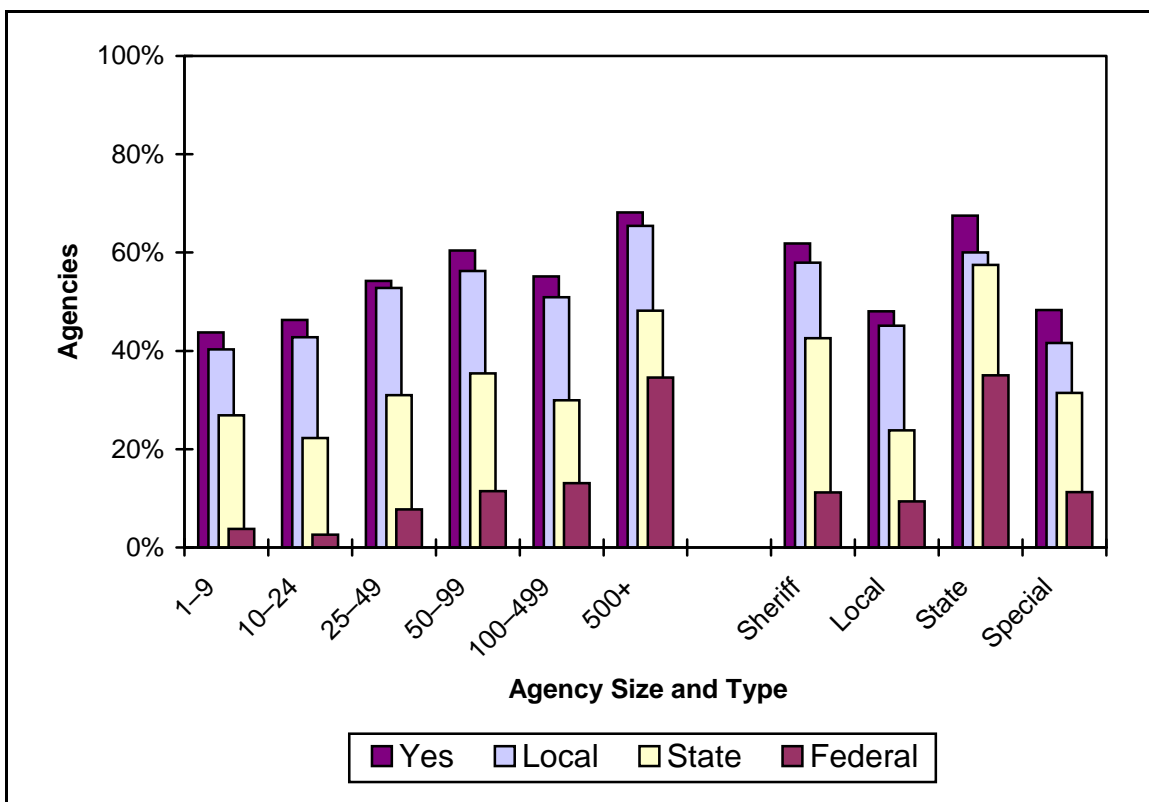
About half of the local and special police agencies participate in joint training activities that involve other organizations and the actual use of communications equipment, compared to two-thirds of sheriff's departments and State agencies, usually with other organizations at the local level. Agencies that participate in such "hands-on" practice are significantly more confident in their preparation as well as in their overall ability to handle interoperability situations.

Larger agencies are more likely than smaller agencies to use the Internet for official business, while all but the smallest agencies use the National Crime Information Center (NCIC) and the National Law Enforcement Teletype System (NLETS). As agency size increases, so does familiarity with initiatives related to interoperability and wireless communications such as the FCC Frequency Application Process, Project 25 Interoperability Standards, and/or NPSPAC guidelines. All sizes and types of agencies rated manufacturers as the primary source of information when planning for the purchase of communication technologies. Other government agencies ranked as the second most important source.

Seventy percent of respondents said consideration of interoperability issues and interoperability standards was important to their agency when planning for the purchase of their next land mobile radio system. About a third (36 percent) of respondents indicated they were very likely to adopt Project 25 Interoperability Standards for their next land mobile radio system, another third (33 percent) were in the middle (rating of 3 on a 5-point scale), and 19 percent were very unlikely (12 percent did not answer the question). The likelihood of adopting Project 25 Standards was not dependent on agency familiarity with the standards.



*Question: Does your agency participate in joint training exercises with other organizations that involve actual use of communications equipment? Indicate the levels of other organizations, including both government and nongovernment organizations.*

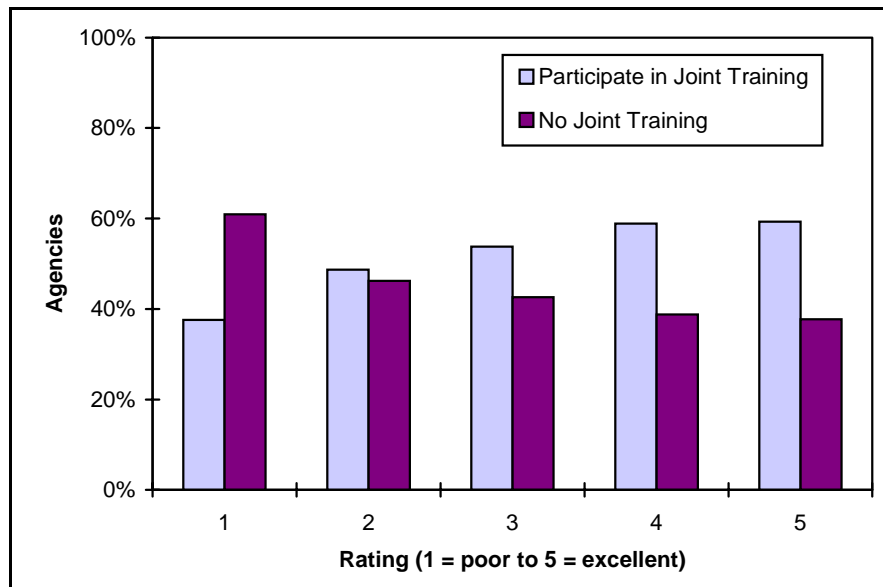


**Exhibit 29: Agencies That Participate in Joint Training Exercises That Use Communications Equipment and Training Partners, by Level**

**Joint training that uses communications equipment builds confidence.**

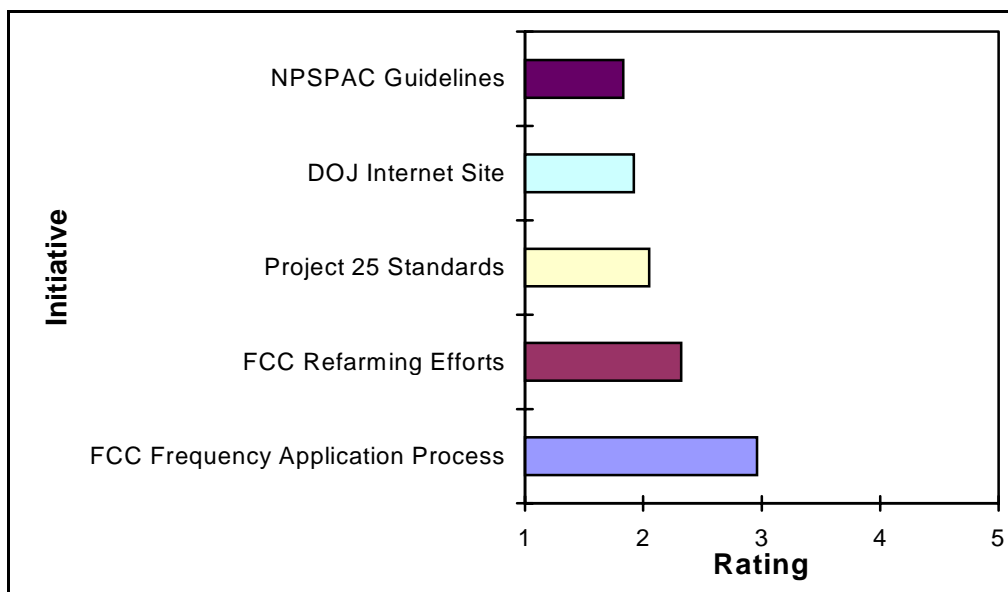
Agencies were asked if they participate in joint training exercises that involve the actual use of communications equipment. Half of the local (50 percent) and special police (51 percent) agencies participate in such joint training exercises, compared to two-thirds of sheriff’s departments (66 percent) and State agencies (69 percent). Larger agencies tend to be more likely to participate in “hands on” training activities (see Exhibit 29 and Appendix E–V). Agencies that do participate in joint training activities were significantly more confident in their preparation and felt better able to handle day-to-day, mutual aid, and task force interoperability situations than agencies that do not participate in such training. Regardless of the type of training used, when asked if they thought their training prepared their agency’s staff to handle interoperability situations, 31 percent of all respondents felt their training gave them very good or excellent preparation (ratings of 4 or 5), 42 percent felt moderately well prepared (3), and 27 percent felt poorly prepared. Exhibit 30 shows the relative percentages within each rating category.

Question: How well do you believe your agency's training has prepared your staff to handle communication interoperability situations?



**Exhibit 30: Effectiveness of Preparation (Joint Training With/Without Communications Equipment)**

Question: How familiar is your agency with the following?



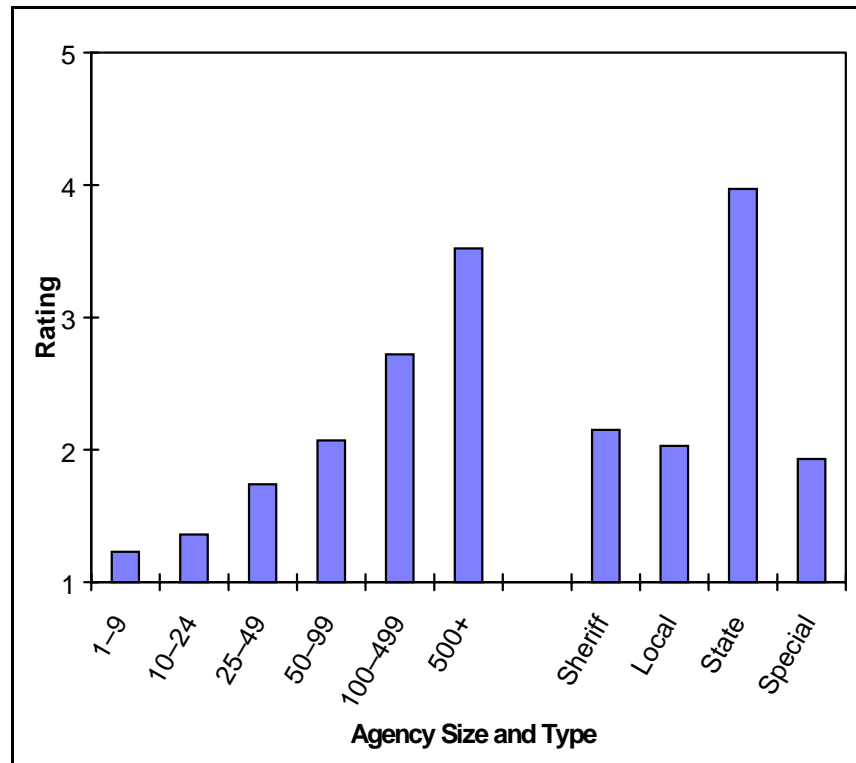
**Exhibit 31: Agency Familiarity With Recent Initiatives**

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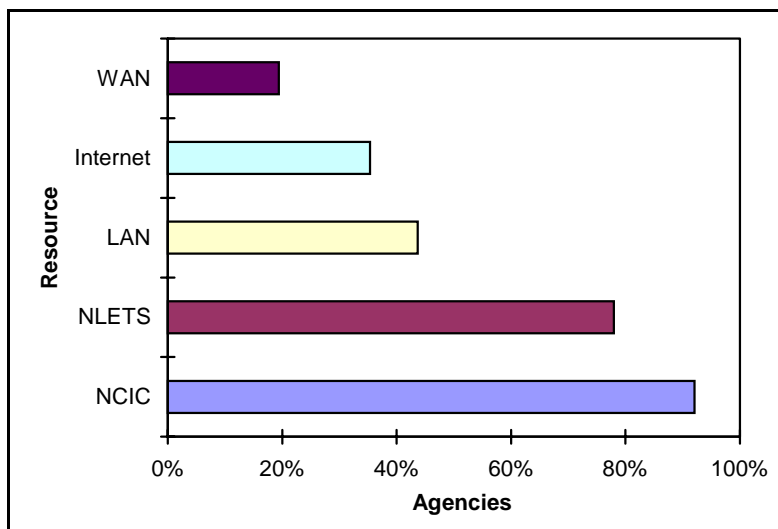
**Small agencies are less familiar with recent initiatives.**

Respondents were asked to rate their familiarity with the following initiatives related to wireless communications and/or interoperability: Project 25 standards, FCC refarming efforts, the FCC frequency application process, and the National Public Safety Planning Advisory Committee (NPSPAC) guidelines<sup>24</sup> for 800 MHz allocations. Exhibit 31 summarizes the average ratings of the extent to which agencies were familiar with the different initiatives. Averages are based on a rating scale where 1 = no knowledge and 5 = very knowledgeable. Agencies tended to be most knowledgeable about the FCC frequency application process, and least knowledgeable about NPSPAC guidelines, the DOJ Internet Site, and Project 25 Standards. Knowledge ratings increase with agency size (see Exhibit 32). As expected, agencies with 800 MHz systems were significantly more knowledgeable about NPSPAC guidelines, although there was no significant difference between agencies using 800 MHz and agencies using other bands with regards to their satisfaction with the FCC frequency application process.



**Exhibit 32: Familiarity With Project 25 Interoperability Standards, by Agency Size and Type**

Question: Does your agency use the following external information networks to interoperate with outside organizations? Fill in ALL that apply.



**Exhibit 33: Use of Information Networks**

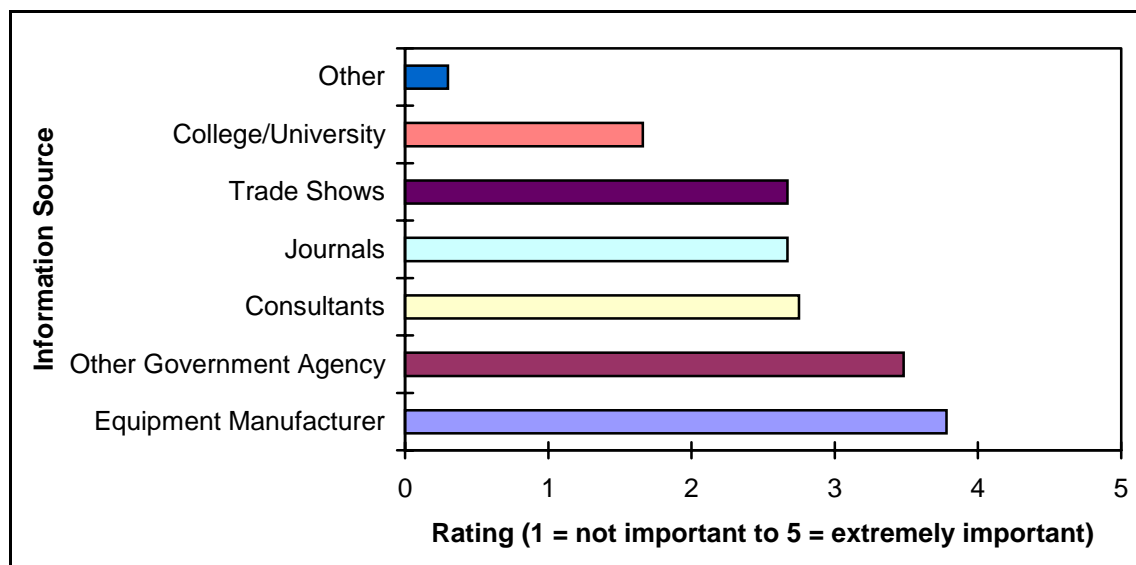
Agency Size and Type	Information Network				
	NCIC	NLETS	LAN	WAN	Internet
<i>Size:</i>					
1-9	83%	58	26	8	14
10-24	92	77	36	9	22
25-49	95	83	37	16	28
50-99	97	84	46	15	37
100-499	96	87	57	28	53
500 +	96	90	64	46	61
<i>Type:</i>					
Local	91	76	43	16	33
Sheriff	94	83	44	23	33
Special	87	65	45	24	59
State	98	98	58	48	68

**Exhibit 34: Percent of Agencies Using Information Networks, by Agency Size and Type**

**Most agencies use NCIC and NLETS.**

More than 90 percent of all respondents indicated they use the National Crime Information Center (NCIC), and 78 percent use the National Law Enforcement Teletype System (NLETS). A smaller number of agencies, generally the larger State and municipal agencies, use Local (LAN) or Wide Area Networks (WAN). Larger agencies use the Internet for official business more than smaller agencies. See Exhibit 33 and Exhibit 34.

Question: How important is each source of information to your agency when planning for the purchase of communication technologies?



**Exhibit 35: Importance of Selected Information Sources When Purchasing Communications Technology**

**Agencies use external sources of information and assistance.**

Agency decisions related to the purchase of new communications technologies are based on input from a variety of information sources, primarily equipment manufacturers, which ranked as an extremely important source of information among *all* agencies; other government agencies ranked second. Larger agencies were significantly more likely to include independent consultants as an important source of information. Exhibit 35 shows comparative averages.

Agencies of all sizes and types were most likely to handle their own radio spectrum licensing issues, and the majority of agencies have the Association of Public-Safety Communications Officials handle their radio frequency coordination with the FCC. State agencies were the most likely to pay outsiders to handle frequency coordination services, and they had the highest number of interactions annually.

Agency Type	Radio Spectrum Licensing (%)		Frequency Coordination (%)		Pay for Frequency Coordination (%)	Annual Interactions with Frequency Coordinator	
	Self	County	APCO	Other		Average	Median
Local	52	24	54	26	26	9.7	2
Sheriff	44	29	61	17	35	6.1	2
Special	64	12	46	13	25	4.8	2.5
State	76	N/A	93	29*	60	61	12

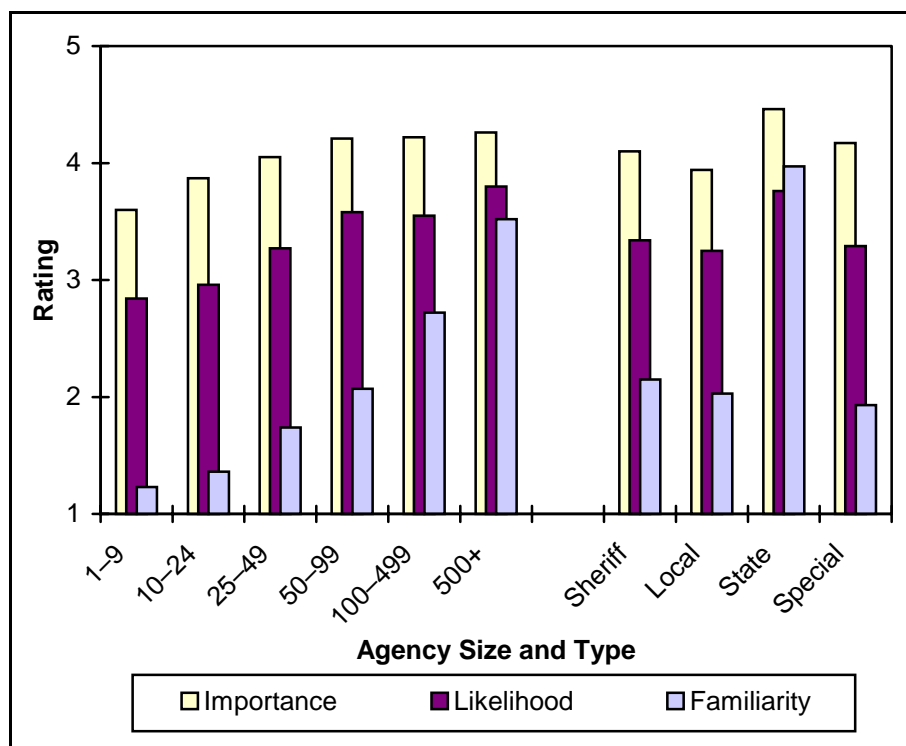
\* Note: Some agencies indicated they use more than one organization for their frequency coordination needs.

