United States Government Accountability Office

Report to Congressional Requesters

October 2016

EMERGENCY COMMUNICATIONS

Improved Procurement of Land Mobile Radios Could Enhance Interoperability and Cut Costs

GAO-17-12

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GAO Highlights

Highlights of GAO-17-12, a report to congressional requesters

Why GAO Did This Study

Public safety personnel across the nation rely on LMR to share information and coordinate their emergency response efforts. LMR systems are intended to provide secure, reliable, mission-critical voice communications in a variety of environments, scenarios, and emergencies; however, LMR interoperability—the ability to communicate across agencies—has been a long-standing challenge at all levels of government.

GAO was asked to examine federal agencies' LMR interoperability and procurement practices. GAO examined (1) LMR equipment used by federal agencies and the state of LMR interoperability among these agencies; (2) factors that help and hinder LMR interoperability among agencies; and (3) agencies' LMR procurement practices. GAO surveyed civilian federal agencies, identified through their membership in the Emergency Communications Preparedness Center (57 agencies fully responded to the survey and one agency provided a partial response); reviewed Department of Homeland Security planning documents related to interoperability; and interviewed federal agency officials with responsibilities related to emergency communications and procurement of LMR equipment. GAO also reviewed OMB initiatives to improve federal procurement.

What GAO Recommends

GAO recommends that OMB examine the feasibility of including LMR in its category management initiative. OMB generally agreed with GAO's recommendations.

View GAO-17-12. For more information, contact Rebecca Shea at (202) 512-2834 or shear@gao.gov.

What GAO Found

Federal agencies GAO surveyed generally use land mobile radio (LMR) equipment to meet their core missions, such as public safety, emergency management, or firefighting. More than two-thirds of the 57 agencies GAO surveyed reported using equipment from the same manufacturer because, for example, they believe doing so will help ensure compatibility of new LMR equipment with existing system requirements. Most agencies GAO surveyed were consistent in identifying each other as agencies with which they have or have not needed LMR interoperability over the past 5 years. Of the agencies that identified the need to communicate with each other, about two-thirds reported generally having a good or excellent level of LMR interoperability.

The use of standards-based and multi-band LMR equipment has helped to enhance interoperability among agencies, but the use of proprietary features and other factors continue to hinder interoperability. Almost all of the agencies that GAO surveyed reported using LMR equipment that meets voluntary technical standards, which have improved interoperability. Further, almost half of these agencies reported using multiband radios, which operate on multiple public-safety radio bands, to enhance interoperability. However, agencies reported several factors continue to limit their progress in achieving interoperability with other federal agencies. These factors include the use of proprietary features and encryption in devices and limited investments in LMR systems and devices. For example, about half of the agencies surveyed reported that the use of proprietary features within LMR devices has hindered interoperability.

Nearly half of the agencies GAO surveyed reported using pre-approved vendors with established prices to acquire LMR equipment, mainly through contracts sponsored by the Departments of Homeland Security and the Interior. While this approach can facilitate cost savings and interoperability, many of these agencies reported purchasing equipment through multiple agreements, a practice that can reduce these benefits. About 40 percent of agencies GAO surveyed reported using sole-source procurement or independent approaches. According to the Office of Management and Budget (OMB), in general, agencies often purchase and manage items in a fragmented and inefficient manner. This approach can result in duplication of effort, which imposes significant costs on federal agencies. OMB has directed agencies to implement "category management" as an improved way to manage spending across government for commonly purchased goods and services. This approach enables the government to leverage its purchasing power and realize cost savings. However, OMB's category management initiative does not include LMR equipment even though federal agencies spend millions of dollars annually purchasing such equipment. By including LMR equipment in OMB's category management initiative, the government could more fully leverage its aggregate buying power to obtain the most advantageous terms and conditions for LMR procurements. OMB officials agreed that a category management approach to LMR procurement might save the government money while supporting the goal of enhanced interoperability among agencies that require it, but OMB has not examined the feasibility of applying this approach to the procurement of LMR equipment.

Contents

Abbreviations

DHS	Department of Homeland Security
ECPC	Emergency Communications Preparedness Center
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
GSA	General Services Administration
IT	information technology
LMR	land mobile radio
NTIA	National Telecommunications and Information Administration
OMB	Office of Management and Budget
P25	Project 25
SOP	standard operating procedures

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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October 5, 2016

Congressional Requesters

Whether conducting daily operations, overseeing planned events, or responding to emergencies, many federal agencies use land mobile radio (LMR) systems to gather and communicate information across multiple disciplines and jurisdictions and to coordinate response efforts with other federal agencies. Although LMR systems have similar components—including handheld portable radios and mobile radios mounted in vehicles, as well as base stations to transmit signals or audio—interoperable LMR communications remains a challenge for various technical and non-technical reasons.[1] Legislation enacted over the past 10 years, such as the Post-Katrina Emergency Management Reform Act of 2006 and the Department of Homeland Security (DHS) Interoperable Communications Act of 2015, highlighted the critical importance of effective, interoperable communication systems for federal agencies with law-enforcement and emergency-response missions.[2] For example, the Post-Katrina Emergency Management Reform Act established the Emergency Communications Preparedness Center (ECPC) to improve coordination and information sharing among federal emergency communications programs in support of interoperability and continued communications during disasters and incidents.[3] According to DHS, advancements in LMR technology—including further development of standards-based equipment and multi-band radios capable of operating on several different channels across multiple radio bands—may help address some interoperability challenges. However, there is no single operational authority for emergency response among federal departments

[1] By interoperable LMR communications or LMR interoperability in this report, we are referring to the ability of agencies to achieve timely, mission-critical voice communication with partner agencies when needed and as authorized.

[2] The Post-Katrina Emergency Management Reform Act was enacted as Title VI of the Department of Homeland Security Appropriations Act, 2007, Pub. L. No. 109-295, 120 Stat. 1355, 1394 (2006). DHS Interoperable Communications Act was enacted in 2015 as Pub. L. No. 114-29, 129 Stat. 421 (2015).

[3] The ECPC has 14 federal department members, which all have a role in emergency communications, including regulatory, policy, operations, grants management, and technical assistance.

and questions remain regarding the ability of federal agencies to achieve interoperable LMR communications.

Amid continuing questions about LMR interoperability among federal agencies and in light of advancements in LMR technology, we were asked to examine aspects of this interoperability as well as LMR procurement practices. In this report, we examine: (1) LMR systems and devices used by selected federal agencies and the state of LMR interoperability among these agencies; (2) factors that help and hinder interoperability among agencies that use LMR; and (3) selected agencies' practices for procuring LMR systems.

To address these objectives, we conducted a web-based survey of civilian federal agencies, identified through their membership in the ECPC. We screened an initial set of 74 agencies to determine which agencies use LMR technologies to communicate with at least one other federal agency for daily operations, planned events, such as Presidential inaugurations, or emergency incidents.[4] All 74 agencies responded to our screening question. Agencies that met this criterion—58 federal LMR users in all—were further surveyed about the types of equipment they use, interoperability needs, and procurement practices, among other topics. Fifty-seven of the 58 agencies that we identified as federal LMR users responded to the full survey. The Federal Bureau of Investigation (FBI) did not respond to the full survey but provided responses to a limited set of survey questions related to our first objective, identifying agencies with which they require LMR interoperability. Therefore, for the first objective we include information from the 57 agency responses and the FBI; for the other two objectives we only include information from the 57 agencies. Throughout this report, we provide survey results based on the number of respondents to each question because not all respondents answered every question. Therefore the number of respondents may be fewer than 57 for some results. The survey and a more comprehensive tabulation of the results can be viewed at GAO-17-13SP.[5]

[4] Agencies were identified to us by the civilian participating members of the ECPC. We did not survey agencies of the Department of Defense.

[5] GAO, *Emergency Communications: Survey of Selected Federal Agencies' Use and Procurement of Land Mobile Radio Equipment, an E-supplement to* GAO-17-12, GAO-17-13SP (Washington, D.C.: Oct. 5, 2016).

We also reviewed relevant statutes and DHS planning documents related to interoperability among federal agencies, including the National Emergency Communications Plan,[6] the National Response Framework,[7] and the SAFECOM Interoperability Continuum[8] documentation related to key elements of interoperability. We interviewed officials from federal agencies with responsibilities related to emergency communications and procurement of LMR equipment, including DHS; the National Telecommunications and Information Administration (NTIA) and the National Institute of Standards and Technology within the Department of Commerce; the Federal Communications Commission (FCC); the General Services Administration (GSA); the Office of Management and Budget (OMB); and administrators of the ECPC.[9] Last, we reviewed OMB initiatives for improving efficiency and cost-effectiveness in federal procurement and compared them to procurement practices reported by the agencies that responded to our survey. Additional information about our scope and methodology is provided in appendix I.

We conducted this performance audit from July 2015 to October 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Public safety personnel across the nation—including first responders, law enforcement officers, and natural resource managers, among others—

[6] DHS, *National Emergency Communications Plan* (Washington, D.C.: November 2014).

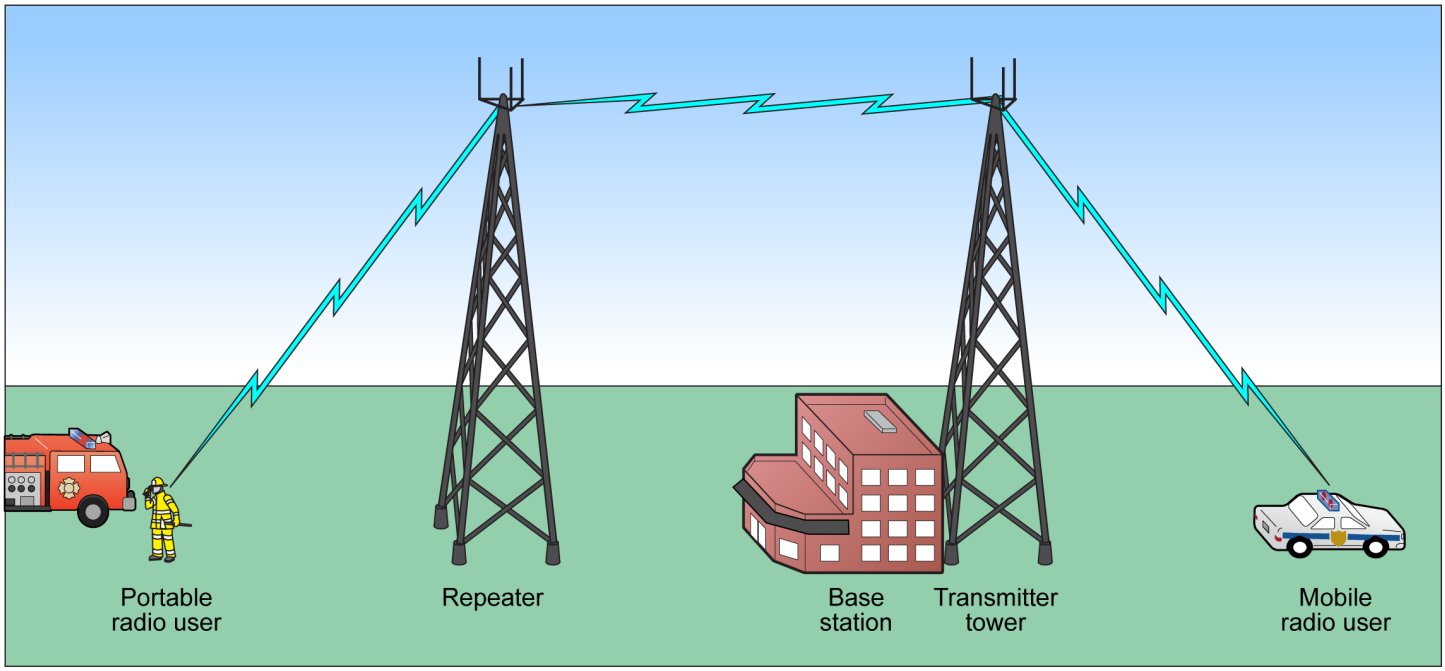
[7] DHS, *National Response Framework,* Third Edition (Washington, D.C.: June 2016).

