United States Government Accountability Office

Report to Subcommittee on Emergency Preparedness, Response, and Recovery, Committee on Homeland Security, House of Representatives

June 2019

EMERGENCY COMMUNICATIONS

Required Auction of Public Safety Spectrum Could Harm First Responder Capabilities

GAO-19-508

GAO Highlights

Highlights of GAO-19-508, a report to the Subcommittee on Emergency Preparedness, Response, and Recovery, Committee on Homeland Security, House of Representatives

June 2019

EMERGENCY COMMUNICATIONS

Required Auction of Public Safety Spectrum Could Harm First Responder Capabilities

Why GAO Did This Study

First responders and others in 11 large metropolitan areas use radio systems operating in the T-Band since spectrum is limited in other bands. In 2012, FCC was required by statute to begin an auction of this T-Band public safety spectrum by February 2021 and to make the proceeds available to the National Telecommunications and Information Administration (NTIA) to develop and administer a grant program to help cover costs associated with relocating public safety users' radio systems.

GAO was asked to review issues related to the required T-Band auction. This report examines, among other things: (1) the challenges selected first responders and local governments anticipate facing in relocating public safety communications from the T-Band and (2) the actions FCC has taken both to help facilitate the required T-Band relocation and to address identified challenges. GAO reviewed FCC's March 2019 congressional briefing and analysis on T-Band spectrum and conducted case studies in four cities selected based on the number of public safety licenses in each area, among other things. GAO reviewed relevant statutes and regulations, FCC documents, and T-Band studies conducted by a public safety organization. GAO interviewed FCC officials and other stakeholders, including first responders in case study cities.

What GAO Recommends

Congress should consider legislation allowing public safety users continued use of the T-Band spectrum.

View GAO-19-508. For more information, contact Mark Goldstein at (202) 512-2834 or GoldsteinM@gao.gov.

What GAO Found

Public safety officials, such as police and fire fighters, in 11 metropolitan areas rely on radio systems that use the portion of spectrum known as the T-Band for mission critical voice communications. Selected stakeholders GAO interviewed, including first responders and officials in three of four areas selected as case studies, anticipate significant challenges in relocating public safety communications from the T-Band. For example, stakeholders in Boston, Los Angeles, and New York said the Federal Communications Commission (FCC) has not identified sufficient alternative spectrum. Additionally, two studies conducted by a public safety organization concluded these three areas and others may also have insufficient alternative spectrum (see figure below). Moreover, a recent FCC analysis showed that relocation options for public safety users are limited or nonexistent. Further, costs for relocating public safety users from the T-Band were calculated by FCC to be $5-to-$6 billion. Selected stakeholders said relocating their communication systems would require such things as new towers and radios as well as other infrastructure.

Metropolitan Areas Using T-Band Spectrum (470 to 512 megahertz) for Public Safety and Availability of Alternative Spectrum Options

Sources: GAO analysis of Federal Communications Commission (FCC) and public safety stakeholder data. | GAO-19-508

FCC has taken limited actions to address challenges and assist public safety users of the T-Band with the mandatory relocation. For example, FCC has taken steps to notify stakeholders, but officials told GAO they have not begun planning the auction. FCC officials acknowledged challenges the auction and relocation requirements present. FCC officials explained that public safety entities were licensed to operate on the T-Band in large metropolitan areas because other public safety spectrum was already heavily used. In March 2019, FCC briefed Congress on the auction's challenges and concluded that all T-Band auction scenarios would fail. Nonetheless, FCC officials said the agency will conduct the auction unless the law is amended. While FCC provided information to Congress, it did not suggest changes to law in this instance. Stakeholders in two metropolitan areas said the auction could result in substantial harmful effects on their ability to maintain continuous and effective communications during an emergency.

Contents

Abbreviations

DHS	Department of Homeland Security
FCC	Federal Communications Commission
FirstNet	First Responder Network Authority
GHz	gigahertz
KHz	kilohertz
LMR	land mobile radio
NPSTC	National Public Safety Telecommunications Council
NTIA	National Telecommunications and Information Administration

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

June 21, 2019

The Honorable Donald M. Payne, Jr
Chairman
The Honorable Peter T. King
Ranking Member
Subcommittee on Emergency Preparedness, Response, and Recovery
Committee on Homeland Security
House of Representatives

During emergencies, reliable communications are critical for a rapid response. Public safety users, including first responders—such as police and firefighters—and state and local governments, use land mobile radio (LMR) systems as the primary means to gather and share information both for daily operations and emergency response efforts. In 11 large U.S. metropolitan areas, public safety users have built and are operating LMR systems in a portion of the radio frequency spectrum known as the T-Band.[1] Other users of the T-Band include business-industrial users of LMR systems in those same metropolitan areas and television stations.

The Federal Communications Commission (FCC)—the agency that regulates spectrum use for commercial and other nonfederal users—manages spectrum through *allocation* and *assignment*. *Allocation* involves designating bands of spectrum for specific types of services or classes of users, such as for land mobile radio or broadcasting use. *Assignment* provides a license to a specific entity, like a wireless carrier or a state or local government agency, to use a specific portion of spectrum after it has been allocated. FCC uses a competitive-bidding process, or auctions, to assign some licenses to entities that submit the highest bids for licensing in specific bands. In 2012, FCC was required by statute to commence the process for an auction by February 2021 of the T-Band spectrum currently used for public safety and relocate public safety operations from this portion of the band within 2 years of the auction's conclusion.[2] In addition, the proceeds from this auction were

[1]The radio frequency spectrum is the part of the natural spectrum of electromagnetic radiation lying between the frequency limits of 3 kilohertz (KHz) and 300 gigahertz (GHz), with the T-Band lying between 470 to 512 megahertz. Radio signals travel through space in the form of waves. These waves vary in length, and each wavelength is associated with a particular radio frequency.

[2]Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, § 6103, 126 Stat. 156 (2012).

required to be made available to the National Telecommunications and Information Administration (NTIA) to make grants to cover costs for the relocation of public safety entities. Relocated public safety users would therefore need to build new LMR systems on an alternative spectrum band. Public safety users relying on the T-Band and other public safety organizations have expressed concern that relocating to other spectrum could negatively affect public safety and render past investments in public safety infrastructure, such as emergency radio communications systems, useless. According to FCC, its spectrum auctions are intended, among other things, to support the efficient assignment of spectrum licenses and to provide funds to the U.S. Treasury, in certain cases, for specific purposes such as deficit reduction and supporting other government programs.

You asked us to review issues related to the requirement that public safety users relocate their communications systems from the T-Band spectrum. This report examines: (1) the challenges selected first responders and local governments anticipate facing in relocating first responder communications from the T-Band spectrum and (2) any actions FCC and NTIA have taken to help facilitate the mandated T-Band relocation and address identified challenges.

