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SPECTRUM MANAGEMENT

NTIA Planning and Processes Need Strengthening to Promote the Efficient Use of Spectrum by Federal Agencies

GAO-11-352

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Highlights

Highlights of GAO-11-352, a report to congressional committees

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Why GAO Did This Study

Radio frequency spectrum enables vital wireless communications services used by the federal government, businesses, and consumers. Spectrum capacity is necessary for wireless broadband (high-speed Internet access) and broadband deployment will boost the nation's capabilities in many important areas. As the demand for spectrum continues to increase, there is concern about adequate access to meet future needs. This requested report examines (1) how the National Telecommunications and Information Administration (NTIA) is managing spectrum needs of federal agencies, (2) how federal agencies are using and managing assigned spectrum, and (3) what steps NTIA has taken to meet recent initiatives aimed at making spectrum available for broadband. GAO reviewed NTIA's spectrum management documents; surveyed the 19 federal agencies comprising the Interdepartment Radio Advisory Committee; and interviewed NTIA officials and industry and academic experts.

What GAO Recommends

NTIA should develop an updated strategic plan, examine its assignment review processes to determine if the current approach can be improved, and establish internal controls to ensure the accuracy of agency-reported data. The Department of Commerce concurred with GAO's recommendation to examine the review processes and, citing competing priorities, partially concurred with the remaining two.

View GAO-11-352 or key components.
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What GAO Found

NTIA is responsible for governmentwide federal spectrum management, but its efforts in this area have been limited. In 2003, the President directed NTIA to develop plans identifying federal and national (both federal and nonfederal) spectrum needs, and in 2008, NTIA issued the federal plan. GAO found this plan has several limitations, does not identify governmentwide spectrum needs, and does not contain key elements and best practices of strategic planning. NTIA has yet to issue the national plan. Furthermore, NTIA's primary spectrum management operations do not focus on governmentwide needs. Instead NTIA depends on agency self-evaluation of spectrum needs and focuses on interference mitigation, with limited emphasis on holistic spectrum management. Lacking a strategic vision, NTIA cannot ensure that spectrum is being used efficiently by federal agencies. Additionally, NTIA's data management system is antiquated and lacks internal controls to ensure the accuracy of agency-reported data, making it unclear if decisions about federal spectrum use are based on reliable data. NTIA is developing a new data management system, but full implementation of the system is years away.

Federal agencies use spectrum for many purposes such as emergency communications and national defense, and NTIA requires the agencies to periodically evaluate their current and future spectrum needs. Agencies are supposed to ensure spectrum assignments fulfill established mission needs; however, NTIA does not have specific requirements for agencies to justify their spectrum assignments or validate data used for these evaluations. Consequently, NTIA has limited assurance that the data used to make spectrum management decisions are accurate. Federal agencies rely heavily on their program offices to obtain data for the required evaluations and often face challenges, such as resource constraints and staff turnover, when coordinating with field program staff. Given that validating spectrum assignments could require significant agency resources, it would be beneficial for NTIA to consider options for a different approach to obtain and validate critical spectrum assignment information from the agencies, such as requiring agencies to conduct site surveys or attest to the accuracy of data they submit.

In response to recent initiatives, NTIA has taken steps to identify spectrum that could be made available for broadband use. First, NTIA evaluated various spectrum bands and identified 115 megahertz of spectrum that could be made available for broadband within the next 5 years based on criteria it developed. Second, NTIA developed an initial plan and timetable for evaluating and repurposing additional spectrum for broadband use in 10 years. Affected federal agencies—that is, those agencies operating devices in the spectrum bands being evaluated—encountered difficulties providing NTIA with the necessary data and analyses during the most recent evaluation. For example, according to the affected agencies, they were required to analyze and submit a significant amount of detailed impact analyses that were not readily available. Agencies will likely continue to face challenges providing such analyses to NTIA in the future as NTIA begins evaluating a larger number of spectrum bands for possible broadband use in the next 10 years.

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Abbreviations

CSEA	Commercial Spectrum Enhancement Act
CSMAC	Commerce Spectrum Management Advisory Committee
DOD	Department of Defense
FAA	Federal Aviation Administration
FAS	Frequency Assignment Subcommittee
FCC	Federal Communications Commission
FSMS	Federal Spectrum Management System
GHz	gigahertz
GMF	Government Master File
GOES-R	Geostationary Operational Environmental Satellite-R series
IRAC	Interdepartment Radio Advisory Committee
kHz	kilohertz
MHz	megahertz
NOAA	National Oceanic and Atmospheric Administration
NTIA	National Telecommunications and Information Administration
PPSG	Policy Plans Steering Group
SPS	Spectrum Planning Subcommittee

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United States Government Accountability Office
Washington, DC 20548

April 12, 2011

The Honorable Fred Upton
Chairman
The Honorable Henry A. Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable John D. Rockefeller IV
Chairman
The Honorable Kay Bailey Hutchison
Ranking Member
Committee on Commerce, Science,
and Transportation
United States Senate

The Honorable Greg Walden
Chairman
The Honorable Anna G. Eshoo
Ranking Member
Subcommittee on Communications
and Technology
Committee on Energy and Commerce
House of Representatives

The radio frequency spectrum is a natural resource that is used to provide an array of wireless communications services critical to the U.S. economy and a variety of government functions, such as scientific research, national defense, homeland security, and other vital public safety activities. Spectrum capacity is necessary to deliver wireless broadband[1] to consumers and businesses and also to support the communication needs of industries that use commercial wireless broadband to transmit large quantities of information quickly and reliably. Broadband deployment stimulates economic growth, spurs job creation, and boosts the nation's capabilities in education, health care, homeland security, and other areas. As the U.S. experiences significant growth in commercial wireless

[1]The term "broadband" commonly refers to high-speed Internet access. Wireless broadband connects a home or business to the Internet using a radio link.

broadband services, the demand for radio frequency spectrum has increased and additional capacity will be needed to accommodate future growth. As new spectrum-dependent technologies and services are brought to the market and new mission needs unfold among government users, Congress, industry stakeholders, and federal agencies expressed concern about the availability of additional spectrum for future needs, and that current spectrum management in the U.S. may not be able to respond adequately to these rapidly changing needs. This is compounded by the fact that not all radio frequency spectrum has equal value. The spectrum most highly valued generally consists of frequencies between 300 megahertz (MHz) and 3 gigahertz (GHz), as these frequencies have properties well suited to many important wireless technologies, such as mobile phones, radio, and television broadcasting.[2] According to the Department of Commerce's National Telecommunications and Information Administration (NTIA), as of December 2009, federal agencies had exclusive access to about 18 percent of these high-value frequencies, nonfederal users had exclusive licenses to about 30 percent, and access to the remaining 52 percent is shared between federal and nonfederal users.[3]