[8] SAFECOM was formed in 2001 after the terrorist attacks of September 11, 2001, to improve public safety interoperability. SAFECOM's mission is to improve emergency response providers' emergency communications interoperability through collaboration with emergency responders across all levels of governments.

[9] The DHS Office of Emergency Communications (OEC) administers the ECPC on behalf of the Secretary of Homeland Security. OEC is responsible for coordinating data-gathering efforts and product development, supporting meeting logistics, and transmitting products to the ECPC Executive and Steering Committees for review and approval.

rely on LMR systems to gather and share information while conducting daily operations and to coordinate their emergency response efforts. These systems are intended to provide secure, reliable, mission-critical voice communications in a variety of environments, scenarios, and emergencies. We reported in 2012 that these public safety communications systems are fragmented across thousands of federal, state, and local jurisdictions and often lack "interoperability," or the ability to communicate across agencies and jurisdictions.[10] Figure 1 displays the typical components of an LMR system, including handheld portable radios, mobile radios typically mounted in vehicles, base stations, and repeaters, which retransmit radio signals to extend the coverage area.

Figure 1: Components of Land Mobile Radio Systems for Voice and Data Communications



Source: GAO. | GAO-17-12

[10] GAO, *Emergency Communications: Various Challenges Likely to Slow Implementation of a Public Safety Broadband Network*, GAO-12-343 (Washington, D.C.: Feb. 22, 2012).

- **Handheld portable radios** are typically carried by the LMR user and tend to have a limited transmission range.
- **Mobile radios** are often located in vehicles and use the vehicle's power supply and a larger antenna, providing a greater transmission range than handheld portable radios.
- **Base station**[11] **radios** are located in fixed positions, such as dispatch centers, and tend to have the most powerful transmitters. A network is required to connect base stations to the same communication system.
- **Repeaters** increase the effective communication range of handheld portable radios, mobile radios, and base station radios by retransmitting received radio signals.[12]

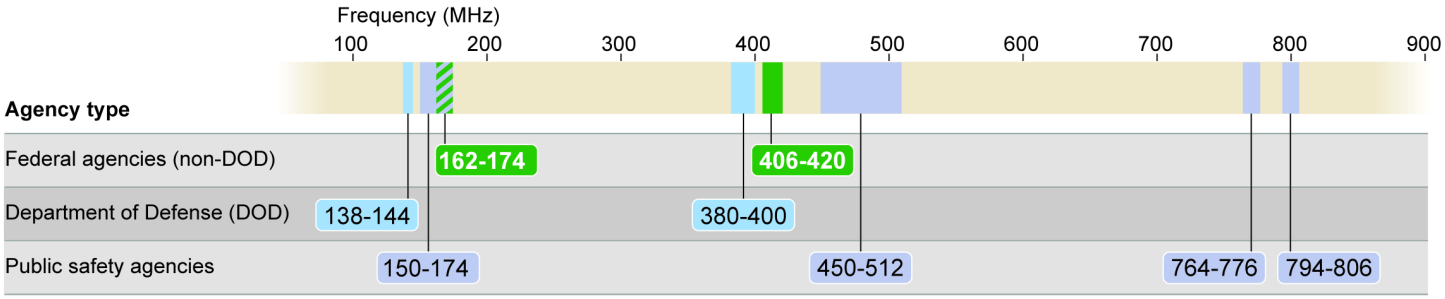
LMR networks connect different base stations to the same communications system and operate by transmitting voice and data through radio waves at specific frequencies and channels within the radio frequency portion of the electromagnetic spectrum.[13] According to DHS, the shortage of available channels within a single radio band resulted in the expansion of public safety systems into multiple radio frequency bands within the radio frequency spectrum. In the United States, NTIA administers spectrum for federal government use and FCC administers spectrum for non-federal use (e.g., state and local government, and commercial use). Federal agencies generally operate on different radio frequency bands than those used by state and local agencies, as shown in figure 2.

[11] A base station contains the equipment for transmitting and receiving the radio signals that allow portable radios to communicate with each other.

[12] The distance over which a transmitter or repeater can send a signal is determined by the power and frequency of the signal transmitted and may be limited by obstruction from hills, trees, or buildings.

[13] The electromagnetic spectrum covers the full range of all possible frequencies of electromagnetic radiation, including frequency ranges such as radio, microwave, infrared, visible, ultraviolet, X-rays, and gamma rays. According to DHS, LMR use by local, state and federal public safety officials operates on very high frequency (VHF) channels—those located between 30 and 300 megahertz (MHz)—and ultrahigh frequency (UHF) channels—located between 300 MHz and 3 gigahertz (GHz). VHF channels are more useful for communications that must occur over long distances without obstruction from buildings, since the signals cannot penetrate building walls very well. As such, VHF signals are well suited to rural areas. UHF channels are more appropriate for denser urban areas as they have more capacity and can penetrate buildings more easily.

Figure 2: Radio Frequency Bands Used by Federal and State or Local Agency Land Mobile Radio Users



Source: GAO summary of information from the Department of Homeland Security. | GAO-17-12

LMR systems that operate on different radio frequency bands are not always interoperable, making it potentially difficult for different jurisdictions to communicate with one another. To address this issue, NTIA has designated specific radio frequencies, known as federal interoperability channels, for use among federal agencies and between federal agencies and non-federal entities with which federal agencies require interoperability. Similarly, FCC designated national interoperability channels for use by the public safety community at the state and local levels.[14] FCC licensees of other Public Safety and Industrial/Business Pool frequencies may also share their facilities with federal users. According to FCC, interoperability channels licensed by FCC are reserved specifically for different agencies or jurisdictions to coordinate and resolve initial interoperability issues when responding to an incident. Federal users may use the national interoperability channels only for interoperability with (and at the invitation of) a non-federal entity.

Technology solutions have been developed to enhance interoperability across different radio frequency bands and equipment. According to FCC, advancements in LMR technology—including software-defined radios, multi-band radios, and interoperable gateways—have enhanced interoperability among different LMR devices. Software-defined radios use reconfigurable software that can be changed to alter the radio's operating parameters without making any changes to the hardware

[14] To assist federal and non-federal agencies and potential users of the interoperability channels, DHS has published the *National Interoperability Field Operations Guide*, which contains a listing of the national interoperability channels and additional information.

components. Multi-band radios can operate on more than one radio frequency band, with the goal of allowing emergency responders to communicate with partner agencies regardless of the radio frequency band on which they operate. Interoperable gateways use "bridging" or network approaches to enhance interoperability, by using radio network bridges or "gateways" that provide a direct interface between separate radio networks.

In addition to these and other technology solutions, a suite of voluntary national standards, known as Project 25 (P25) standards, is intended to facilitate interoperability among different manufacturers' LMR communications products.[15] The goal of P25 is to specify formal standards for interfaces among the various components of an LMR system commonly used by emergency responders. The P25 standards are intended to benefit the public safety community by promoting marketplace competition for interoperable products and enabling interoperable communications within and among public safety agencies, among other intended benefits.

To further support interoperable communications and to address emergency communications breakdowns that undermined response efforts during terrorist attacks in 2001 and Hurricane Katrina in 2005, various pieces of legislation have been enacted over the past 15 years. The Homeland Security Act of 2002 created the Department of Homeland Security, and within the department, a Directorate of Emergency Preparedness and Response responsible for, among other things, "developing comprehensive programs for developing interoperative communications technology, and helping to ensure that emergency response providers acquire such technology."[16] The Post-Katrina Emergency Management Reform Act of 2006 was enacted to address various shortcomings identified in the preparation for and response to Hurricane Katrina and included legislative reforms related to emergency

[15] The federal government, in partnership with the Association of Public Safety Communications Officials and the National Association of State Telecommunications Directors, signed a memorandum of understanding with the Telecommunications Industry Association to develop digital LMR standards (1992, amended in 1993). Federal, state, and local public safety representatives worked with the Telecommunications Industry Association to develop standards for LMR systems, known as P25.

[16] Pub. L. No. 107–296, title V, § 502(7), 116 Stat. 2135, 2213 (2002).

management.[17] For example, the act required DHS, among other things, to develop the *National Emergency Communications Plan* and created the Office of Emergency Communications within DHS to improve first responder communications.[18] More recently, the DHS Interoperable Communications Act was enacted in 2015 with the goal to achieve and maintain interoperable communications capabilities among DHS agencies.[19]

The Office of Emergency Communications administers the ECPC, which serves as a focal point to improve coordination and share information among 14 federal agencies in support of enhanced interoperability and the ability to provide emergency responders and officials with continued communications during disasters and incidents. According to a 2013 report prepared by the ECPC Research and Development focus group, federal agencies plan to continue to rely on existing LMR systems to support mission-critical emergency communications needs. The Office of Emergency Communications also worked with federal, state, local, and tribal jurisdictions to create its 2014 *National Emergency Communications Plan*,[20] which it views as the nation's strategic plan for emergency communications. The long-term vision of the plan—to enable the nation's emergency response community to communicate and share information across levels of government, jurisdictions, disciplines, and organizations for all threats and hazards, as needed and when authorized—aligns with a broad goal of achieving interoperability. One of the top priorities of the 2014 plan is to identify and prioritize areas for improvement in emergency responders' LMR systems.

[17] The Post-Katrina Emergency Management Reform Act of 2006 was enacted as Title VI of the Department of Homeland Security Appropriations Act, 2007, Pub. L. No. 109-295, 120 Stat. 1355 (2006).

[18] The Homeland Security Act of 2002, Pub. L. No. 107-296, title XVIII, §§ 1801,1802 as added by the Post-Katrina Act, Pub. L. No. 109-295, title VI, § 671 (2005) codified at 6 U.S.C. §§ 571 and 572.

[19] Pub. L. No. 114-29, 129 Stat. 421 (2015).

[20] DHS, *National Emergency Communications Plan* (Washington, D.C.: November 2014).