**Exhibit 36: Use of Frequency Coordination and Radio Spectrum Licensing Services**

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*Question: How important will interoperability STANDARDS be to your agency when planning for its next land mobile radio system?*

*AND How likely is it your agency will adopt Project 25 Interoperability Standards for its next land mobile radio system?*



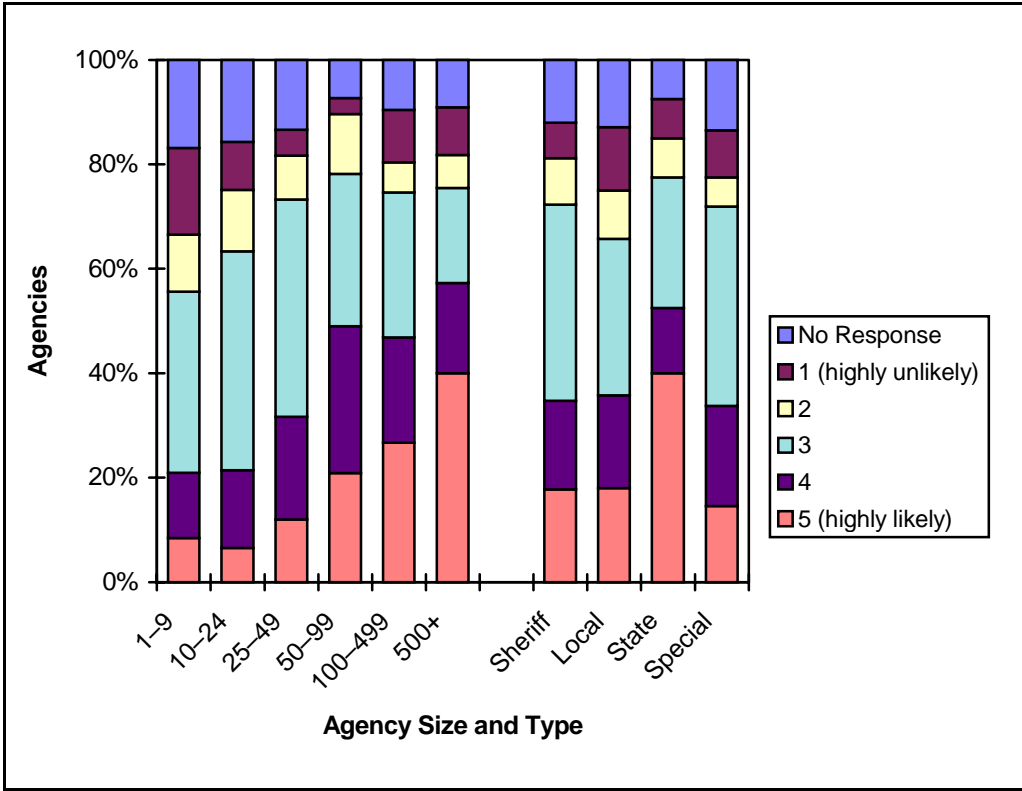
**Exhibit 37: Comparison of Ratings of Importance of Interoperability Standards, Likelihood of Adopting Project 25 Standards, and Agency Familiarity With Project 25 Standards**

**Interoperability is rated as an important consideration in purchase decisions.**

When agencies were asked to rate the importance of interoperability in planning for the purchase of their next LMR system, 70 percent indicated interoperability issues and standards were very important considerations (ratings of 4 or 5 on a 5-point scale where 1 = not important and 5 = extremely important). Exhibit 37 shows the relationship between agency size and type and familiarity with Project 25 Standards, importance ratings, and agency likelihood of adopting Project 25 Interoperability Standards.

Agencies that were planning to upgrade or replace their LMR systems within the next 10 years (46 percent of all respondents) gave interoperability issues a higher importance rating (average rating of 4.18) than agencies that were not planning to replace or upgrade their systems (rating of 3.85). Agencies that were not planning to replace or upgrade their system tended to have newer systems (an average age of 8 years compared to 13 years for those with plans to replace or upgrade their system), and may have already made adjustments to facilitate interoperability.

Question: How likely is it that your agency will adopt the Project 25 Interoperability Standards for its next land mobile radio system?



**Exhibit 38: Likelihood of Adopting Project 25 Interoperability Standards, by Agency Size and Type**

**Adoption of Project 25 Standards.**

The graph in Exhibit 38 summarizes the proportion of all responses in each category. Each bar represents 100 percent of all responses, allowing a comparison of relative distributions of ratings across categories. The stacked bars show clear differences by size. Overall, 36 percent of all respondents indicated they were very likely to adopt Project 25 Standards, compared to 33 percent that were in the middle, and 19 percent that were very unlikely. Ratings are based on a 5-point scale where 1 = highly unlikely and 5 = highly likely. The interpretation of agencies’ responses to this question depends upon how responses are clustered. For example, if willingness to adopt Project 25 Standards is defined as a 4 or 5 rating, then 36 percent of all sizes and types of respondents are likely to adopt. If willingness is defined to include agencies that gave a rating of 3, 69 percent are likely to adopt. Since 3 was not defined in the questionnaire, it is unclear how agencies defined it other than as a middle rating. A rating of 4 or 5 is considered here as an indication that agencies are very likely to adopt Project 25 Standards, and a rating of 3 is interpreted as a moderate response. More than half of the respondents in each category indicated they would *probably* adopt Project 25 Interoperability Standards (likelihood ratings of 3 or more). A significant number of agencies (12 percent) did not respond to the question. See Appendix E, Table VI.

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Smaller agencies' reluctance to adopt interoperability standards may be due to different needs. One respondent noted, "*Interoperability is not our most serious problem. Basic coverage in the voice and data modes is our problem. Interoperability is sometimes needed, but it too is dependent on coverage.*" Write-in comments also revealed considerable concern about the cost factor associated with the imposition of external standards and issues related to local control of budgets. See the discussion and comments on page 77 for more detail.



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### ***Interoperability Experience and Requirements***

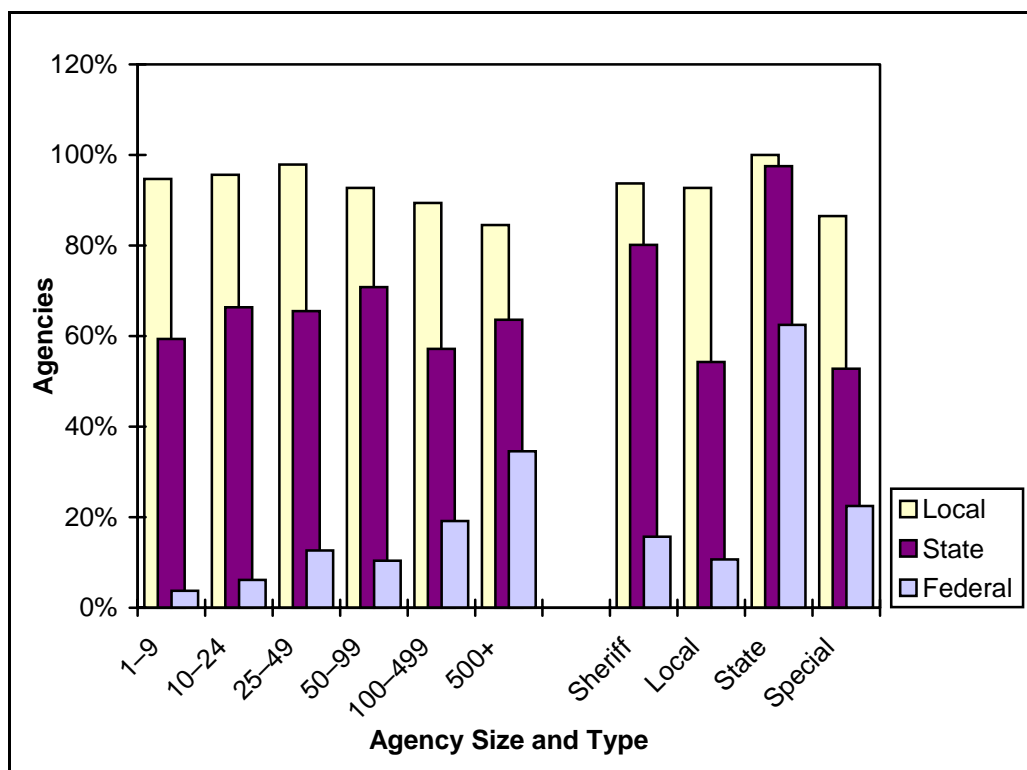
Interoperability is an extremely common event for all sizes and types of law enforcement agencies, with 93 percent indicating they interoperate with local organizations and 63 percent with State-level organizations on a daily or weekly basis. The majority of respondents (82 percent) have at least one radio channel solely dedicated to communicating with other organizations. Plain English is preferred by 59 percent, but 37 percent use a code system for communications between agencies.

Interactions with Federal organizations are relatively uncommon for most local agencies (only 15 percent interoperate with Federal organizations on a daily or weekly basis), but considerably more common for State agencies and/or larger metropolitan agencies. State agencies interact with the largest number of Federal, State, and local organizations and are the most likely to use formal written agreements. Local agencies are the least likely to use written interoperability agreements, and smaller agencies are less likely than larger agencies. Most agencies use high band VHF for interoperating with other organizations, although larger agencies were a little more likely to use 800 MHz (they are more likely to have 800 MHz systems than smaller agencies).

Seventy-four percent of respondents expressed a high level of confidence in their agency's ability to establish radio links at the local level, compared to 50 percent that expressed confidence in their ability to establish links with State organizations, and 15 percent with Federal organizations. More agencies expressed confidence in the ability of their radio system to handle day-to-day interoperability (57 percent), than to handle mutual aid (33 percent) or task force (32 percent) situations. Almost half (43 percent) were *very* confident in their agency's overall ability to handle interoperability situations, 73 percent rated their agency as moderate or above, and 22 percent rated their agency's overall ability as poor.

Sheriffs' departments, local police, and special police indicated a preference for *local* interoperability planning (local region/multijurisdictional), while State agencies preferred State-level planning. Approximately a quarter of the responding State agencies indicated their State had a formal State interoperability plan, although there were notable discrepancies between the responses of State and local agencies, with a few agencies in almost every State indicating awareness of a State plan. The differences in awareness suggest a need for improved dialogue and information dissemination.

Question: HOW OFTEN does your agency have radio communication with public safety and/or public service organizations at the Federal, State, and local levels?

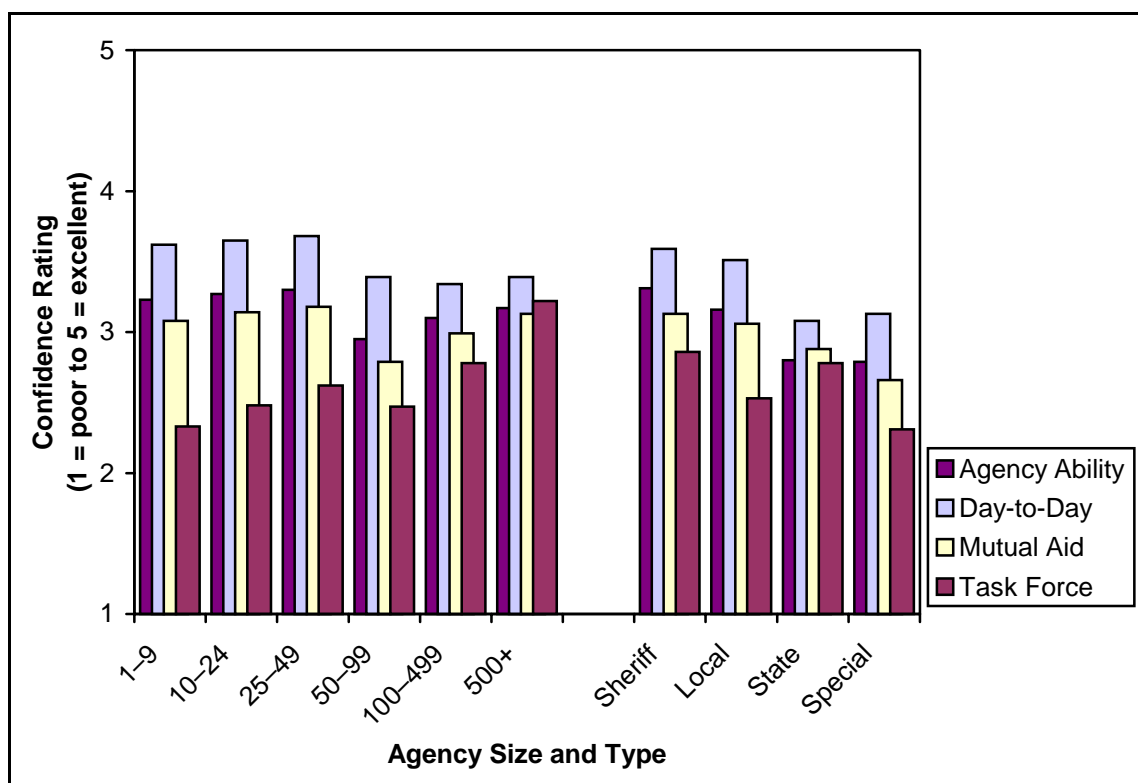


**Exhibit 39: Daily or Weekly Interoperability Events With Federal, State, and Local Organizations**

**Ninety-three percent interoperate on a daily or weekly basis.**

Agencies were asked to indicate how frequently they interoperate with Federal, State, and local organizations—daily, weekly, monthly, or yearly. Exhibit 39 summarizes the most frequent interactions (i.e., daily or weekly). Interoperability is an extremely common event for agencies of all sizes and types. On a daily or weekly basis, 93 percent of all responding agencies interoperate with local organizations, 63 percent with State-level organizations, and 15 percent with Federal-level organizations. State agencies reported the highest incidence of interoperability with local and State organizations, and were the most likely to interoperate with Federal organizations on a regular basis. See Table VII in Appendix E.

Question: Rate the ABILITY of your agency's radio system to effectively handle the three types of interoperability.



**Exhibit 40: Ratings of Agency Ability Compared to Radio System Ability to Handle Different Types of Interoperability Situations**

**Most agencies are confident in their ability to handle routine interoperability situations.**

Three questions were designed to assess agency confidence in their ability to interoperate with other organizations. Agencies were asked to rate: (1) their agency's overall ability to handle interoperability situations 5 years ago, today and 5 years in the future; (2) the ability of their agency's radio system to effectively handle day-to-day, mutual aid and task force operations; and (3) their agency's ability to establish radio communications links with Federal, State, and local level organizations. All questions used a 5-point rating scale where 1 = poor and 5 = 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 taken as an indication of serious concern.

Forty-three percent expressed high levels of confidence (ratings of 4 or 5) in their **agency's current overall ability** to handle interoperability situations. Overall, 74 percent rated their agency with a 3 or more; about one in five (22 percent) gave their agency a poor rating of 1 or 2.

Agencies were more confident in their ability to handle day-to-day situations than they were for mutual aid or task force operations. More than half (57 percent) expressed confidence in the **ability of their radio system** to handle day-to-day interoperability situations, 33 percent

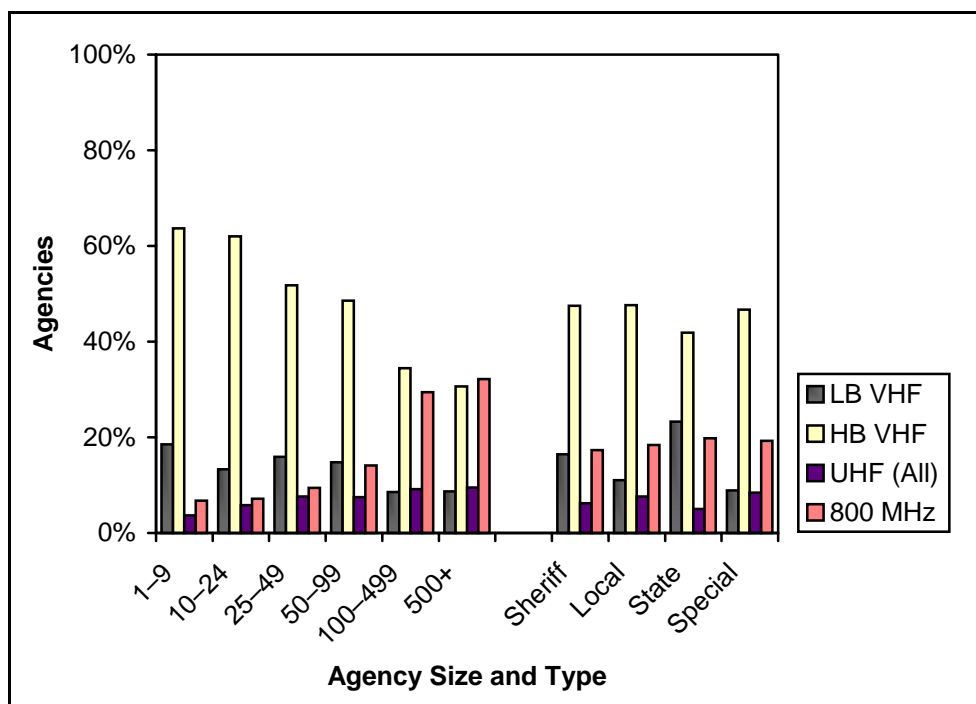
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expressed confidence in their ability to handle mutual aid situations, and 32 percent expressed confidence in their ability to handle task force situations. Once again, there was a significant difference between agencies with newer radio systems and those with older systems in their ratings of their ability to handle the three types of interoperability situations. Agencies with older radio systems were the least confident in their ability to handle task force situations (average rating of 2.75 compared to an average of 3.23 by those with newer radios). See Exhibit 40.

Three quarters of the respondents (74 percent) expressed confidence in their **agency's ability to establish radio links** at the local level, 50 percent were confident in their ability to link with the State level, and 15 percent were confident in their ability to link with the Federal level. Agencies with relatively new radio systems (5 years old or younger) were significantly more confident in their ability to link with local organizations than agencies with older systems (6 years old or older). However, the age of the radio system had little impact on agency assessments of their ability to link with State or Federal organizations. See Exhibit 43.

Question: What radio frequencies does your agency use to interoperate with other public safety and public service organizations? Fill in ALL that apply.



**Exhibit 41: Radio Frequencies Used for Interoperability**

**VHF and 800 MHz are most common for interoperability.**

High band VHF is the most commonly used frequency for interoperability (Exhibit 41). In fact, two thirds (69 percent) of all respondents indicated they use high band VHF. The larger the agency, however, the less likely it was to use VHF and the more likely it was to use 800 MHz. Many agencies indicated the use of more than one frequency band for interoperability, and most State agencies reported the use of multiple bands (to facilitate interoperation with the many different systems that may exist within their jurisdiction). See Table III in Appendix E.

Write-in responses indicated that for some agencies the purchase of an 800 MHz system solved their interoperability problems. One large metropolitan agency noted, “[Our] 800 MHz radio system has 4600 SERS and 28 agencies. It has worked well for interoperability because it is reliable and the jurisdictions all participate in the planning. The system...is managed by the Telecommunications Department, which also manages a combined, consolidated E-911/Fire/Law/EMS dispatch center. This has facilitated interoperability.” In contrast, another large metropolitan agency noted, “In 1996 we switched over to 800 MHz, which essentially made us an island.... No other law enforcement agency within 100 miles of us is on the 800 MHz. We had to keep a few channels on our old system in order to communicate with county and Federal officials. Communications between our department and those other agencies have now become almost nil, with the exception of the investigative units who continuously monitor the old frequency.”

Question: Estimate the total number of public safety and/or public service organizations at each level with which your agency requires radio communication.

Category		Level of Public Safety and/or Public Service Organizations					
Agency Size and Type	n	Local		State		Federal	
		Average	Median	Average	Median	Average	Median
<i>Size:</i>							
1–9	320	8.0	5	2.4	2	0.8	0
10–24	225	10.7	7	2.5	2	1.0	0
25–49	138	11.8	7.5	2.8	2	1.5	1
50–99	93	18.1	10	5.4	2	1.8	1
100–499	380	25.9	10	3.1	2	2.1	2
500 +	106	23.3	11.5	10.2	2	4.5	3
<i>Type:</i>							
Local	379	12.0	7	2.6	2	1.5	1
Sheriff	787	18.4	10	4.1	3	2.1	1
State	39	217	100	31.4	10	7.7	5.5
Special	78	49	5	10.8	2	2.0	0

**Exhibit 42: Estimates of Number of Required Radio Communication Links With Federal, State, and Local Public Safety and/or Public Service Organizations, by Agency Size and Type**

**The need for radio communications with Federal, State, and local levels varies.**

Agencies were asked to estimate the total number of public safety and/or public service organizations they require radio communication with at the Federal, State, and local level. Exhibit 42 summarizes agency responses and provides both averages and medians. Since *averages* may be somewhat distorted by a small number of agencies that have many links with other organizations, *medians*, the middle number among all numbers reported, are often a better indication of the actual experience of the majority of agencies within each group. As expected, the number of links at the local level far exceeds the numbers at the State and Federal levels for all agencies (there are more local than State organizations, and more State than Federal organizations). State agencies are involved with the largest number of organizations at all levels. Special police agencies are the only other agency type that even begins to approach the number of contacts reported by State agencies. As can be seen by the medians, most agencies require radio communications links with relatively small numbers of organizations (5 to 12 local organizations, 2 States, and about 3 Federal organizations—even for very large agencies). On the other hand, the numerical difference between the averages and the medians in each category is an indication of the wide variety of agency experiences. The difference between State agencies with an *average* of 217 local contacts and a *median* of 100 is a reflection of the size differences (e.g.,

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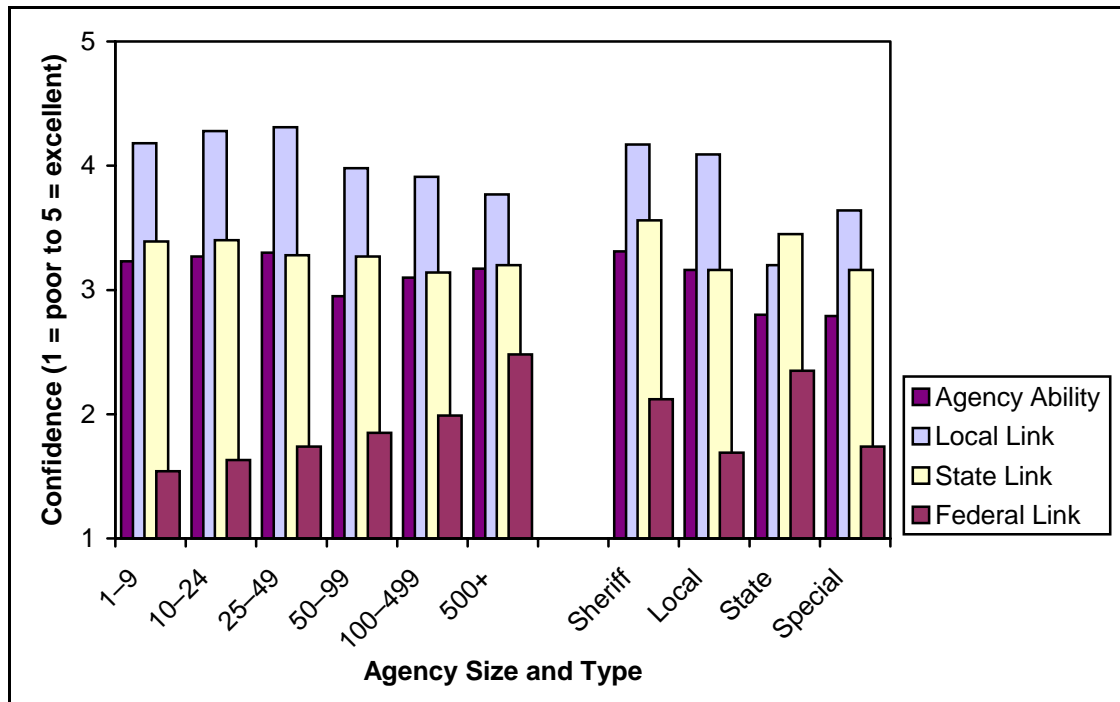
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compare New York and North Dakota) as well as the different roles and political structure within different States. These numbers include interactions with other law enforcement agencies, other public safety agencies such as fire and emergency medical services, and other public service organizations.