Within the federal government, NTIA is responsible for managing the federal government's use of the radio frequency spectrum, and the Federal Communications Commission (FCC) is responsible for regulating nonfederal spectrum use. Currently, there are federal government initiatives under way aimed at identifying spectrum that can be made available to meet the nation's increased demand for commercial wireless broadband services. For example, in March 2010, an FCC task force issued the *National Broadband Plan* recommending that 500 MHz of spectrum be made newly available for broadband use within the next 10 years,[4] and

[2]Highly valued spectrum is sometimes called "beachfront" spectrum. For many mobile radio systems, the 300 MHz to 3 GHz spectrum range is the portion of the spectrum where scarcity concerns are the greatest. However, for some industry representatives, the "beachfront" spectrum is larger, located anywhere between 100 MHz to 6 GHz. As spectrum-dependent technologies improve over time, the definition of high-value spectrum can change.

[3]Karl Nebbia, Director NTIA Office of Spectrum Management, presentation to the Commerce Spectrum Management Advisory Committee (CSMAC) (December 9, 2009). These percentages represent how much of this spectrum is available (allocated) for use by federal and nonfederal entities, not how much high-value spectrum is actually being used or shared by these groups.

[4]Federal Communications Commission, *Connecting America: The National Broadband Plan* (Mar. 16, 2010).

in June 2010, the President issued a memorandum directing NTIA to begin identifying federal spectrum that can be made available for wireless broadband.[5] NTIA's ability to implement these initiatives is important—specifically its ability to identify spectrum needs of federal users, ensure spectrum is being used efficiently, and develop policies to strategically meet these needs while simultaneously providing federal agencies with adequate access to spectrum to conduct their essential missions.

In response to your request and in light of the recent focus on federal use of spectrum, we examined (1) the extent to which NTIA's spectrum management oversight and policy addresses governmentwide spectrum needs, (2) how federal agencies are using assigned spectrum and the extent to which they manage their spectrum use, and (3) what steps NTIA and the federal agencies have taken to meet the requirements and expectations of the *National Broadband Plan* and presidential memorandum to repurpose spectrum for broadband,[6] and the challenges these efforts face. While the focus of this report is on federal use of assigned spectrum, we have ongoing work examining FCC's oversight of spectrum used by commercial entities.[7] Further, we expect to continue reviewing issues related to spectrum management in the United States, including what lessons have been learned from prior efforts to repurpose spectrum from government to commercial entities and the extent to which the government is collaborating with the private sector to understand their spectrum needs.

To address these objectives, we obtained and reviewed NTIA documents, including its *Manual of Regulations and Procedures for the Federal Radio Frequency Management* (commonly referred to as the Redbook); an assessment of spectrum bands that could possibly be repurposed for wireless broadband (referred to as the Fast Track Evaluation); and other documentation of NTIA's current processes, policies, and procedures. To develop an understanding of how federal agencies use and manage spectrum, we conducted a Web-based survey of the 19 federal agencies comprising the Interdepartment Radio Advisory Committee (IRAC), whose agencies hold over 90 percent of federally assigned spectrum, and which is

[5]*See*, Memorandum for the Heads of Executive Departments and Agencies, *Unleashing the Wireless Broadband Revolution*, 75 Fed. Reg. 38387 (2010).

[6]Repurposing, as defined by NTIA, refers to the altering of the use of spectrum from that which is currently allowed to other or different uses.

[7]We expect to issue this report in fall 2011.

responsible for coordinating federal use of spectrum and providing NTIA policy advice on spectrum issues. The agency officials responding to the survey were top-level spectrum managers. We received completed responses from 18 of the 19 IRAC members; the results of our survey can be found in appendix III. To supplement information from our survey, we obtained documents from and interviewed top-level spectrum managers from the following 10 federal agencies: Department of Defense (DOD), Department of Homeland Security, Department of Labor, Environmental Protection Agency, National Oceanic and Atmospheric Administration (NOAA), U.S. Coast Guard, Federal Aviation Administration (FAA), Department of Health and Human Services, Department of Housing and Urban Development, and Department of the Treasury. We selected these federal agencies to achieve a mix of characteristics for various factors, such as the number of spectrum assignments, representation on IRAC, particular band of spectrum holdings, and mission needs. We also interviewed officials from NTIA's Office of Spectrum Management about their spectrum management policies and procedures and interviewed stakeholders with knowledge of spectrum issues including industry and academic experts, and representatives of an industry association and telecommunications companies. We selected the experts and industry stakeholders based on prior published literature, stakeholders' recognition and affiliation with the spectrum management industry, and NTIA and other stakeholders' recommendations.

We conducted this performance audit from May 2010 to April 2011 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.