DHS developed the SAFECOM Interoperability Continuum[21] in partnership with the federal, state, and local LMR users to help agencies and jurisdictions to plan and implement interoperability solutions for data and voice communications. The Interoperability Continuum can be used as a tool by LMR users to track progress in strengthening interoperable communications by addressing five interrelated elements viewed as necessary to achieve interoperability. These five elements are:

- **Governance** refers to establishing a shared vision, across jurisdictions and disciplines, and an effective organizational structure to support any project or initiative that seeks to enhance interoperability by providing guidance and support through common policies, processes, and procedures.
- **Standard operating procedures** (SOP) refer to documents containing formal written guidelines or instructions that outline the expected actions for various scenarios, including normal day-to-day operations and emergency situations. SOPs typically have both operational and technical components and enable LMR users to act in a coordinated fashion in the event of an emergency.
- **Technology** refers to the equipment/infrastructure, network, and applications that agencies use to exchange critical information when responding to incidents.
- **Training & Exercises** refers to the instructional support designed to develop knowledge, skills, and performance of public safety personnel.
- **Usage** refers to how often interoperable communications capabilities are used—for example, for daily operations, overseeing planned events, or only for emergency or unplanned events.

According to DHS's Office of Emergency Communications, LMR systems can be complex and costly to implement, requiring a lifecycle approach to manage them.[22] For example, DHS alone has reported that it owns a collective inventory of LMR equipment valued at more than $1 billion.

[21] For more information about SAFECOM and an overview of the Interoperability Continuum, see: https://www.dhs.gov/safecom (accessed Aug. 26, 2016).

[22] DHS, *Emergency Communications System Life Cycle Planning Guide* (Washington, D.C.: August 2011).

DHS operates and maintains six LMR national networks and almost 520 systems providing mission essential support to approximately 125,000 frontline agents and officers who help to prevent terrorism and secure our national borders, among other responsibilities.[23] Also, according to DHS, since the useful life of an LMR system is 10–15 years, continued investment is needed to operate and maintain these systems and ensure they continue to support users' needs. In addition to the investments made by federal departments in LMR systems, the federal government has provided billions of dollars in 2015 and 2016 in grant funding for state, local, tribal, and territorial governments to install, expand, and enhance their LMR systems, according to SAFECOM and the National Council of Statewide Interoperability Coordinators.

Agencies Use LMR Systems to Meet Their Needs, but Interoperability with Partner Agencies Varies

Mission Needs Drive Choice of LMR Systems and Devices

Based on responses to our survey, federal agencies generally use LMR devices to meet their unique mission or operational requirements. For example, the equipment needed to operate underground in a mining facility is different from what is needed to fight fires (in a high-heat environment, with the user wearing gloves) or for law enforcement (which may require encryption). DHS's *National Response Framework*[24]—a guide to how the nation plans to respond to disasters and emergencies—describes 15 emergency support functions, or federal coordinating structures, that group resources and capabilities of federal departments

[23] DHS, *DHS Interoperable Communications Act Strategic Plan Initial Report to Congress* (Washington, D.C.: Mar. 10, 2016).

[24] DHS, *National Response Framework,* Third Edition (Washington, D.C.: June 2016). According to DHS officials, the scope of the *National Response Framework* is much wider than LMR interoperability.

and agencies into functional areas that are most frequently needed in a national response. Based on responses to our survey, the six most frequently cited emergency support functions relating directly to the agencies' core missions are shown in table 1.

Table 1: Most Commonly Identified Emergency Support Functions Related to Federal Agencies' Core Missions

Emergency Support Functions Related to Agency Mission	
1.	*Public Safety and Security*—Coordinates the integration of public safety and security capabilities (including law enforcement) and resources to support the full range of incident management activities.
2.	*Emergency Management*[a]—Coordinates all federal departments and agencies across the spectrum of domestic incident management from hazard mitigation and preparedness to response and recovery.
3.	*Communications*—Coordinates government and industry efforts to reestablish and provide critical communications infrastructure after an incident, facilitates the stabilization of systems and applications after malicious cyber activity, and coordinates communications support to response efforts.
4.	*Firefighting*—Coordinates the support for the detection and suppression of fires (including wildland, rural, and urban firefighting operations)
5.	*Agriculture and Natural Resources*—Coordinates a variety of functions designed to protect the nation's food supply, respond to plant and animal pest and disease outbreaks, and protect natural and cultural resources.
6.	*Transportation*—Assists federal, state, tribal, and local governmental entities, voluntary organizations, nongovernmental organizations, and the private sector in the management of transportation systems and infrastructure during domestic threats or in response to incidents.

Source: GAO summary of DHS information (definitions) and GAO's survey on land mobile radio interoperability. | GAO-17-12

[a]Emergency Management (in the first edition of the National Response Framework) has been replaced by Information and Planning (in the second and third editions of the National Response Framework).

Although there are many manufacturers of LMR systems and devices, most agencies that we surveyed reported using equipment provided by the same manufacturer. Specifically, of the 57 agencies that responded to our related survey questions, more than two-thirds reported using LMR systems (40 of 57) and LMR devices (44 of 57) manufactured by Motorola.[25] In written responses to our survey, agencies reported that they prefer to continue to use equipment from the same manufacturers for various reasons, including ensuring compatibility of new LMR equipment with existing system requirements and reducing the need for training on new equipment and systems.

[25] The remainder of the agencies used equipment from several other manufacturers, including RELM, Harris, ICOM, Midland Radio Corporation, Kenwood USA, EF Johnson Technologies, Codan Radio Communications and other manufacturers.

Most Agencies Surveyed Mutually Identified Whether They Required LMR Interoperability, but Ratings of Interoperability Varied

For our analysis of agencies' LMR interoperability requirements and ratings, we asked each agency participating in our survey to identify (from a list of all agencies we surveyed) all other agencies with which the respondent agency requires LMR interoperability. We also asked the respondent agency to rate the level of interoperability with each agency that they had identified, among other questions. We refer to this as "independently" identifying the need for LMR interoperability. We later compared all agency responses to determine whether pairs of agencies identified each other, meaning that both agencies in the pair reported that they require LMR interoperability with each other. We refer to this as "mutually" identifying the need for LMR interoperability.

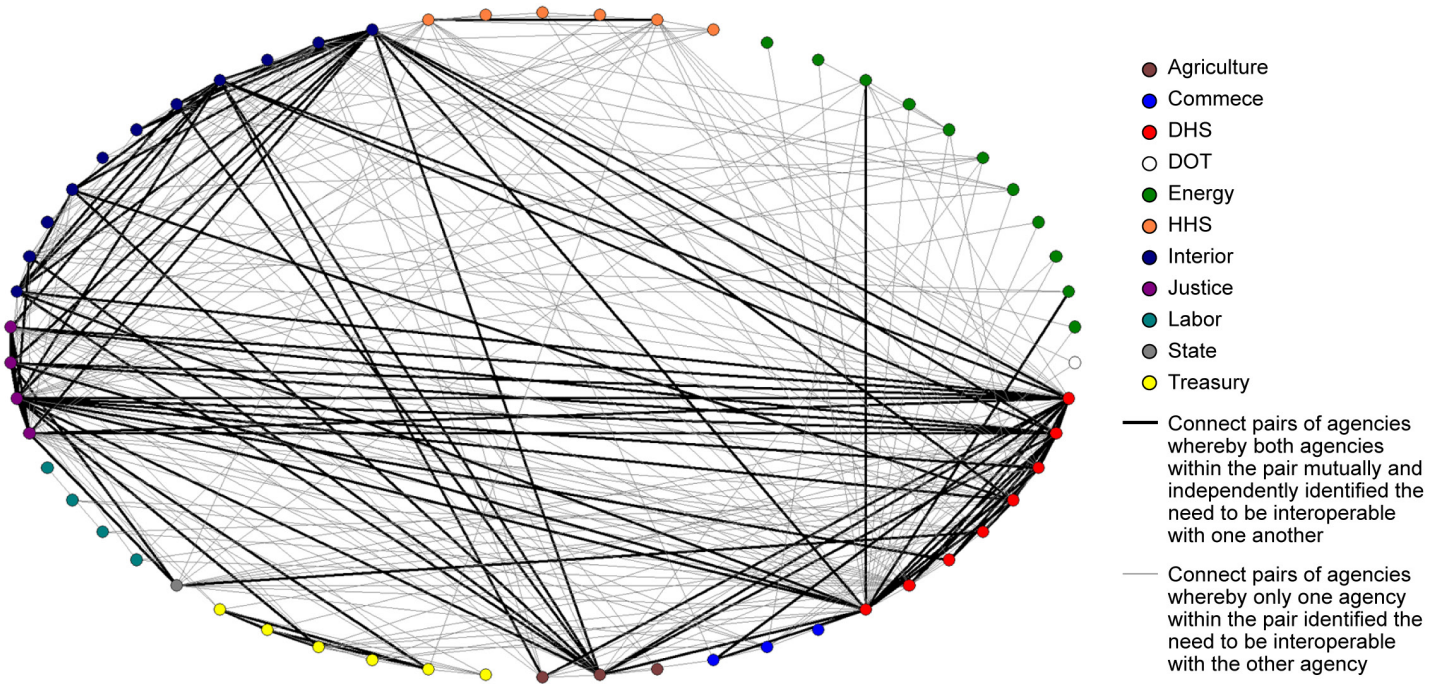
Not all federal agencies that responded to our survey reported a need for LMR interoperability with one another, but most agencies mutually and independently agreed whether or not they require it. That is, more than 80 percent of the possible pairs of agencies we surveyed mutually and independently reported that they do not generally require LMR interoperability; and another 5 percent mutually and independently reported that they do generally require it. The remaining approximately 14 percent of possible agency pairs reported a potential need for this two way communication, but this potential need was not mutually and independently reported by both agencies within the pair. For example, the Office of the Secretary of the Interior reported requiring interoperability with 22 other agencies, but only 2 agencies reported requiring interoperability with it. Alternatively, FEMA reported requiring LMR interoperability with only 8 agencies but 21 other agencies reported requiring interoperability with it.[26]

Figure 3 represents the level of mutual agreement between agencies regarding their need for LMR interoperability. That is, the dots in the figure represent the 57 agencies we surveyed plus the FBI, the gray lines connect pairs of agencies whereby only one agency within the pair identified the need to be interoperable with the other agency (i.e., lack of agreement), and the black lines connect pairs of agencies whereby both

[26] We asked agencies to independently identify other federal agencies with which they have required LMR interoperability over the past 5 years. The responses were based on the recollection and judgment of the survey respondent. Other agencies that resembled FEMA in this way included the Secret Service; the Federal Bureau of Investigation; and the Bureau of Alcohol, Tobacco, Firearms, and Explosives.

agencies within the pair mutually and independently identified the need to be interoperable with one another.

Figure 3: Agencies' Assessment of Land Mobile Radio Interoperability among Agency Pairs



Source: GAO's survey on land mobile radio interoperability. | GAO-17-12

Note: The dots in the figure represent the 57 agencies that responded to our survey, plus the FBI. The gray lines connect pairs of agencies whereby only one agency within the pair identified the need to be interoperable with the other agency, and the black lines connect pairs of agencies whereby both agencies within the pair mutually and independently identified the need to be interoperable with one another.