To address these objectives, we (1) reviewed FCC's documents on the T-Band spectrum auction, including public notices and fact sheets; (2) analyzed comments filed with FCC in response to a public notice on the auction; and (3) reviewed FCC's 2015–2018 and 2018–2022 strategic plans. We also reviewed FCC's March 2019 congressional briefing materials and analysis on the T-Band relocation and auction. We reviewed relevant reports from the National Public Safety Telecommunications Council (NPSTC) on the T-Band spectrum auction, the potential effect and cost of relocating public safety users, and NPSTC's assessment of the viability of relocation options.[3] We interviewed NPSTC representatives about these reports and their analysis and concluded the methodology used to conduct the analysis

[3]NPSTC is a federation of organizations whose mission is to improve public safety communications and interoperability through collaborative leadership. Membership includes: the Association of Public-Safety Communications Officials International, the International Association of Chiefs of Police, International Association of Emergency Managers, International Association of Fire Chiefs, and the National Council of Statewide Interoperability Coordinators.

and the conclusions drawn based on the analysis were reasonable.[4] We also reviewed relevant statutes and regulations, including the Middle Class Tax Relief and Job Creation Act of 2012 (the Act) and its provisions related to the T-Band spectrum auction, and the grant program created under the Act to help cover public safety entities' relocation costs from the T-Band spectrum.[5] Additionally, we obtained data from FCC as of August 2018, for the purpose of reviewing T-Band spectrum licenses including city and state in which the license was granted, licensee name, and type of license (public safety, business-industrial, or television broadcast). We then determined in which of the 11 metropolitan areas each public safety license was located. We also conducted a literature search focused on the T-Band spectrum auction's requirements, spectrum relocation costs for public safety, equipment compatibility with alternative spectrum, and the effect of the T-Band spectrum's relocation on neighboring jurisdictions.

In addition, we interviewed officials from FCC and NTIA, which is an agency within the Department of Commerce that is responsible for, among other activities, managing the federal use of spectrum and identifying additional spectrum for commercial use and administering grant programs that further the deployment and use of broadband and other technologies, and the First Responder Network Authority (FirstNet), which is responsible for developing a nationwide, interoperable public safety broadband network. We also interviewed officials from Department of Homeland Security (DHS), which has responsibilities for emergency communications. We also interviewed representatives from professional organizations, industry groups, and business-industrial users of the T-Band to obtain their perspectives on topics related to the T-Band auction requirement and how they might be affected by such a requirement.

We conducted case studies of four of the 11 metropolitan areas where public safety users are assigned T-Band licenses: Boston, Dallas-Fort Worth, Los Angeles, and New York City. We chose these locations by reviewing FCC data on public safety license holders of T-Band spectrum and by identifying and selecting regions that had a high (Boston, Los Angeles, and New York City), and low (Dallas-Fort Worth) likelihood of challenges relocating first responder communications based on the

[4]NPSTC, *T-Band Report* (Mar. 15, 2013) and NPSTC, *T-Band Update Report* (May 31, 2016).

[5]Middle Class Tax Relief and Job Creation Act of 2012§ 6103.

number of public safety licenses in each area. In each location, we spoke with the DHS emergency communications coordinator,[6] representatives from police or fire departments, and a representative of a public safety communications system if one existed. We chose these groups by first identifying organizations that submitted comments to FCC on the T-Band auction and then selecting approximately three to five groups per location. We did not necessarily speak with the same types of groups in each location since the holders of T-Band licenses vary by location. While the results of our case studies are not generalizable, they provide illustrative examples of the challenges public safety officials may face in relocating. A full list of the stakeholders we interviewed can be found in appendix I.

We conducted this performance audit from April 2018 to June 2019 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

Effective communication is vital for first responders' ability to respond to emergencies, ensure the safety of both their personnel and the public, and protect public and private property. For example, first responders use public safety communications systems to gather information, coordinate a response, and, if needed, request resources and assistance from neighboring jurisdictions and the federal government. First responders use several types of communications systems, such as LMR systems, commercial wireless services, and the FirstNet network.

- **LMR systems.** These systems are the primary means for first responders to use voice communications to gather and share information while conducting their daily operations and coordinating their emergency response efforts. LMR systems are intended to

[6]For our case study of the Boston metropolitan area, we interviewed the former emergency communications coordinator since the position was vacant at the time of our review.

provide secure, reliable voice communications in a variety of environments, scenarios, and emergencies.[7]

- **Commercial wireless services.** Public safety entities often pay for commercial wireless services to send data transmissions such as location information, images, and video.[8]
- **FirstNet network.** FirstNet is working to establish a nationwide, dedicated broadband network for public safety use that is intended to foster greater interoperability among first responders, support important voice and data transmissions, and meet public safety officials' reliability needs on a priority basis, including call "preemption."[9] FirstNet's network is intended to complement LMR systems with broadband capabilities and does not serve as a substitute for mission-critical voice needs.

Communications systems must work together, or be interoperable, to ensure effective communication. Emergency communications interoperability refers to the ability of first responders and public safety officials to use their radios and other equipment to communicate with each other across agencies and jurisdictions when needed and as authorized.

First responders' LMR systems operate by transmitting voice communications through radio waves at specific frequencies and

[7]For additional information on LMR, see: GAO, *Emergency Communications: Improved Procurement of Land Mobile Radios Could Enhance Interoperability and Cut Costs*, GAO-17-12, (Washington D.C.: Oct. 5, 2016).

[8]We have previously reported that commercial networks do not always support the reliability and other requirements that public safety officials need. See: GAO, *Public-Safety Broadband Network: FirstNet Should Strengthen Internal Controls and Evaluate Lessons Learned*, GAO-15-407 (Washington, D.C.: Apr. 28, 2015) 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).

[9]Generally, priority transmission of calls and data is provided through special enhancements embedded in telecommunications networks to identify transmissions made by authorized users as higher priority than those made by other users. These enhancements automatically place the transmission higher in the queue over those made by other users. "Preemption" is used together with priority to control use of network resources by removing lower priority users and allowing allocation of resources to higher priority users, when network resources are scarce or fully occupied. For additional information on FirstNet's activities, see: GAO, *Public-Safety Broadband Network: FirstNet Has Made Progress Establishing the Network, but Should Address Stakeholder Concerns and Workforce Planning,* GAO-17-569 (Washington, D.C.: June 20, 2017).

channels within the electromagnetic spectrum. FCC is responsible for allocating spectrum for various purposes and assigning spectrum licenses in a specific area and to a specific entity such as a police department or a telecommunications company. As previously noted, an auction is one mechanism that FCC may use to assign spectrum licenses. According to FCC officials, due to certain restrictions in the Communications Act, FCC has used administrative procedures, not auctions, to assign licenses for public safety and non-commercial educational broadcast stations.[10]

Over the years, spectrum for public safety has expanded to new frequency bands, as previously available frequencies became congested and public safety needs for spectrum increased. As we have previously reported, congestion results from growth in the overall number of users and demand for spectrum dependent technologies and services.[11] Because of the increased demand for spectrum, in 1971 FCC authorized public safety and business-industrial users to share a portion of the T-Band spectrum (470 to 512 megahertz) with television broadcast stations in 11 metropolitan areas.[12] The 11 metropolitan areas, which are identified in figure 1, include almost all the most populous metropolitan areas in the United States.[13] The entire T-Band is not available for public safety and business users in these 11 metropolitan areas to build and operate LMR systems, and the amount of spectrum varies in each area. FCC rules allow "base station transmitters"—the equipment that emits radio signals to communicate with mobile units—to be located within 50 miles from the geographic center of each metropolitan area, as shown in figure 1.[14]

[10]FCC lacks the statutory authority to auction licenses for (1) public safety radio services that are used to protect the safety of life, health, or property and are not made commercially available to the public, and (2) noncommercial educational broadcast stations. 47 U.S.C. § 309(j)(2)(A).