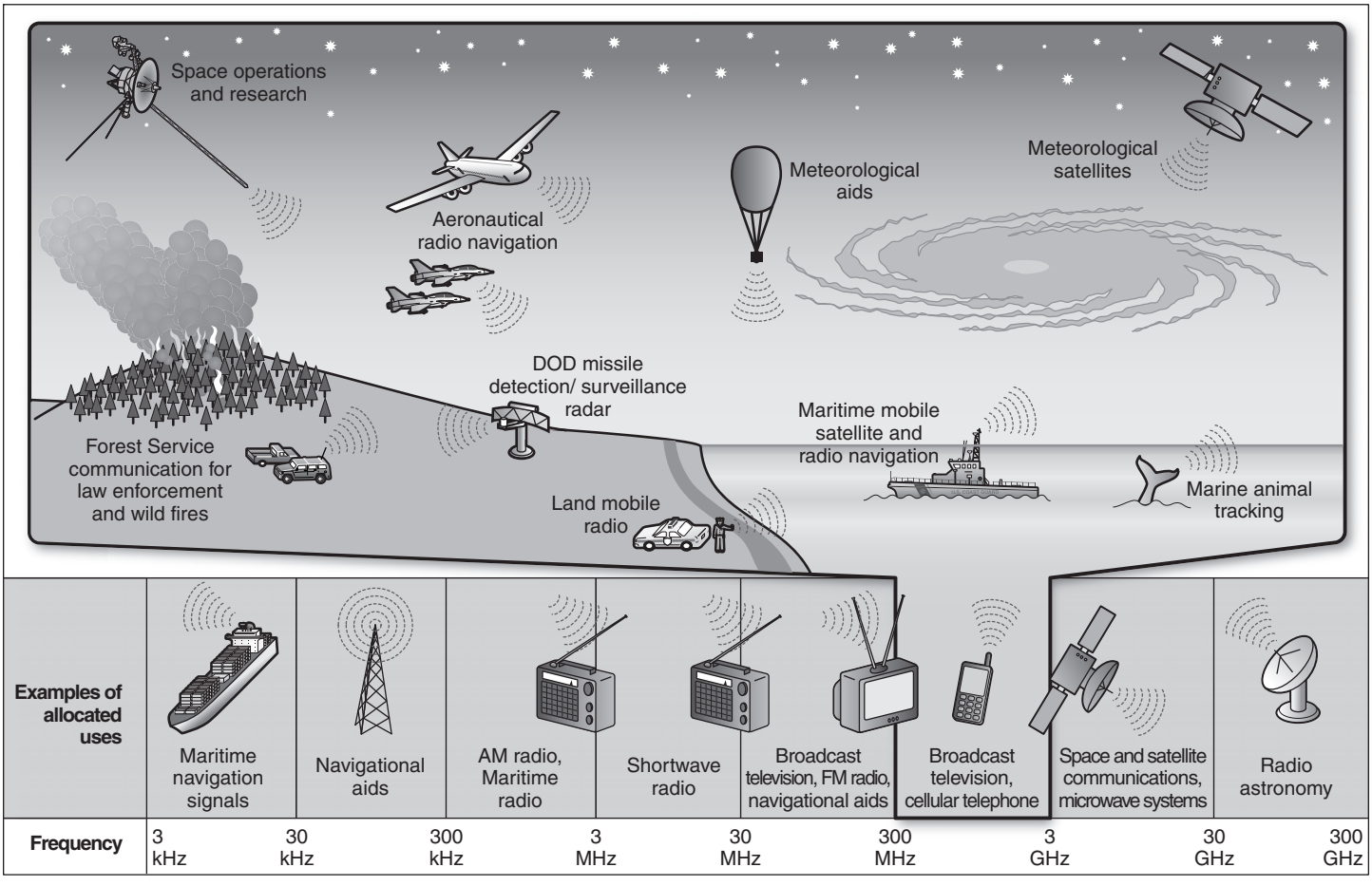
Background

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 GHz.[8] Federal agencies use spectrum to help meet a variety

[8]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. Radio frequencies are grouped into bands and are measured in units of Hertz. The term kHz refers to thousands of Hertz, MHz to millions of Hertz, and GHz to billions of Hertz. The Hertz unit of measurement is used to refer to both the quantity of spectrum (such as 500 MHz) and the frequency bands (such as the 1710–1755 MHz band).

of missions, such as national defense, law enforcement, weather services, and aviation communication. Nonfederal entities (which include commercial companies and state and local governments) also use spectrum to provide a variety of services. For example, state and local police departments, fire departments, and other emergency services agencies use spectrum to transmit and receive critical voice and data communications, while commercial entities use spectrum to provide wireless services, including mobile voice and data, paging, broadcast radio and television, and satellite services. See figure 1 for examples of how spectrum is used.

Figure 1: Examples of Allocated Spectrum Uses, and Federal Spectrum Use in the High-Value Range



Source: GAO analysis of NTIA, federal agencies, and industry information.

In the United States, responsibility for spectrum management is divided between NTIA and FCC.[9] NTIA and FCC jointly determine the amount of spectrum allocated for federal, nonfederal, and shared use.[10] After this allocation occurs, in order to use spectrum, nonfederal users must obtain a license from FCC to use specific spectrum frequencies, and federal users must obtain a similar authorization from NTIA—usually referred to as a frequency assignment. In addition to its spectrum allocation and authorization duties, NTIA serves as the President's principal advisor on telecommunications and information policy and manages federally assigned spectrum, including preparing for, participating in, and implementing the results of international radio conferences, as well as conducting extensive research and technical studies through its research and engineering laboratory, the Institute for Telecommunication Sciences. NTIA has authority to issue rules and regulations as may be necessary to ensure the effective, efficient, and equitable use of spectrum both nationally and internationally. It also has authority to develop long-range spectrum plans to meet future government spectrum requirements, including those of public safety.

In addition to NTIA and FCC, there are other entities involved in spectrum management:

- The Office of Management and Budget (OMB) is involved in managing agency spectrum use through the budget process. OMB's Circular A-11, Section 33.4, directs agencies to consider the economic value of spectrum when requesting funding to procure a spectrum-dependent system. The circular states that spectrum should generally not be considered a free resource, but rather should be considered to have value and be included, to the extent practical, in economic analyses of alternative systems.[11]

[9]The Department of State also plays a role in spectrum management by coordinating and mediating the U.S. position and leading the nation's delegation to international conferences on spectrum management.

[10]Allocation involves segmenting the radio spectrum into bands of frequencies that are designated for use by particular types of radio services or classes of users. For example, the frequency bands between 88 and 108 MHz are allocated to FM radio broadcasting in the United States, while frequency bands between 300 and 322 MHz are government exclusive bands allocated for mobile, mobile satellite, and fixed radio use. In addition to allocation, NTIA and FCC also specify service rules, which include the technical and operating characteristics of equipment.

[11]OMB Circular No. A-11, Preparation, Submission and Execution of the Budget, §33.4, Radio-Spectrum Dependent Communications-Electronic Systems (July 2010).

- IRAC—an interagency advisory committee—was established in 1922 to coordinate federal use of spectrum and provide policy advice on spectrum issues. It is comprised of representatives from 19 federal agencies that use spectrum. IRAC's mission and placement have evolved over its 80-year history. IRAC was originally organized by federal agencies that were seeking a way to resolve issues related to federal spectrum use in a cooperative manner; its initial mission was to assist in the assignment of radio frequencies to federal users and to coordinate federal government spectrum use. In 1952, its mission was expanded to include formulating and recommending policies, plans, and actions for federal government spectrum use. Currently, IRAC is primarily involved in the frequency assignment and system certification processes and is chaired by NTIA, whose role as chair is to call IRAC meetings, establish IRAC agendas, and manage other tasks associated with the administrative operations of IRAC.