Table 2 quantifies the information covered in figure 3 for the 1,653 possible agency pairs—given the group size of 57 agencies we surveyed plus FBI[27]—including the specific number of agency pairs that mutually identified a need for LMR interoperability or not, and the number of pairs

[27] Although FBI did not fully respond to our survey, officials did identify agencies with which they required LMR interoperability for daily use, planned events, and unplanned or emergency events within the past 5 years. With 57 agencies surveyed for this question plus information provided by FBI (N=58), there are (N)*(N-1)/2 possible pairs.

that did not mutually identify a need for LMR interoperability (i.e., within a possible agency pair, one agency identified a need for interoperability but the other agency did not).

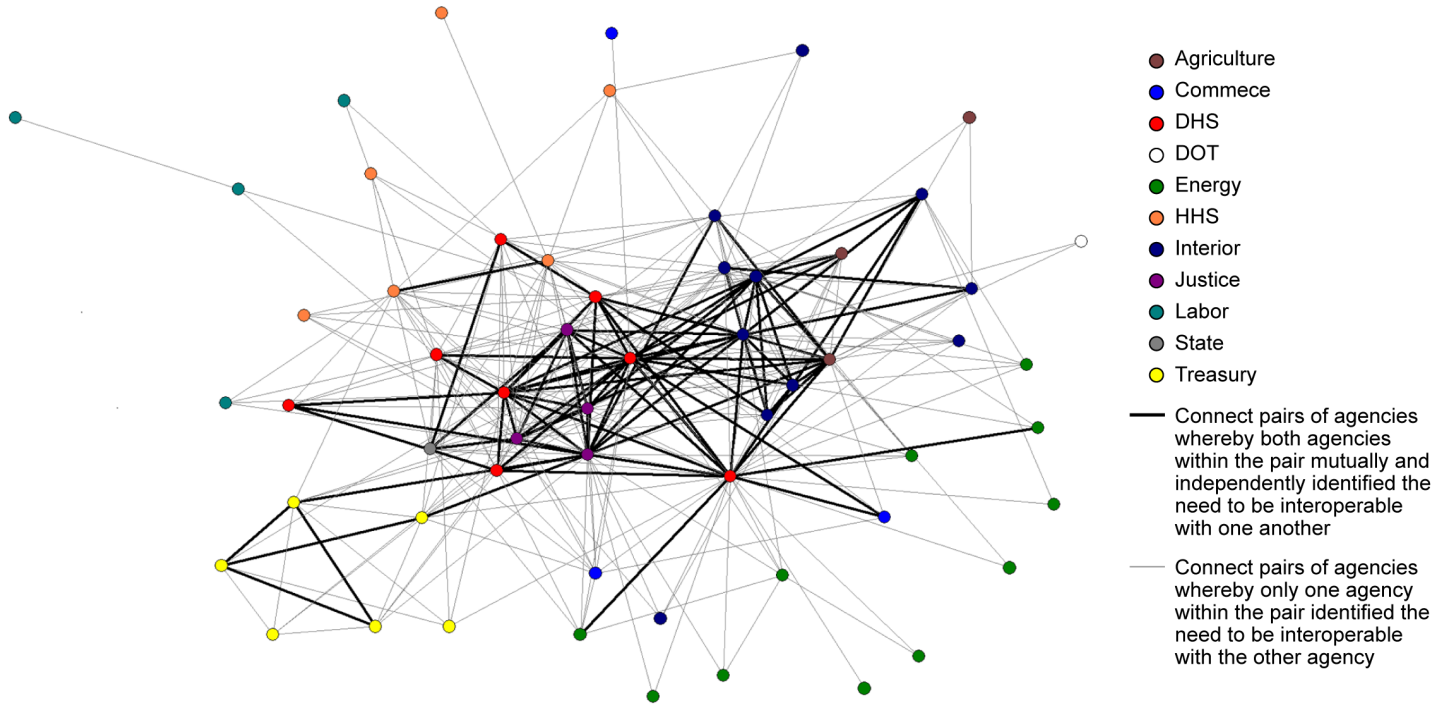
Table 2: Agencies' Level of Agreement Regarding the Need for Land Mobile Radio (LMR) Interoperability, Given 1,653 Possible Pairs among 58 Agencies

Description of interoperability need	Example	Number of agency pairs	Percentage of agency pairs
Number of agency pairs whereby the agencies within the pair mutually reported that LMR interoperability with each other is required.	The Forest Service and the Park Service mutually reported that they do require LMR interoperability.	86 pairs	5.2 percent
Number of agency pairs whereby only one agency within the pair reported that LMR interoperability is required (i.e., one agency believes it is required while the other does not).	The Forest Service and the Federal Emergency Management Agency (FEMA) did not mutually report whether they require LMR interoperability. (That is, the Forest Service noted an interoperability need with FEMA, but FEMA did not note a similar interoperability need with the Forest Service).	226 pairs	13.7 percent
Number of agency pairs whereby the agencies within the pair mutually reported that LMR interoperability with each other is not required.	The Forest Service and the Food and Drug Administration mutually reported that they do not require LMR interoperability.	1,341 pairs	81.1 percent

Source: GAO's survey on land mobile radio interoperability. | GAO-17-12

Based on our survey results, figure 4 shows agencies within federal departments with an identified need for LMR interoperability. Agencies closer to the center of the figure reported requiring interoperability with the greatest number of other agencies whereas those agencies located toward the edge of the figure require interoperability with fewer agencies. Similar to figure 3, each of the 226 gray lines connects an agency pair whereby only one agency within the pair identified the need to be interoperable with the other agency and each of the 86 black lines connects an agency pair whereby both agencies within the pair mutually and independently identified the need to be interoperable with one another.

Figure 4: Agencies within and among Departments with an Identified Need for Land Mobile Radio Interoperability



Source: GAO's survey on land mobile radio interoperability. | GAO-17-12

Note: The dots in the figure represent the 57 agencies we surveyed plus the FBI. The gray lines connect pairs of agencies whereby only one agency within the pair identified the need to be interoperable with the other agency, and the black lines connect pairs of agencies whereby both agencies within the pair mutually and independently identified the need to be interoperable with one another.

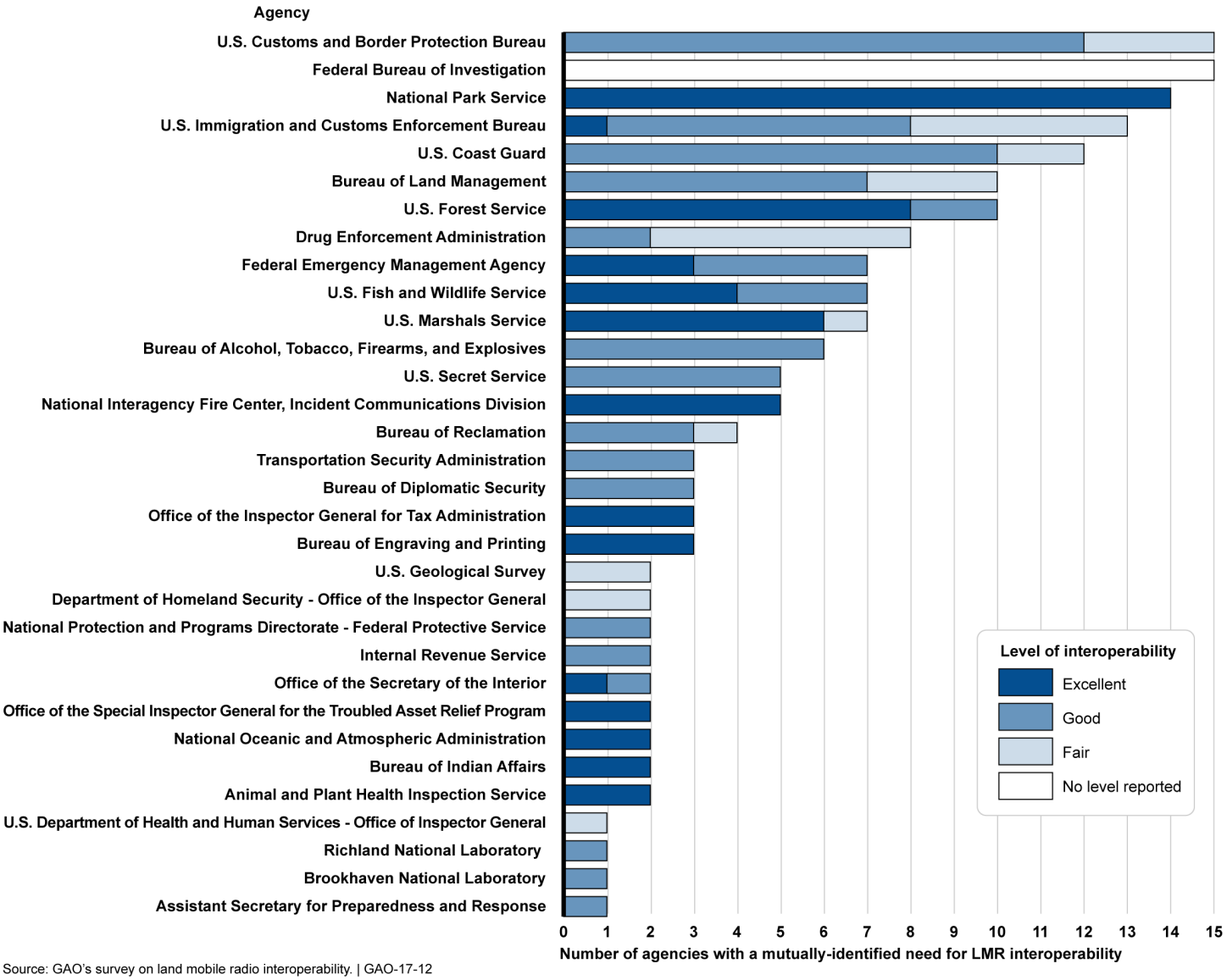
Among the pairs of agencies that agreed on their need for two-way communication, the quality of interoperability—as rated by the agencies requiring it—was generally good. To develop an understanding of the extent to which a mutually identified need for LMR interoperability is actually being achieved, we asked agencies to evaluate the general level of LMR interoperability actually achieved with each of their identified partner agencies. Based on the 86 pairs of agencies that mutually reported that LMR interoperability with each other was required, we expected 172 ratings—that is, a rating from each agency in each pair. However, because FBI did not provide us with its rating of the quality of interoperability with its partner agencies, we received 157 ratings in total.

About 68 percent of the ratings from agencies that mutually agreed on the need to communicate with each other using LMR reported having good or excellent LMR interoperability.[28]

Figure 5 lists federal agencies (including FBI) that reported the need for LMR interoperability with other federal agencies for daily operations, planned events, or unplanned or emergency events within the past 5 years. The color-coded blocks correspond with each listed agencies' assessment of the quality of its LMR interoperability with its identified partner agencies. For more detailed information about the specific agencies requiring LMR interoperability, the partner agencies they identified, and their assessment of their levels of interoperability with each identified partner agency, see an interactive graphic which can be viewed at http://www.gao.gov/products/gao-17-12.