Agencies' confidence in their ability to establish radio links with Federal, State, and local agencies was related to their evaluation of the extent to which funding issues were an obstacle to interoperability. Agencies that said they had adequate funding (ratings of 1 or 2) were significantly more confident in their ability to establish radio links at all levels than agencies that said they did not have adequate funding (ratings of 4 or 5). Ratings were based on a 5-point scale where 1 = not a problem and 5 = major problem.

Question: Rate your agency's ABILITY to establish a radio communications link with each of the following levels of public safety and/or public service organizations.

AND Rate your agency's OVERALL ABILITY to handle interoperability situations today.



**Exhibit 43: Confidence in Agency Ability Compared to Confidence in Radio System Ability to Establish Links With Different Levels**

**Confidence in agency tied to confidence in LMR system.**

The frequency with which an agency has radio communications with different levels of organizations is related to that agency's confidence in its ability to establish communication links with those levels. Exhibit 43 reveals consistently high confidence levels among all sizes and types of agencies in their ability to establish radio communications links with the organizations they interact with on a regular basis. The low ratings of ability to establish links with the Federal level are a reflection of different experiences (large agencies interact with Federal organizations more often than small agencies), as well as the fact that different sizes and types of agencies operate on different frequency bands. Note that the ratings of agency ability to handle different types of interoperability situations (Exhibit 40 on page 51) tend to be more similar within each category than the ratings of ability to establish radio links with different levels of public safety or public service organizations. The comparison suggests there is a difference between rating the difficulty of a *task* (such as day-to-day, mutual aid, or task force interoperability events) and the difficulty of working with particular *partners* in accomplishing that task (Federal, State, or local organizations).



Question: How many mutual aid and task force operations does your agency participate in during a typical year?

AND Rate your agency's OVERALL ABILITY to handle interoperability situations today.

Agency Size and Type	n	Overall Agency Ability	Average # of Events in Typical Year	Average # of Orgs. Involved	Mutual Aid		Task Force	
					Ability to Handle Mutual Aid	Average # of Events in Typical Year	Average # of Orgs. Involved	Ability to Handle Task Force
<i>Size:</i>								
1-9	320	3.4	62	6	3.4	10	4	2.8
10-24	229	3.4	44	6	3.3	20	6	2.8
25-49	142	3.5	61	9	3.2	17	4	2.9
50-99	96	3.1	35	11	3.0	24	6	2.7
100-499	397	3.2	63	9	3.2	36	6	3.0
500 +	110	3.2	57	11	3.1	22	7	3.2
<i>Type:</i>								
State	40	2.9	99	14	2.9	61	10	2.8
Local	823	3.3	53	7	3.2	23	5	2.8
Sheriff	382	3.4	67	10	3.3	28	5	3.1
Special	89	3.0	68	7	2.9	17	5	2.7

Ability ratings are averages based on a 5-point scale where 1 = poor and 5 = excellent.

#### **Exhibit 44: Experience With Mutual Aid and Task Force Operations in 1996 and Confidence Ratings**

##### **Experience builds confidence and expertise.**

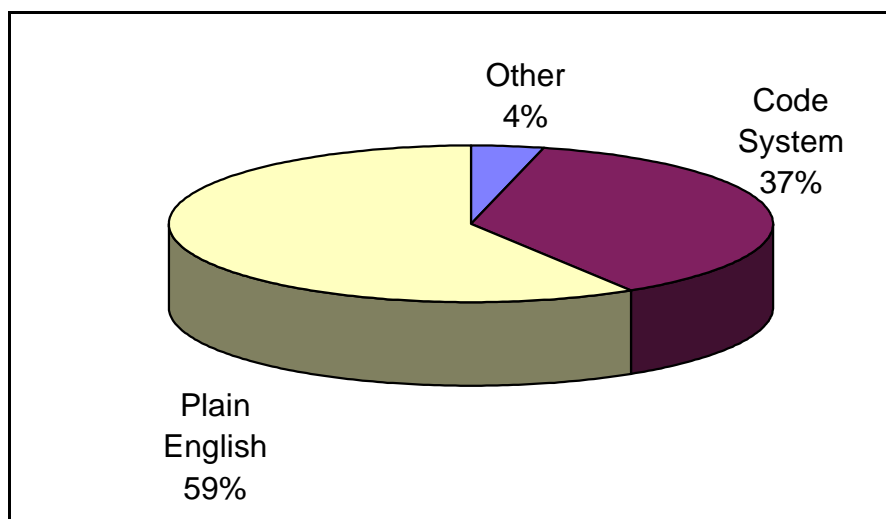
With the exception of agencies that employ 500 or more sworn officers, all sizes and types of agencies rated their ability to handle day-to-day operations higher than their ability to handle mutual aid or task force operations. Since day-to-day events are common by definition, agencies were only asked to estimate the number of mutual aid and task force operations in which their agency participate. As expected, agencies consistently reported more mutual aid than task force events in a typical year. Most agencies rated their ability to handle task force operations lower than their ability to handle day-to-day or mutual aid operations. This is consistent with reports of participation in fewer task force events in a typical year (i.e., less experience). Task force operations also provide more opportunity for conflicts to surface, since they tend to span a longer period of time, involve multiple levels of government, and often have a covert component.

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Write-in comments indicated that the working definition of mutual aid varied considerably (regardless of the definition provided in the questionnaire). For example, many agencies indicated they participated in hundreds of mutual aid events in a typical year, while one California agency referred to an earthquake as the “*only mutual aid event in the last eight years.*” See Exhibit 40 and Exhibit 44.

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*Question: What is the PRIMARY radio language used by your agency when communicating with other organizations?*



**Exhibit 45: Radio Language Used for Interoperability**

**Most agencies (82 percent) have a dedicated channel; 59 percent use plain English.**

Four out of five agencies (82 percent) indicated they have at least one radio channel solely designated for communicating with other organizations. The majority (59 percent) uses plain English for communications between their agencies and other organizations, but about 37 percent use a code system. Relatively few agencies (about 7 percent) indicated that the use of different radio languages hindered effective communications.

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*Question: Do you have written communication interoperability agreements with the public safety/public service organizations your agency requires radio communication with at each level? If so, how many?*

Agency Type	Federal		State		Local	
	Percent	Number	Percent	Number	Percent	Number
Local	7	2	20	2	37	7
Sheriff	12	2	24	3	30	10
Special	19	3	29	2	40	10
State	38	6	40	10	43	120

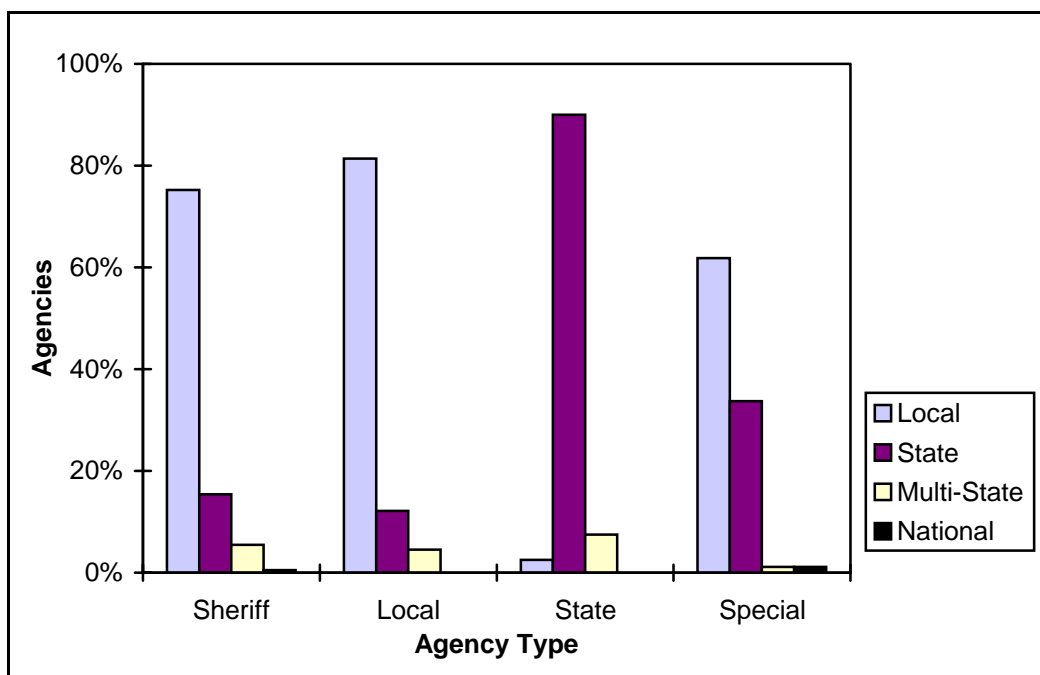
*Note: The number of written agreements reported here is the median, the middle number among all numbers reported. Half of the respondents have fewer written agreements; half have more.*

**Exhibit 46: Percent of Agencies That Use Written Interoperability Agreements and Median Number of Agreements With Federal, State, and/or Local Organizations**

**Less than half use written agreements.**

State agencies were the most likely and local agencies were the least likely to report the use of written communications interoperability agreements with Federal, State, and/or local organizations. See Exhibit 46. In addition, large agencies are more likely to have formal written agreements than smaller agencies. Most written interoperability agreements are with local agencies, as would be expected given the fact that there are more local agencies than either State or Federal, and all agencies are more likely to interoperate with local organizations than with State or Federal agencies.

Question: What LEVEL of interoperability planning would best serve your agency? Fill in ONLY ONE.



**Exhibit 47: Agency Preferences for Interoperability Planning**

**Interoperability planning preferences reflect perspective.**

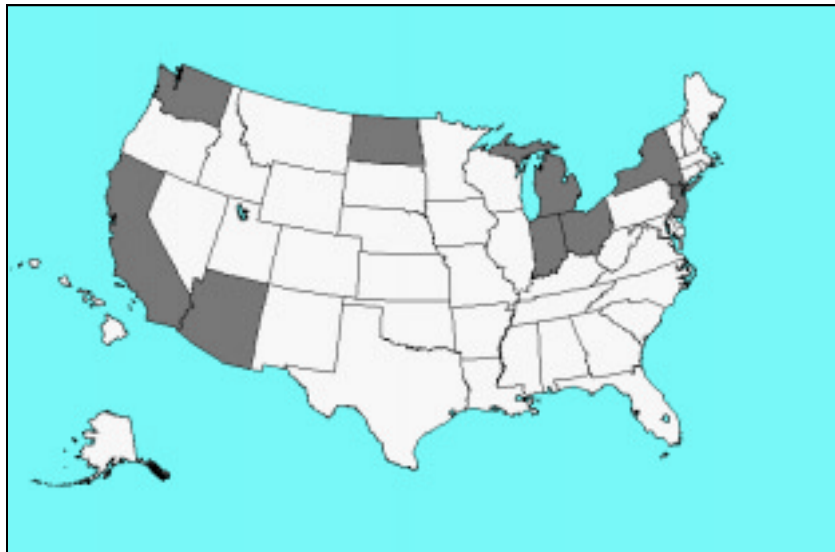
Agencies were asked which level of interoperability planning would best serve their agency, local region (multijurisdiction), statewide, multi-State region, or national. Sheriffs, local police, and special police clearly preferred *local (multijurisdiction)* planning over State, multi-State, or national interoperability planning. The only exceptions to the preference for local planning were State agencies that, as expected, overwhelmingly preferred State-level planning. The California Highway Patrol, Indiana State Police, and Nebraska State Patrol were exceptions in that they indicated a preference for *multi-State regional* planning. Only three agencies out of all 1,334 respondents indicated that *national* planning would best serve their agency.

Write-in comments alluded to both the value and the complexity of working across different levels of government:

- *Reality! We can't function at the local level! What? With national! We have had to survive despite Federal "assistance." Keep them on the sidelines as much as possible.*
- *Before expanding anything to the Federal level, I think issues should be worked out between local and county levels and then expand those issues to the State level.*
- *Police and local government service frequencies need to be coordinated by one organization with regulations on prices.*

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*Question: To your knowledge does your State have a formal written interoperability plan?*



Map A

Map B



**Exhibit 48: Awareness of State Interoperability Plan: State and Local Perspectives**

**Awareness of State interoperability plans differs among local and State agencies.**

State agency awareness of a formal State interoperability plan may not be synonymous with the existence of such a plan, but 9 of the 40 State agency respondents indicated awareness of a formal State plan (see Exhibit 48, map A). When asked to rate the effectiveness of their State plans, however, they tended to give conservative ratings. None of them rated their State’s plan as either excellent (rating of 5) or poor (rating of 1). A few agencies in almost every State indicated awareness of a State interoperability plan (see Exhibit 48, map B). The maps suggest a discrepancy between State and local perspectives in regards to the existence of a State interoperability plan. Whatever the truth may be, the difference between the two maps suggests a need for improved dialogue and/or information dissemination.

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### **Interoperability Shortfalls**

Agencies of all sizes and types rated “limitations in funding” and “different bands” as the biggest obstacles to interoperability. A comparison of the average ratings helps indicate the extent to which each of the issues has been experienced as an obstacle to interoperability.

Agencies that rated limitations in funding as a serious problem also rated both their *radio system* ability and their *agency* ability to handle different types of interoperability situations significantly lower than did agencies that felt adequately funded. Underfunded agencies were significantly more likely to indicate that “outdated equipment” was a serious problem, but they were no more or less likely to be in the process of planning to replace or upgrade their radio system, to share frequencies and/or infrastructure with other organizations, or to have a channel solely dedicated for communicating with other organizations. They were just as likely as their better funded colleagues to participate in joint training activities that involve other organizations and the actual use of communications equipment. Overall, 69 percent of respondents rated limitations in funding as a severe problem (88 percent of State agencies, 78 percent of special police, 70 percent of sheriff’s departments, and 67 percent of local police).

State agencies (68 percent) and special police (60 percent) were the most likely to experience severe interoperability problems due to different frequency bands, although a large number of local police (51 percent) and sheriff’s departments (47 percent) also indicated severe problems. Generally, larger agencies were experiencing more problems as a result of different frequency bands than smaller agencies. They were also more likely to have 800 MHz systems. Agencies have developed a variety of “low-tech” methods to work around frequency incompatibilities, and 47 percent of them (most with dispatcher assistance) can patch across channels if necessary.

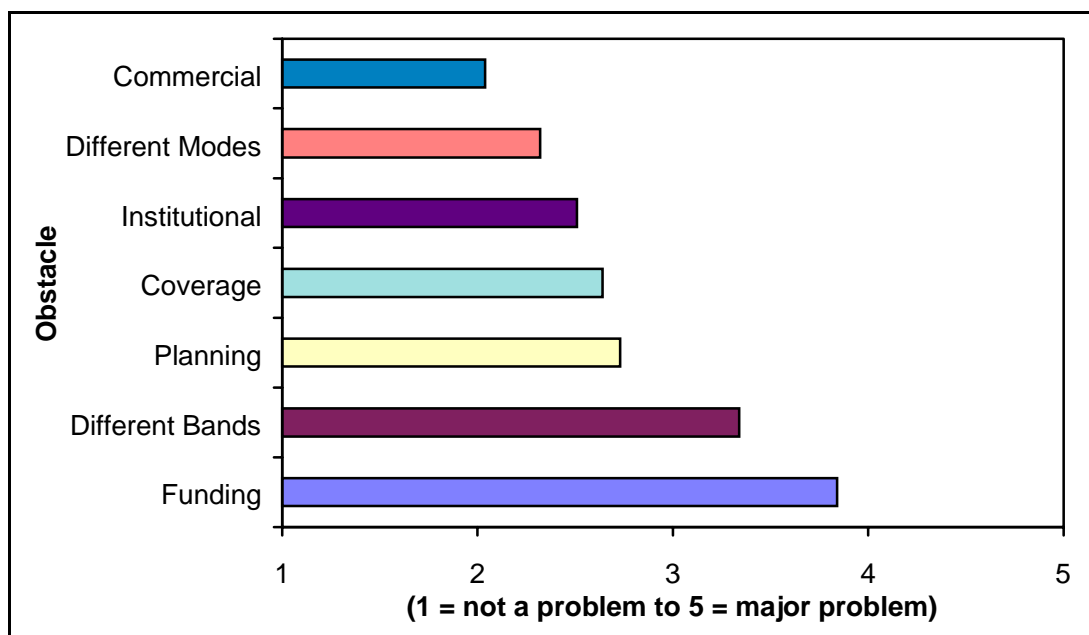
Three out of ten agencies indicated severe obstacles to interoperability due to lack of adequate planning. Although different coverage areas, human and institutional limitations, and different communication modes have an adverse effect on approximately one in four agencies, the overall averages do not indicate a severe nationwide problem. Limitations in commercial services were viewed as a relatively minor obstacle to interoperability.

When agencies were asked if they thought there should be “date-certain” timelines to ensure implementation of interoperability standards, they were more likely to say “yes” (35 percent) than “no” (28 percent), but it is difficult to draw a firm conclusion because 37 percent of them did not even answer the question (it was the last question on the questionnaire!). Many of the written responses raised issues of local control; some suggested linking Federal or State dollars to mandates (i.e., “*No dollars, no mandate*”), but many agencies noted that an external requirement could help them free up the funds needed to update their equipment (e.g., “*The only way we will update our system is if it is mandated. If not, the Council will not spend the money*”).

All sizes and types of agencies expect their agency’s overall ability to handle interoperability situations to improve over the next 5 years. The generally optimistic outlook may be related to the fact that almost half of them plan to replace or upgrade their radio systems within the next 10 years, and many plan to adopt new technologies that can improve interoperability by increasing efficiency and effectiveness.

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Question: Based on your agency's experience, indicate the severity of each of the following obstacles to interoperability.



**Exhibit 49: Obstacles to Interoperability**

**All sizes and types of agencies experience similar obstacles to interoperability.**

Agencies were given a list and asked to rate the severity of each as an obstacle to interoperability based on their agency's experience. The biggest obstacles, classified as severe/major problems, were limitations in funding (69 percent of respondents), and the use of different bands (51 percent of respondents). These two issues were causing severe problems for a significantly larger percentage of agencies than any of the other issues. In contrast, only 14 percent of agencies viewed limitations in commercial services as a severe obstacle. Although there were differences in the extent to which different sizes and types of agencies experienced the various factors as an obstacle to interoperability, the relative ratings were remarkably consistent across all agency size and type categories. Ratings of 4 or 5 were interpreted as an indication of a severe obstacle, and a rating of 3 as an indication that agencies view the problem as a moderate or occasional problem (rather than an ongoing major problem). Exhibit 49 and Exhibit 50 summarize the relative ratings and information about the percentage of agencies that viewed each issue as a severe obstacle. Ratings of 1 or 2 have been interpreted to mean that agencies view the issue as a minor or infrequent problem.

The four most common issues addressed in written responses at the end of the survey were funding issues (252 comments), frequency bands (115 comments), political/turf issues (56 comments), and terrain/dead spot issues (41 comments). A comment such as: *“Cost issues and political turf issues seem most critical. Political entities do not like being told what equipment or needs are best for their agencies”* was recorded under two headings (funding and political/turf). Since it was not an issue that agencies were asked to rate, it is difficult to assess the extent to



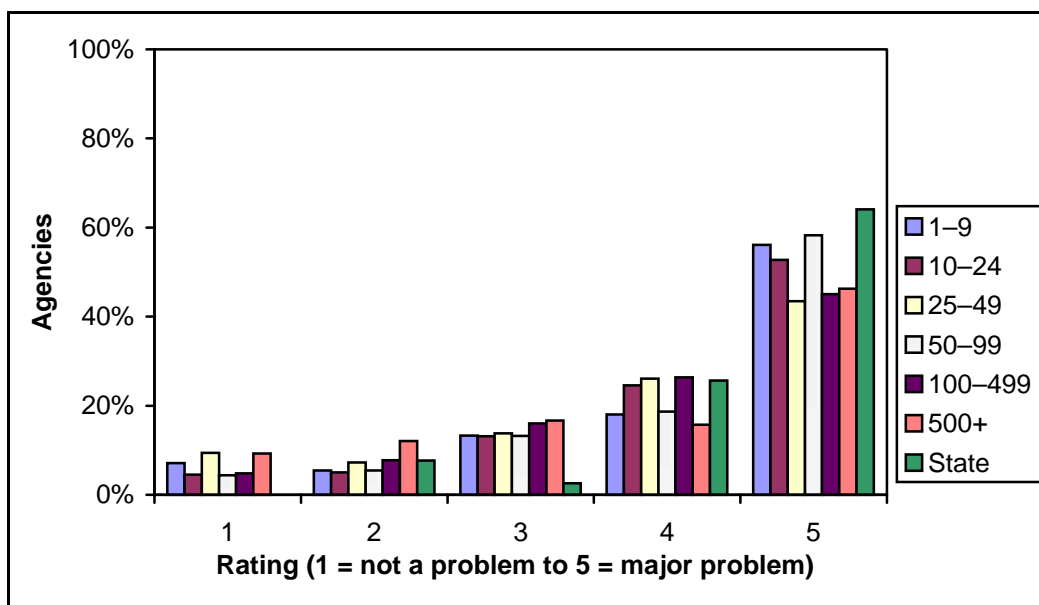
which political or turf issues are viewed as an obstacle to interoperability. Each of the obstacles is analyzed in more detail and addressed in the pages that follow. See Table VIII in Appendix E.