- The Commerce Spectrum Management Advisory Committee (CSMAC)—a federal advisory committee—provides advice and recommendations to NTIA. This advisory committee is organized through NTIA's Office of Policy Analysis and Development and was created following a recommendation made in President Bush's 21st Century Spectrum Policy Initiative.[12] CSMAC consists of approximately 25 spectrum policy experts from the private sector and it offers expertise and perspective on long-range spectrum planning, as well as other issues, and makes recommendations to NTIA to facilitate this planning.[13] CSMAC was organized in 2006, and operates under the provisions of the Federal Advisory Committee Act.[14]

  Currently, there are three ongoing spectrum-related initiatives aimed at identifying spectrum that can be made available to meet the nation's

[12]Presidential Memorandum on Spectrum Policy for the 21st Century, 69 Fed. Reg. 1568 (Jan. 9, 2004). Pursuant to this directive, NTIA issued two reports. *See*, Department of Commerce, *Spectrum Policy for the 21st Century – The President's Spectrum Policy Initiative: Report 1*, *Recommendations of the Federal Government Spectrum Task Force* (June 2004) and Department of Commerce, *Spectrum Policy for the 21st Century – The President's Spectrum Policy: Report 2*, *Recommendations from State and Local Governments and Private Sector Responders* (June 2004). In a subsequent memorandum, the President provided guidance for the recommendations' implementation. *See*, *President's Memorandum on Improving Spectrum Management for the 21st Century*, 49 Weekly Comp. Pres. Doc. 2875,) (Nov. 29, 2004).

[13]NTIA designates an employee of NTIA to serve as the Designated Federal Officer for CSMAC.

[14]5 U.S.C. App. 2.

demand for commercial wireless broadband services. These initiatives include (1) a recommendation in the National Broadband Plan, (2) a June 28, 2010, presidential memorandum, and (3) the NTIA Fast Track Evaluation.

- The *National Broadband Plan* recommends that a total of 500 MHz of federally and nonfederally allocated spectrum be made available for mobile, fixed, and unlicensed broadband use over the next 10 years. This spectrum can come from several different frequency ranges and would be made available for a variety of licensed and unlicensed flexible commercial uses, as well as to meet the broadband needs of specialized users such as public safety, energy, educational, and other users. The plan states that for spectrum from the 225 MHz to 3.7 GHz range, a total of 300 MHz should be made available for mobile flexible use within 5 years.

- On June 28, 2010, the President issued a memorandum directing NTIA to begin identifying federally allocated spectrum that can be made available for wireless broadband. This memorandum, in line with the *National Broadband Plan*, directs NTIA to collaborate with FCC to develop a plan and timetable to make the 500 MHz of federally and nonfederally allocated spectrum available for wireless broadband use in the next 10 years.

- A joint request from OMB, the National Economic Council, and the White House's Office of Science and Technology Policy requested that NTIA identify and make available federally allocated spectrum for broadband use in the next 5 years. In response to this request, NTIA analyzed federally assigned spectrum to determine the feasibility of making certain federally allocated spectrum bands available for broadband use, referred to as the Fast Track Evaluation.[15]

  In addition, legislation has also been introduced in the House and Senate that would help identify spectrum or relocate spectrum for commercial uses, including (1) the Spectrum Inventory and Auction Act of 2011,[16] and the (2) Reforming Airwaves by Developing Incentives and Opportunistic

[15]NTIA, *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands* (October 2010).

[16]H.R. 911, 112th Cong. (2011). Among other things, the bill includes provisions on voluntary incentive auctions.

Sharing Act,[17] which would require an inventory of existing users on prime radio frequencies; (3) the Spectrum Optimization Act,[18] which would provide FCC with authority to conduct incentive auctions; and (4) the Spectrum Relocation Improvement Act of 2011,[19] which would clarify the rights and responsibilities of federal users in the spectrum relocation process.

NTIA's Strategic Spectrum Planning and Its Processes for Managing Federal Spectrum Lack Governmentwide Focus and Accountability

NTIA Has Conducted Spectrum Planning, yet Its Efforts to Address Strategic Governmentwide Spectrum Management Have Lacked Continuity

As the federal agency authorized to develop national spectrum policy,[20] NTIA has been directed to conduct several projects focused on reforming governmentwide federal spectrum management and promoting efficiency among federal users of spectrum; however, its efforts in this area have resulted in limited progress toward improved spectrum management. NTIA has authority to, among other things, establish policies concerning assigning spectrum to federal agencies, coordinate spectrum use across federal agencies, and promote efficient use of spectrum resources by federal agencies in a manner which encourages the most beneficial public use. As such, NTIA has a role in ensuring that federally allocated spectrum is used efficiently. According to NTIA's Redbook and agency officials,

[17]S. 455, 112th Cong. (2011). Among other things, the bill includes provisions to modify the Spectrum Relocation Fund; provide for voluntary incentive actions; and require the development of a triennial national strategic spectrum plan.

[18]S. 415, 112th Cong. (2011).

[19]S. 522, 112th Cong. (2011).

[20]The NTIA Organization Act, 47 U.S.C. §§ 901 *et seq.*

efficient use includes ensuring that federal agencies' decisions to use spectrum to support government missions have been adequately justified and that all viable tradeoffs and options have been explored before making the decision to use spectrum-dependent technology, and ensuring that these tradeoffs are continuously reviewed to determine if the need for spectrum has changed over time. NTIA's primary guidance to federal agencies is technical guidance concerning how to manage assigned spectrum provided through NTIA's Redbook.

In May 2003, the Bush Administration directed NTIA to develop two strategic plans, yet it has only completed one. At that time, the Bush Administration launched the *Spectrum Policy Initiative for the 21st Century*, which recognized the rapidly increasing role for wireless services and demands on the use of the radio frequency spectrum. In response to this initiative, NTIA stated it would produce two plans.

- First, NTIA would produce a federal strategic spectrum plan to address governmentwide spectrum needs. Specifically, the Bush Administration directed federal agencies to develop individual strategic spectrum plans, which would then be compiled by NTIA along with input from other stakeholders such as FCC and state and local governments, to form a governmentwide strategic spectrum plan.[21]

- Second, NTIA was to use the federal strategic spectrum plan to assist in developing a national spectrum plan to address comprehensive federal and nonfederal spectrum needs.[22] NTIA responded to this directive by stating it would produce a national spectrum plan, and encourage state, regional, and local government agencies to synthesize long-range planning processes into a nonfederal government strategic spectrum plan which would also provide input into the national strategic spectrum plan. Additionally, NTIA stated that it would invite FCC to provide information

[21]Under the November 2004 presidential memorandum, the Department of Commerce was tasked with integrating the agency-specific spectrum plans and spectrum needs plan based upon a Department of Commerce framework into a federal spectrum plan and to assist in the formulation of a national strategic spectrum plan. The Secretary of Commerce, in consultation with FCC, as appropriate, was to update the national strategic spectrum plan on a biennial basis. *President's Memorandum on Spectrum Management for the 21st Century*, § 3(a).