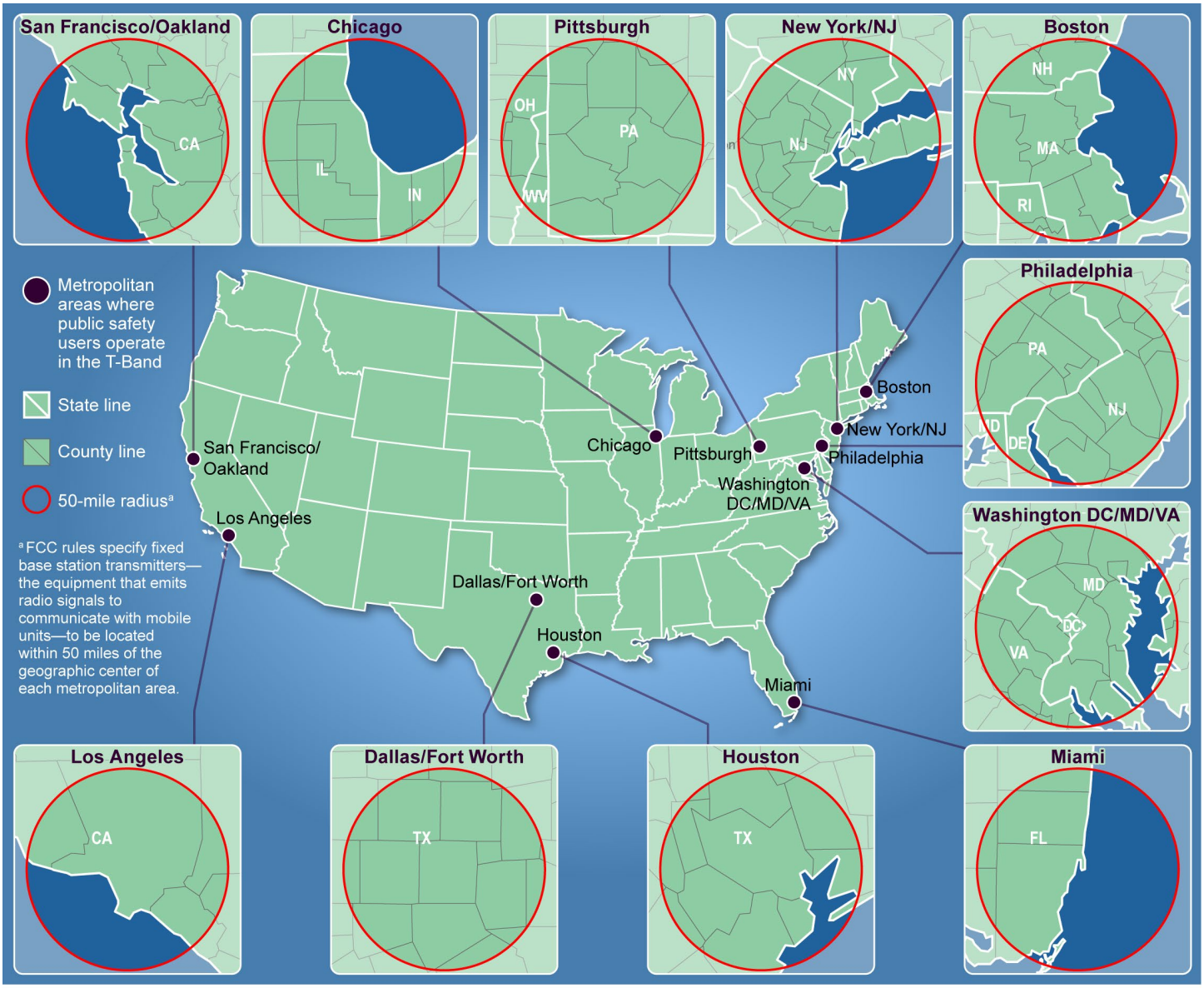
[11]GAO-13-78R

[12]Part 90, subpart L, of title 47 of the C.F.R. governs the authorization and use of frequencies by land mobile stations in the band 470-512MHz on a geographically shared basis with television broadcast stations. Because this spectrum corresponds with television channels 14-20, it is referred to as the T-Band.

[13]Metropolitan population totals are based on 2017 U.S. Census Bureau estimates.

[14]47 C.F.R. § 90.305(a). FCC's rules also allow mobile units to operate within a 30 mile radius of transmitter sites. *C.F.R.* § 90.305(b). This means that public safety operations are generally allowed to operate within 80 miles of the geographic center of the metropolitan area.

Figure 1: Metropolitan Areas Where FCC Rules Authorize Public Safety and Businesses to Use the T-Band Spectrum, 470 to 512 megahertz



Sources: GAO analysis based on Federal Communications Commission (FCC) rules and Map Resources. | GAO-19-508

In 2012, as part of the Middle Class Tax Relief and Job Creation Act of 2012 (the Act), FCC was required by statute to reallocate the T-Band spectrum currently used by public safety and commence the process for an auction by February 22, 2021.[15] As part of the reallocation of the T-Band for the 11 metropolitan areas listed above, the proceeds from the required auction shall be available to NTIA to make grants to cover relocation costs for the relocation of public safety entities. The grants are to be funded by the auction proceeds for the purpose of helping cover these users' relocation costs.[16] According to FCC officials, the Act does not address the hundreds of business-industrial users also using the T-Band and does not set aside or identify replacement spectrum for public safety users. DHS officials told us that the Act does not provide a formal role for DHS in the T-Band spectrum auction or relocation of public safety users.[17] While one purpose of spectrum auctions is to recover the public portion of the value of spectrum, FCC officials told us that the Act and its legislative history do not explain the purpose of the T-Band auction and relocation, and we confirmed the absence of legislative history for the auction mandate.

According to FCC officials, there are approximately 925 public safety entities with licenses in the T-Band. Each of these entities holds at least one license, but in some cases may hold many licenses. For example, the State of Texas holds one public safety license in the T-Band in the Houston metropolitan area, while the New York City Police Department has 180 licenses in the New York City metropolitan area. The number of

[15]Middle Class Tax Relief and Job Creation Act of 2012 § 6103(a)(1)-(2). The Act also requires FCC to reallocate the "D Block" spectrum— a previously commercial spectrum block located in the upper 700 megahertz band—for use by public safety and allows FCC to use narrowband spectrum—769-775 and 799-805 megahertz—in a flexible manner, including usage for public safety broadband communications. §§ 6101(a), 6102.