<b>Obstacles to Interoperability</b>	<b>Percentage of all Respondents (Severity rating of 4 or 5)</b>	<b>Overall Average</b>
Limitations in funding	69	3.84
Different bands	51	3.34
Lack of adequate planning	30	2.73
Different coverage areas	27	2.64
Human and institutional limitations	22	2.51
Different communication modes (analog vs. digital)	23	2.32
Limitations in commercial services	14	2.04

*Note: Percentages indicate the percentage 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 50: Obstacles to Interoperability and Percentage of Agencies That Experience Each One as a Severe Obstacle**

Question: Based on your agency's experience, indicate the severity of limitations in funding as an obstacle to interoperability.



**Exhibit 51: Extent to Which Limitations in Funding Are an Obstacle to Interoperability**

**Limitations in funding affect ability to interoperate for 69 percent of all agencies.**

Limitations in funding were rated as a *severe* obstacle to interoperability by 69 percent of all agencies (ratings of 4 or 5). There were significant differences between agencies that rated limitations in funding as a severe obstacle and the agencies that indicated it was not a problem (12 percent of responding agencies that gave ratings of 1 or 2). *Well-funded agencies* had more confidence in their overall ability to handle all types of interoperability situations (average ratings of 3.89 compared to 3.12 for agencies with limited funds). They were significantly more confident in their ability to handle day-to-day, mutual aid, and task force operations, and they were more confident in their ability to establish radio communication links with Federal, State, or local public safety and public service organizations.

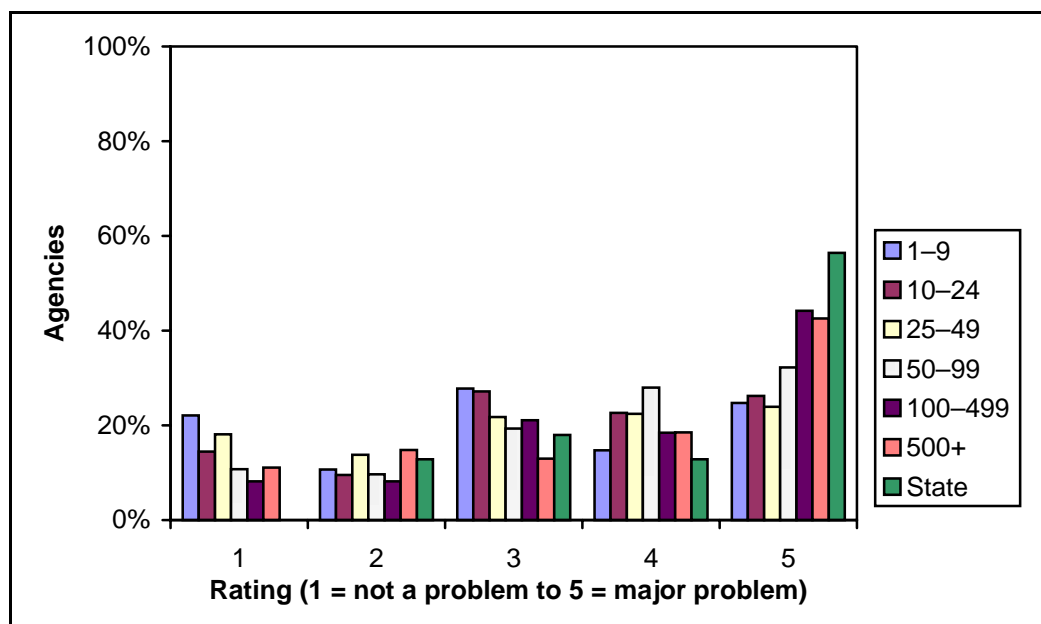
There were also significant differences between well-funded and poorly funded agencies in regards to the problems they were experiencing with their land mobile radio systems. *Agencies with limited funding* were significantly more likely to indicate problems with dead spots, outdated equipment, insufficient equipment, frequency interference, and channel congestion. There were no significant differences, however, in whether or not they participated in joint training with other organizations (actually using communications equipment), had at least one radio channel solely designated for communicating with other organizations, or were planning to replace or upgrade their systems within the next 10 years. There were no significant differences in the extent to which they shared frequencies and/or infrastructure with other organizations. The data are summarized in Table IX in Appendix E.

Funding issues were also the most commonly mentioned in write-in responses at the end of the questionnaire. Written comments about funding were frequently linked to comments about

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mandates for interoperability standards. The linkage between the two issues was stated succinctly by one respondent: *“No dollars, no mandate.”* Some agencies viewed a mandate as an opportunity to free up funds they needed to replace or upgrade their systems: *“The only way we will update our system is if it is mandated. If not, the council will not spend the money.”* Exhibit 59 on page 77 provides an overview of some of the issues and perspectives related to funding and mandates.

Question: Based on your agency's experience, indicate the severity of different bands as an obstacle to interoperability.



**Exhibit 52: Percent of Agencies Indicating Severity of Different Bands as Obstacle to Interoperability**

**Half say different bands have a serious impact on ability to interoperate.**

Fifty-one percent of all respondents are experiencing severe problems with interoperability as a result of different bands. If agencies that gave a rating of 3 are included, 72 percent of all respondents are experiencing significant problems as a result of using different bands. One respondent stated it simply, “We can’t talk to each other.” Given the frequency of interoperability (93 percent interoperate at the local level on a daily or weekly basis), such percentages suggest that half of all respondents are routinely working with serious levels of frustration due to frequency differences. Although the survey did not ask agencies to rate the impact of different bands on their agency’s effectiveness or efficiency, it is logical to assume there is an impact. State agencies (69 percent) and larger agencies were the most likely to rate different bands as a major problem, but it is a severe problem for 62 percent of all agencies with 50 or more sworn officers, and for 41 percent of agencies with less than 25 sworn officers.

There were no significant differences between agencies using 800 MHz, high band VHF, low band VHF, or UHF with regards to their ability to handle day-to-day interoperability events, their ability to establish radio communications links with local organizations, the extent to which they rated different bands as a problem, or the extent to which different communication modes (analog versus digital) were a problem (agencies operating in 800 MHz are significantly more likely to be using digital).

There were significant differences in other regards: 800 MHz users were considerably more confident in their ability to handle both mutual aid and task force operations, and in the ability of

their radio system to link with Federal organizations (although ratings were still low compared to ratings of ability to link with either local or State organizations). Agencies with high band VHF were more confident in their ability to link with State agencies than agencies using 800 MHz, low band VHF, or UHF bands (73 percent of all respondents currently operate in high band VHF). Agencies with 800 MHz were more likely to have newer equipment, and they reported fewer problems with dead spots than agencies operating in other bands. Summary data from the analyses of agencies using different bands may be found in Tables II and X in Appendix E.

<b>Agencies by Size Category and State Agencies</b>								
<b>Extent of problem</b>	<b>1–9</b>	<b>10–24</b>	<b>25–48</b>	<b>50–99</b>	<b>100–499</b>	<b>500 +</b>	<b>State</b>	<b>TOTALS (all)</b>
Minor problem (1/2)	31	26	32	15	18	25	13	23
Moderate (3)	27	28	18	22	20	16	18	22
<b>Significant problem (4/5)</b>	<b>42</b>	<b>46</b>	<b>50</b>	<b>63</b>	<b>62</b>	<b>61</b>	<b>69</b>	<b>51</b>

**Exhibit 53: Agencies Rate Extent That Different Bands Are an Obstacle to Interoperability**

Respondents’ written comments illustrate some of the problems they have experienced as the result of different bands and some of the methods they have used to work around frequency incompatibilities:

- *In our area it is very common to have multiple channels, [and] scan radios with other agencies’ frequencies. We also have a spare walkie-talkie that we issue other agencies’ personnel to assure we can communicate.*
- *Many times we could not communicate due to different frequencies. We have posted agency representatives in our dispatch center with their portable radio to relay information.*
- *[Our] Department of Public Safety is a combined police-fire department. Our officers do both disciplines and both police and fire dispatching are done from the same dispatch center.*
- *We had a train derailment in which numerous outside agencies were brought in. A command post had to be established with a radio from each agency so information could be relayed. We now have excellent radio.*
- *During only mutual aid event in last eight years (earthquake) police department issued mobile radios to other agencies, fire department, paramedics, public works, etc., to coordinate communications.*
- *Differences of radio bands. No adjustments were made. Just did without direct radio communication and relayed the information through the respective comm center via the telephone.*
- *The incidents are many and we try to overcome them through equipment purchased to operate on frequency ranges other than our main system.*

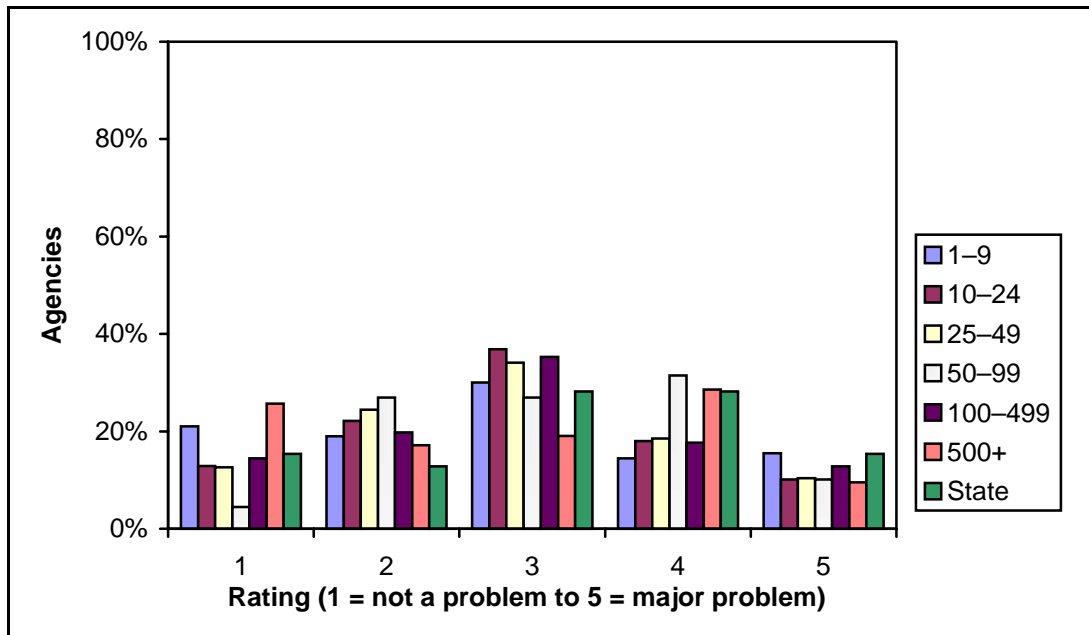
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There are limits, however, to such arrangements, as noted by the following respondents:

- *We interoperate with 102 different county sheriff's departments; those on 450–512 we cannot communicate with. We have no funds for a third vehicle radio and no space in the vehicles' radio console to put it.*
- *We are only able to talk with agencies on our current system. Agencies not on 800 have no contact.*
- *We have to go through another agency to communicate with other agencies.*

Question: Based on your agency's experience, indicate the severity of lack of adequate planning as an obstacle to interoperability.

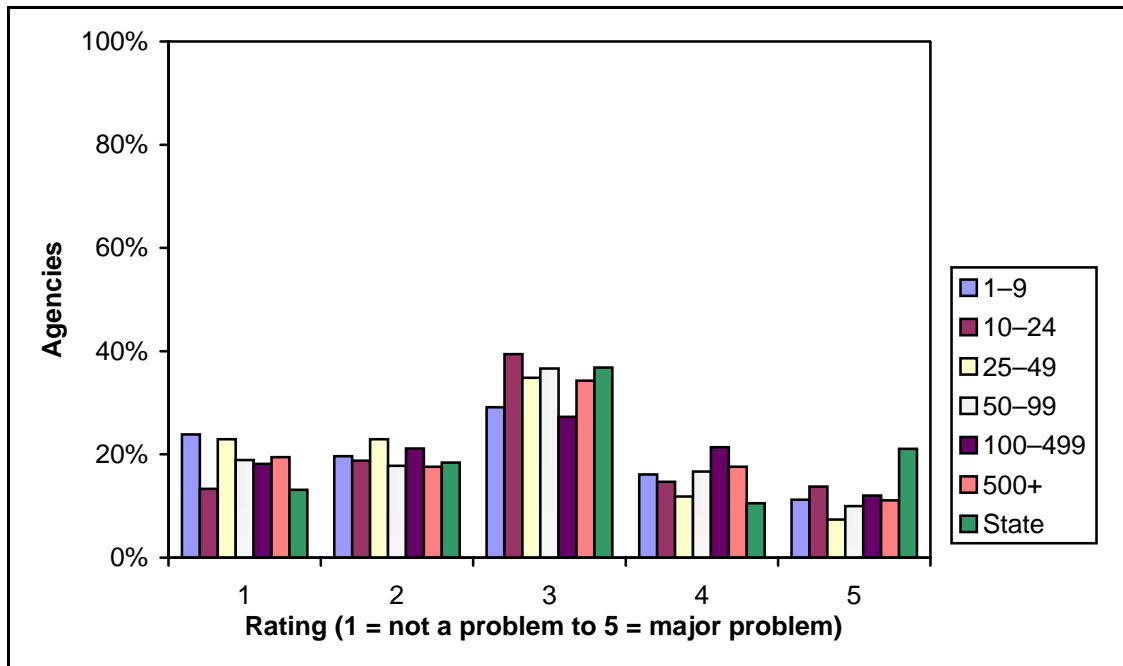


**Exhibit 54: Percent of Agencies Rating Lack of Adequate Planning as Obstacle to Interoperability**

**Lack of adequate planning is a severe obstacle for 3 out of 10 agencies.**

Thirty percent of all respondents indicated lack of adequate planning was a severe obstacle (combined ratings of 4 or 5) to interoperability. Although relatively few agencies in each size and type category rated lack of adequate planning as a *major* obstacle (a rating of 5), it is a severe problem (rating of 4 or 5) for 44 percent of State agencies, 42 percent of agencies with 50–99 sworn officers, and 38 percent of agencies with 500 or more sworn officers. Agencies that reported participation in joint training exercises that involved other organizations and the actual use of communications equipment were significantly less likely to report severe problems with lack of planning as an obstacle to interoperability.

Question: Based on your agency's experience, indicate the severity of different coverage areas as an obstacle to interoperability.



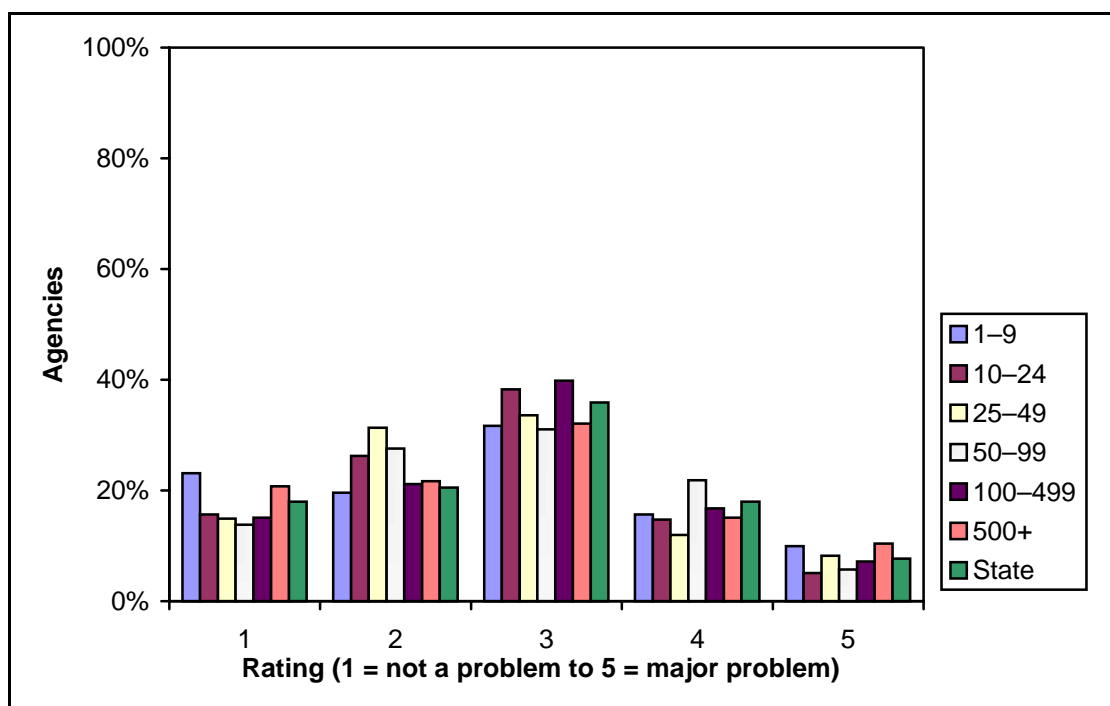
**Exhibit 55: Percent of Agencies Indicating Different Coverage Areas as an Obstacle to Interoperability**

**Different coverage areas complicate interoperability for 27 percent of agencies.**

Most agencies were not experiencing severe problems with interoperability as a result of different coverage areas, (i.e., nonoverlapping geographic radio coverage areas), but 27 percent reported severe problems (rating of 4 or 5). The graph in Exhibit 55 summarizes the extent to which different coverage areas are a problem for different size categories and State agencies. State agencies and agencies with 100 or more sworn officers were most likely to experience severe obstacles to interoperability as a result of different coverage areas. On the other hand, 37 percent of all respondents indicated it was *not* a significant problem and 30 percent rated it as a moderate problem. Agencies that have problems resulting from different coverage areas have worked out a variety of solutions such as issuing walkie-talkies at the scene and using CB radios or cellular phones.



Question: Based on your agency's experience, indicate the severity of human and institutional limitations as an obstacle to interoperability.

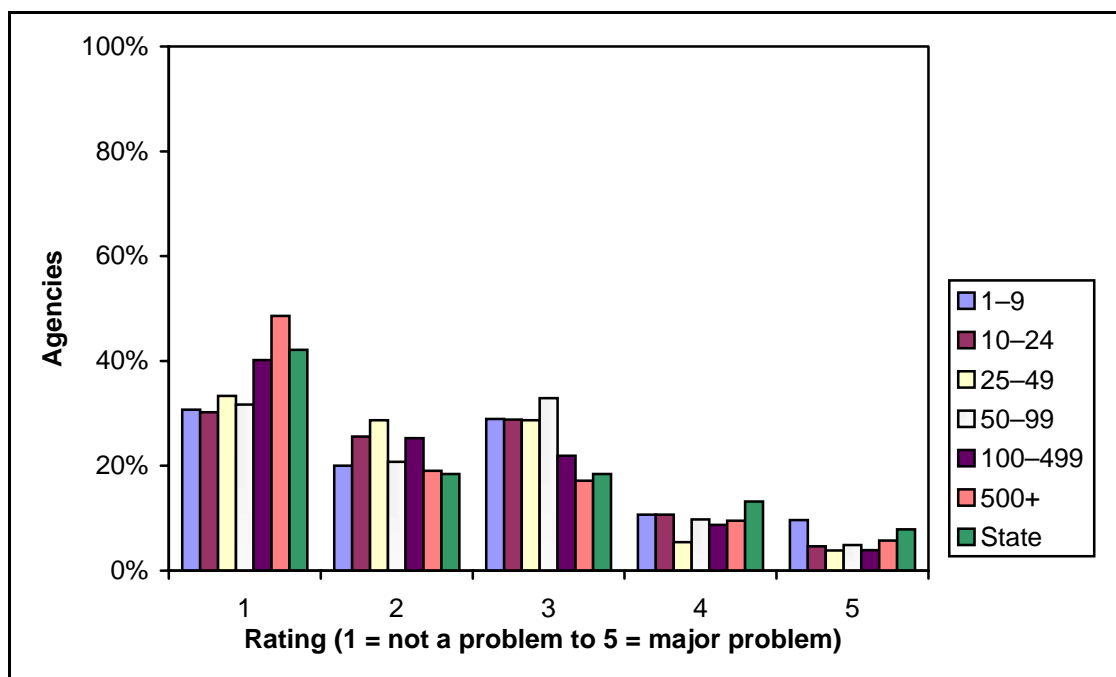


**Exhibit 56: Percent of Agencies Indicating Human and Institutional Limitations as an Obstacle to Interoperability**

**Human and institutional limitations are a moderate problem.**

Human and institutional limitations such as those cited in the PSWAC report (i.e., limitations or constraints in human memory, agency concerns over maintaining a communications link with their own personnel, or agency reluctance to allow personnel to join other systems) are not a serious obstacle to interoperability for 78 percent of agencies (38 percent rated it 1 or 2, and 33 percent gave it a rating of 3). Seven percent of respondents did identify human and institutional limitations as a *major* obstacle, and another 15 percent indicated they were a serious obstacle, adding up to 22 percent overall that were experiencing severe problems due to human and institutional limitations (ratings of 4 or 5).

Question: Based on your agency's experience, indicate the severity of limitations in commercial services as an obstacle to interoperability.