[22]This is not the first experience NTIA has had with developing a forward looking strategic plan. In September 2000, it issued a long-range plan. See Department of Commerce, National Telecommunications and Information Administration, *Federal Long-Range Spectrum Plan* (September 2000).

regarding the future requirements of nonfederal government spectrum to be included in the national strategic spectrum plan.[23]

In March 2008, NTIA issued its report on federal spectrum use entitled *The Federal Strategic Spectrum Plan.*[24] Neither NTIA nor FCC has issued the national spectrum plan that was initially scheduled for completion in December 2007.[25]

While the intent of the *Federal Strategic Spectrum Plan* was to identify the current and projected spectrum requirements and long-range planning processes for the federal government, we found the final plan is limited in these areas. For example, the plan does not identify or include quantitative governmentwide data on federal spectrum needs. Instead, NTIA's plan primarily consists of a compilation of the plans submitted by 15[26] of the more than 60 agencies that use federal spectrum. Additionally, due to the fact that they contained limited information regarding future requirements and technology needs, NTIA concluded that its "long-range assumptions are necessarily also limited."

Furthermore, NTIA's plan did not contain key elements and best practices of strategic planning, which the Government Performance and Results Act, OMB, and we have identified as including the following elements:[27]

[23]Department of Commerce, National Telecommunications and Information Administration, *Spectrum Management for the 21st Century: Plan to Implement Recommendations of the President's Spectrum Policy Initiative* (2006).

[24]Department of Commerce, National Telecommunications and Information Administration, *Spectrum Policy for the 21st Century – The President's Spectrum Policy Initiative: The Federal Strategic Spectrum Plan* (March 2008).

[25]In the fiscal year 2008 progress report, NTIA noted that it sent a letter to FCC in June 2008 seeking FCC participation, but that the expected completion date was to be determined.

[26]The agencies that submitted strategic spectrum plans include the Departments of Agriculture, Commerce, Defense, Energy, Homeland Security, Interior, Justice, State, Transportation, Treasury, and Veterans Affairs; the National Aeronautics and Space Administration, National Science Foundation, Broadcasting Board of Governors, and the U.S. Postal Service. In September 2010, these agencies held over 80 percent of federal frequency assignments.

[27]See Government Performance and Results Act of 1993, Pub. L. No. 103-62, 107 Stat. 285 (1993); Office of Management and Budget, Cir. No. A-11, Preparation, Submission and Execution of the Budget, Part 6-Prepation and Submission of Strategic Plans, Annual Performance Plan, and Annual Program Performance Reports (July 2010); and GAO, *Agencies' Strategic Plans Under GPRA: Key Questions to Facilitate Congressional Review*, GAO-GGD-10.1.16 (Washington, D.C.: May 1997).

- identification of long-term goals and objectives,
- approaches or strategies to achieve these goals and objectives,
- program evaluations,
- stakeholder involvement, and
- an ongoing process for revising the plan approximately every 3 years.

For example, NTIA's plan does not include a discussion of long term goals and objectives for governmentwide spectrum management, or approaches and next steps for achieving these goals. Also, whereas strategic planning is intended to be continuous, not a static or occasional event, we found that NTIA's strategic planning activities are not ongoing. For example, while agencies were required to update their strategic plans every 2 years, they have not submitted plans to NTIA since November 2007, when 14 agencies submitted plans.[28]

We found that NTIA does not appear to be meeting its responsibilities as directed by President Bush's 2004 memorandum. As shown in appendix II, NTIA discontinued many of the governmentwide projects initiated by the *Spectrum Policy Initiative for the 21st Century*, demonstrating a lack of continuity in its spectrum management operations. For example, NTIA was directed to issue annual progress reports on the status of the initiatives. While NTIA issued four annual progress reports from fiscal years 2005 through 2008, these reports focused on detailing the individual activities agencies have undertaken to improve their spectrum management and provided limited information on actions NTIA is taking to improve governmentwide use of spectrum. Furthermore, NTIA has not issued a progress report since fiscal year 2008.[29] We asked NTIA officials why the agency was not implementing many of the presidential initiatives, and they said due to limited resources the agency has decided to put its

[28]Of the original 15 agencies to submit plans in 2005, the Departments of the Interior and State did not resubmit plans in 2007. While it did not submit a plan in 2005, the U.S. Coast Guard submitted a plan in 2007.

[29]The November 2004 presidential memorandum directed the Secretary of Commerce within 6 months of the issuance of the memorandum to provide the President a report describing the progress on implementing the recommendations in the reports and to update this report on an annual basis until completion of the actions required by the memorandum. President's Memorandum on Improving Spectrum Management for the 21st Century, §3(c).

strategic planning activities on hold, and has instead turned its focus to recent initiatives directed by the Obama Administration.[30] Based on our conversations with NTIA officials, it is unclear when or if NTIA will resume its forward-looking strategic planning activities. See appendix II for a full list of NTIA activities focused on reforming governmentwide spectrum management and the status of the activities as of February 2011.

NTIA's Current Processes for Managing Federal Spectrum Focus on Interference Mitigation

NTIA's primary spectrum management operations include authorizing federal frequency assignments and certifying spectrum-dependent equipment for federal users; however, these processes are primarily focused on interference mitigation as determined by IRAC and do not focus on ensuring the best use of spectrum across the federal government.[31] IRAC, an interagency committee of the federal government's primary spectrum users, includes six subcommittees and several ad hoc working groups.[32] Two IRAC subcommittees play significant roles in two of NTIA's key processes—frequency assignment and system certification. These subcommittees, the Frequency Assignment Subcommittee (FAS), which includes representatives from the 19 IRAC agencies and FCC, and the Spectrum Planning Subcommittee (SPS), which includes representatives from 17 of the IRAC agencies, review all requests for new spectrum assignments by federal agencies and make recommendations to NTIA on the outcomes.[33] As shown in table 1, final decisions regarding

[30] On February 10, 2011, the Obama Administration launched another initiative aimed at expanding wireless coverage to 98 percent of Americans. NTIA officials told us they anticipate this initiative will result in additional directives for the agency.