[16]Middle Class Tax Relief and Job Creation Act of 2012 § 6103(b).

[17]DHS has responsibilities for emergency communications, including awarding preparedness grants to state, local, tribal, and territorial governments, that can be used to help build communications systems and to provide guidance, governance planning, and technical assistance to help ensure federal, state, local, tribal, and territorial agencies have the necessary plans, resources, and training they need to support operable and interoperable emergency communications. For more information see GAO, *Emergency Communications: Office of Emergency Communications Should Take Steps to Help Improve External Communications,* GAO-19-171 (Washington, D.C.: Dec. 12, 2018) and GAO, *Emergency Communications: Increased Regional Collaboration could Enhance Capabilities*, GAO-18-379 (Washington, D.C.: Apr. 26, 2019).

licenses held by each entity depends on the demand for the spectrum for LMR systems and the availability of spectrum in other bands allocated for public safety use. FCC estimates that public safety entities have approximately 3,000 stations within the T-Band. Additionally, FCC said that the T-Band also contains approximately 700 business-industrial users that occupy about 1,700 stations.

T-Band Relocation Poses Significant Challenges, Including Uncertainty of Available Spectrum, High Cost, and Interoperability Concerns

Lack of Available Alternative Spectrum in Major Metropolitan Areas

Public safety officials in three of our four selected metropolitan areas—Boston, Los Angeles, and New York City—told us that they have not been able to identify alternative spectrum to relocate from the T-Band, a situation that raises questions about the feasibility of the auction and relocation.[18] For example, all of the officials we interviewed from New York City police, fire, and emergency management departments said there is no spectrum available for them to relocate to. The officials noted that the New York City Police Department is the largest municipal police department in the country and that it relies on the T-Band to dispatch police for 911 calls. Additionally an official from Pasadena in the Los Angeles metropolitan area said that the spectrum allocated for public safety in the region is already crowded and that officials are unsure of where to relocate their emergency communication operations. Public safety officials from Boston, Los Angeles, and New York City metropolitan areas also said that FCC has not provided a plan or identified alternative spectrum for relocation.

[18]As discussed above, while FCC regulates spectrum for commercial and other nonfederal users, many of the public safety officials we discussed this issue with had knowledge of the overall usage of public safety spectrum in their areas.

In 2013, in anticipation of the mandatory T-Band auction, FCC published a notice and solicited public comment to gather information on when, how, and under what circumstances to relocate public safety and business-industrial users of the T-Band.[19] At that time, FCC asked commenters what alternative spectrum bands were potentially available for relocation of T-Band's public safety users, and whether these users could relocate to other public safety bands including the 700 and 800 MHz bands.

In response to FCC's request for comment, NPSTC conducted an analysis and reported in 2013 that the 11 different metropolitan areas would face different likelihoods of relocating to alternative spectrum.[20] NPSTC analyzed FCC data on T-Band licenses to determine the number of public safety licenses that would need to be relocated, and then compared the need for licenses to the available licenses in other spectrum bands that FCC has allocated for public safety use.[21] Based on that analysis NPSTC concluded the following.

- In five of the 11 metropolitan areas, relocating public safety users from the T-Band would not be possible. Specifically, in addition to identifying the three metropolitan areas we discuss above (Boston, Los Angeles and New York City), NPSTC concluded that at least two other metropolitan areas (Chicago and Philadelphia) lacked sufficient spectrum in any band to relocate public safety's existing T-Band operations.
- For the other six metropolitan areas (Pittsburgh, San Francisco, Washington, D.C., Dallas-Fort Worth, Houston, and Miami) NPSTC's analysis found that these areas might have sufficient spectrum to relocate T-Band users, with the 700 MHz narrowband offering the greatest potential. These metropolitan areas have fewer public safety T-Band licensees needing to relocate. Representatives from a trade organization that represents business-industrial users of the T-Band told us that in five of these six metropolitan areas, business-industrial users hold more than half of T-Band licenses. Specifically, the

[19]*Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Seek Comment on Options for 470-512 MHz (T-Band) Spectrum*, 28 FCC Rcd. 1130 (2013).

[20]NPSTC, *T-Band Report,* (March 15, 2013).

[21]NPSTC examined the availability of Very High Frequency, Ultra High Frequency, 800 MHz, and 700 MHz public safety spectrum bands.

representatives noted that approximately 95 percent of T-Band users in the Houston metropolitan area are business-industrial users and that in Pittsburgh, Washington, D.C., Dallas-Fort Worth, and Miami metropolitan areas more than 50 percent of the T-Band users are business-industrial users.

Our interviews with selected local officials confirmed that public safety users in Dallas-Fort Worth (our fourth selected metropolitan area) have had success transitioning off the T-Band. Two of the three public safety licensees we talked with told us they had already transitioned off the T-Band and noted that it was unrelated to the required T-Band auction. For example, an official from the City of Dallas, which holds one public safety license in the T-Band, told us that in 2012 the city began replacing existing radios with new radios that did not operate on the T-Band. The official said the city stopped operating on the T-Band in 2013 and relocated operations onto another spectrum band where most of the city's public safety communications operated.[22] Another T-Band public-safety licensee from the Dallas-Fort Worth metropolitan area told us that although it has active licenses they were unaware of the required auction or need to relocate from the T-Band.

FCC and DHS officials told us the analysis conducted by NPSTC was a good source of information about the potential negative effects of the T-Band auction on public safety users, including numbers related to licensing and potential cost. DHS officials told us that NPSTC has broad expertise in emergency communications, noting that it is a member of two federally supported organizations that promote the interoperability of emergency communications—the Public Safety Advisory Committee and SAFECOM.[23] Additionally, SAFECOM worked with another federally supported emergency communications advisory group—the National Council of Statewide Interoperability Coordinators—to create a publicly available document on the T-Band auction and the potential effects on public safety and cited the NPSTC's report in the assessment.[24] The

[22]Although the City of Dallas no longer operates on the T-Band, the city continues to hold the license until it expires in 2025.

[23]The Public Safety Advisory Committee is composed of members of local, tribal, and state public safety organizations; federal agencies; and national public safety organizations. SAFECOM consists of more 60 members representing Federal, State, local, tribal, and territorial emergency responders, and major intergovernmental and national public safety associations.

[24]National Council of Statewide Interoperability Coordinators and SAFECOM, *The T-Band Giveback: Implications for the Public Safety Community* (October 2015).

document, notes that insufficient spectrum alternatives leave few options for identifying replacement spectrum in several major metropolitan areas.

Selected representatives from industry groups whose members are business-industrial T-Band users in the 11 T-Band metropolitan areas, such as the American Petroleum Institute and the Utilities Technology Council, also said they anticipate that there would not be alternative spectrum available if required to relocate. For example, representatives with the American Petroleum Institute said that there are staff at major refineries that use the T-Band on a daily basis for all plant operations including emergency response (firefighters and hazardous materials), control room, engineering, and maintenance, and that relocating to new spectrum would be challenging given the lack of available spectrum. These representatives noted that most of the refineries that use the T-Band are located in Houston, but there are also some facilities in the San Francisco, Los Angeles, and Philadelphia metropolitan areas.