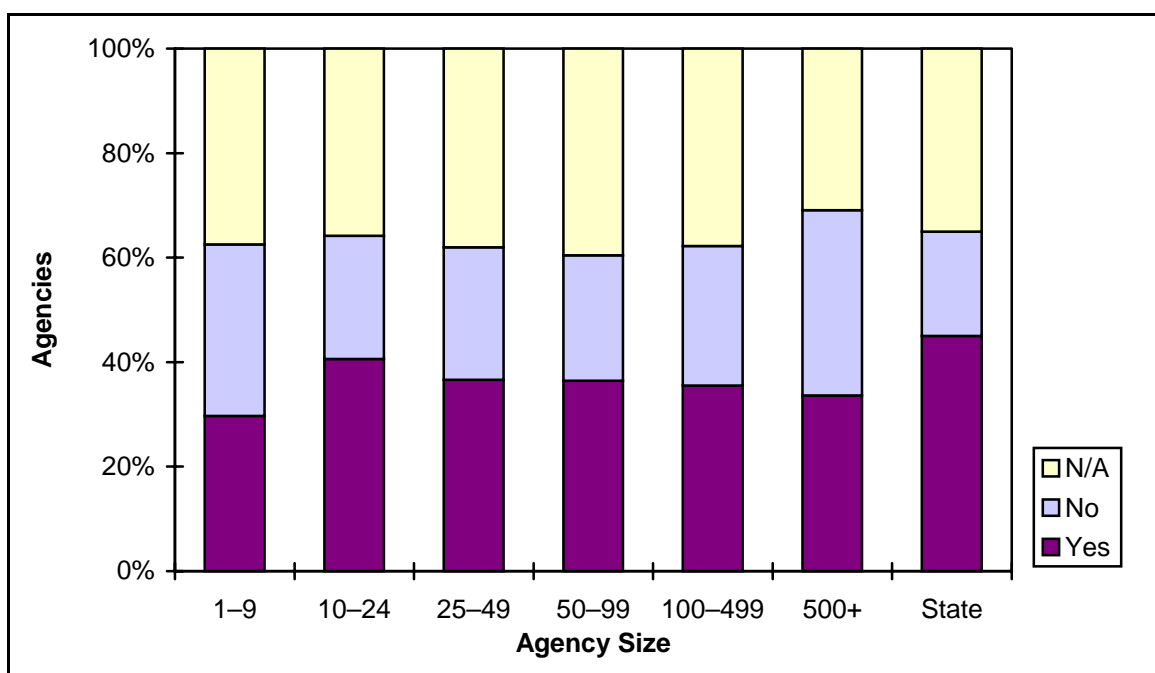
**Exhibit 57: Extent to Which Limitations of Commercial Services Are an Obstacle to Interoperability**

**Limitations in commercial services do not hinder interoperability.**

The information about communications equipment used by law enforcement agencies, presented earlier in this report, reveals extensive use of commercial services such as telephones, fax, and cellular phones. No questions were asked about the extent to which commercial services were used for interoperability, but agencies were asked to rate the extent to which limitations in commercial services served as an obstacle to interoperability. Respondents did not view limitations of commercial services as a particularly severe obstacle to interoperability (overall average rating of 2.04 on a 5-point scale). In fact, several agencies reported using commercial services when their wireless systems were inadequate or incompatible in an emergency. The Oklahoma City Police Department wrote, “April 19, 1995 bombing of the Murrah Federal Building in Oklahoma City. Responding agencies had no interoperability plan or capabilities. Cellular phones provided interagency communication.” The California Highway Patrol, referring to a situation where interoperability was impeded, used commercial services: “Differences of radio bands. No adjustments were made. Just did without direct radio communication and relayed the information through the respective comm center via the telephone.”

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Question: Do you think there should be Federal or State mandates with “date-certain” timelines to ensure interoperability?



**Exhibit 58: Proportion That Favor or Oppose Federal or State Mandates With "Date Certain" Timelines to Ensure Interoperability**

**Agencies are split on value of State or Federal mandates.**

When agencies were asked if they thought there should be State or Federal mandates with “date certain” timelines to ensure interoperability, they were slightly more likely to say “yes” (35 percent) than “no” (28 percent). It is difficult to draw any conclusions because 37 percent did not answer the question, which may be due to respondents either not having an opinion on this matter or, more likely, overlooking the question entirely. (The question may have been overlooked either because it was the very last question on the questionnaire or because an agency skipped the written response section.) The question about mandates elicited strong responses. The comments below and in Exhibit 59 provide some of the pros and cons of mandates.

Written responses reflected the variety of circumstances in the responding agencies:

- *We feel that State mandates and controls would be in our best interest.*
- *If the State or Federal Government mandates a date-certain timeline, local agencies would greatly benefit and [it] would expedite matters. Government funding, all or part of, would help local governments.*
- *Interoperability is important, but agencies should not be mandated to keep up with technology. Communications technology is quite expensive, and many agencies would find it difficult to allocate funding for upgrading of systems.*

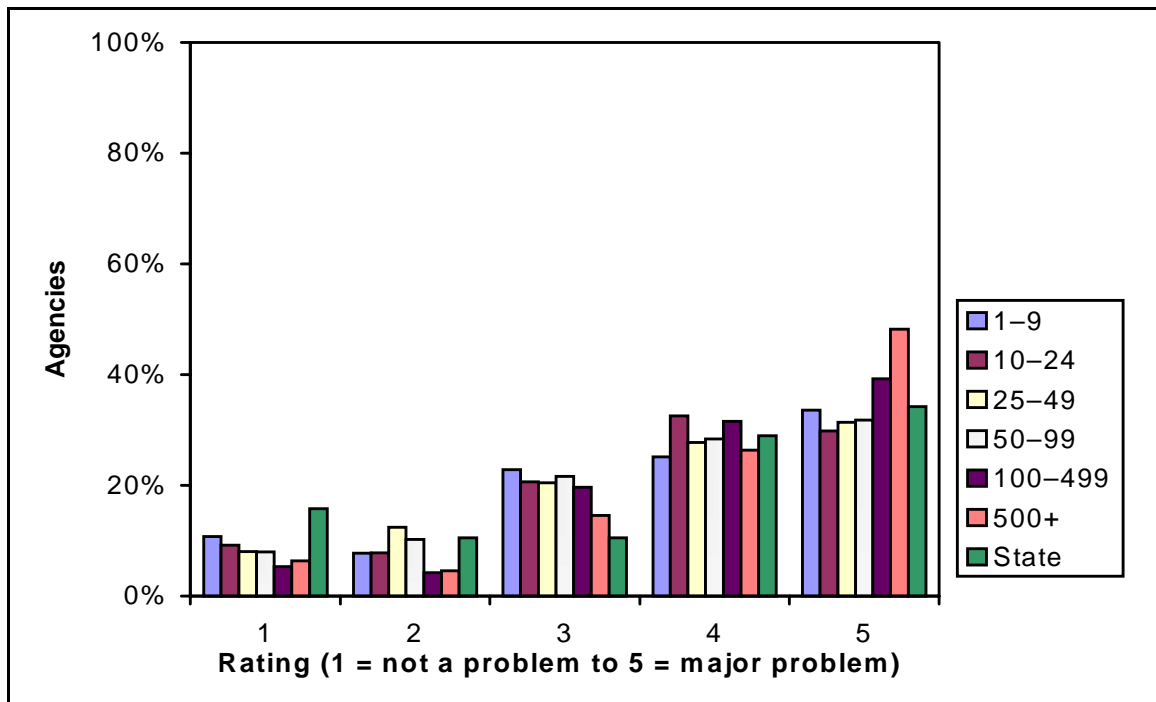
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- *Many police departments have no need or very little need to ever work with State or Federal agencies. It is absolutely unreasonable to ask local police to purchase...equipment for interoperability when it is not needed or desired.*
  - *Problems that seem to appear whenever any change is made [are due to the] fact that the changes are decided and dictated by larger agencies. The small agencies are basically left to fend for themselves - jump on the bandwagon or walk.*
  - *Timelines must be flexible to allow for life cycles of existing equipment and available funding.*

**Question: 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?**

YES	NO
<i>Forces politically motivated organizations to act.</i>	<i>No dollars, no mandate.</i>
<i>To ensure conversions will take place [rather than waiting] until users “get around to it.”</i>	<i>[Mandates] sound good but would discourage new technology in the future by limiting competition.</i>
<i>Potential liability issues...related to officer safety.</i>	<i>Local buy-in cannot be obtained by a Federal [mandate].</i>
<i>Most government agencies won’t expend any funds unless they are forced by some statutory requirement.</i>	<i>Mandates restrict proper use of budget and take away from other areas that may need the money.</i>
<i>A mandate is the only certain method of gaining uniform compliance and funding allocation by agencies with varied interests.</i>	<i>Mandates should not be put on small departments unless grants are in place to help them with procurement costs.</i>
<i>The only way we will update our system is if it is mandated. If not, the council will not spend the money.</i>	<i>Even government agencies are unable to meet deadlines when funding is not timely. Small town governing bodies are tight with a buck, regardless of mandates.</i>
<i>No agency is an island. We all need to share information rapidly on a regional level.  Without mandates, our local agencies will continue to operate with outdated systems and equipment.</i>	<i>Mandating change by a particular point in time could result in ... a job done too quickly. Without the timeline it may be done slower, more carefully and ultimately result in a more effective system.</i>
<i>A definite standard for network and equipment must be developed because local governments will always go for the lowest cost with effectiveness a secondary concern.</i>	<i>Many police departments have little or no need to ever work with State or Federal agencies. It is absolutely unreasonable to ask local police to purchase digital equipment for interoperability when it is not needed or desired.</i>
<i>Firm timelines with detailed compatibility guidelines help smaller agencies make informed purchases. Interoperability is too easily overlooked when only a consideration, difficult to ignore when it is a law.</i>	<i>Agencies are severely hampered by mandates that leave them at the mercy of budget managers and legislative bodies. It is never possible to get adequate funding to comply.</i>
<i>There needs to be a mandate or incentive for manufacturers to develop interoperable equipment.</i>	<i>Mandates usually result in higher costs. Let the market promote competition to meet standards—not Federal mandates.</i>
<i>Manufacturers are confused about the long-range objectives.</i>	<i>Date certain usually causes problems by limiting planning and preparing for startup.</i>
<i>Agencies are already purchasing equipment that will not be replaced for many years.  Won’t happen without requirements, guidelines and funding assistance.</i>	<i>Event driven circumstances will dictate cooperation. As technology advances and upgrading takes place...this will take place naturally in our area.</i>
<i>Political leaders do not understand the importance of up-to-date equipment for doing the job [well].</i>	<i>Each community should have the right and responsibility to determine needs and resource [allocation].</i>

**Exhibit 59: Agency Comments on the Pros and Cons of Mandates**

Question: Estimate your agency's OVERALL ABILITY to handle interoperability situations 5 years into the future.



**Exhibit 60: Agency Estimates of Ability to Handle Interoperability Situations 5 Years in Future**

**Agencies expect improved interoperability with new systems.**

Most agencies rated their current ability to handle interoperability situations as equal to or better than it was 5 years ago, and many expressed optimism that it will be even better in 5 years. The generally optimistic outlook may be related to the fact that 46 percent of respondents expect to purchase new radio systems or significantly upgrade their current system within the next 10 years, and new technology is helping to alleviate problems as they emerge.

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## Section IV: Discussion and Concluding Comments

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This study was designed to provide a baseline portrait of law enforcement agencies' experiences with wireless telecommunications equipment for routine operations and interoperability, to explore issues identified by the Public Safety Wireless Advisory Committee, and provide quantitative data from State and local law enforcement agencies across the Nation, to quantify the nature and extent of current use and anticipated needs for wireless communications, particularly as they relate to interoperability. It confirmed and quantified much of what was already "known" or suspected, but it also revealed some surprises. Aggregate data such as those presented in this report are useful for developing a broadbrush portrait of nationwide practice and even for assessing national trends. What it cannot do is provide an accurate picture of the problems or obstacles encountered by individual agencies. The analyses by size and type of agency provide some insight into the differences that exist at the national level but do not address the specific situation faced by any one agency or community. The data support the PSWAC conclusion that many agencies are experiencing serious problems with interoperability. The data also support contentions that there is a need for additional spectrum, and that larger agencies and State agencies have greater needs for additional spectrum than smaller agencies. The actual number of additional channels that agencies say they need, however, is not large. The requests for additional channels appear to be reasonable when one compares the totals to the number of channels being used by agencies with sufficient channels.

There is widespread use of channels dedicated solely for communicating with other organizations (i.e., for interoperability) and high levels of confidence in interoperability with other local organizations. Written comments revealed a variety of "solutions" that agencies have used to deal with frequency incompatibilities, a severe problem for half of them. The variety of approaches used to solve local interoperability problems undoubtedly contribute to the difficulty most agencies experience interoperating with State and Federal agencies.

Each community and each law enforcement agency is working with a unique combination of interrelated factors. The finding that most agencies prefer local rather than State or national planning for interoperability appears to contradict the PSWAC conclusion that the lack of a common, nationwide mutual aid plan and incident command system impedes interoperability.

Some problems agencies are experiencing with their radio systems are related to the issues they identified as obstacles to interoperability. Limitations in funding contribute to problems with outdated equipment, insufficient equipment, channel congestion, and insufficient infrastructure to compensate for dead spots. But funding can't solve all of the problems agencies are experiencing. Topography/terrain may make it economically difficult or impossible to totally eliminate dead spots - particularly in mountainous regions and in areas with many high-rise buildings.

The general knowledge level among smaller agencies should be a concern for State and national policymakers, as should the resentment smaller agencies feel toward the influence exerted by large agencies, and the loss of control over their local budgetary decisionmaking. On the other hand, these data support the observation that external mandates can serve as either threat or opportunity, depending on the agency.

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Janet Reno, in her address to the International Association of Chiefs of Police referred to radio spectrum as a “precious commodity” subject to “fierce competition” and “among the most pressing issues faced at every level of law enforcement.” She encouraged the Chiefs to begin thinking about the cost of upgrading and how to pay for it.<sup>25</sup> Law enforcement agencies *are* concerned about the cost of communications equipment, and are already working on processes for systematically replacing aging equipment, but there are a disproportionate number of agencies working with old equipment at this time. This may be due to the fact that radio technology is changing quite rapidly right now and some agencies, especially larger agencies for which a complete overhaul of their communications system is a major investment, may be holding off until the bugs get worked out of the technology. Some appear to be waiting for the turn of the century. Many of the agencies that complained of outdated equipment already have plans to replace or upgrade their systems within the next 10 years. At a time when technology is changing very rapidly 10 years can seem like a very long time. This study found an average equipment life cycle of about 8–15 years, depending on the size of the agency and, therefore, the price of the system to be replaced. Agencies are generally willing to adopt Project 25 Interoperability Standards when they upgrade but would clearly appreciate Federal or State funds to help defray or absorb the costs. The policy question is whether to allow the replacement process to happen naturally as a result of agency need and market forces, or use incentives and sanctions to speed the process. The extent to which lack of modern equipment is a threat to agencies’ effectiveness and ability to carry out their mandates is ultimately a local determination, although this study suggests there may be many communities depending on marginal communications equipment should a disaster strike.

Channel congestion is a significant problem for many agencies, especially for large agencies and State police. Even if funding were unlimited, spectrum is not, and agencies are making plans to *increase* the use of available spectrum by expanding the use of wireless data applications and accessing commercially available services such as cellular voice, GPS, CDPD, SMR, and satellite systems. The proliferation of laptops and their integration into routine law enforcement operations indirectly affects the availability of spectrum for other uses, such as channels available for interoperability.

New technologies (e.g., trunking) can increase efficiency in the use of spectrum, but the demand for advanced technology services and the increasing use of mobile computers by all sizes and types of agencies will require additional spectrum. An FCC decision to allocate additional spectrum for public safety is consistent with the needs identified in this study. Wise decisions about the actual amount of additional spectrum needed will require further analysis of both quantitative data and political realities. The allocation of additional public safety spectrum, narrow-banding, increased use of trunking across all bands, digital technology and other innovations may make it possible to absorb continued expansion of applications with limited spectrum.

The fragmentation of public safety spectrum is a serious problem. The migration to 800 MHz and allocation of adjoining spectrum for public safety could greatly facilitate interoperability, and the national negotiation and adoption of interoperability standards, a widely recognized need, may serve as an impetus to hasten the shift to higher frequencies. On the other hand, this study also identified problems related to the shift toward greater use of 800 MHz by the larger agencies, a shift that is apparently facilitating interoperability for those that are on the system but isolating them from colleagues and neighboring jurisdictions that are not using 800 MHz. Also,



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the needs of some agencies are best served by conventional analog radios operating in low VHF, high VHF, or UHF bands.

This study did not find a groundswell of support for national interoperability planning, but it did reveal some of the reasons why the vast majority of agencies prefer local planning. Agencies interoperate primarily with other local organizations. They have more confidence in their ability to handle all kinds of interoperability events with the organizations they interact with on a regular basis. The data suggest that interoperability problems may be more of a State and/or Federal issue than a local issue—it is in the interactions with these more distant colleagues that agencies express the least confidence in their ability to establish radio communications links.

Agencies that participate in joint training activities that involve other organizations and the actual use of communications equipment appear to be ahead of the game a bit, at least in so far as their confidence in their agency's ability to respond to interoperability situations.

Written comments confirm the notion that critical incidents often spur communities into action and release funds for upgrading wireless communications systems. The cost of communications equipment appears to be contributing to the use of regionalized communications centers that cross jurisdictions and facilitate interoperability.

This intent of this study was to provide data that could be used by policymakers at all levels, by agencies of all sizes and types. A national portrait provides important information for comparisons, and data such as those presented here can be used to inform the local decisionmaking process, but ultimately decisionmakers must weigh many factors and assess the value of the data for the decisions *they* must make to protect life and property in their own community.

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## Endnotes

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- <sup>1</sup> McDole, Arthur. Personal communication. September, 1997.
- <sup>2</sup> ACCESS America, AO6 Establish the Intergovernmental Wireless Public Safety Network (Feb. 24, 1997) Government Information Technology Services (GiTS)
- <sup>3</sup> Focused Research International, Inc., *Maryland Law Enforcement Telecommunications Interoperability Analysis*, produced for the Maryland State Police, Leonardtown, MD, 1993.
- <sup>4</sup> Irving, Larry, *Final Report of the Public Safety Wireless Advisory Committee (PSWAC) to the Federal Communications Commission and the National Telecommunications and Information Administration* (September 11, 1996).
- <sup>5</sup> Information about the National Public Safety Telecommunications Council can be obtained through their web page (<http://rmlectc.dri.du.edu/npstc>), by calling the National Law Enforcement and Communications Center–Rocky Mountain Region (1–800–416–8086), or by writing to NLECTC–RM (2050 East Iliff Avenue, Denver, CO 80208).
- <sup>6</sup> Radio Resource Magazine, October 1997, page 50.
- <sup>7</sup> Irving, Larry, *Final Report of the Public Safety Wireless Advisory Committee*, page 49.
- <sup>8</sup> *ibid.*, page 1.
- <sup>9</sup> *ibid.*, page 2.
- <sup>10</sup> The Committee requested spectrum set-asides that would add up to 70 MHz over the next fifteen years. In February of 1997, as a result of the recommendations of PSWAC, the Clinton Administration announced support for reserving 40 percent of the frequencies available in TV channels 60–69 (24 MHz) for the exclusive use of police, fire fighters, and other public safety workers. A final decision is pending.
- <sup>11</sup> Southeastern Institute of Research, Inc., *Research Report: Public Safety Wireless Advisory Committee*, prepared for PSWAC Operational Requirements Subcommittee, November 20, 1995, Richmond, VA.
- <sup>12</sup> Clark, John F., *Public Safety Communications in the Years Ahead: A Time of Crisis and Opportunity*, Remarks to the annual business meeting of the Major Cities Chiefs of Police, Orlando, FL, October 25, 1997.
- <sup>13</sup> Specific Interagency Tactical Channels (nationwide mutual aid channels) in the 800 MHz band are 866.0125; 866.5125; 867.0125; 867.5125; and, 868.0125.
- <sup>14</sup> Irving, Larry, *Final Report of the Public Safety Wireless Advisory Committee*, 51–52.
- <sup>15</sup> This conclusion is based on the statements made in the final PSWAC report. Although there is no nationwide plan or incident command system, there are radio channels that have been dedicated nationwide for mutual aid.
- <sup>16</sup> Statistics derived from Reaves, LEMAS Report: 1993
- <sup>17</sup> Although the questionnaire was sent only to law enforcement agencies, some of the written comments indicated that the respondents were part of a combined communications center that included police, fire, and emergency medical services.
- <sup>18</sup> The first mailing of the survey was addressed to the Chief of Police. Subsequent mailings were addressed to the Radio Communications Manager.

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<sup>19</sup> For a discussion of the limitations of self administered agency mail surveys, the reader is referred to the Police Foundation's study *Police Use of Force, Citizen Complaints, and Legal Consequences*, Volume I, pages 58–62.

<sup>20</sup> Paired t-tests were used to compare differences between agency sizes and types for questions that asked respondents to provide a rating, Chi square tests were used for yes-no questions. Independent t-tests and Chi square were used to test significance of differences between those who responded to the written survey and those who responded to the phone survey. SPSS version 6.1.3 was used for all tests of significance.

<sup>21</sup> The maximum error figure is based on analyses of yes/no questions and questions that asked agencies to rate on a scale of 1 to 5. Only two questions yielded errors greater than  $\pm 4$  percent: *How effective is your State's interoperability plan?* And, *How involved is your agency in the decisionmaking process related to the operation of your land mobile radio base system?* Both yielded errors of  $\pm 6$  percent. Weighted analyses yielded a maximum error of  $\pm 2$  percent.

<sup>22</sup> Independent sample t-tests and Chi square using SPSS version 6.3.1.