[31] Interference mitigation refers to ensuring that systems are not interfering with each other.

[32] IRAC consists of representatives of the following departments and agencies: Agriculture, Air Force, Army, Broadcasting Board of Governors, Coast Guard, Commerce, Energy, Federal Aviation Administration, Homeland Security, Interior, Justice, National Aeronautics and Space Administration, National Science Foundation, Navy, State, Transportation, Treasury, U.S. Postal Service, Veterans Affairs. Nonmember departments and agencies may designate one of the members to act as their accredited agent on IRAC. The Department of the Treasury acts as the accredited agent for the Department of Education, Federal Reserve System, and Small Business Administration. The Department of the Interior acts as the accredited agent for the International Boundary and Water Commission (U.S. Section) and the Tennessee Valley Authority. The Federal Aviation Administration acts as the accredited agent for the Volpe National Transportation Systems Center. NTIA acts as the accredited agent for all other nonmember agencies with spectrum requirements.

[33] The U.S. Postal Service and Department of Transportation are not members of the SPS.

approval and use of federally allocated spectrum are made based on IRAC review and committee consensus.

Table 1: Federal Agency, IRAC, and NTIA Roles in the Frequency Assignment and System Certification Processes

Activity	Role of agency requiring/using spectrum	Role of IRAC	Role of NTIA Office of Spectrum Management
Frequency assignment process	• Determine need for spectrum and receive authorization to use a specific frequency prior to operating a spectrum- dependent technology. • Make necessary technical studies, select potential frequencies, coordinate with other agencies involved, and prepare and file an application with NTIA's Office of Spectrum Management for consideration by the FAS.	• FAS considers pending items on a daily basis. • Makes decision within 9-days to approve request or table for further review, correction, or referral to a formal meeting of the FAS.	• Processes applications through a series of automated routines to check them for completeness, accuracy, and compliance with regulations in procedures. • Publishes applications in daily agenda for FAS review. • Conducts manual review, with assistance from FAS, to ensure adequate justification, compliance with policy and regulations, and technical appropriateness, and to ensure there is no conflict with FAS nonmember agencies. • Makes final decisions on matters that cannot be resolved within the FAS. (Final NTIA decisions can be appealed to the Director of the Office of Management and Budget.)
System certification process	• As required by OMB Circular A-11, agencies must obtain certification by NTIA that the radio frequency required can be made available before submission of estimated costs for the development of procurement of "major radio spectrum-dependent systems" (including all systems employing space satellite techniques). • Makes a determination as to whether a system is "major" as defined by having a "significant impact on existing or potential future use of the radio frequency spectrum," and whether or not to seek certification.	• SPS conducts review of new spectrum-dependent systems at a number of stages of their evolution, prior to the assignment of frequencies. These reviews require an examination of the existing systems in the frequency bands being considered to ensure that new systems will not interfere with existing systems. • Makes recommendations to NTIA on whether a new system should be certified for operational use.	• Based on SPS recommendation, makes final decision to approve or disapprove certification.

Source: GAO presentation of Redbook policies and additional NTIA and agency data.

Currently the process as established by federal regulations for review and approval of frequency assignment and system certification is technical in nature, focusing on ensuring that the new frequency or system that an agency wants to use will not interfere with another agency's operations. According to NTIA officials, this focus on day-to-day spectrum activities, such as interference mitigation, is due to the agency's limited resources. This focus, while important, makes limited consideration about the overall best use of federally allocated spectrum. Therefore, NTIA's current processes provide limited assurance that federal spectrum use is evaluated from a governmentwide perspective to ensure that decisions will meet the current and future needs of the agencies, as well as the federal government as a whole. Additionally, throughout these processes, there is heavy reliance on agencies to self-evaluate and report their current and future spectrum needs. For example, in the frequency assignment process, all analysis to determine whether spectrum-dependent technology should be used is made by the agencies prior to a request for authorization, therefore agencies are expected to have adequate expertise and resources to make these determinations.

Finally, NTIA has limited ability to monitor federal spectrum use. NTIA has four programs in place to oversee agency use of spectrum, yet according to NTIA officials, only one program is actively implemented, one is conducted on an as-needed basis, and two programs have been discontinued due to lack of resources, as shown in table 2. Without ongoing programs to monitor that agencies are using their assigned spectrum in accordance with federal regulations, NTIA is limited in its ability to track how federally allocated spectrum is being used or detect Redbook violations.