In March 2019 FCC officials told us that based on their analysis alternative spectrum relocation options for public safety users are limited or non-existent. For example, FCC found that other frequency bands are insufficient because: (1) existing public safety spectrum bands are already largely occupied; (2) spectrum is heavily encumbered (that is currently used by another licensee) in major cities; or (3) available spectrum is not viable for public safety due to interference

Relocation Costs Could be in the Billions of Dollars

Public safety officials in Boston, Los Angeles, and New York City agreed that relocating LMR operations from one spectrum band to another can be costly, complicated, and time intensive given infrastructure and equipment needs. These officials told us that transitioning from the T-Band requires identifying and acquiring new sites to build towers, purchasing new radios, testing new systems, building other infrastructure, and training personnel on the new systems.

NPSTC calculated in its 2013 report that the cost to relocate public safety operations in the 11 metropolitan areas would be approximately $5.9 billion. Their calculation includes the costs for the total estimated number of new towers, cables, antennas, and mobile, portable, and vehicular

radios. [25] In 2016, after updating its analysis, NPSTC's second report confirmed that the conclusions from the 2013 report remain valid.[26] According to FCC officials, in early 2019 they analyzed the costs for relocating public safety users from the T-Band and estimated the total cost would be between $5 and $6 billion.

Officials from nearly all of the public safety entities we interviewed in the Boston and New York City metropolitan areas cited the NPSTC reports as the best source of publicly available cost calculations for relocating public safety users from the T-Band.[27] Officials from nearly all of the public safety entities we interviewed in Boston, Los Angeles, and New York City told us that estimating relocation costs is and will remain difficult until alternative spectrum is identified. However a few selected public safety users provided us with high-level cost estimates for replacing LMR system components. For example, an official in Pasadena said a conservative estimate for those components would be $13 to $14 million; while public safety officials in New York City estimated component costs would be at least $1.8 billion. According to public safety officials in Morris County, New Jersey, and Yonkers, New York, the financial burden may be greater for less populated areas, despite the higher anticipated actual cost for more populated areas. For instance, public safety officials in Morris County, New Jersey, told us they estimated $30 million in relocation costs, which exceeds the county's total annual capital project budgets (approximately $20 to 25 million).

According to public safety users in the Boston, Los Angeles, and New York City metropolitan areas, costs for relocating LMR systems from the T-Band depend on a variety of factors including (1) equipment, (2) infrastructure, and (3) real estate.

[25]The report notes that the cost calculations are high level and the working group may have overlooked costs associated with the transition, and that the actual cost could vary substantially from the calculations included in the report. NPSTC, *T-Band Report* (Mar. 15, 2013).

[26]NPSTC, *T-Band Update Report* (May 31, 2016).

[27]Officials with two public safety entities in the Dallas-Fort Worth metropolitan area did not comment on NPSTC's cost analysis since they had already transitioned off the T-Band. However a city official from one of these entities explained that transitioning off the T-Band had been relatively inexpensive—approximately $25,000 to $50,000—because the city held only one public safety license with 10 to 20 radios operating on the spectrum. The official also explained that purchasing new radios was their only cost since they moved to an existing city system that required no additional infrastructure or real estate.

1. **Equipment.** Transitioning to another spectrum band could require public safety users to purchase new equipment such as radios. Some radios can only operate on one spectrum band, so moving to a new band requires purchasing new radios that can operate on that band. Alternatively, users could purchase multi- band radios, which can operate on more than one radio frequency band. According to public safety officials we spoke with, multi-band radios might be the best option since it is not clear which frequencies they will ultimately be relocated to. However, they also noted that multi-band radios are substantially more expensive than single band radios. For example, officials with the Boston Fire Department told us a regular radio costs approximately $5,000 each while multi-band radios cost up to $8,000. These officials told us that relocating from the T-Band would mean replacing approximately 1,800 radios with multi-band units, meaning that just replacing the Boston Fire Department's handheld and portable radios could cost more than $14 million. Additionally, public safety officials in Boston and New York City added that local building codes in those areas require buildings of a certain size to install equipment that amplifies wireless signals throughout a building and improves coverage. These systems help first responders, such as police and firefighters, communicate with each other in large buildings.
2. **Infrastructure.** Infrastructure costs could include new radio towers and antennas and fiber-optic cable systems. Because different radio frequencies have different characteristics and can cover different distances, depending on to which spectrum band public safety users are relocated, circumstances may require more radio towers and antennas. For example, officials with the Boston Fire Department told us that if space were available and they were to relocate from the T-Band to the 800 MHz public safety band, they would need additional radio towers. Specifically, these officials said their current system consists of 42 receivers and five transmitting sites and estimated that a system in the 800 MHz band would likely require up to 60 receivers and five-to-nine transmit sites. FCC officials told us that based on the characteristics of other spectrum bands allocated to public safety, users may need to build between two and three times as much infrastructure to provide the same coverage. The officials noted this would substantially increase relocation costs. Additionally, public safety officials in Boston and New York City told us they are able to use the T-Band to communicate in the tunnels beneath each city because of infrastructure investments like the T-Band specific radiating cables, which allow first responder's radios to work underground. Officials from New York City police, fire, emergency-

management department and the mayor's office said that relocating to a new spectrum would require installing a new radiating cable system in hundreds of miles of subway, train, and vehicle tunnels. These officials estimated that replacing the radiating cable infrastructure alone would take at least a decade and cost over $1 billion. Officials added that replacing the infrastructure would involve closing subway lines for extended periods of time as the new cables are installed.

3. **Real estate.** Costs associated with buying or leasing new real-estate sites for towers and other radio equipment will also affect the cost estimate for public safety users. Officials from Boston, Los Angeles, and New York City told us that because of the characteristics of different spectrum bands, building a replacement system might require additional sites. Additionally, officials with New York City told us that identifying locations and negotiating leases for radio towers and spaces for other equipment including radio cabinets would likely be difficult due to the scarcity of and high costs of appropriate sites in New York City.

Public safety officials in Boston, Los Angeles, and New York City added that relocating from the T-Band would require building and operating parallel systems to avoid disrupting emergency communications. This project would require some duplication of investments—for example, radio towers, radio cabinets, and antennas, among other equipment and infrastructure—during the transition. For example, officials in New York City police, fire, and emergency-management departments told us they would need to build a dual system that could require at least twice as much space for equipment. They also noted that the current sites are rent free because of existing arrangements, but they believe that it is unlikely that landlords will provide additional space rent free. These officials told us that even if FCC identified available spectrum for them to relocate to, they would be unable to build and test the systems in the 2-year time frame required by statute.[28] For example, New York City officials estimated buildout and testing could take over a decade, which they indicated would also substantially increase the city's cost.