<sup>23</sup> The differences between the respondents to the phone survey and the written survey were significant to the .001 confidence interval. In other words, the possibility that these results would occur by random chance is less than one in a thousand. The averages for the written and phone respondents on "outdated equipment" were 3.2 and 2.7 respectively on a 5-point scale where 1 = not a problem and 5 = major problem. The averages for agency's overall ability to handle interoperability situations were 3.3 for written responders and 3.7 for phone respondents, on a 5-point scale where 1 = poor and 5 = excellent.

<sup>24</sup> National Public Safety Planning Advisory Committees were established in each State to develop State-level guidelines for 800 MHz frequency allocations and make recommendations to the FCC.

<sup>25</sup> Reno, Janet. October 27, 1997. Remarks on Public Safety Radio Communications excerpted from her address to the International Association of Chiefs of Police, Orlando, FL.

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## Appendix A - Law Enforcement Interoperability Questionnaire

**INTRODUCTION:**

Your agency has been selected to participate in a national study on the use of communication systems for interoperating with other public safety agencies. Participation is voluntary, and your responses will be kept confidential. The data will be analyzed by staff at The National Law Enforcement and Corrections Technology Center and compiled in a final report. Please indicate below if your agency is willing to be contacted by phone to provide additional information regarding the issue of interoperability and return with the completed questionnaire.

**DIRECTIONS:**

- 1) This questionnaire should be completed by the individual in your agency who is most knowledgeable about communication interoperability. Assistance by other personnel, if needed, is encouraged.
- 2) Read each question carefully.
- 3) Answer where requested by completely filling in the appropriate oval (e.g. ).
- 4) PRINT responses where requested. Leave blank spaces to the left of numbers (e.g.   ).
- 5) The response forms will be scanned electronically, use pencil and make a dark mark. Erase completely to change a response.
- 6) If you wish to expand on the information you are providing, please feel free to make additional comments on page 10 of the questionnaire.
- 7) DO NOT fold, bend, or staple the questionnaire.
- 8) Return the completed questionnaire in the enclosed pre-addressed, stamped envelope as soon as possible.

If you need assistance or additional information, please call Ms. Jeanne Collins at 1-800-416-8086.

Thank you for your participation in this important study.

DATA SUPPLIED BY:																								
Agency Contact:																								
Title:																								
Agency address:																								
City:													State:			Zip:								
Enter your 9 digit NCIC-ORI number:																								
Tele:Area code:			Number :					-					Extension:											
FAX:Area code:			Number :					-																
E-mail address:																								
<b>Return To:</b>	<b>National Law Enforcement &amp; Corrections Technology Center                  2050 East Iliff Avenue - Denver, Colorado 80208</b>																							

- Yes, please send a copy of the executive summary of this study.
- Yes, my agency is willing to be contacted by phone to provide more information regarding the issue of interoperability.

## DEFINITIONS

1) **Definition of Interoperability:** Essential communication links within or between public safety and public service communication systems that permit 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. This may include communication between governmental and non-governmental public safety and public service providers.

2) **Types of Interoperability: *Day-to-Day, Mutual Aid, and Task Force***

Day-to-Day Interoperability (e.g., High-speed chase across jurisdictions)

- Most often encountered type of interoperability.
- Commonly used in areas of concurrent jurisdiction.
- Commonly used where agencies need to monitor each other's routine traffic.
- If agencies are using different radio bands, may involve the use of multiple radios.

Mutual Aid Interoperability (e.g., Riots or wildland fires)

- Can involve multiple agencies with little opportunity for prior planning.
- Often requires assignment of several to many small groups, each on their talk group or frequency.
- Once on scene, typically involves the use of portable and mobile radios.

Task Force Interoperability (e.g., Counter narcotics operation or major event)

- Usually involves several levels of government (federal, state, and/or local).
- Typically an opportunity for prior planning exists.
- Usually involves use of portable and/or covert equipment.
- Often requires extensive close-range communications.  
Users may rove in and out of infrastructure coverage (metro to rural, in and out of buildings).

3) **Types of Organizations Involved: *Public Safety and Public Service***

- Public Safety Organizations include all federal, state, and local agencies that have been given, by law, the responsibility for protecting and preserving life, property and natural resources.
- Public Service Organizations include all agencies that help furnish, maintain, and protect the infrastructures that promote the public's safety and welfare.

4) **Examples of Different Levels of Organizations: *Federal, State, and Local***

Federal Level Organizations

- Federal Bureau of Investigation (FBI)
- Bureau of Alcohol, Tobacco, and Firearms (BATF)
- Federal Emergency Management Agency (FEMA)
- Military/Defense Department
- Coast Guard

State Level Organizations

- State Police
- State Bureau of Investigation
- Department of Fish and Wildlife
- Department of Highways/Roads
- State Emergency Preparedness

Local Level Organizations

- City Police Departments
- County Sheriff's Departments
- Fire Departments
- Emergency Medical
- Hospitals
- Private Security

**Section I. DESCRIPTIVE INFORMATION**

1. Which category below best describes your agency? Fill in ONLY ONE.

- Municipal Police Department
- County Police Department
- State Police Department
- Sheriff's Department
- Special Police Department (e.g., campus police, transit, housing, alcoholic beverage control, or park).

2. Number of full-time employees in your agency.

										Sworn
										Non-sworn

3. What is the population of your jurisdiction?

														People

4. Which of the following best describe the topography/terrain in which your agency operates? Fill in ALL that apply.

- Coastal or Intracoastal waterway
- Relatively flat
- Rolling hills
- Mountainous
- Many High-rise Buildings

5. How many square miles does your jurisdiction cover?

														Square Miles

3. To what extent does the use of different radio languages hinder effective communication between your agency and other organizations? (where 1 = not a problem to 5 = major problem)

1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Does your agency SHARE radio frequencies with other organizations?

Yes  No

5. What radio frequencies does your agency use to interoperate with other public safety and/or public service organizations? Fill in ALL that apply.

- Does not apply
- Low band VHF (25-50 MHz )
- High band VHF (150-174 MHz )
- Federal band UHF (406-420 MHz)
- Low band UHF (450-470 MHz )
- Low band UHF TV Sharing (470-512 MHz )
- 800 MHz (806-869 MHz )
- Other

6. HOW OFTEN does your agency have radio communication with the following levels of public safety and/or public service organizations (see definitions on page 2)?

	Daily	Weekly	Monthly	Yearly
Federal Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
State Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Section II. OPERATIONS**

1. Does your agency have at least one radio channel solely designated for communicating with other organizations?

Yes  No

2. What is the PRIMARY radio language used by your agency when communicating with other organizations? Fill in ONLY ONE.

- "Plain" English
- Code System
- Other

7. Identify the TYPES of interoperability (see definitions on page 2) your agency has experienced during the 1996 calendar year with the following levels of public safety and/or public service organizations.

	Day-to-Day	Mutual Aid	Task Force
Federal Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
State Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. Rate your agency's ABILITY to establish a radio communication link with each of the following levels of public safety and/or public service organizations. (where 1 = poor to 5 = excellent.)

	1	2	3	4	5
Federal Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
State Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local Level?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Estimate the total number of public safety and/or public service organizations at each level with which your agency requires radio communication.

Number of Organizations

<input type="text"/>	<input type="text"/>	<input type="text"/>	Federal Level
<input type="text"/>	<input type="text"/>	<input type="text"/>	State Level
<input type="text"/>	<input type="text"/>	<input type="text"/>	Local Level

10. Do you have a written communication interoperability agreement with any of the organizations you indicated in question #9? If no, skip to question #11. If yes, indicate how many for each level.

Number of Organizations

<input type="text"/>	<input type="text"/>	<input type="text"/>	Federal Level
<input type="text"/>	<input type="text"/>	<input type="text"/>	State Level
<input type="text"/>	<input type="text"/>	<input type="text"/>	Local Level

11. How many mutual aid and task force operations (see definitions on page 2) does your agency participate in during a typical year?

Number of Times

<input type="text"/>	<input type="text"/>	<input type="text"/>	Mutual Aid
<input type="text"/>	<input type="text"/>	<input type="text"/>	Task Force

12. What is the MAXIMUM number of organizations your agency has had to communicate with during any mutual aid or task force operation?

Maximum # of Organizations

<input type="text"/>	<input type="text"/>	<input type="text"/>	Mutual Aid
<input type="text"/>	<input type="text"/>	<input type="text"/>	Task Force

13. Rate the ABILITY of your agency's radio system to effectively handle the three types of interoperability as defined on page 2. (where 1 = poor to 5 = excellent)

	1	2	3	4	5
Day-to-Day?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mutual Aid?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task Force?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Rate your agency's OVERALL ABILITY to handle interoperability situations 5 years ago, today, and estimate its ability 5 years into the future. (where 1 = poor to 5 = excellent)

	1	2	3	4	5
5 years ago?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Today?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5 years from now?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Based on your agency's experience, indicate the severity of each of the following obstacles to interoperability. (where 1 = not a problem to 5 = major problem)

	1	2	3	4	5
Different Bands?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Human and Institutional Limitations?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Different Communication Modes (analog vs. digital)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Different Coverage Areas?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limitations of Commercial Services?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of Adequate Planning?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Limitations in Funding?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. What LEVEL of interoperability planning would best serve your agency? Fill in ONLY ONE.

- Local Region (multi-jurisdiction)  
 State-wide  
 Multi-state Region  
 National

17. To your knowledge, does your state have a formal written interoperability plan?

- Yes       No - SKIP to question #19



18. How effective is your state's interoperability plan?  
(where 1 = poor to 5 = excellent)
- 1      2      3      4      5      Don't Know
- 

19. Does your agency currently use the following types of WIRELESS voice and/or data security? Please answer each question with a yes or no.

	Yes	No
scrambling devices?	<input type="radio"/>	<input type="radio"/>
digital encryption?	<input type="radio"/>	<input type="radio"/>
digital voice processing?	<input type="radio"/>	<input type="radio"/>

20. How essential is WIRELESS voice and/or data security protection to your agency?  
(where 1 = not needed to 5 = essential)

	1	2	3	4	5
VOICE Security?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DATA Security?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. HOW OFTEN does your agency use WIRELESS voice and/or data security protection?

	Never	Dly	Wkly	Mthly	Yrly
VOICE Security?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DATA Security?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Section III. INFORMATION AND TRAINING**

1. How important is each source of information to your agency when planning for the purchase of communication technologies?  
(where 1 = not important to 5 = extremely important)

	1	2	3	4	5
Equipment manufacturers?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional journals/magazines?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional/Trade Conferences?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Independent consultants?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other government agencies?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local college or university?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other, specify below:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Does your agency participate in joint training exercises with other organizations that involve the actual use of communication equipment?
- Yes       No - SKIP to question #4

3. Regarding question #2 above, indicate the levels of other organizations that participate in the joint training. Include both government and non-government organizations. Fill in ALL that apply.
- Federal Level       State Level       Local Level

4. How well do you believe your agency's training has prepared your staff to handle communication interoperability situations?  
(where 1 = poor to 5 = excellent)
- 1      2      3      4      5
- 

5. How familiar is your agency with the following?  
(where 1 = no knowledge to 5 = very knowledgeable)

	1	2	3	4	5
Project 25 Standards?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
FCC Refarming efforts?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
FCC Frequency Application Process?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NPSAC Guidelines?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dept. of Justice Internet Sites?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Section IV. COMMUNICATION SYSTEMS**

1. Indicate the types of communication equipment used by your agency. Fill in ALL that apply.

- Hand-held land mobile radio
- Vehicle-mounted land mobile radio
- Citizens band radio
- Amateur radio
- Telephone line
- FAX line
- Cellular phone/voice
- Cellular FAX
- Mobile pagers
- Mobile data terminal (Dumb-Terminal)
- Mobile laptop computer

2. Which best describes your PRIMARY land mobile radio base system? Fill in ONLY ONE.

- Conventional analog (non-trunked)
- Conventional digital (non-trunked)
- Trunked analog
- Trunked digital

3. Does your agency SHARE the infrastructure for its land mobile radio base system with other organizations?

- Yes
- No- SKIP to question #5

4. How involved is your agency in the decision-making process related to the operation of your land mobile radio base system? (where 1 = not at all to 5 = extensively)

- 1
- 2
- 3
- 4
- 5

5. Does your agency own or lease its PRIMARY land mobile radio base system? Fill in ONLY ONE.

- Own
- Lease

6. How many of the following are in your land mobile radio base system? If none, place a zero (0) next to the corresponding item.

- Fixed radio transmitter sites
- Radio repeaters
- Gateways
- Relays

7. Approximately how old is your land mobile radio base system?

years old

8. Identify the radio frequencies your agency CURRENTLY uses for VOICE-ONLY communication and indicate the current NUMBER of channels in those radio frequencies.

CURRENTLY USES	CURRENT # of VOICE-ONLY channels
<input type="radio"/> None	
<input type="radio"/> Low band VHF (25-50 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> High band VHF (150-174 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> Low band UHF (450-470 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> UHF TV Sharing (470-512 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> 800 MHz (806-869 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> Other	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>

9. Identify the radio frequencies your agency CURRENTLY uses for DATA-ONLY communication and indicate the current NUMBER of channels in those frequencies.

CURRENTLY USES	CURRENT # of DATA-ONLY channels
<input type="radio"/> None	
<input type="radio"/> Low band VHF (25-50 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> High band VHF (150-174 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> Low band UHF (450-470 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> UHF TV Sharing (470-512 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> 800 MHz (806-869 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> Other	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>

10. Identify the radio frequencies your agency CURRENTLY uses for ALTERNATE VOICE & DATA and indicate the current NUMBER of channels in those frequencies.

CURRENTLY USES	CURRENT # of ALTERNATE VOICE & DATA channels
<input type="radio"/> None	
<input type="radio"/> Low band VHF (25-50 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> High band VHF (150-174 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> Low band UHF (450-470 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> UHF TV Sharing (470-512 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> 800 MHz (806-869 MHz )	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>
<input type="radio"/> Other	<input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/> <input type="text" value=""/>

11. Does your agency have the ability to patch across channels?

- Yes
- No - SKIP to question #14

12. How many simultaneous cross patches can be set up?

# of cross-patches

13. Is a dispatcher REQUIRED to set up and break down the patch?

- Yes
- No

14. How serious are the following problems regarding your land-mobile radio system?  
(where 1 = not a problem to 5 = major problem)

	1	2	3	4	5
Not enough channels?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Not enough talk groups?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dead spots?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fading?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frequency Interference?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Static?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Battery problems?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Not enough equipment?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Outdated equipment?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equipment Size/Weight?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. If you marked "not enough channels" in question #14 as a problem, estimate the number of ADDITIONAL channels your agency needs for each of the following.

<input type="text"/> <input type="text"/> <input type="text"/>	ADDITIONAL VOICE-ONLY Channels
<input type="text"/> <input type="text"/> <input type="text"/>	ADDITIONAL DATA-ONLY Channels
<input type="text"/> <input type="text"/> <input type="text"/>	ADDITIONAL ALTERNATE VOICE & DATA Channels

16. To what extent does topography/terrain hinder the effectiveness of your land mobile radio base system?  
(where 1 = no problem to 5 = major problem)

1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. Who handles your agency's RADIO SPECTRUM LICENSING issues?

My agency                       The county  
 A regional group               The state  
 Other, please specify below

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

18. What organization handles your RADIO FREQUENCY COORDINATION with the FCC? Fill in ALL that apply.

AAR  
 APCO  
 IMSA  
 NABER  
 UTC  
 Other, please specify below

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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19. Does your agency PAY outsiders for radio spectrum frequency coordination services?

Yes                       No

20. How many times does your agency interact with a radio spectrum frequency coordinator in a typical year?

Times per year

21. How satisfied is your agency with the following?  
(where 1 = very satisfied to 5 = very dissatisfied)

	1	2	3	4	5
FCC Licensing procedures?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
FCC Regulations?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
FCC Administrative procedures?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22. Indicate ALL services your agency USES or PLANS TO USE within the next 5 years. If your agency does not use or plan to use any of the services, please fill here.

Currently Use	Plan to Use (within 5 yrs)	
<input type="radio"/>	<input type="radio"/>	Cellular/Voice
<input type="radio"/>	<input type="radio"/>	Cellular Digital Pocket Data (CDPD)
<input type="radio"/>	<input type="radio"/>	Personal Communications System (PCS)
<input type="radio"/>	<input type="radio"/>	Specialized Mobile Radio (SMR)
<input type="radio"/>	<input type="radio"/>	Mobile Satellite System
<input type="radio"/>	<input type="radio"/>	Global Positioning System (GPS)

23. Does your agency use a mobile paging system?

Yes               No - SKIP to question #25

24. How serious are the following problems with your mobile paging system?  
(where 1 = not a problem to 5 = major problem)

	1	2	3	4	5
Delayed receipt of pages?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of coverage?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Garbled pages?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Missed pages?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
False pages?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

25. Does your agency use the Internet for official business?

Yes  No

26. Does your agency use the following external information networks to interoperate with outside organizations? Fill in ALL that apply.

- National Crime Information Center (NCIC)
- National Law Enforcement Teletype System (NLETS)
- Local Area Network (LAN)
- Wide Area Network (WAN)

27. Does your agency have plans to replace or substantially upgrade its land mobile radio system?

Yes  No - SKIP to question #33

28. In what year does your agency plan to replace or substantially upgrade its land mobile radio base system?

19   or 20

29. What is your agency's PREFERENCE for its NEXT land mobile radio system? Fill in ONLY ONE.

- Conventional analog (non-trunked)
- Conventional digital (non-trunked)
- Trunked analog
- Trunked digital
- Unknown

30. Identify the radio frequencies your agency needs for VOICE-ONLY communication for its NEXT land mobile radio base system and indicate the TOTAL NUMBER of channels it will need in those radio frequencies.

NEEDS	TOTAL # Of VOICE-ONLY channels
<input type="radio"/> None	
<input type="radio"/> Low band VHF (25-50 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> High band VHF (150-174 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> Low band UHF (450-470 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> UHF TV Sharing (470-512 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> 800 MHz (806-869 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> Other	<input type="text"/> <input type="text"/> <input type="text"/>

31. Identify the radio frequencies your agency needs for DATA-ONLY communication for its NEXT land mobile radio system and indicate the TOTAL NUMBER of channels it will need in those radio frequencies.

NEEDS	TOTAL # of DATA-ONLY channels
<input type="radio"/> None	
<input type="radio"/> Low band VHF (25-50 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> High band VHF (150-174 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> Low band UHF (450-470 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> UHF TV Sharing (470-512 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> 800 MHz (806-869 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> Other	<input type="text"/> <input type="text"/> <input type="text"/>

32. Identify the radio frequencies your agency needs for ALTERNATE VOICE & DATA communication for its NEXT land mobile radio system and indicate the TOTAL NUMBER of channels it will need in those radio frequencies.

NEEDS	TOTAL ALTERNATE VOICE & DATA channels
<input type="radio"/> None	
<input type="radio"/> Low band VHF (25-50 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> High band VHF (150-174 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> Low band UHF (450-470 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> UHF TV Sharing (470-512 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> 800 MHz (806-869 MHz )	<input type="text"/> <input type="text"/> <input type="text"/>
<input type="radio"/> Other	<input type="text"/> <input type="text"/> <input type="text"/>

33. What is the TOTAL number of mobile data terminals and/or lap-top computers your agency CURRENTLY uses? If none, place a zero (0) next to the corresponding item.

# Mobile Data Terminals (Dumb Terminals)

# Lap-top Computers

34. What is the TOTAL number of mobile data terminals and/or lap-top computers your agency estimates it WILL USE in the year 1999? If none, place a zero (0) next to the corresponding item.

# Mobile Data Terminals (Dumb Terminals)

# Lap-top Computers

35. Regarding mobile data terminals and lap-top computers identify the types of WIRELESS DATA communication (not voice) your agency currently USES and PLANS TO USE within the next 2 years. Fill in yes or no for each type.

	Currently Uses		Plans to Use (within 2 years)	
	Yes	No	Yes	No
Free Text?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data Base Information?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Still Images (e.g., photos or maps)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fingerprints?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Video?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

36. Independent of your agency's plans, rate its NEED for the following types of WIRELESS DATA communication. (where 1 = no need to 5 = extreme need)

	1	2	3	4	5
Free Text?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data Base Information?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Still Images (e.g., photos or maps)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fingerprints?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Video?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

37. How important will interoperability ISSUES be to your agency when it purchases its next land mobile radio system? (where 1 = not important to 5 = extremely important)

1      2      3      4      5  
               

38. How important will interoperability STANDARDS be to your agency when planning for its next land mobile radio system? (where 1 = not important to 5 = extremely important)

1      2      3      4      5  
               

39. How likely is it that your agency will adopt the Association for Public Safety Communications Officials (APCO) Project 25 Interoperability Standards for its next land mobile radio system? (where 1 = highly unlikely to 5 = highly likely)

1      2      3      4      5

**Section V ADDITIONAL INFORMATION**

*The responses to the following questions will be scanned by a computer.  
Please PRINT and stay within the boxes provided. Continue  
on the next page, if needed.*

1. Are there any interoperability issues that we should have asked about and did not?  Yes  No  
Please explain.


2. Have you experienced a situation where the ability to interoperate with other agencies was impeded?  
 Yes  No If yes, briefly describe the situation and adjustments that were made.


3. What regulatory or licensing policies/procedures limit your ability to achieve interoperability?


4. What operational, technological or political issues do you think should be considered in the planning and implementation of a nationwide WIRELESS network for public safety and emergency preparedness entities at all levels of federal, state and local government?


5. 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?  Yes  No  
Please explain your reasons.




## **Appendix B - Bias Study**

The bias study was conducted by telephone. The sample included 155 agencies: 5 State agencies, 44 agencies employing more than 100 sworn officers, and 44 agencies employing 99 or fewer. The sample consisted of Local police departments (56%), Sheriff's departments (35%), Special police (5%), and State police (3%). Questions were modified somewhat to accommodate the auditory format of the telephone survey. Chi-square and independent t-tests were used to assess differences.