[28] Eighteen percent of the links were rated as "excellent" quality, 49 percent were rated "good," and about 32 percent were rated as "fair."

Figure 5: Agencies' Assessment of Their Level of Interoperability with Partner Agencies



Source: GAO's survey on land mobile radio interoperability. | GAO-17-12

While Standardized Equipment and Training Help, Proprietary Features and Other Factors Continue to Hinder Interoperability

Standardized Technology and Training Help Enhance Interoperability

The use of standards-based and multi-band LMR equipment and training and exercises have helped to enhance interoperability, according to agencies we surveyed. With respect to standards-based equipment, almost all of the agencies that use LMR equipment to communicate with other agencies have partially or fully implemented the use of P25-compliant LMR devices, according to our survey. P25 standards are intended to facilitate interoperability among communications products of different manufacturers by supporting a variety of LMR system configurations, call types, and features (including encryption). Most agencies that we surveyed (49) reported that their agency or department requires the use of P25 standards-compliant LMR devices; however, not all agencies reported fully using P25 equipment, nor do they all view the standards as helpful. That is, of the 36 agencies that reported having fully implemented P25-compliant equipment, 32 reported that using P25-compliant equipment somewhat or greatly enhances interoperability. Six agencies reported that they do not use P25-compliant LMR devices for the following reasons: (1) it would be difficult for the agency to integrate the technology with its current LMR system, (2) no perceived need for the technology, (3) benefits of the technology are unclear, and (4) the agency requires LMR devices with proprietary or unique features that do not comply with P25 standards.

Another LMR technology—the multiband radio (including dual, tri- and quad-band devices)—operates on multiple public-safety radio bands and can help to enhance interoperability across users on different parts of the radio spectrum. However, fewer than half of the agencies responding to this question in our survey—21 out of 56—reported fully implementing the

use of multiband radios.[29] More than 85 percent of agencies (18 of 21) that routinely use multiband radios reported that they somewhat or greatly helped interoperability with identified partners. Multiband radios can help enhance interoperability because they enable a single portable radio to operate on multiple radio bands, thereby enhancing LMR interoperability with partners at the state and local level, or with other agencies operating at a different radio frequency band.

Regarding training and exercises, more than half of the agencies we surveyed (32 of 57) reported that they participate in training on LMR equipment used for daily operations, and almost all of the agencies participating in such training reported that it helped interoperability with partner agencies.[30] In addition to training, exercises can help to reinforce what is learned in training. Nearly one-third of the agencies told us they fully implemented exercises to test specific technologies and procedures, and almost all of those agencies reported they found these exercises to somewhat or greatly help their agency's interoperability with key partners. Nearly one-quarter of the agencies reported that they fully implemented joint exercises with key partners to gain familiarity with LMR equipment for daily operations, planned events, or unplanned or emergency incidents.

In written responses to our survey, agencies noted additional training and exercises that could enhance interoperability, including: making LMR training available online,[31] sharing lessons learned from incidents,[32] and continuing to implement large-scale exercises to gain familiarity with equipment before an emergency occurs. For example, one agency

[29] Most of these agencies use dual-band radios, but some use tri- and quad-band radios.

[30] Twenty-one agencies found such training to greatly help, and 7 found such training to somewhat help interoperability with key partners.

[31] One agency noted that new LMR training will be available on the Online Learning Consortium online training system. The Online Learning Consortium is a professional organization devoted to advancing quality online learning for professional development, instruction, best practice publications and guidance to educators. (See http://www.onlinelearningconsortium.org/ for more information.)

[32] The ECPC shares after-action reports, including lessons learned from large-scale incidents and emergencies, such as reports from the emergency response efforts during Hurricane Sandy (2012), the Boston Marathon bombing (2013), and the Navy Yard shooting in Washington, DC (2013).

reported that wide-scale wildland fire-fighting exercises involving multiple-county, state, Bureau of Land Management, and Forest Service personnel have been helpful toward achieving interoperability when needed.

Use of Certain LMR Features and the Lack of Standard Operating Procedures Continue to Hinder Interoperability

Several factors continue to hinder interoperability, according to agencies we surveyed. In particular, the following factors continue to limit agencies' progress in achieving interoperability with partner agencies: (1) the use of proprietary features and encryption in devices, (2) the limited use of interoperability channels, (3) the lack of standard operating procedures, and (4) the limited investments in LMR systems and devices.

Use of Proprietary Features and Encryption in Devices

Some of the agencies we surveyed reported that proprietary features used within the LMR systems and devices of their partner agencies have hindered interoperability with their partner agencies. As we reported in 2012, while the P25 standards are intended to facilitate interoperability among LMR systems and devices of different manufacturers, the standards remain voluntary.[33] As a result, LMR systems and devices marketed as P25-compliant can also include proprietary features that render the equipment incompatible with equipment from other manufacturers. To help ensure that LMR equipment is truly compliant with the P25 standards, DHS's Office for Interoperability and Compatibility has partnered with the Department of Commerce Public Safety Communications Research program to develop the P25 Compliance Assessment Program. This voluntary program aims to independently test LMR equipment to ensure that equipment marketed as P25-compliant actually complies with P25 standards for performance and interoperability.[34]

[33] GAO, *Emergency Communications: Various Challenges Likely to Slow Implementation of a Public Safety Broadband Network,* GAO-12-343 (Washington, D.C.: Feb. 22, 2012).

[34] The P25 Compliance Assessment Program allows LMR equipment manufacturers to formally demonstrate their products' compliance with a select group of requirements by testing products in recognized labs. For more information about the P25 Compliance Assessment Program, including a list of products that have been tested in the program, see: https://www.dhs.gov/science-and-technology/p25-cap.

Proprietary Features Increase Switching Costs

In GAO-12-343, we reported that the use of proprietary features makes it costly for agencies to switch their LMR devices from one manufacturer to another, since doing so would require replacing or modifying older devices to be compatible with new ones. Thus, these switching costs may compel agencies to continue to buy devices from the incumbent device manufacturer. The cost of switching is particularly high when a manufacturer has installed proprietary features that are not interoperable with competitors' devices. Additionally, even in cases where devices from different manufacturers are supposed to be compatible—that is, interoperable and compliant with P25 standards—a fear of incompatibility may deter an agency from switching to a new manufacturer when it needs to add additional LMR devices to its existing LMR system.

Source: GAO. | GAO-17-12

More than a quarter of the agencies responding to these questions in our survey use LMR systems (16 of 56) or devices (20 of 57) with proprietary features and over half (34 of 57) also reported using LMR devices with encryption features. In written responses to our survey, agencies provided reasons for using proprietary features, several of which relate to unique mission-related situations or the need to access other LMR networks, such as state and local networks. For example, agencies noted mission-related situations such as underground operations, high-density and congested environments,[35] and "man-down" signaling to call for help when a LMR user is incapacitated as reasons for including proprietary features. With respect to encryption, one agency noted that its LMR devices use an encryption feature to maintain interoperability with state and local public safety partner agencies using the same type of encryption.

DHS's Office of Emergency Communications notes that encryption features in LMR devices can help protect critical information transmitted from one LMR device to another from being compromised or disclosed and can provide assurance that sensitive information is reasonably protected from unauthorized access.[36] Although more than 30 percent of the agencies responding to our survey (18 of 57) reported that incompatible encryption capability with systems used by partner agencies somewhat or greatly hindered their ability to maintain interoperability, we did not observe this result in the specific examples of identified agency pairs and their assessment of their LMR interoperability. That is, agencies that require LMR interoperability rated interoperability with their identified partner agencies similarly regardless of whether or not their identified partner agency uses encryption in its LMR devices. According to DHS officials, partner agencies can enhance interoperability when they agree to share common encryption keys.[37] According to our survey, 14 agencies have implemented SOPs for sharing of encryption keys or agreeing to an

[35] The "vote scan" feature allows the LMR device users to receive the best signal available so they can stay in contact.

[36] DHS, *Office of Emergency Communications: Considerations for Encryption in Public Safety Radio Systems* (Washington, D.C., December 2014).

[37] An encryption key is a parameter that allows the encryption algorithm to function effectively by "locking" and "unlocking" protected information. Only agencies that have agreed to share encryption keys are authorized to decipher the information transmitted over encrypted LMR devices.

encryption standard and 13 of these 14 agencies reported that doing so was greatly or somewhat helpful toward achieving interoperability with their partner agencies.

Limited Use of Interoperability Channels

Federal and national interoperability channels provide agencies with a set of radio frequencies to use on location, to coordinate and resolve initial challenges to achieving interoperability when responding to an emergency or unplanned event. DHS encourages LMR users to maximize their flexibility and be prepared for emergency events by preprogramming as many interoperability channels into their radios as possible (as permitted by applicable regulations), including the federal and national interoperability channels. DHS's *National Interoperability Field Operations Guide*—available on the ECPC library webpage within the www.max.gov website—includes rules and regulations for the use of nationwide and other interoperability channels, and other reference material.[38] LMR users who have not pre-programmed their devices or are unfamiliar using the channels may be slow to respond or experience interoperability difficulties during an emergency event. For example, during the 2013 Boston Marathon bombings, when traditional communications systems—including radio networks and protocols, and some of the radio channels designated for the Marathon under the communications plan—were overloaded, Boston's police, fire, and public and private emergency medical service personnel used a dedicated radio channel to communicate and quickly summon aid to the scene.[39] By comparison, some regional specialized weapons and tactics (SWAT)[40] teams from state and local police departments and law enforcement councils experienced difficulty communicating because their radios were not

[38] DHS Office of Emergency Communications, *National Interoperability Field Operations Guide* Version 1.5 (January 2014). According to the guide, there are 20 VHF and 20 UHF NTIA-regulated interoperability channels and 21 VHF and 8 UHF FCC-regulated interoperability channels.

[39] Massachusetts Emergency Management Agency et al, *After Action Report for the Response to the 2013 Boston Marathon Bombings* (Boston, MA: December 2014).

[40] According to the *After Action Report for the Response to the 2013 Boston Marathon Bombings*, SWAT resources were deployed for a variety of missions, including protection of critical infrastructure and high-value targets such as hospitals, government buildings, and hotels. SWAT teams were comprised of members from the Watertown, Boston, Cambridge, and Brookline police departments; Massachusetts State Police; and Northeastern Massachusetts and Metropolitan law enforcement councils.

programmed to the interoperable channels. Similarly, the after-action report for the 2012 Navy Yard shooting noted that officers from federal and local law enforcement agencies were communicating on separate channels while searching for the gunman, resulting in gaps in communications and increased risk to fellow officers.[41]

Although more than two-thirds of the federal agencies responding to our survey reported that their radios are pre-programmed to the federal and national interoperability channels, 11 of the 57 agencies reported that their radios are not pre-programmed to use these NTIA-regulated federal emergency channels, and 17 of the 57 federal agencies reported that their devices are not pre-programmed to use FCC-regulated national interoperability channels. In written responses related to this survey question, some of these agencies explained that they did not see the need to do so or were unaware that the channels existed. However, as mentioned previously, DHS views these channels as providing greater flexibility to agencies in the event of an emergency. About one-fourth of the agencies responding to our survey reported that training related to accessing federal and national interoperability channels was a medium or high priority for their agency.