Public safety stakeholders in the Boston, Los Angeles, and New York City metropolitan areas told us that it is difficult to estimate the time needed to build new LMR systems, but estimates ranged from 2 to more than 10

[28]According to FCC officials as of March 2019, FCC had not defined what actions would need to be taken to constitute relocating.

years from the time that alternative spectrum was identified. They noted that these time frames would also depend on the availability of funding and on the complexity of the new systems to be designed, built, and tested. FCC officials also told us that the time and expense of relocating hundreds of licensees at thousands of sites is difficult to predict due to many local factors. For instance, FCC officials cited their ongoing experience relocating public safety licensees within the 800 MHz band which was originally estimated to take 3 years. However, based on certain factors such as the geographic location and interdependencies of communications systems, this relocation effort remains incomplete after 14 years.[29]

Potential Difficulties in Maintaining Interoperability and Reliability of Emergency Communications on Alternative Spectrum

Public safety stakeholders we talked to told us that the T-Band is important for the interoperability of public safety equipment and said that maintaining interoperability on alternative spectrum would be a challenge. Boston officials told us interoperability is vital for public safety and the T-Band is the key for their interoperability capabilities. For example, these officials said the LMR systems that allow almost 170 local, county, state, and federal law enforcement agencies to communicate with each other use the T-Band. The officials said this network of LMR systems is the only way for all these entities to communicate on a daily basis and is also used for command and control for crisis response at major events such as the Boston Marathon. These officials credited this system on the T-Band for the successful response to the 2013 Boston Marathon bombing. Officials said the LMR system allowed first responders in neighboring jurisdictions to provide additional communication equipment and personnel during the ensuing manhunt. Similarly, officials from New York City told us the T-Band now provides the foundation for all first responder communications in the area. Officials said the September 11, 2001, terrorist attacks demonstrated the loss of life that can occur when first responders are unable to communicate with each other because there was no system in place to allow police, fire, and emergency medical services to easily communicate. As a result, officials said New York City has spent countless hours and millions of dollars to improve interoperability, and that the interoperable system currently in place is based on the T-Band.

[29]According to FCC officials, another reason for the extended time frame was that public safety systems cannot be turned off while equipment (such as antennas) is reconfigured. Relocating public safety from the T-Band would face similar challenges. However, due to unique challenges for each, a direct comparison cannot be made to a mandated T-Band auction.

In December 2018, we reported that it is vital for first responders—such as police officers and firefighters—to have (1) timely communications; (2) sufficient capacity to handle the communications; and (3) interoperable communications systems that enable first responders to connect with their counterparts in other agencies and jurisdictions, even if their counterparts' systems or equipment vendors differ.[30] As noted previously, public safety users rely on LMR systems as their primary means to gather and share information. For public safety users that rely on the T-Band for interoperable communications and that lack alternative spectrum to build new interoperable systems, losing access to the T-Band would mean public safety officials in multiple large metropolitan areas would be unable to communicate with first responders within their community, neighboring jurisdictions, and the federal government.

Public safety officials in Boston, Los Angeles, and New York City told us that the characteristics of the T-Band spectrum are ideal for reliable emergency communications and that moving to another spectrum band may present a challenge to reliability. Since different frequencies of radio waves have different characteristics, jurisdictions typically use the spectrum that is best suited for their particular location. The officials told us that the T-Band's characteristics allow radio signals to penetrate buildings and across varied terrain and require less infrastructure investments, such as radio towers, than other frequency bands assigned for public safety use. Los Angeles County officials cited the characteristics of the T-Band as the primary advantage the current radio system has over other systems operating on other spectrum bands. They explained that the characteristics make it more suitable for challenging terrain on the forested, mountainous, and coastal areas of the county, than similarly equipped radio systems operating in other frequency bands.

[30]GAO-19-171.

FCC Has Taken Limited Actions to Help Facilitate the Mandated Spectrum Auction and Address Relocation Challenges; NTIA Is Awaiting FCC Action before Designing a Grant Program

FCC Has Taken Some Preliminary Steps to Prepare for the Auction but Has Not Taken Additional Action

FCC has taken some preliminary steps to help facilitate the mandated relocation of public safety users from the T-band, such as imposing a T-Band license freeze, requesting public comments, and creating a fact sheet to notify stakeholders of the spectrum auction and prepare for the auction.

In April 2012, FCC froze the processing of applications for new or expanded T-Band radio operations in an effort to avoid adding to the cost and complexity of the mandated public safety relocation. Affected applications included those seeking: (1) new T-Band licenses; (2) modifications to existing licenses by adding or changing frequencies or locations within the T-Band; (3) modifications to existing licenses by changing technical parameters—such as increases in bandwidth, power level, antenna height, or area of operation—in a manner that expands the station's spectral or geographic footprint; and (4) any other modification that could increase the degree to which the 470–512 MHz band currently is licensed. Both public safety and business-industrial users we interviewed expressed concerns about the license freeze and said it has caused some uncertainty and in limited cases has affected their ability to maintain existing systems. For example, public safety officials from one department we interviewed in the Boston metropolitan area said the freeze has affected users' ability to replace aging equipment, which has led to poor communications in the area. Additionally, representatives from one business-industrial user told us that Hurricane Harvey destroyed one of its LMR sites and that the entity was having trouble rebuilding a site elsewhere since FCC considers this action a major change and thus affected by the license freeze. FCC staff told us that the public notice

announcing the license freeze specifically advised affected parties that they could request a waiver in unusual circumstances where the public interest so warrants, and that that no such request appears to have been filed in this instance.

In addition, as discussed earlier, FCC sought public comment in February 2013 to gather information and specific proposals for reallocating and auctioning the T-Band. FCC officials said they continue to evaluate auction proposals from these comments. In October 2014, FCC released a report and order making 24 channels in the 700 MHz narrowband, previously held in reserve, available for public safety users.[31] FCC concluded that given the significant increase in demand for 700 MHz narrowband spectrum, particularly in urban areas, these channels should be made available for use. Public safety users of the T-Band were given priority to these new channels if they committed to return an equal amount of T-Band channels and obtained the concurrence of the relevant regional-planning committees.[32] According to NPSTC's 2016 report, these 24 additional channels are beneficial but insufficient to relocate all current users of the T-Band. The report notes that channel insufficiency is particularly challenging in the five metropolitan areas where T-Band usage is the highest—Boston, Chicago, Los Angeles, New York City, and Philadelphia. Furthermore, one public safety official in the Los Angeles metropolitan area raised concerns about potential radio interference if relocated to another frequency. The official said that currently, because the T-Band is not used by neighboring jurisdictions, the city does not currently have to worry about frequency interference. By contrast, the 700 and 800 MHz band is currently occupied by public safety in neighboring Riverside and San Diego Counties. This means, according to the official, that building a new system operating in the 700-800 MHz band could potentially introduce interference issues.

[31] *In the Matter of Proposed Amendments to the Service Rules Governing Public Safety Narrowband Operations in the 769-775/799-805 MHz Bands,* Report and Order, 29 FCC Rcd. 13283 (2014); *National Public Safety Telecommunications Council Petition for Rulemaking on Aircraft Voice Operations at 700 MHz,* Report and Order, 28 FCC Rcd. 4783 (2013).