<b>Question</b>	<b>Results of t-tests (averages) and Chi-Square test</b>		
	<b>Written Survey</b>	<b>Phone Survey</b>	<b>Statistical Significance</b>
Does your agency have at least one radio channel designated for communicating with other organizations?	1092 yes/203 no	131 yes/24 no	<b>nsd</b>
Does your agency SHARE radio frequencies with other organizations?	939 yes/363 no	123 yes/32 no	<b>nsd</b>
On a scale of 1 to 5 (where 1 = poor and 5 = excellent), rate your agency's OVERALL ABILITY today to handle situations where it needs to interoperate with other agencies. (Interoperate means the ability of your agency to communicate with other organizations in the process of performing its functions.	3.31	3.71	<b>sd (.001)</b>
On a scale of 1 to 5 (where 1 = no knowledge to 5 = very knowledgeable), how familiar is your agency with the Project 25 Standards?	2.04	1.83	<b>nsd</b>
On a scale of 1 to 5 (where 1 = no knowledge to 5 = very knowledgeable), how familiar is your agency with the FCC's refarming efforts?	2.31	2.48	<b>nsd</b>
On a scale of 1 to 5 (where 1 = not a problem to 5 = major problem), how serious is the problem of not having enough channels on your land mobile radio system?	2.76	2.60	<b>nsd</b>
On a scale of 1 to 5 (where 1 = not a problem to 5 = major problem), how serious is the problem of frequency interference on your land mobile radio system?	2.82	2.71	<b>nsd</b>
On a scale of 1 to 5 (where 1 = not a problem to 5 = major problem), how serious is the problem of outdated equipment regarding your land mobile radio system?	3.15	2.66	<b>sd (.001)</b>
Does your agency have plans to replace or substantially upgrade its land mobile radio system? [If yes, proceed to question ten]	636 yes/649 no	80 yes/75 no	<b>nsd</b>
On a scale of 1 to 5 (where 1 = not important to 5 = extremely important), how important will interoperability ISSUES be to your agency when it purchases its next land mobile radio system?	4.26	4.20	<b>nsd</b>

Note: **sd** = statistically significant difference between the two groups; **nsd** = no statistically significant difference



## **Appendix C - Instrument Reliability**

It is useful to measure the reliability of a new instrument so that interpretations based on current and future use of the instrument can be made with confidence. The reliability estimate is an indicator of the instrument's stability. If it is highly reliable, then over repeated administrations with the same or similar groups of people, the results should be consistent, assuming the conditions that are being assessed have not changed.

For estimates of reliability, SPSS produces both an unstandardized Cronbach's alpha and a standardized alpha. Both were considered for this survey. Standardized alphas assume similar variances (equal to 1), so if variances are similar across items, the two alphas will be approximately the same. Unstandardized alphas reflect actual item variances so if variances are widely dissimilar, the two alphas will be quite different. Cronbach's alpha is used as a measure of the internal consistency of the instrument and is based on the average correlation among the items on a scale. Reliability tends to increase with longer scales and heterogeneous (mixed) groups. Cronbach's alpha is expressed as a correlation coefficient, ranging in value from 0 to +1. An estimate of .70 or higher is desired for judging a scale reliable.

It is best for reliability analysis if items are scaled the same. Since the items on this instrument use different formats, three subscales were generated for analysis: 1) a 61-item subscale of rating responses (*e.g. rate from one to five...*); 2) a 60-item subscale of fill-in type numeric responses (*e.g. indicate how many...*); and 3) a 27-item subscale of dichotomous responses (*e.g. yes-no*). Descriptive items such as questions about topography, population, and the type of services and/or equipment being used provided important information, but neither their format nor the type of information provided fit the above categories so they were not included in this analysis.

An initial disparity between the standardized and unstandardized alphas indicated unequal item variances, particularly within the dichotomous subscale. Closer examination revealed a decrease in reliability due to the inclusion of the following items: Item II-18 (rating the effectiveness of the state's interoperability plan); Item IV-4 (the extent to which agencies were involved in decision-making); Item IV-13 (the need for a dispatcher to set-up and breakdown a patch); and item IV-24 a-e (the seriousness of problems with mobile paging systems). All were SKIP items that generated means that were substantially different from the other items in their respective subscales. Recoding these items changed the standardized alphas (unstandardized alphas in parentheses) to .90 (.91), .87 (.85), and .85 (.83) for the three respective subscales. Deleting the problem items yielded alphas of .90 (.90), .85 (.87), and .84 (.86) for the subscales. All of these estimates mark strong internal consistency of items.

The reliability analysis, then, demonstrated evidence of an instrument comprised of several scales, each of which is internally-consistent. It merits attention, with only minor changes, as a dependable instrument to be used with other groups interested in measuring the status of interoperability among public safety organizations, and adds credibility to the conclusions drawn.

## Appendix D - Weighting Analyses

The goal of this study was to accurately portray interoperability needs for the nation. It is a characteristic of survey research, however, that respondents are by definition volunteers, so they tend to be a more interested and educated sample than the population as a whole, as well as more motivated to express their needs. With loss of subjects due to non-response, the intended proportions may not occur in the final sample, resulting in over- or under-sampling of some categories. To correct for this, numerical weights are applied to restore the categories to their proportion in the total population. Results are analyzed and the assumption is that the weighted sample is more representative of the total population than the unweighted sample, making any inferences for the wider population more believable.

In this study, the proportion in each sample category differed from actual population proportions. To determine sample weights, the *population* subgroup proportions were divided by the *sample* subgroup proportions to obtain the factor required to restore the sample to proportions that are representative of agencies nationwide. Some categories received more weight than others. The table summarizes the numbers and proportions of subgroup categories in both the *total population* and the *respondent sample*, with the appropriate weights for the weighting analysis. Smaller weights tend to reduce the impact of a subgroup that is over-sampled, while larger weights increase the impact of under-sampled groups. There is a risk, however, in assuming that the opinions and ideas expressed by the under-sampled groups accurately reflect those of their respective nationwide groups.

Agency Size/Type	National Population		Survey Sample		Weighting Factor
	N	Proportion of N	n	Proportion of n	
<b>Local Police</b>					
≥100	486	.0280	313	.2345	.1194
<100	12020	.6925	510	.3820	1.8128
<b>Sheriffs</b>					
≥100	271	.0156	153	.1147	.1360
<100	2814	.1621	229	.1715	.9452
<b>Special Police</b>					
≥100	63	.0036	41	.0307	.1173
<100	1652	.0092	48	.0360	2.6444
<b>State</b>	51	.0029	40	.0300	.0967
<b>Totals</b>	17,357	.9999	1,334	1.0001	

For example, using the data for Local police with 100 or more sworn officers: the 313 survey respondents are 23% (.2345) of the total sample, but they are actually 2.8% (.0280) of the total law enforcement population. Multiplying  $.2345 \times .1194$  (the weighting factor) =  $.0280$ , thus restoring Local police agencies with 100 or more sworn officers to their proportionate weight of the total population, and allowing a more accurate picture of their needs within the context of the broader population. The weighting factors were entered into the SPSS program and descriptive statistics were run to determine impact. Averages and percents changed very little. There were significant differences on open-ended questions where agencies were asked to fill in numbers (e.g. *How many additional voice only channels does your agency need?*). Averages for rating scale and yes-no questions were very similar between weighted and unweighted versions. The largest difference in these averages was .58 for the question on degree of familiarity with Project 25 standards. The weighted average was slightly lower than for the unweighted sample.

Statistical error changed slightly for some individual questions, but *maximum* error did not change. Yes-no questions had a maximum statistical error of  $\pm 2\%$  and rating scale questions had a maximum error of  $\pm 6\%$ , though only two questions actually exceeded a  $\pm 4\%$  error rate. Those two questions were “*How effective is your state’s interoperability plan?*” and “*How involved is your agency in the decision-making process related to the operation of your land mobile radio base system?*” Despite small differences overall, the weighted means and percents were judged more accurate for making inferences for the total population. The weighting adds subgroup proportions that assume responses comparable to those of the actual sample, whereas in reality, actual responses may differ. However, since the averages, except for the open-ended questions, were similar for the two analyses, the risk may be negligible. With the large sample ( $n = 1,334$ ), the probability of accuracy occurring as a result of the weighting strategy is increased.

## Appendix E - Selected Tables

Table I: Percent of Agencies Experiencing Problems with LMR System

Obstacle	c	Dead Spots											
					1		2		3		4		5
Rating	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	301	3.2	48	15	52	16	75	23	48	15	78	24
10-24	229	223	3.5	21	9	39	17	41	18	58	25	64	28
25-49	142	139	3.1	22	15	24	17	31	22	39	27	23	16
50-99	96	91	3.3	17	18	9	9	16	17	26	27	23	24
100-499	397	383	3.0	59	15	98	25	70	18	78	20	78	20
500+	110	109	3.0	7	6	37	34	25	23	24	22	16	15
<b>Sheriff</b>	383	369	3.6	29	8	57	15	74	19	92	24	117	31
<b>Local</b>	822	790	3.0	137	17	188	23	168	20	156	19	141	17
<b>State</b>	40	38	3.8	-	0	5	13	10	25	10	25	13	33
<b>Special</b>	89	87	3.5	8	9	14	16	16	18	25	28	24	27

Obstacle	i	Outdated Equipment											
					1		2		3		4		5
Rating	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	292	3.1	75	23	32	10	53	17	55	17	77	24
10-24	229	218	3.3	34	15	35	15	35	15	51	22	63	28
25-49	142	139	3.2	27	19	21	15	29	20	28	20	34	24
50-99	96	90	3.3	13	14	12	13	23	24	16	17	26	27
100-499	397	382	3.0	99	25	68	17	56	14	51	13	108	27
500+	110	110	3.0	25	23	21	19	21	19	13	12	30	27
<b>Sheriff</b>	383	359	3.3	65	17	46	12	70	18	67	17	111	29
<b>Local</b>	822	789	3.0	190	23	134	16	132	16	126	15	207	25
<b>State</b>	40	37	4.1	1	3	4	10	6	15	5	13	21	53
<b>Special</b>	89	83	3.2	18	20	9	10	15	17	21	24	20	22

Obstacle	h	Not Enough Equipment											
					1		2		3		4		5
Rating	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	284	3.0	72	23	34	11	61	19	42	13	75	23
10-24	229	218	3.0	49	21	37	16	42	18	44	19	46	20
25-49	142	136	2.9	33	23	26	18	22	15	32	23	23	16
50-99	96	89	3.1	17	18	16	17	19	20	18	19	19	20
100-499	397	375	2.8	95	24	69	17	76	19	77	19	58	15
500+	110	108	2.9	25	23	21	19	21	19	24	22	17	15
<b>Sheriff</b>	383	360	3.1	74	19	52	14	86	22	73	19	75	20
<b>Local</b>	822	765	2.9	196	24	140	17	134	16	144	18	151	18
<b>State</b>	40	36	3.4	4	10	4	10	8	20	13	33	7	18
<b>Special</b>	89	85	2.9	21	24	11	12	21	24	20	22	12	13

Obstacle	16		Terrain/Topography											
					1		2		3		4		5	
	n	n	Avg	n	%	n	%	n	%	n	%	n	%	
1-9	320	301	3.0	54	17	53	17	89	28	47	15	58	18	
10-24	229	220	3.3	18	8	38	17	60	26	58	25	46	20	
25-49	142	141	3.0	21	15	36	25	30	21	28	20	26	18	
50-99	96	92	2.9	21	22	16	17	19	20	20	21	16	17	
100-499	397	387	2.9	62	16	105	26	94	24	73	18	53	13	
500+	110	110	3.1	12	11	27	25	29	26	24	22	18	16	
<b>Sheriff</b>	383	369	3.4	25	7	66	17	97	25	84	22	97	25	
<b>Local</b>	822	798	2.8	151	18	196	24	206	25	143	17	102	12	
<b>State</b>	40	39	3.9	-	0	2	5	11	28	16	40	10	25	
<b>Special</b>	89	84	3.3	12	13	13	15	18	20	23	26	18	20	

Obstacle	e		Frequency Interference											
					1		2		3		4		5	
	n	n	Avg	n	%	n	%	n	%	n	%	n	%	
1-9	320	291	3.0	63	20	46	14	71	22	57	18	54	17	
10-24	229	220	3.1	37	16	45	20	51	22	41	18	46	20	
25-49	142	139	2.8	34	24	29	20	26	18	30	21	20	14	
50-99	96	90	3.0	16	17	20	21	21	22	13	14	20	21	
100-499	397	382	2.6	105	26	91	23	81	20	56	14	49	12	
500+	110	110	2.4	30	27	36	33	21	19	11	10	12	11	
<b>Sheriff</b>	383	364	3.0	67	17	79	21	79	21	64	17	75	20	
<b>Local</b>	822	784	2.7	202	25	171	21	167	20	131	16	113	14	
<b>State</b>	40	37	3.3	4	10	9	23	5	13	11	28	8	20	
<b>Special</b>	89	84	2.9	16	18	17	19	25	28	13	15	13	15	

Obstacle	c		Not Enough Channels											
					1		2		3		4		5	
	n	n	Avg	n	%	n	%	n	%	n	%	n	%	
1-9	320	289	2.3	136	43	41	13	51	16	24	8	37	12	
10-24	229	220	2.6	79	34	36	16	43	19	25	11	37	16	
25-49	142	137	2.7	40	28	30	21	25	18	17	12	25	18	
50-99	96	92	3.2	23	24	12	13	13	14	16	17	28	29	
100-499	397	382	3.0	99	25	52	13	60	15	78	20	93	23	
500+	110	110	3.0	36	33	10	9	14	13	18	16	32	29	
<b>Sheriff</b>	383	361	2.9	100	26	61	16	63	16	60	16	77	20	
<b>Local</b>	822	784	2.7	280	34	113	14	132	16	104	13	155	19	
<b>State</b>	40	37	3.7	6	15	1	3	7	18	8	20	15	38	
<b>Special</b>	89	85	2.8	33	37	7	8	11	12	14	16	20	22	

Obstacle	d		Fading										
			1		2		3		4		5		
	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	284	2.7	75	23	64	20	56	18	54	17	35	11
10-24	229	212	2.8	42	18	55	24	45	20	37	16	33	14
25-49	142	136	2.5	45	32	25	18	28	20	29	20	9	6
50-99	96	88	2.9	23	24	15	16	19	20	14	15	17	18
100-499	397	373	2.4	109	27	120	30	56	14	50	13	38	10
500+	110	108	2.4	28	25	42	38	18	16	12	11	8	7
Sheriff	383	354	2.9	69	18	80	21	76	20	78	20	51	13
Local	822	765	2.4	231	28	222	27	127	15	108	13	77	9
State	40	35	2.9	7	18	5	13	12	30	6	15	5	13
Special	89	82	2.6	22	25	19	21	19	21	10	11	12	13

Obstacle	f		Static										
			1		2		3		4		5		
	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	289	2.5	77	24	72	23	73	23	42	13	25	8
10-24	229	216	2.5	59	26	54	24	50	22	32	14	21	9
25-49	142	135	2.4	42	30	36	25	33	23	15	11	9	6
50-99	96	91	2.5	22	23	27	28	22	23	12	13	8	8
100-499	397	279	2.9	11	3	119	30	73	18	45	11	31	8
500+	110	107	2.2	39	35	35	32	14	13	12	11	7	6
Sheriff	383	353	2.7	86	22	88	23	82	21	57	15	40	10
Local	822	779	2.4	235	29	230	28	167	20	91	11	56	7
State	40	37	2.8	6	15	10	25	10	25	6	15	5	13
Special	89	85	2.3	29	33	25	28	16	18	10	11	5	6

Obstacle	g		Battery Problems										
			1		2		3		4		5		
	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	286	1.9	140	44	73	23	45	14	15	5	13	4
10-24	229	216	2.3	66	29	73	32	45	20	19	8	13	6
25-49	142	136	2.4	40	28	36	25	34	24	17	12	9	6
50-99	96	90	2.4	21	22	28	29	27	28	8	8	6	6
100-499	397	379	2.4	110	28	102	26	96	24	50	13	21	5
500+	110	107	2.5	24	22	37	34	24	22	17	15	5	5
Sheriff	383	356	2.2	122	32	107	28	74	19	40	10	13	3
Local	822	776	2.3	255	31	218	27	179	22	77	9	47	6
State	40	37	2.2	11	28	12	30	12	30	1	3	1	3
Special	89	82	2.4	24	27	24	27	18	20	9	10	7	8

Obstacle	j		Equipment Weight/Size										
	n	n	Avg	1		2		3		4		5	
Rating	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	285	2.2	127	40	51	16	55	17	27	8	25	8
10-24	229	215	2.4	73	32	45	20	54	24	21	9	22	10
25-49	142	135	2.2	50	35	36	25	29	20	11	8	9	6
50-99	96	87	2.4	25	26	29	30	15	16	9	9	9	9
100-499	397	377	2.2	138	35	103	26	87	22	32	8	17	4
500+	110	109	2.2	37	34	36	33	21	19	10	9	5	5
<b>Sheriff</b>	383	350	2.3	125	33	90	23	77	20	31	8	27	7
<b>Local</b>	822	773	2.2	294	36	183	22	164	20	75	9	57	7
<b>State</b>	40	36	2.6	7	18	11	28	10	25	7	18	1	3
<b>Special</b>	89	85	2.1	31	35	27	30	20	22	4	4	3	3

Obstacle	b		Not Enough Talk Groups										
	n	n	Avg	1		2		3		4		5	
Rating	n	n	Avg	n	%	n	%	n	%	n	%	n	%
1-9	320	271	1.8	163	51	41	13	40	13	16	5	11	3
10-24	229	205	2.0	110	48	35	15	25	11	18	8	17	7
25-49	142	128	1.8	77	54	20	14	14	10	11	8	6	4
50-99	96	83	2.3	35	36	17	18	13	14	5	5	13	14
100-499	397	331	2.2	174	44	40	10	40	10	34	9	43	11
500+	110	95	1.9	58	53	13	12	7	6	6	5	11	10
<b>Sheriff</b>	383	320	2.1	167	44	49	13	50	13	28	7	26	7
<b>Local</b>	822	715	2.0	403	49	111	14	83	10	53	6	65	8
<b>State</b>	40	35	2.7	16	40	2	5	3	8	4	10	10	25
<b>Special</b>	89	78	2.1	47	53	6	7	6	7	9	10	10	11

Table II: Agency Use of Different Frequency Bands for Interoperability

Agency Size/Type	Sample n	Bands n	Low VHF		High VHF		UHF (All)		800 MHz	
			n	%	n	%	n	%	n	%
<b>1-9</b>	320	383	71	19	244	64	42	11	26	7
<b>10-24</b>	229	308	41	13	191	62	54	18	22	7
<b>25-49</b>	142	201	32	16	104	52	46	23	19	10
<b>50-99</b>	96	143	21	15	69	49	33	23	20	14
<b>100-499</b>	397	742	55	9	221	34	277	37	189	30
<b>500+</b>	110	196	17	9	60	31	56	29	63	32
<b>Sheriff</b>	383	613	101	17	291	48	115	19	106	17
<b>Local</b>	822	1,124	124	11	535	48	258	23	207	18
<b>State</b>	40	86	20	23	36	42	13	15	17	20
<b>Special</b>	89	135	12	9	63	47	34	25	26	19
<b>Total</b>	1,334	1,958	257	13	925	47	420	22	356	18

*Note: Totals may differ since individual agencies could indicate the use of more than one band.*

Table III: Current Use and Projected Need for Voice-Only Channels

Current Use of Voice-only Channels						
Agency Size/Type	Sample (n)	Agencies that Answered Question	Total # of Current Channels	Average # of Channels/Agency	# of Agencies with Problem (3,4,5)	% of Agencies with Problem
1-9	320	270	2,715	10.1	101	32
10-24	229	208	1,653	8.0	98	43
25-49	142	131	1,054	8.1	64	45
50-99	96	92	1,186	12.9	56	58
100-499	397	368	5,033	13.7	220	55
500+	110	105	2,500	23.8	61	56
State	40	36	1,300	36.1	28	70
<b>Total</b>	<b>1,334</b>	<b>1,210</b>	<b>15,441</b>	<b>12.8</b>	<b>628</b>	<b>47</b>

Projected Need for Agencies Indicating Not Enough Channels						
Agency Size/Type	Sample (n)	Agencies Needing Additional Channels	Percent Needing Additional Channels	Average Current # of Channels	Additional Channels Needed	Average # of Additional Channels
1-9	320	107	33	9.3	301	2.8
10-24	229	108	47	6.5	278	2.6
25-49	142	69	49	6.0	158	2.3
50-99	96	48	50	10.4	162	3.4
100-499	397	225	57	10.9	1,215	5.4
500+	110	65	59	21.4	600	9.2
State	40	24	60	27.9	581	24.2
<b>Total</b>	<b>1,334</b>	<b>646</b>	<b>48</b>	<b>11.0</b>	<b>3,295</b>	<b>5.1</b>

Total Estimated for Next System						
Agency Size/Type	Sample (n)	Agencies that Plan to Replace	Total # of Current Channels	Average # of Current Channels/Agency	Total Channels in Next System	Average Channels in Next System
1-9	320	78	751	9.6	799	10.1
10-24	229	67	414	6.2	593	8.8
25-49	142	50	371	7.4	525	10.3
50-99	96	43	383	8.9	314	7.3
100-499	397	190	2,048	10.8	2,509	13.1
500+	110	62	1,280	20.6	1,505	24.1
State	40	22	680	30.9	718	32.4
<b>Total</b>	<b>1,334</b>	<b>512</b>	<b>5,927</b>	<b>11.6</b>	<b>6,963</b>	<b>13.6</b>