Lack of Standard Operating Procedures

DHS SAFECOM guidance states that interoperability requires not only the technical ability to communicate through the use of compatible LMR equipment but also formalized agreement among federal agencies, state and local entities, and other emergency service organizations to communicate and cooperatively respond to emergencies and disaster events.[42] Agencies can establish such agreements by developing SOPs to define roles, responsibilities, and appropriate usage of dedicated interoperability resources (e.g., interoperability channels) during response operations. DHS's SAFECOM recommends that partner agencies that need to use LMR to communicate develop SOPs and engage in training

[41] Washington DC Metropolitan Police Department, *After Action Report: Washington Navy Yard September 16, 2013 Internal Review of the Metropolitan Police Department*. (Washington, D.C.: July 2014).

[42] DHS, *SAFECOM Land Mobile Radio (LMR) for Project Managers,* (Washington, D.C.: February 2016).

for daily operations, planned events, and unplanned or emergency events.[43]

We analyzed survey results for agencies that identified the need for LMR interoperability with other agencies, particularly regarding whether the agencies have SOPs related to interoperability. Based on survey responses, when an agency identified the need for LMR interoperability with another agency, the agency also reported having SOPs with the identified agency in about 48 percent of the cases. Furthermore, the quality of interoperability tended to be higher when SOPs were in place than when they were not. In cases where an agency reported requiring LMR interoperability with another agency and having SOPs with that agency, the quality of interoperability was rated as excellent for 40 percent of the cases; good for 45 percent of the cases; and fair, poor, or nonexistent for 15 percent of the cases. In cases where an agency reported requiring a link and not having SOPs with the other agency, interoperability was rated as excellent for 16 percent of cases; good for 51 percent of cases; and fair, poor, or nonexistent in 33 percent of these cases.

In addition to having SOPs in place with partner agencies, DHS recommends that agencies engage in training and exercises to gain familiarity with the SOPs to improve response to unplanned or emergency events with partner agencies. However, two-thirds of the agencies responding to this survey question (37 of 56) have not fully implemented training on standard operating procedures, continuity processes, and related topics even though many of these agencies (20 of 37) said that doing so is a medium or high priority for their agency. To encourage agencies requiring LMR interoperability to develop SOPs, DHS has published and distributed guidance on its website and via the ECPC clearinghouse for information on www.max.gov. [44] DHS also recognizes

[43] H.R. 3583, the *Promoting Resilience and Efficiency in Preparing for Attacks and Responding to Emergencies Act*, if enacted into law, would require DHS to coordinate with appropriate agency heads to develop a mechanism to ensure that DHS radio users receive initial and ongoing training on the use of the radio systems of such agencies, including interagency radio use protocols. As of April 26, 2016, the act passed the House and was received in the Senate and referred to the Committee on Homeland Security and Governmental Affairs.

[44] DHS, FEMA, *Guide to Developing Effective Standard Operating Procedures For Fire and EMS Departments* (Washington, D.C.: December 1999).

the importance of training to ensure that emergency responders understand SOPs and have the skills needed to carry them out, but according to DHS, it does not have the regulatory authority to require other agencies to develop SOPs or to provide relevant training to federal agencies.

Limited Investment in LMR Systems and Devices

According to DHS, maintaining an LMR system requires a large investment, due to its high cost and relatively-short life cycle of about 10 to 15 years and deferring maintenance and upgrades to aging LMR systems and devices can limit interoperability. To help ensure effective LMR operations, SAFECOM guidance encourages emergency responders to regularly maintain communications systems and equipment, and to upgrade their systems when appropriate.[45] For example, upgrades may include investing in standards-based equipment, adopting new technologies, and updating the hardware and software of existing LMR systems. However, in response to our survey, more than two-thirds of the agencies that responded to this question (39 of 57) reported that the limited availability of funding to replace or upgrade incompatible or aging LMR equipment greatly or somewhat hindered their ability to maintain interoperability with partner agencies. DHS has produced guidance to help agencies to establish and maintain LMR systems, including planning and budgeting for the long-term maintenance of these communication systems.[46]

[45] DHS, Office of Emergency Communications: Fiscal Year 2016 SAFECOM Guidance on Emergency Communications Grants.

[46] DHS, *Emergency Communications System Life Cycle Planning Guide* (Washington, D.C.: August 2011).

Some Agencies Use Preapproved Contracts for LMR Procurement, but a More Coordinated Approach Could Lower Costs and Enhance Interoperability

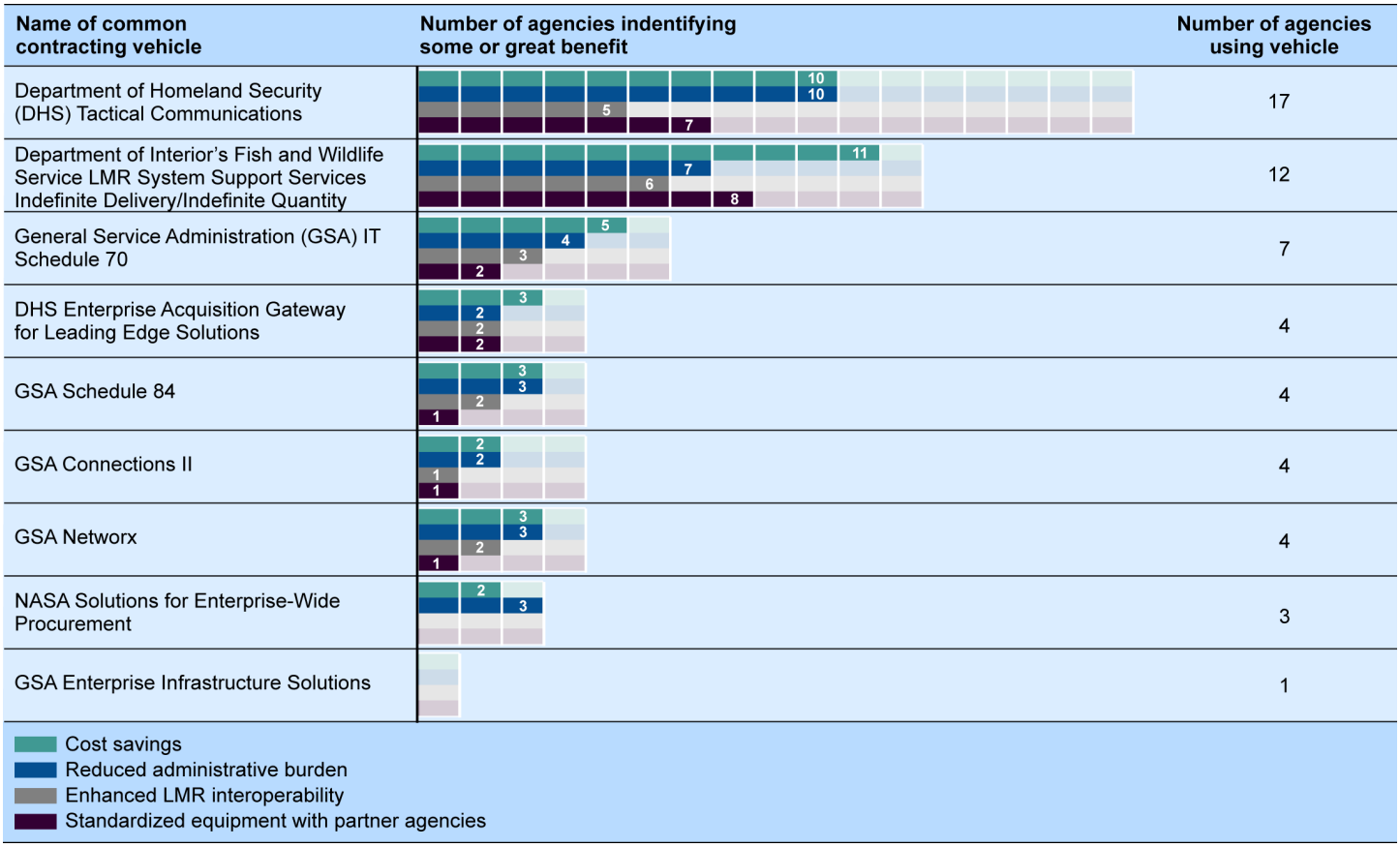
LMR Procurement Practices

Nearly half (27 of 57) of agencies we surveyed reported using contract vehicles to acquire LMR systems and devices. Contract vehicles contain groups of preapproved contracts that enable agencies to purchase LMR equipment from a list of vendors with established prices. We have previously reported that coordinating purchases of like products and services—such as by using preapproved contracts—enables agencies to leverage spending to the maximum extent possible.[47] Agencies using preapproved contracts to purchase LMR equipment reported similar benefits, including cost savings, reduced administrative burden, enhanced interoperability, and standardized equipment. Among the 27 federal agencies that reported using preapproved contracts to procure LMR systems and devices, most reported using contracts sponsored by the DHS or the Department of the Interior, although several other contract vehicles were used by a smaller number of agencies (see fig. 6).[48]

[47] GAO, *Strategic Sourcing: Improved and Expanded Use Could Save Billions in Annual Procurement Costs*, GAO-12-919 (Washington, D.C., Sept. 20, 2012).

[48] Some agencies reported using other contract vehicles to procure LMR devices, such as indefinite delivery, indefinite quantity contracts (IDIQs) from FBI, the Drug Enforcement Agency, and the U.S. Secret Service.

Figure 6: Agencies' Reported Use of Preapproved Contracts to Purchase Land Mobile Radio (LMR) Equipment over the Past 5 Years and Reported Benefits, 2011–2016



Source: GAO analysis of results from survey of 57 federal agencies that use land mobile radio. | GAO-17-12

Note: Fifty-seven agencies responded to this survey question and 27 of those agencies reported using contract vehicles. The number of agencies using contract vehicles is greater than the respondent total because some agencies reported using more than one contract vehicle.

Among the agencies that used preapproved contracts, many reported that they have used multiple contract vehicles to purchase LMR equipment in the past 5 years. For example, 13 agencies reported using two or more different vehicles, and three agencies reported using four different vehicles. We have reported that agencies' use of potentially duplicative contracts to purchase similar goods and services can potentially reduce

their benefits by imposing significant costs to the agencies.[49] That is, agencies may miss an opportunity to leverage their buying power, if purchasing under many different agreements.

Twenty-three agencies we surveyed also have used a sole source or other procurement mechanisms to acquire LMR systems and devices within the past 5 years, whereby agencies contract with one specific manufacturer, without competition, to acquire systems and devices when it is believed to be in the best interest of the agency. In written comments on the survey, some agencies reported using sole source procurements to ensure that all the LMR devices they purchased would work with their existing systems. For example, one agency reported that using a sole source procurement allows it to obtain additional equipment from the same manufacturer as its current LMR system. Another noted that a sole source procurement allows the agency to replace existing equipment with similar equipment, which reduces the cost of training for LMR users and technicians who maintain and repair the equipment. Several other agencies reported using a sole source procurement to ensure that they can obtain LMR devices with needed features to meet operational requirements.