[32] FCC authorizes Regional Planning Committees to serve public safety communications users through planning and management for their spectrum needs. *Proposed Amendments to the Service Rules Governing Public Safety Narrowband Operations in the 769-775/799-805 MHz Bands,* Report and Order, 29 FCC Rcd 13283, 13299, para. 44 (2014).

FCC also created a fact sheet in July 2016 with basic information on the statutory relocation requirement. The T-Band fact sheet states that the relocation shall be completed within 2 years of the auction's completion date: the exact timing of the relocation deadline will depend on when the auction concludes. FCC officials told us the T-Band fact sheet is the only formal T-band auction guidance that they have provided. However, officials said that they have also met with several licensees to discuss T-Band issues. For example, according to officials, FCC has met with public safety entities from areas such as Los Angeles, Chicago, Boston, and New York City. DHS officials told us that while they have no formal role in the T-Band auction and relocation of public safety users, they provide this fact sheet when they are asked for details about the T-Band auction as a way to help raise awareness about the auction and relocation requirements.[33] Although FCC has made efforts to provide guidance and information to T-band users regarding the mandated auction, as we discuss earlier in the report, we found that not all T-Band users we interviewed are aware of the upcoming auction or the need to relocate from the T-Band.

FCC has not set a timeline for initiating the auction but has stated that it is committed under any scenario to ensure the continuity of T-Band licensee's public safety mission-critical communications. According to FCC officials, as of March 2019, almost all T-Band licensees continue to operate on the T-Band spectrum, and FCC officials cited multiple factors for the limited progress in preparing for the T-Band auction:

- FCC has not determined how to address challenges stakeholders identified in response to FCC's 2013 request for public comment, including the lack of available spectrum to relocate and the cost. For example, officials told us that they are taking a wait-and-see approach to see how many T-Band licensees relocate prior to the auction. However, as noted previously, FCC officials told us their analysis of other spectrum bands shows insufficient spectrum for relocating public safety entities from the T-Band. The officials told us that public safety operates on the T-Band in large metropolitan areas where other public safety spectrum is heavily used and that this reason is

[33]DHS officials told us they have also contacted public safety users in the 11 metropolitan areas about the auction and have answered questions to the best of their abilities. They said that they have directed those users to FCC and NTIA for more detailed answers. The officials also said they have shared stakeholder concerns that they have heard about the T-Band auction with FCC and NTIA.

why the T-Band was allocated for LMR in these areas in the first place.

- The T-Band auction has raised complicated relocation questions. For example, select industry groups we spoke to whose members are business-industrial T-Band users expressed concern about the uncertainty of the spectrum auction requirements, since the Act was silent on business-industrial users, but they are constrained by the license freeze from replacing aging equipment. FCC previously told us that it had not determined whether business-industrial users would be required to relocate. However, in April 2019, FCC officials told us that it intends to implement the auction following the statute's language. FCC officials stated that the Act does not expressly require it to auction spectrum licensed to business-industrial users, but officials also stated that FCC may decide that it has the authority to auction that spectrum under a different statutory provision. Before conducting the auction, FCC must issue a notice, which includes a public comment period, to determine the auction procedures and requirements. FCC officials told us they have not progressed beyond the preliminary conceptual stages and do not have a precise timeline for the pre-auction process or auction. The officials explained that if business-industrial users relocate, they would face similar relocation challenges to that of public safety users and the Act does not mention them as eligible for relocation grants. According to FCC officials, licenses for business-industrial users outnumber those of public safety users on the T-Band in some areas.
- According to FCC officials and a FirstNet official, public safety users on the T-Band may subscribe to services on FirstNet's nationwide public safety broadband network, which offers some voice functionality. However, officials said the network currently does not accommodate the need of public safety users for mission-critical voice functionality.[34] For example, FCC officials told us that FirstNet's network is not a substitute for mission critical voice systems operated by public safety licensees in the T-Band because the network does not support such capabilities and because there is no plan or schedule in place for the network to begin offering such services.

[34]FirstNet was created to establish a nationwide, interoperable, wireless broadband network for use by federal, state, tribal, and local public safety personnel. FirstNet is an independent authority within the Department of Commerce. For additional information on FirstNet's activities, see: GAO, *Public-Safety Broadband Network: FirstNet Has Made Progress Establishing the Network, but Should Address Stakeholder Concerns and Workforce Planning,* GAO-17-569 (Washington, D.C.: June 20, 2017).

According to an official at FirstNet, this network is intended to complement LMR systems with broadband capabilities, not replace LMR systems in the near future. In the interim, public safety users electing to use FirstNet's broadband network will need to continue to use LMR networks for their mission critical voice needs while evaluating whether their future voice needs require continued maintenance of their LMR networks or whether FirstNet broadband services could fulfill their wireless communications requirements.

FCC Officials Said That T-Band Spectrum Has Potentially Low Auction Value; NTIA Is Awaiting FCC Action

The amount of proceeds that may be generated from the T-Band auction—which are, according to FCC, expected to be the sole source of federal funding to help cover the relocation costs incurred by public safety entities—is likely to be less than the total relocation costs. FCC officials told us the T-Band has potentially low value because of limited demand by potential bidders in the auction. For example, FCC officials estimated that revenue for the entire T-Band would not exceed $2 billion. To reach this amount would require public safety and business-industrial users to relocate from the T-Band, which according to FCC estimates could cost between $9 and $10 billion.[35] As discussed previously, representatives from a trade organization told us that in five of 11 metropolitan areas where public safety uses the T-Band, business-industrial users hold more than half of T-Band licenses. Because of the high numbers of business-industrial users in the T-Band, there may be less spectrum to auction than perhaps initially contemplated when the Act was passed, which would ultimately affect auction proceeds. If FCC were to decide that it has the authority to auction spectrum utilized by business industrial users under a different statutory provision, as explained above, proceeds would be higher.

As discussed above, NTIA is to make grants to cover relocation costs for the relocation of public safety entities in accordance with the Middle Class Tax Relief Act. However, NTIA officials told us that the agency has no dedicated funding to administer such a program and must wait for auction proceeds to stand one up. The officials also said that only when the auction concludes will NTIA know the total amount available and how best to disburse those funds for relocating agencies. Thus, designing a

[35]In addition to the estimated $5–$6 billion to relocate public safety users, FCC estimated that it would cost approximately an additional $4 billion to relocate business-industrial users from the T-Band.

grant program, notifying eligible parties of available grants, evaluating applications, and issuing awards must all take place during the statutory 2-year relocation period. If agencies require the funds before they can move to other frequencies, it is unlikely that this migration can meet the two-year deadline. NTIA officials also stated that until they design the grant program, they do not have any relevant information to provide public safety stakeholders. NTIA officials said they would provide information on the grant program and begin making grants as soon as possible given the statutory requirement for public safety users to relocate within 2 years of the auction's conclusion.