Table IV: Current Use and Projected Need for Data-Only Channels

<b>Current Use Overall</b>						
<b>Agency Size/Type</b>	<b>Sample (n)</b>	<b>Agencies that Answered Question</b>	<b>Total # of Current Channels</b>	<b>Average # of Channels/Agency</b>	<b># of Agencies with Problem (3,4,5)</b>	<b>% of Agencies with Problem</b>
<b>1-9</b>	320	52	276	5.3	18	6
<b>10-24</b>	229	29	83	2.9	9	4
<b>25-49</b>	142	23	61	2.7	11	8
<b>50-99</b>	96	22	69	3.1	12	13
<b>100-499</b>	397	153	434	2.8	85	21
<b>500+</b>	110	72	423	5.9	41	37
<b>State</b>	40	9	51	5.7	6	15
<b>Total</b>	<b>1,334</b>	<b>360</b>	<b>1,397</b>	<b>3.9</b>	<b>182</b>	<b>14</b>

<b>Projected Need for Agencies Indicating Not Enough Channels</b>						
<b>Agency Size/Type</b>	<b>Sample (n)</b>	<b>Agencies Needing Additional Channels</b>	<b>Percent Needing Additional Channels</b>	<b>Average Current # of Channels</b>	<b>Additional Channels Needed</b>	<b>Average # of Additional Channels</b>
<b>1-9</b>	320	55	17	9.6	111	2.0
<b>10-24</b>	229	61	27	3.3	101	1.7
<b>25-49</b>	142	36	25	1.7	68	1.9
<b>50-99</b>	96	35	37	1.2	62	1.8
<b>100-499</b>	397	158	40	1.5	388	2.5
<b>500+</b>	110	44	40	6.1	154	3.5
<b>State</b>	40	17	43	8.8	217	12.8
<b>Total</b>	<b>1,334</b>	<b>406</b>	<b>30</b>	<b>3.4</b>	<b>1,101</b>	<b>2.7</b>

<b>Total Estimated for Next System</b>						
<b>Agency Size/Type</b>	<b>Sample (n)</b>	<b>Agencies that Plan to Replace</b>	<b>Total # of Current Channels</b>	<b>Average # of Current Channels/Agency</b>	<b>Total Channels in Next System</b>	<b>Average Channels in Next System</b>
<b>1-9</b>	320	14	53	3.8	113	4.2
<b>10-24</b>	229	6	6	1.0	12	2.8
<b>25-49</b>	142	8	18	2.3	63	4.2
<b>50-99</b>	96	9	11	1.2	33	3.7
<b>100-499</b>	397	77	120	1.6	323	4.4
<b>500+</b>	110	40	275	6.9	263	6.0
<b>State</b>	40	7	49	7.0	120	14.9
<b>Total</b>	<b>1,334</b>	<b>161</b>	<b>532</b>	<b>3.4</b>	<b>927</b>	<b>4.9</b>

Table V: Joint Training with Local, State, Federal Partners

Size/Type	Sample n	Agency Participates		Federal		State		Local	
		n	%	n	%	n	%	n	%
<b>1-9</b>	320	140	44	12	4	86	27	129	40
<b>10-24</b>	229	106	46	6	3	51	22	98	43
<b>25-49</b>	142	77	54	11	8	44	31	75	53
<b>50-99</b>	96	58	60	11	11	34	35	54	56
<b>100-499</b>	397	219	55	52	13	119	30	202	51
<b>500+</b>	110	75	68	38	35	53	48	72	65
<b>Sheriff</b>	383	237	62	43	11	163	43	222	58
<b>Local</b>	822	395	48	77	9	196	24	371	45
<b>State</b>	40	27	68	14	35	23	58	24	65
<b>Special</b>	98	43	48	10	11	28	31	37	42
<b>Total</b>	1,334	702	53	144	11	410	31	654	49

Table VI: Plans to Adopt Project 25 Interoperability Standards

Agency Size/Type	Sample n	Rating											
		0		1		2		3		4		5	
		n	%	n	%	n	%	n	%	n	%	n	%
<b>1-9</b>	320	54	16.9	53	16.6	35	10.9	111	34.7	40	12.5	27	8.4
<b>10-24</b>	229	36	15.7	21	9.2	27	11.8	96	41.9	34	14.8	15	6.6
<b>25-49</b>	142	19	13.4	7	4.9	12	8.5	59	41.5	28	19.7	17	12.0
<b>50-99</b>	96	7	7.3	3	3.1	11	11.5	28	29.2	27	28.1	20	20.8
<b>100-499</b>	397	38	9.6	40	10.1	23	5.8	110	27.7	80	20.2	106	26.7
<b>500+</b>	110	10	9.1	10	9.1	7	6.4	20	18.2	19	17.3	44	40.0
<b>Sheriff</b>	383	46	12.0	26	6.8	34	8.9	144	37.6	65	17.0	68	17.8
<b>Local</b>	822	106	12.9	100	12.2	76	9.2	246	29.9	146	17.8	148	18.0
<b>State</b>	40	3	7.5	3	7.5	3	7.5	10	25.0	5	12.5	16	40.0
<b>Special</b>	89	12	13.5	8	9.0	5	5.6	34	38.2	17	19.1	13	14.6

Table VII: Daily or Weekly Radio Communication with Local, State, Federal Partners

Agency Size/Type	Sample n	Federal		State		Local	
		n	%	n	%	n	%
<b>1-9</b>	320	122	4	190	59	303	95
<b>10-24</b>	229	14	6	152	66	219	96
<b>25-49</b>	142	18	13	93	66	139	98
<b>50-99</b>	96	10	10	68	70	89	93
<b>100-499</b>	367	76	19	227	57	355	89
<b>500+</b>	110	38	35	70	64	93	85
<b>Sheriff</b>	383	60	16	307	80	359	94
<b>Local</b>	822	88	11	446	54	762	93
<b>State</b>	40	25	63	39	98	40	100
<b>Special</b>	89	20	23	47	53	77	87
<b>Total</b>	1,334	193	14	839	63	1,238	93

Table VIII: Percent of Agencies Experiencing Obstacles to Interoperability

Obstacle	g		Avg	Limitations in Funding									
	n	n		1		2		3		4		5	
				n	%	n	%	n	%	n	%	n	%
1-9	320	294	4.1	21	7	16	5	39	12	53	17	165	52
10-24	229	220	4.2	10	4	11	5	29	13	54	24	116	51
25-49	142	138	3.9	13	9	10	7	19	13	36	25	60	42
50-99	96	91	4.2	4	4	5	5	12	13	17	18	53	55
100-499	397	375	4.0	18	5	29	7	60	15	99	25	169	43
500+	110	108	3.8	10	9	13	12	18	16	17	15	50	45
<b>Sheriff</b>	383	367	4.1	18	5	25	7	56	15	87	23	181	47
<b>Local</b>	822	774	4.0	53	6	57	7	112	14	166	20	386	47
<b>State</b>	40	39	4.5	-	0	3	8	1	3	10	25	25	63
<b>Special</b>	89	85	4.2	5	6	2	2	9	10	23	26	46	52

Obstacle	a		Avg	Different Bands									
	n	n		1		2		3		4		5	
				n	%	n	%	n	%	n	%	n	%
1-9	320	299	3.1	66	21	32	10	83	26	44	14	74	23
10-24	229	221	3.4	32	14	21	9	60	26	50	22	58	25
25-49	142	138	3.2	25	18	19	13	30	21	31	22	33	23
50-99	96	93	3.6	10	10	9	9	18	19	26	27	30	31
100-499	397	380	3.8	31	8	31	8	80	20	70	18	168	42
500+	110	108	3.7	12	11	16	15	14	13	20	18	46	42
<b>Sheriff</b>	383	365	3.4	51	13	42	11	92	24	68	18	112	29
<b>Local</b>	822	789	3.5	117	14	81	10	174	21	160	19	257	31
<b>State</b>	40	39	4.1	-	0	5	13	7	18	5	13	22	55
<b>Special</b>	89	85	3.8	8	9	5	6	19	21	13	15	40	45

Obstacle	f		Avg	Lack of Adequate Planning									
	n	n		1		2		3		4		5	
				n	%	n	%	n	%	n	%	n	%
1-9	320	290	2.8	61	19	55	17	87	27	42	13	45	14
10-24	229	217	2.9	28	12	48	21	80	35	39	17	22	10
25-49	142	135	2.9	17	12	33	23	46	32	25	18	14	10
50-99	96	90	3.2	4	4	24	25	25	26	28	29	9	9
100-499	397	374	2.9	54	14	74	19	132	33	66	17	48	12
500+	110	105	2.8	27	25	18	16	20	18	30	27	10	9
<b>Sheriff</b>	383	357	2.8	64	17	89	23	107	28	60	16	37	10
<b>Local</b>	822	769	3.0	115	14	152	18	247	30	157	19	98	12
<b>State</b>	40	39	3.2	6	15	5	13	11	28	11	28	6	15
<b>Special</b>	89	85	3.0	12	13	11	12	36	40	13	15	13	15

Obstacle	d	Different Coverage Areas												
					1		2		3		4		5	
		n	n	Avg	n	%	n	%	n	%	n	%	n	%
<b>1-9</b>	320	285	2.7	68	21	56	18	83	26	46	14	32	10	
<b>10-24</b>	229	218	3.0	29	13	41	18	86	38	32	14	30	13	
<b>25-49</b>	142	135	2.6	31	22	31	22	47	33	16	11	10	7	
<b>50-99</b>	96	90	2.8	17	18	16	17	33	34	15	16	9	9	
<b>100-499</b>	397	374	2.9	68	17	79	20	102	26	80	20	45	11	
<b>500+</b>	110	108	2.8	21	19	19	17	37	34	19	17	12	11	
<b>Sheriff</b>	383	360	2.9	59	15	77	20	115	30	62	16	47	12	
<b>Local</b>	822	765	2.8	154	19	150	18	247	30	132	16	82	10	
<b>State</b>	40	38	3.1	5	13	7	18	14	35	4	10	8	20	
<b>Special</b>	89	85	2.7	21	24	15	17	26	29	14	16	9	10	

Obstacle	b	Human and Institutional Limitations												
					1		2		3		4		5	
		n	n	Avg	n	%	n	%	n	%	n	%	n	%
<b>1-9</b>	320	281	2.7	65	20	55	17	89	28	44	14	28	9	
<b>10-24</b>	229	217	2.7	34	15	57	25	83	36	32	14	11	5	
<b>25-49</b>	142	134	2.7	20	14	42	30	45	32	16	11	11	8	
<b>50-99</b>	96	87	2.8	12	13	24	25	27	28	19	20	5	5	
<b>100-499</b>	397	364	2.8	55	14	77	19	145	37	61	15	26	7	
<b>500+</b>	110	106	2.7	22	20	23	21	34	31	16	15	11	10	
<b>Sheriff</b>	383	355	2.7	53	14	96	25	128	33	52	14	26	7	
<b>Local</b>	822	749	2.7	138	17	164	20	268	33	119	14	60	7	
<b>State</b>	40	39	2.8	7	18	8	20	14	35	7	18	3	8	
<b>Special</b>	89	85	2.7	17	19	18	20	27	30	17	19	6	7	

Obstacle	c	Different Communication Modes (analog vs. digital)												
					1		2		3		4		5	
		n	n	Avg	n	%	n	%	n	%	n	%	n	%
<b>1-9</b>	320	281	2.5	103	32	43	13	68	21	23	7	44	14	
<b>10-24</b>	229	219	2.5	73	32	38	17	53	23	32	14	23	10	
<b>25-49</b>	142	133	2.4	44	31	30	21	28	20	21	15	10	7	
<b>50-99</b>	96	89	2.7	25	26	18	19	18	19	16	17	12	13	
<b>100-499</b>	397	376	2.5	136	34	64	16	84	21	48	12	44	11	
<b>500+</b>	110	107	2.5	39	35	15	14	28	25	11	10	14	13	
<b>Sheriff</b>	383	361	2.4	132	34	65	17	79	21	45	12	40	10	
<b>Local</b>	822	761	2.5	262	32	131	16	178	22	96	12	94	11	
<b>State</b>	40	37	2.3	16	40	9	23	3	8	4	10	5	13	
<b>Special</b>	89	83	2.7	26	29	12	13	22	25	10	11	13	15	

Obstacle	e			Limitations of Commercial Services									
				1		2		3		4		5	
Rating	n	n	Avg	n	%	n	%	n	%	n	%	n	%
<b>1-9</b>	320	280	2.5	86	27	56	18	81	25	30	9	27	8
<b>10-24</b>	229	215	2.3	65	28	55	24	62	27	23	10	10	4
<b>25-49</b>	142	129	2.2	43	30	37	26	37	26	7	5	5	4
<b>50-99</b>	96	82	2.4	26	27	17	18	27	28	8	8	4	4
<b>100-499</b>	397	356	2.1	143	36	90	23	78	20	31	8	14	4
<b>500+</b>	110	105	2.0	51	46	20	18	18	16	10	9	6	5
<b>Sheriff</b>	383	345	2.3	115	30	86	22	94	25	33	9	17	4
<b>Local</b>	822	739	2.3	261	32	173	21	189	23	72	9	44	5
<b>State</b>	40	38	2.3	16	40	7	18	7	18	5	13	3	8
<b>Special</b>	89	83	2.1	38	43	16	18	20	22	4	4	5	6

Table IX: Comparison of Well funded and Under-Funded Agencies

<b>Comparison of agencies that consider limited funding a serious problem (4 or 5 rating) with agencies that don't (1 or 2 rating):</b> <b>(Independent t-test, 95% confidence level or better)</b>			
	<b>Limitations in Funding Not a Problem (1,2)</b>	<b>Limitations in Funding a Serious Problem (4,5)</b>	<b>Statistical Significance</b>
Overall ability to handle interoperability situations today (where 1 = poor and 5 = excellent)	3.12 [909]	3.89 [160]	<b>sd</b>
Ability of radio to handle three types of interoperability situations (where 1 = poor and 5 = excellent)			
day-to-day	3.49 [909]	4.03 [157]	<b>sd</b>
mutual aid	3.02 [900]	3.79 [154]	<b>sd</b>
task force	2.70 [866]	3.53 [145]	<b>sd</b>
Ability of agency to establish radio links with different levels (where 1 = poor and 5 = excellent)			
federal	1.85 [868]	2.55 [150]	<b>sd</b>
state	3.27 [905]	3.73 [159]	<b>sd</b>
local	4.05 [917]	4.31 [160]	<b>sd*</b>
Problems with land mobile radio system (where 1 = not a problem and 5 = major problem)			
dead spots	2.75 [157]	3.37 [908]	<b>sd</b>
outdated equipment	2.51 [154]	3.41 [896]	<b>sd</b>
not enough equipment	2.26 [152]	3.20 [882]	<b>sd</b>
frequency interference	2.43 [155]	2.98 [898]	<b>sd</b>
not enough channels	2.34 [157]	2.91 [896]	<b>sd</b>

*Numbers in parentheses indicate number of agencies that responded to question with 1 or 2, etc.; **sd** = statistically significant difference between the two groups; **nsd** = no statistically significant difference between the two groups. Significance at .001 (99.9%) confidence level. \* Significance at .05 (95%) confidence level.*

<b>Comparison of effects of limited funding on agencies indicating it is a serious problem (4/5) or not (1/2):</b> <b>(Chi-square, 95% confidence level or better)</b>			
	<b>Serious problem (4/5)</b>	<b>Not a problem (1/2)</b>	<b>Significance</b>
plan to replace/upgrade	69 yes/89 no	459 yes/441 no	<b>nsd</b>
joint training (participation)	89 yes/66 no	613 yes/505 no	<b>nsd</b>
designated channel	135 yes/23 no	757 yes/148 no	<b>nsd</b>
share radio frequencies	116 yes/43 no	650 yes/261 no	<b>nsd</b>
share infrastructure	109 yes/53 no	558 yes/341 no	<b>nsd</b>



Table X: Comparison of Agencies Using Different Frequency Bands

<b>Comparisons of agencies using particular frequency bands with all other agencies with respect to the following characteristics (statistical comparison using independent t-tests, 95% confidence level or better):</b>						
	<b>800 MHz / Not 800 MHz</b>		<b>High VHF/ Not High VHF</b>		<b>Low VHF/Not Low VHF</b>	
Ability of radio to handle three types of interoperability situations (where 1 = poor and 5 = excellent)						
day-to-day (average ratings)	3.76 / 3.60	<b>nsd</b>	3.65 / 3.64	<b>nsd</b>	3.63 / 3.64	<b>nsd</b>
mutual aid	3.44 / 3.15	<b>sd</b>	3.22 / 3.23	<b>nsd</b>	3.22 / 3.23	<b>nsd</b>
task force	3.25 / 2.79	<b>sd</b>	2.87 / 2.99	<b>nsd</b>	2.74 / 2.95	<b>sd</b>
Ability of agency to establish radio links with different levels (where 1 = poor and 5 = - excellent)						
federal	2.21 / 1.95	<b>sd</b>	2.04 / 1.99	<b>sd</b>	1.91 / 2.05	<b>nsd</b>
state	3.31 / 3.45	<b>nsd</b>	3.52 / 3.17	<b>sd</b>	3.42 / 3.41	<b>nsd</b>
local	4.16 / 4.14	<b>nsd</b>	4.17 / 4.08	<b>nsd</b>	4.09 / 4.16	<b>nsd</b>
Problems with land mobile radio system (where 1 = not a prblem and 5 = major problem)						
dead spots	2.90 / 3.30	<b>sd</b>	3.28 / 3.04	<b>sd</b>	3.44 / 3.14	<b>sd</b>
outdated equipment	2.49 / 3.38	<b>sd</b>	3.28 / 2.89	<b>sd</b>	3.33 / 3.11	<b>sd</b>
not enough equipment	2.79 / 3.01	<b>sd</b>	2.98 / 2.90	<b>nsd</b>	3.05 / 2.93	<b>nsd</b>
frequency interference	2.20 / 3.04	<b>sd</b>	3.05 / 2.34	<b>sd</b>	3.07 / 2.77	<b>sd</b>
not enough channels	2.36 / 2.90	<b>sd</b>	2.85 / 2.57	<b>sd</b>	2.84 / 2.74	<b>nsd</b>
Obstacles to interoperability (where 1 = not a problem and 5 = major problem)						
different bands	3.47 / 3.49	<b>nsd</b>	3.49 / 3.48	<b>nsd</b>	3.58 / 3.46	<b>nsd</b>
different communication modes	2.45 / 2.51	<b>nsd</b>	2.48 / 2.53	<b>nsd</b>	2.50 / 2.49	<b>nsd</b>
Satisfaction with FCC licensing process:						
	3.24 / 3.24	<b>nsd</b>	3.24 / 3.25	<b>nsd</b>	3.15 / 3.26	<b>nsd</b>
Familiarity with NPSPAC:						
	2.42 / 1.63	<b>sd</b>	1.74 / 2.03	<b>sd (less)</b>	1.88 / 1.82	<b>nsd</b>

Note: **sd** = statistically significant difference between the two groups; **nsd** = no statistically significant difference between the two groups. Significance at .05 (95%) confidence level or better.

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If you have any questions, call or e-mail NCJRS.

## **About the National Institute of Justice**

The National Institute of Justice (NIJ), a component of the Office of Justice Programs, is the research agency of the U.S. Department of Justice. Created by the Omnibus Crime Control and Safe Streets Act of 1968, as amended, NIJ is authorized to support research, evaluation, and demonstration programs, development of technology, and both national and international information dissemination. Specific mandates of the Act direct NIJ to:

- Sponsor special projects, and research and development programs, that will improve and strengthen the criminal justice system and reduce or prevent crime.
- Conduct national demonstration projects that employ innovative or promising approaches for improving criminal justice.
- Develop new technologies to fight crime and improve criminal justice.
- Evaluate the effectiveness of criminal justice programs and identify programs that promise to be successful if continued or repeated.
- Recommend actions that can be taken by Federal, State, and local governments as well as by private organizations to improve criminal justice.
- Carry out research on criminal behavior.
- Develop new methods of crime prevention and reduction of crime and delinquency.

In recent years, NIJ has greatly expanded its initiatives, the result of the Violent Crime Control and Law Enforcement Act of 1994 (the Crime Act), partnerships with other Federal agencies and private foundations, advances in technology, and a new international focus. Some examples of these new initiatives:

- New research and evaluation is exploring key issues in community policing, violence against women, sentencing reforms, and specialized courts such as drug courts.
- Dual-use technologies are being developed to support national defense and local law enforcement needs.
- The causes, treatment, and prevention of violence against women and violence within the family are being investigated in cooperation with several agencies of the U.S. Department of Health and Human Services.
- NIJ's links with the international community are being strengthened through membership in the United Nations network of criminological institutes; participation in developing the U.N. Criminal Justice Information Network; initiation of UNOJUST (U.N. Online Justice Clearinghouse), which electronically links the institutes to the U.N. network; and establishment of an NIJ International Center.
- The NIJ-administered criminal justice information clearinghouse, the world's largest, has improved its online capability.
- The Institute's Drug Use Forecasting (DUF) program has been expanded and enhanced. Renamed ADAM (Arrestee Drug Abuse Monitoring), the program will increase the number of drug-testing sites, and its role as a "platform" for studying drug-related crime will grow.
- NIJ's new Crime Mapping Research Center will provide training in computer mapping technology, collect and archive geocoded crime data, and develop analytic software.
- The Institute's program of intramural research has been expanded and enhanced.

The Institute Director, who is appointed by the President and confirmed by the Senate, establishes the Institute's objectives, guided by the priorities of the Office of Justice Programs, the Department of Justice, and the needs of the criminal justice field. The Institute actively solicits the views of criminal justice professionals and researchers in the continuing search for answers that inform public policymaking in crime and justice.