A Category Management Approach to Procurement Could Lower LMR Costs and Improve Interoperability

While some agencies that responded to our survey reported using contract vehicles, many reported that they do not coordinate with other agencies before purchasing new LMR equipment. According to the Office of Management and Budget (OMB), better coordination among agencies interested in commonly-purchased items—such as information technology (IT)—can help the agencies to leverage the government's purchasing power. We have previously identified using a coordinated procurement approach as a key practice that can reduce procurement costs to agencies.[50] According to GSA, a structured and collaborative approach to procurement can help agencies save money and improve overall performance by better leveraging their purchasing power.[51]

[49] GAO, *Strategic Sourcing: Opportunities Exist to Better Manage Information Technology Services Spending*, GAO-15-549 (Washington, D.C.: Sept. 22, 2015).

[50] GAO, *Strategic Sourcing: Improved and Expanded Use Could Save Billions In Annual Procurement Costs*, GAO-12-919 (Washington, D.C.: Sept. 20, 2012).

[51] GSA, *Federal Strategic Sourcing Initiative,* accessed July 15, 2016, http://www.gsa.gov/portal/category/25623.

However, in response to our survey, nearly 40 percent of agencies (22 of 57) reported that they have not coordinated procurement activities of LMR devices and related equipment with other federal agencies within the past 5 years, such as by identifying common technical requirements before purchasing new LMR equipment. In written comments on the survey, some of these agencies provided the following reasons for not coordinating LMR procurements:

- *Difference in mission:* for example, one agency reported that its mission does not overlap with that of other federal agencies, a circumstance that made it difficult to coordinate procurements with them.
- *Lack of common technical requirements:* for example, one agency reported that its radio system needs to have maritime capabilities that most other federal agencies do not need.
- *Low quantity of LMR devices:* for example, one agency reported that it needs only about 100 LMR devices and trying to coordinate the purchase of such a small quantity would be more burdensome than helpful.[52]
- *Timing of procurement:* for example, one agency reported that it tried to execute a contract for LMR purchases with another agency in the past, but the timing of the cycles by which the two agencies' purchased new LMR equipment was difficult to coordinate due to their having two different contract-performance periods.

According to OMB officials, agencies had noted similar reasons for not coordinating other commonly purchased goods, such as IT hardware and software. In particular, OMB officials told us that although agencies may initially struggle to identify common technical requirements, agencies can typically identify and agree to a limited number of standard technical configurations to meet the needs of about 80 percent of common IT requirements, such as those for laptops and desktops. These items make up more than half of the federal government's overall expenditures and agencies often purchase and manage these items in a fragmented and

[52] According to DHS, LMR devices have a useful life of about 10 years and, therefore, would be expected to be replaced on a 10-year cycle.

inefficient manner, according to OMB.[53] In response, in 2014, OMB's Office of Federal Procurement Policy announced its category management initiative, an approach based on leading practices to manage entire categories of spending across government for commonly purchased goods and services, such as IT hardware and software.[54] The initiative is designed to allow the federal government to buy goods and services more like a single enterprise, leveraging its purchasing power as the world's largest consumer.[55] OMB identified three critical steps departments and agencies could take to improve procurement practices and achieve cost savings: (1) reduce administrative costs by consolidating acquisitions through fewer high-performing contract vehicles; (2) standardize configurations for common requirements to drive savings; and (3) implement smarter business practices, such as jointly purchasing replacement IT equipment on a regular cycle, to achieve strategic and predictable budget requirements and optimize price and performance.[56]

At the time of our review, OMB had not yet considered LMR equipment within its category management initiative, in part because the initial strategic plan for IT focused on implementing OMB policy related to laptops and desktops, software, and mobile devices and services. However, OMB officials acknowledged that a category management approach to LMR procurement may save the government money while also supporting the goal of enhanced LMR interoperability among agencies, largely because it would require agencies to identify their common technical requirements and purchase equipment in larger quantities through fewer transactions. OMB officials said that LMR

[53] In addition, there is no single place for government contracting officers to find out important details about existing contract vehicles for particular commodity areas.

[54] OMB, *Memorandum for Chief Acquisition Officers and Senior Procurement Executives: Transforming the Marketplace: Simplifying Federal Procurement to Improve Performance, Drive Innovation, and Increase Savings* (Washington D.C.: Dec. 4, 2014).

[55] White House, *Taking Category Management Government-Wide*, White House blog (Jan. 7, 2015), accessed July 17, 2015, https://www.whitehouse.gov/blog/2015/01/07/taking-category-management-government-wide-0.

[56] OMB, *Memorandum for the Heads of Department and Agencies, Category Management Policy 15-1: Improving the Acquisition and Management of Common Information Technology: Laptops and Desktops* (Washington, D.C.: Oct. 16, 2015).

equipment could be a focus of future efforts once data analysis is conducted to understand how many agencies use LMR equipment, which contract vehicles are used to purchase LMR equipment, and overall LMR expenditures.[57] In our discussion with OMB officials, they noted the widespread use of LMR equipment and the large number of contract vehicles currently being used to purchase LMR equipment as reasons for pursuing a consolidated procurement of LMR equipment through a category management approach. Including LMR equipment in OMB's category management initiative may enable the federal government to more fully leverage its aggregate buying power to obtain the most advantageous terms and conditions for LMR procurements and realize cost savings.[58] Although the exact amount of federal funds spent each year on LMR equipment government-wide is unknown, we estimate it is likely hundreds of millions of dollars, given the known costs to DHS, a single department. Specifically, DHS has reported that its agencies spent almost $526 million on LMR infrastructure, equipment, and personnel in fiscal year 2016, with plans to continue spending approximately $450 million for each of the next 5 years, on average.[59]

According to OMB officials, the coordination required for a category management approach includes discussions to standardize configurations for common requirements and establish a shared vision through common policies, processes, and procedures. Agencies' subject matter experts must first identify the common technical standards and features required for a category management approach, according to OMB officials. For example, to develop such standards for the IT goods

[57] Government agencies are required to report their procurement data in a single searchable website which has been designated the Federal Procurement Data System. Pub. L. No. 109-282 § 2, 120 Stat. 1186 (2002). Although OMB officials told us that they would typically use data from this system to identify areas of common expenditures, officials from GSA told us that the system does not currently collect data at a level that would be needed to identify how much is spent on LMR systems and devices.

[58] The White House anticipates significant cost savings with the category management initiative, but as it is a new program, the actual cost savings are not known. However, we previously reported that by using a strategic approach to procurement, agencies would achieve annual savings of 4 to 15 percent. See GAO, *Strategic Sourcing: Opportunities Exist to Better Manage Information Technology Services Spending*, GAO-15-549 (Washington, D.C.: Sept. 22, 2015).

[59] DHS, *Interoperable Communications Act Strategic Plan: Initial Report to Congress* – 2016, (Washington, D.C., Mar. 10, 2016).

and services category management initiative, OMB convened IT and procurement professionals from the National Aeronautics and Space Administration, the General Services Administration, and the National Institutes of Health to work with industry partners and representatives from 20 federal agencies to develop a government-wide solution for purchasing IT products and services.[60] As a result of this initiative, three existing contract vehicles were identified as high-performance, and OMB began requiring civilian agencies to use those vehicles to purchase from among six standard configurations of laptops and desktops.

Our survey results suggest that such coordination, if applied to LMR procurement, could enhance interoperability among partner agencies.[61] For example, many of the agencies that engage in coordinated procurement also reported a better general level of LMR interoperability. Based on survey responses, when an agency identified the need for LMR interoperability with another agency and coordinated with that agency on technical requirements before purchasing new equipment, the quality of interoperability was reported as: excellent in 50 percent of the cases; good in 39 percent of the cases; and worse (fair, poor, nonexistent) in 11 percent of the cases. In cases when an agency identified the need for LMR interoperability with another agency but did not coordinate on technical requirements before purchasing new equipment, a much lower quality of interoperability was reported—that is, LMR interoperability was rated excellent for 13 percent of the cases; good for 55 percent of the cases; and worse (fair, poor, nonexistent) for the remaining 32 percent of the cases. In addition, the cost-saving potential of category management could aid agencies that, as previously noted, reported funding constraints in their ability to replace or upgrade aging LMR equipment to maintain interoperability.

[60] In fiscal year 2014, agencies awarded more than 10,000 contracts and delivery orders for common laptops and desktops totaling about $1.1 billion, resulting in reduced buying power, inefficient duplication of contracts, and very little transparency into prices paid.

[61] In addition to coordinated procurement of LMR devices, certain activities mentioned earlier in this report may be necessary to further enhance interoperability, such as the use of standards-based and/or multi-band LMR equipment, inter-agency agreements, and training and exercises among agencies.

Conclusions

Several federal agencies have required LMR interoperability with one another in recent years for daily operations, planned events, and during emergencies. Although these agencies spend millions of dollars each year on LMR equipment, many of them do not coordinate with one another before purchasing new equipment—for example, by agreeing to purchase through a limited number of high-performing contract vehicles. As a result, the agencies may be limited in their ability to exert buying power with manufacturers to obtain quantity discounts. This duplication of procurement efforts for similar goods and services imposes significant costs to agencies. OMB recognizes that agencies often purchase and manage items in a fragmented and inefficient manner, through tens of thousands of contracts and delivery orders. To address this issue, OMB's Office of Federal Procurement Policy directs agencies to implement category management as a way to manage spending across government for commonly purchased goods and services. This approach enables the federal government to leverage its purchasing power and realize cost savings and may also help to enhance interoperability, particularly if taken in combination with inter-agency agreements, and training and exercises. Although OMB's category management approach includes many IT goods and services, it does not include LMR equipment. By including LMR equipment in the category management initiative, the federal government may be able to more fully leverage its aggregate buying power to save money and obtain the most advantageous terms and conditions for LMR procurements while also helping agencies to more effectively communicate in their day-to-day operations and when responding to emergencies.

Recommendations for Executive Action

To improve federal agency LMR procurement practices, the Director of OMB should direct the Office of Federal Procurement Policy to:

- examine the feasibility of including LMR technology in the category management initiative, and
- if warranted, include LMR technology within the appropriate spend category.

Agency Comments

We provided a draft of this report to OMB, DHS, Commerce, FCC and GSA for their review and comment. OMB, DHS, and Commerce provided technical comments, which we incorporated as appropriate. In commenting on a draft of the report, OMB generally agreed with our recommendations and noted that it is working to identify which IT strategies will produce the best return on investment and that it continues

to evaluate its category-specific strategic plans. In DHS's technical comments, officials stressed that interoperability is achieved by strong leadership and governance structures; planning and coordination; common policies and procedures that promote interoperability across agencies and jurisdictions (e.g., mutual aid agreements, joint procurement policies that ensure equipment is interoperable); regular training and exercises that allow responders to practice interoperability skills; and the purchase of standards-based equipment.