Table 2: Status of NTIA Spectrum Oversight Programs

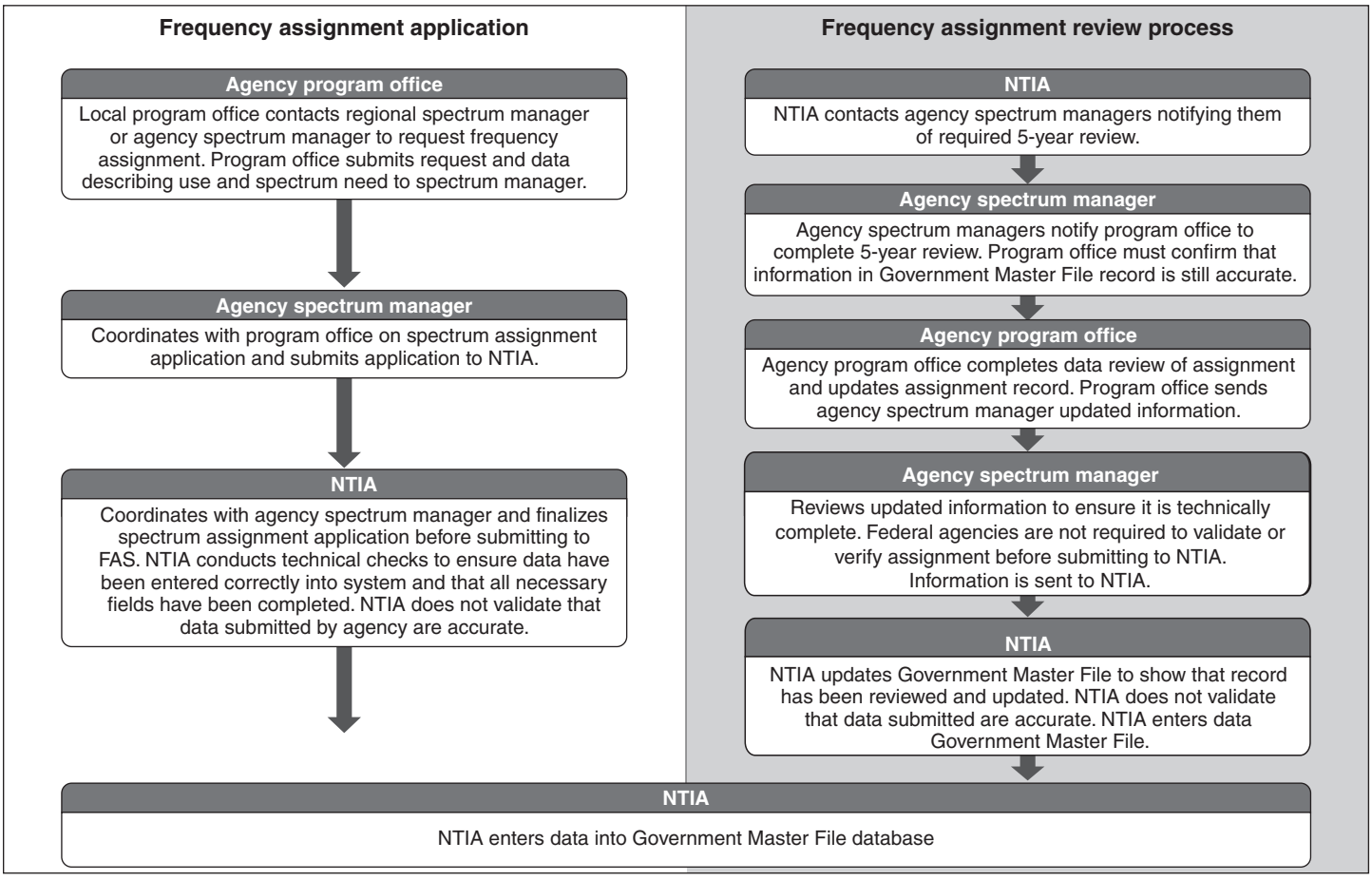
Program name	Objective	Status
Frequency Assignment Review Program	Federal agencies are required to review frequency assignment data every 5 years to ensure that frequency assignments are (1) in current use and are correctly reflected in the Government Master File (GMF), (2) required for continued operations for the purposes stated in their justifications, and (3) still qualified for authorizations under the provisions of the Redbook.	Currently ongoing.
Spectrum Measurement Program	Established in 1973 under which a van-mounted Radio Spectrum Measurement System operated by NTIA is used to determine (1) whether radio installations operated by the federal government are using authorized frequencies and are operating in accordance with applicable regulations, (2) whether additional uses can be made in a particular band at a particular location, and (3) to prevent or resolve cases of interference between two or more users.	Conducted as-needed for research purposes.
Spectrum Management Survey Program	Established in 1965 to determine at the operational level the degree of implementation of the applicable provisions of the Redbook, whether frequency usage is in accordance with authorizations, and to exchange information with a view toward improving spectrum management. NTIA personnel conduct on-site surveys to observe facilities and conduct discussions with local frequency managers.	Discontinued due to resource constraints.
Spectrum Resource Assessment Program	Program to review and document the characteristics and deployment of existing and proposed systems, to identify potential band-sharing problems which may impact the efficient use of the spectrum.	Discontinued due to resource constraints.

Source: GAO analysis of NTIA data.

NTIA's Data Management System Lacks Transparency and Data Validation Processes, Making It Uncertain If Spectrum Management Decisions Are Based on Accurate and Complete Data

NTIA's data management system is antiquated and lacks transparency and internal controls. NTIA collects all federal spectrum data in the Government Master File (GMF), which according to NTIA officials is an outdated legacy system that was developed primarily to store descriptive data. This system does not meet the current analytical needs of NTIA or other federal users. NTIA does not generate any data, but maintains agency-reported spectrum data in the GMF, which are collected during the frequency assignment and review processes, as shown in figure 2.

Figure 2: NTIA Frequency Data Collection Processes



Source: GAO analysis of NTIA information.

NTIA's processes for collecting and verifying GMF data lack key internal controls including those focused on data accuracy, integrity, and completeness. We have defined internal control activities as the policies, procedures, techniques, and mechanisms that help ensure that agencies mitigate risk.[34] Control activities such as data verification and reconciliation are essential for ensuring accountability for government resources and for achieving effective and efficient program results. Additionally, the standards for internal controls recommend that agency systems have controls in place to ensure data accuracy, including processes for ensuring

- the agency's data entry design features contribute to data accuracy;
- data validation and editing are performed to identify erroneous data;
- erroneous data are captured, reported, investigated, and promptly corrected; and
- output reports are reviewed to help maintain data accuracy and validity.

We found that NTIA's data collection processes lack accuracy controls and do not provide assurance that data are being accurately reported by agencies. For example, the data are generally only subject to compliance reviews that ensure all reported data meet technical and database parameters (i.e., that they have the proper number of characters per field, or that the frequency requested is allocated for desired use). Throughout this process, NTIA expects federal agencies to supply accurate and up-to-date data submissions. For example, during the frequency assignment process, a federal agency must justify that the assignment will fulfill an established mission need and that other means of communication, such as commercial services, are not appropriate or available. However, NTIA does not provide agencies with specific requirements on how to justify these needs. NTIA officials told us that they rely on federal agencies to conduct any necessary analysis, such as engineering and technical studies, to support the use and need of the assignment, but agencies are not required to submit documentation verifying that the agency had completed the analysis necessary to justify the agency's spectrum need. Moreover, NTIA does not require federal spectrum managers to validate or verify that the data or information program offices do submit is accurate. According

[34]GAO, *Internal Control Management and Evaluation Tool*, GAO-01-1008G (Washington, D.C.: August 2001).

to NTIA officials, if NTIA or other agencies identify errors, NTIA requires the correction of these data. However, since agencies submitting data do not have to attest to their accuracy or demonstrate the extent to which they are actually using the spectrum which they have, NTIA has limited assurance that information used to make spectrum management decisions is accurate and reliable.