According to NTIA officials, because the requirements for NTIA's grant program for public safety relocation costs have not yet been specified, it is unclear what expenses will be covered. As previously discussed, FCC and NPSTC each calculated the cost for relocating public safety users in the 11 metropolitan areas and each arrived at an estimate between $5 and $6 billion. FCC officials said because of the high relocation costs and likely low value of the T-Band's being auctioned, there is a strong likelihood auction proceeds would not cover public safety relocation costs. Although the Act stipulates that auction proceeds shall be made available through grants in such sums necessary to cover costs for the relocation of public safety entities from the T-Band spectrum, FCC officials said the Act did not address what would happen if the auction generated insufficient funds to cover relocation costs. Consequently, public safety stakeholders from Boston, Los Angeles, and New York City expressed concern about moving forward with relocating. These stakeholders identified the uncertainty of what spectrum would ultimately be auctioned as one of the main reasons they were concerned they would be unable to fully cover their relocation costs.

FCC Plans to Proceed with the T-Band Auction Unless There Is a Statutory Change

FCC officials stated that they recognize that the T-Band auction and relocation requirement present challenges for FCC and public safety entities—and potentially business-industrial users—particularly since spectrum for relocating all public safety users is limited to non-existent. However, these officials said they will design and conduct the spectrum auction, as required, unless the law is changed. In this case, FCC officials told us they provided Congress with information on the challenges associated with the auction. While FCC provided information to Congress, it did not suggest changes to law in this instance. As such, officials told us in March 2019 they were in the process of briefing key congressional committees on the challenges associated with the T-Band auction based on FCC analysis. According to this analysis, all T-Band auction scenarios

would fail. FCC ran auction scenarios that looked at different options for relocating users and auctioning the T-Band used by public safety. These scenarios included relocating only public safety users, relocating public safety and business-industrial users, relocating public safety users, and reorganizing business-industrial users within the T-Band. In 2018, bills were introduced in both the House of Representatives and the Senate to repeal the requirement for FCC to reallocate and auction the T-Band. These bills were not enacted and expired at the end of the 115th Congress. However, in January 2019, a bill was introduced—and subsequently referred to a House subcommittee—to repeal the T-Band relocation and auction requirements. As of June 2019, no further action has taken place on the legislation.[36]

According to FCC's strategic plan, one of FCC's priorities is to protect public safety, and in particular, take steps to assist and safeguard the communications of our nation's law enforcement officers and first responders.[37] However, auctioning the T-Band spectrum, as FCC has been mandated to do, could hamper its ability to safeguard these communications.

As mentioned above, the Act and its legislative history do not discuss the purpose of the T-Band auction. Public safety stakeholders in Boston, Los Angeles, and New York City told us they believe that there may have been an assumption the FirstNet network could absorb public safety users, but at this time the network does not support mission-critical voice capabilities first responders need. According to stakeholders in the Boston and New York City metropolitan areas, if the provision requiring the auction of public safety users' T-band spectrum remains in effect and if the auction takes place, they could experience substantial harmful effects on their ability to maintain continuous and effective communications during an emergency. Officials representing seven public safety entities told us they favored Congress' repealing the required T-Band auction for this very reason. For example, public safety officials in New York City said they believe the T-Band auction would severely negatively affect their ability to respond to emergencies and could lead to the loss of lives. In addition, officials with the Boston police department told us the T-Band is the lifeblood of police communications and the only way for almost 170 law enforcement departments in the Boston

[36]Don't Break Up the T-Band Act of 2019, H.R. 451, 116th Cong. (2019).

[37]FCC, *Strategic Plan 2018-2022 (Washington, D.C.)*.

metropolitan area to communicate with one another on a daily basis and during major events. These officials said that auctioning the T-Band and forcing them to relocate and build a new system over several years would disrupt critical public safety communications and be disastrous.

Conclusions

Since the passage of legislation requiring the relocation of public safety users from, and auction of, the T-band radio spectrum, the potential consequences of these actions have become far more apparent. If FCC conducts such an auction, it is unclear that all public safety users in the affected areas will be able to relocate. If alternative spectrum is not available, public safety would be jeopardized in some of the nation's largest metropolitan areas. Even if alternate available spectrum can be found, public safety users are likely to bear significant costs associated with relocating and reestablishing interoperability. These costs could go well beyond the revenue produced by such an auction.

Matter for Congressional Consideration

Congress should consider legislation allowing public safety users continued use of the T-Band radio spectrum. (Matter for Consideration 1)

Agency Comments

We provided a draft of this report to the Department of Commerce, DHS, and FCC for review and comment. DHS and FCC provided technical comments, which we incorporated as appropriate. The Department of Commerce indicated that it did not have comments.

We are sending copies of this report to the appropriate congressional committees, the Secretaries of Commerce and Homeland Security, and the Chairman of FCC. In addition, the report is available at no charge on the GAO 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 goldsteinm@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.

Mark L. Goldstein
Director, Physical Infrastructure Issues

Appendix I: List of Interviewees

Table 1: List of T-Band Spectrum Stakeholders GAO Interviewed

Category		Stakeholder
Government agencies		Federal Communications Commission
		National Telecommunications and Information Administration
		Department of Homeland Security (DHS)
		First Responder Network Authority
Industry and professional associations		National Public Safety Telecommunications Council
		Enterprise Wireless Alliance
		Utilities Technology Council
		American Petroleum Institute
		Telecommunications Industry Association
		International Association of Fire Chiefs
		National Association of Broadcasters
Business-industrial users		Exxon Mobile
		General Motors
		Shell Oil Company
Case study	Boston Metropolitan Area	DHS – Former Office of Emergency Communications Region 1 Coordinator[a]
		Boston Fire Department
		Boston Police Department
		Cambridge Public Safety
		Franklin Fire Department
		Greater Boston Police Council
	New York City Metropolitan Area	DHS – Office of Emergency Communications Region 2 Coordinator
		New York Department of Information Technology and Telecommunications
		New York City Mayor's Office
		New York City Fire Department
		New York City Police Department
		New York City Emergency Management
		Morris County Department of Law and Public Safety
		Yonkers Fire Department
	Los Angeles Metropolitan Area	DHS – Office of Emergency Communications Region 9 Coordinator
		Interagency Communications Interoperability System
		Los Angeles Regional Interoperable Communications System
		City of Los Angeles
		Los Angeles County Fire Department
		Los Angeles County Sheriff Department

Category		Stakeholder
		City of Pasadena
Case Study	Dallas-Fort Worth Metropolitan Area	DHS – Office of Emergency Communications Region 6 Coordinator
		City of Dallas
		City of Burleson Fire Marshal's Office
		Dallas Independent School District[b]

Source: GAO source. | GAO-19-508

[a]We interviewed the former coordinator since the position was vacant at the time of our review

[b]Dallas Independent School District provided us written responses to our questions.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Mark Goldstein, (202) 512-2834 or goldsteinm@gao.gov

Staff Acknowledgments

In addition to the individual named above, David Sausville (Assistant Director); Aaron Kaminsky (Analyst in Charge); Camilo Flores; Ray Griffith; Delwen Jones; Josh Ormond; Kelly Rubin; and Jessica Walker made key contributions to this report.