We are sending copies of this report to appropriate congressional committees, the Secretary of Homeland Security, the Secretary of Commerce, the Chairman of FCC, the Administrator of GSA, and the Director of OMB. In addition, the report is available at no charge on GAO's website at http://www.gao.gov.

If you or members of your staff have any questions about this report, please contact me at (202) 512-2834 or shear@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Major contributors to this report are listed in appendix II.

Rebecca Shea
Acting Director, Physical Infrastructure Issues

List of Requesters

The Honorable Bill Nelson
Ranking Member
Committee on Committee on Commerce, Science,
and Transportation
United States Senate

The Honorable Tim Kaine
United States Senate

The Honorable Marco Rubio
United States Senate

The Honorable Mark Warner
United States Senate

Appendix I: Objectives, Scope, and Methodology

This report focuses on the current LMR technology, procurement practices, policies, and guidance to identify ways that select agencies can further facilitate interoperability among first responders. Specifically, we reviewed (1) LMR systems and devices used by selected federal agencies and the state of LMR interoperability among these agencies; (2) factors that help and hinder interoperability among agencies that use LMR; and (3) selected agencies' practices for procuring LMR systems. We plan to review federal agencies' LMR interoperability with tribal, state, and local entities in future work.

To obtain information for all of our objectives, we conducted a web-based survey of 74 civilian federal agencies. We were interested in agencies that have used LMR to communicate with at least one other federal agency for daily operations, planned events like presidential inaugurations or unplanned/emergency incidents within the past 5 years. The initial list of federal agencies was identified by the civilian participating members of the Emergency Communications Preparedness Center (ECPC)[1] and confirmed by e-mail;[2] we did not survey agencies from the Department of Defense. These agencies were sent a web-based survey that included questions related to LMR technology used, procurement practices, and technical and non-technical factors that helped or hindered agencies' ability to achieve interoperability. The first question of the survey was a screening question to confirm that the agency used LMR to communicate with at least one other federal agency. All 74 agencies responded to the screening question. Agencies that met this criterion—58 federal LMR users in all—were further surveyed about the type of equipment they use, interoperability needs, and procurement practices, among other topics. Fifty-seven of the 58 agencies that we identified as federal LMR users responded to the full survey. The Federal Bureau of Investigation (FBI) did not respond to the full survey but provided responses to a limited set of survey questions related to our first objective, identifying agencies with which they require LMR interoperability. Specifically, the FBI provided a list of civilian federal agencies that it required LMR to communicate with within the past 5

[1] The ECPC has 14 federal department members, which all have a role in emergency communications, including regulation, policy, operations, grants, and technical assistance.

[2] We contacted representatives of the ECPC Executive and Steering Committees from each department and asked them to confirm whether or not component agencies within their department use LMR.

years, which we included in the partner agency network analysis. Sixteen agencies that confirmed that they did not use LMR for communication in the first question did not continue with the survey. To ensure that our survey questions and skip pattern were clear and logical and that respondents could answer the questions without undue burden, we pre-tested our survey with five agencies: the Office of the Chief Information Officer at the Department of Interior, the Office of the Chief Information Officer at the Department of Homeland Security; the Forest Service at the Department of Agriculture; the Office of the Inspector General for Tax Administration at the Department of the Treasury; and the Bureau of Diplomatic Security at the Department of State. We administered the survey from April 2016 through June 2016; therefore, responses reflect information and views as of that time.

We provide survey results based on the number of respondents to each question because not all respondents answered every question of the survey. Therefore the total number of respondents may be fewer than 57 for some results. We did not ask agencies to provide additional explanation on how they arrived at their responses. The survey and a more comprehensive tabulation of the results can be viewed at GAO-17-13SP.[3] Table 3 provides the list of federal agencies we surveyed.

Table 3: Civilian Agencies, Offices, and Bureaus Surveyed

Emergency Communications Preparedness Center Member	Agencies, Offices, and Bureaus Surveyed
Department of Agriculture	Animal and Plant Health Inspection Service
	Grain Inspection, Packers, and Stockyards Administration
	Forest Service
	National Resources Conservation Service
	Agricultural Research Service
Department of Commerce	Office of the Secretary

[3] GAO, *Emergency Communications: Survey of Selected Federal Agencies' Use and Procurement, an E-supplement to* GAO-17-12, GAO-17-13SP (Washington, D.C.: Oct. 5, 2016).

Emergency Communications Preparedness Center Member	Agencies, Offices, and Bureaus Surveyed
	Bureau of Industry and Security
	Bureau of the Census
	National Institute of Standards and Technology
	National Oceanic and Atmospheric Administration
	Office of the Inspector General
Department of Energy	Argonne National Laboratory
	Bonneville Power Administration
	Brookhaven National Laboratory
	Fermi National Accelerator Laboratory
	Idaho National Laboratory
	National Nuclear Security Administration
	Oakridge National Laboratory
	Richland National Laboratory
	Sandia National Laboratory
	Savanah River National Laboratory
	Southwestern Power Administration
	Strategic Petroleum Reserve
	Western Area Power Administration
Department of Health & Human Services	Centers for Medicare & Medicaid Services
	Office of Inspector General
	Centers for Disease Control and Prevention
	Food and Drug Administration
	Indian Health Service
	National Institute of Health
	Office of the Secretary of Health and Human Services – Assistant Secretary for Preparedness and Response, Office of Emergency Management
	Office of the Secretary–Office of Security & Strategic Information
Department of Homeland Security	Customs and Border Protection
	Immigration and Customs Enforcement
	Federal Emergency Management Agency
	Federal Law Enforcement Training Centers
	Office of the Inspector General
	Science and Technology Directorate
	Transportation Security Administration

Emergency Communications Preparedness Center Member	Agencies, Offices, and Bureaus Surveyed
	National Protection and Programs Directorate–Federal Protective Service
	U.S. Coast Guard
	U.S. Secret Service
Department of the Interior	Office of the Secretary of the Interior
	National Park Service
	U.S. Fish and Wildlife Service
	Indian Affairs
	Bureau of Land Management
	Bureau of Reclamation
	Geological Survey
	Bureau of Indian Education
	National Interagency Fire Center, National Interagency Incident Communications
	Office of Law Enforcement and Security, Operations and Policy
	Tennessee Valley Authority
	International Boundary and Water Commission
Department of Justice	Bureau of Alcohol, Tobacco, Firearms, and Explosives
	Drug Enforcement Administration
	Federal Bureau of Investigation
	U.S. Marshals Service
Department of Labor	Bureau of Labor Statistics
	Mine Safety and Health Administration
	Occupational Safety and Health Administration
	Office of the Assistant Secretary for Administration and Management
	Office of the Inspector General
Department of State	Bureau of Diplomatic Security
Department of Transportation	Federal Aviation Administration
Department of the Treasury	Bureau of Engraving and Printing
	Internal Revenue Service
	Office of Inspector General
	Office of the Inspector General for Tax Administration
	U.S. Mint

Emergency Communications Preparedness Center Member	Agencies, Offices, and Bureaus Surveyed
	Office of the Special Inspector General for the Troubled Asset Relief Program
Federal Communications Commission	Office of Managing Director
	Enforcement Bureau
	Public Safety and Homeland Security Bureau

Source: GAO. | GAO-17-12

To determine the LMR systems and devices used by the agencies and the state of interoperability among select federal agencies, we asked survey respondents to provide information about the characteristics of LMR systems and devices they currently use. We also asked each agency to identify—from the list of 74 agencies—those agencies with which they have required LMR interoperability within the past 5 years (i.e., "partner agencies"). We asked them to indicate whether LMR interoperability with each partner agency was needed for daily operations, planned events, or unplanned events (including emergencies), and we asked them to rate their current level of interoperability with each partner agency.

To identify factors that have helped or hindered agencies' interoperability with their identified partner agencies, we surveyed agencies' current practices against recommended practices identified in the five elements of the SAFECOM Interoperability Continuum, which includes governance, standard operating procedures, technology, training and exercises, and usage.[4] For example, we asked agencies to indicate whether they have standard operating procedures related to their LMR interoperability with their partner agencies. For each factor that the agencies have implemented, we asked how much the factor helped, if at all, and for factors that they have not implemented fully, we asked if the factor is a priority for the agency to implement. We also asked agencies to rate the

[4] SAFECOM is a communications program formed in 2001 as part of the Presidential E-Government Initiative to improve public safety interoperability, allowing emergency responders to communicate effectively before, during, and after emergencies and disasters. The SAFECOM Interoperability Continuum is a tool to evaluate progress in strengthening interoperable communications.

extent to which factors have hindered their ability to maintain interoperability with partner agencies.

Lastly, to understand how LMR procurement practices of select agencies affected interoperability, we surveyed agencies' procurement practices, including whether they use common contract vehicles and their identified outcomes for each vehicles. In addition, we asked if the agencies have used sole source contracts to procure LMR equipment and an explanation for why they do so. We reviewed literature to identify category management as a potential procurement practice that can leverage the buying power of the federal government to increase cost saving and reduce redundancy. To understand the feasibility of using category management to procure LMR equipment, we asked officials from the Office of Management and Budget what factors they consider when deciding whether a particular technology makes a good candidate for its category management initiative. We also asked the officials if LMR procurement would benefit from inclusion in the category management initiative.

We also reviewed relevant legislation and Department of Homeland Security (DHS) planning documents related to interoperability among federal agencies, including the *National Emergency Communications Plan*,[5] the *National Response Framework*,[6] and SAFECOM documentation related to five key elements of interoperability. We reviewed our prior reports and others from federal agencies for examples of how factors helped or hindered their interoperability.[7] We interviewed officials from federal agencies with responsibilities related to emergency communications and procurement of LMR equipment, including DHS; the National Telecommunications and Information Administration and the National Institute of Standards and Technology, within the Department of

[5] DHS, *National Emergency Communications Plan* (Washington, D.C.: November 2014).

[6] DHS, *National Response Framework,* Third Edition (Washington, D.C.: June 2016).

[7] GAO, *Border Security: Additional Efforts Needed to Address Persistent Challenges in Achieving Radio Interoperability*, GAO-15-201 (Washington, D.C.: Mar. 23, 2015); GAO, *2014 Annual Report: Additional Opportunities to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits*, GAO-14-343SP (Washington, D.C.: Apr. 8, 2014); and GAO, *Emergency Communications: Various Challenges Likely to Slow Implementation of a Public Safety Broadband Network*, GAO-12-343 (Washington, D.C.: Feb. 22, 2012).

Commerce; the Federal Communications Commission; the General Services Administration; the Office of Management and Budget; and administrators of the ECPC.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the individual named above, Sally Moino (Assistant Director), John Healey, (Analyst in Charge), Teresa Anderson, Jenn Beddor, Melissa Bodeau, Russ Burnett, Thanh Lu, Josh Ormond, Cheryl Peterson, Ernest Powell, Elizabeth Wood, and John Yee made key contributions to this report.