NTIA is developing a new data management system—Federal Spectrum Management System (FSMS)—to replace GMF. According to NTIA officials, the new system will modernize and improve spectrum management processes by applying modern information technology to provide more rapid access to spectrum and make the spectrum management process more effective and efficient. Whereas the GMF is only a descriptive database used to store information, it does not have analytical capabilities that agencies can use when they are conducting the technical studies required by the frequency assignment and certification processes. FSMS is intended to provide these analytical capabilities and will allow federal agencies to conduct more consistent and accurate analysis when developing frequency assignment proposals. Ultimately this will facilitate the more efficient use of spectrum because frequency assignments can be located closer together. Currently, the limited data available on frequency assignments results in users overestimating their needs to avoid interference; the additional data that will be made available will allow users to make more accurate judgments when determining interference.[35] As part of the development of FSMS, the existing GMF data will be replaced with a new data structure, yet development is still early and final implementation is not expected until fiscal year 2014. FSMS will increase the amount of data agencies are required to submit to NTIA, but the data submission process will remain similar to its current structure. NTIA projects FSMS will improve existing GMF data quality, but not until 2018. According to NTIA's FSMS transition plan, at that time data accuracy will improve by over 50 percent. However, in the meantime it is unclear whether important decisions regarding current and future spectrum needs are based on reliable data.

[35]The agency practice of overestimating needs is due to the fact that more detailed data is not available. The extent to which agencies overestimate their needs is unclear.

Federal Agencies Use Spectrum for Many Purposes, and Lack of Specific Spectrum Management Requirements Leads to Limited Assurance That Agencies Are Recording Accurate Data

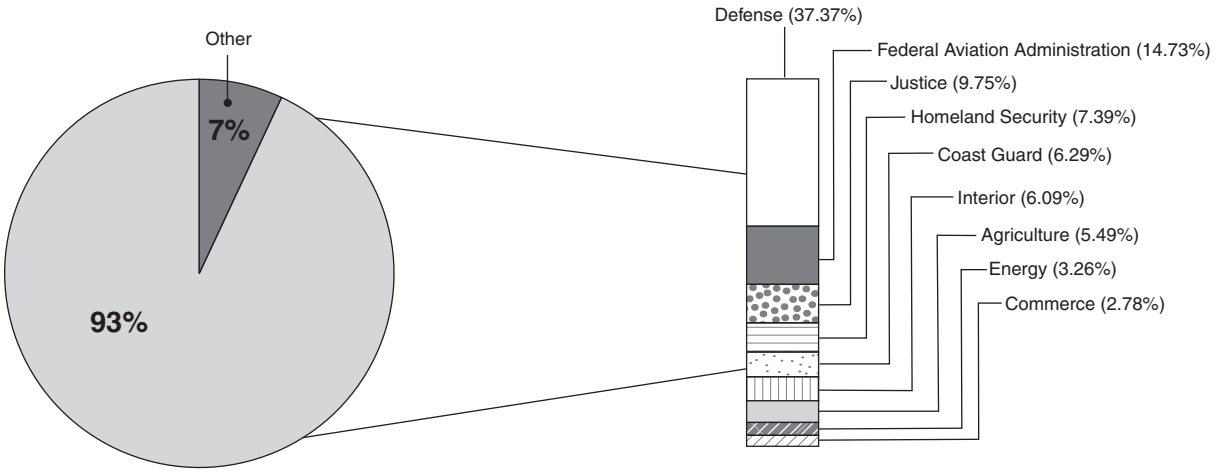
Federal Agencies Use Spectrum for a Wide Variety of Purposes, such as Emergency Communications, National Defense, and Land Management

Federal agencies and departments combined have over 240,000 frequency assignments, which are used for a variety of purposes, including emergency communications, national defense, land management, and law enforcement. Over 60 federal agencies and departments currently have federal spectrum assignments.[36] Agencies and departments within DOD[37] have the most assignments, followed by FAA, the Department of Justice, the Department of Homeland Security, U.S. Coast Guard, the Department of the Interior, the Department of Agriculture, the Department of Energy, and the Department of Commerce, respectively. These federal agencies and departments hold 93 percent of all federally assigned spectrum (see figure 3).

[36]These data reflect only unclassified federal spectrum assignments.

[37]For the purposes of our analysis, we combined data from the Departments of the Air Force, Army, Navy, and Marine Corps into the DOD category.

Figure 3: Federal Agencies with the Most Spectrum Assignments

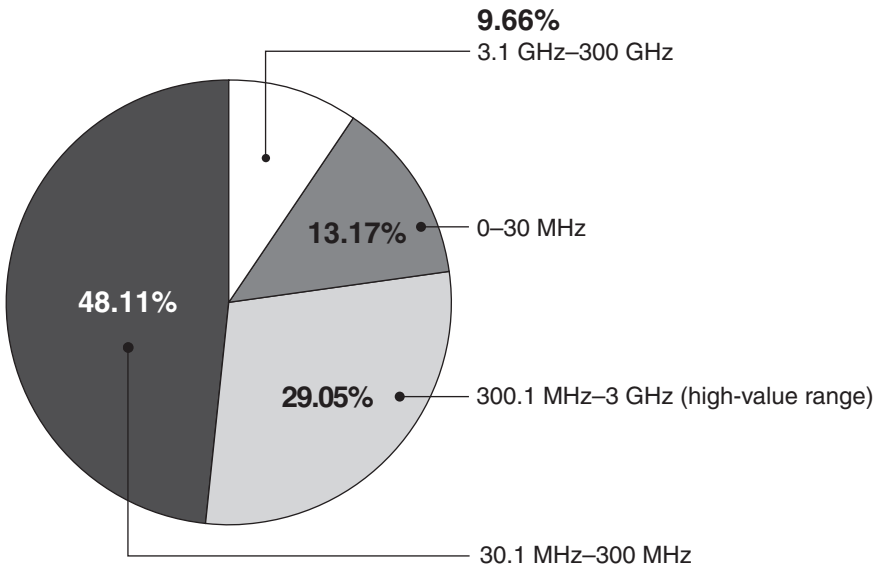


Source: GAO analysis of NTIA GMF spectrum assignment data, September 7, 2010.

Note: Other includes the remaining 48 federal agencies and departments with spectrum frequency assignments.

As illustrated in figure 4, less than one-third of all frequency assignments held by federal agencies are located in the high-valued range (generally considered the spectrum bands located above 300 MHz and below 3 GHz). In contrast, over 48 percent of the spectrum held by federal agencies is located in the 30–300 MHz range. The 18 IRAC agencies responding to our survey reported holding some spectrum assignments in the high-value range.

Figure 4: Percent of Federally Assigned Spectrum Located in Various Ranges

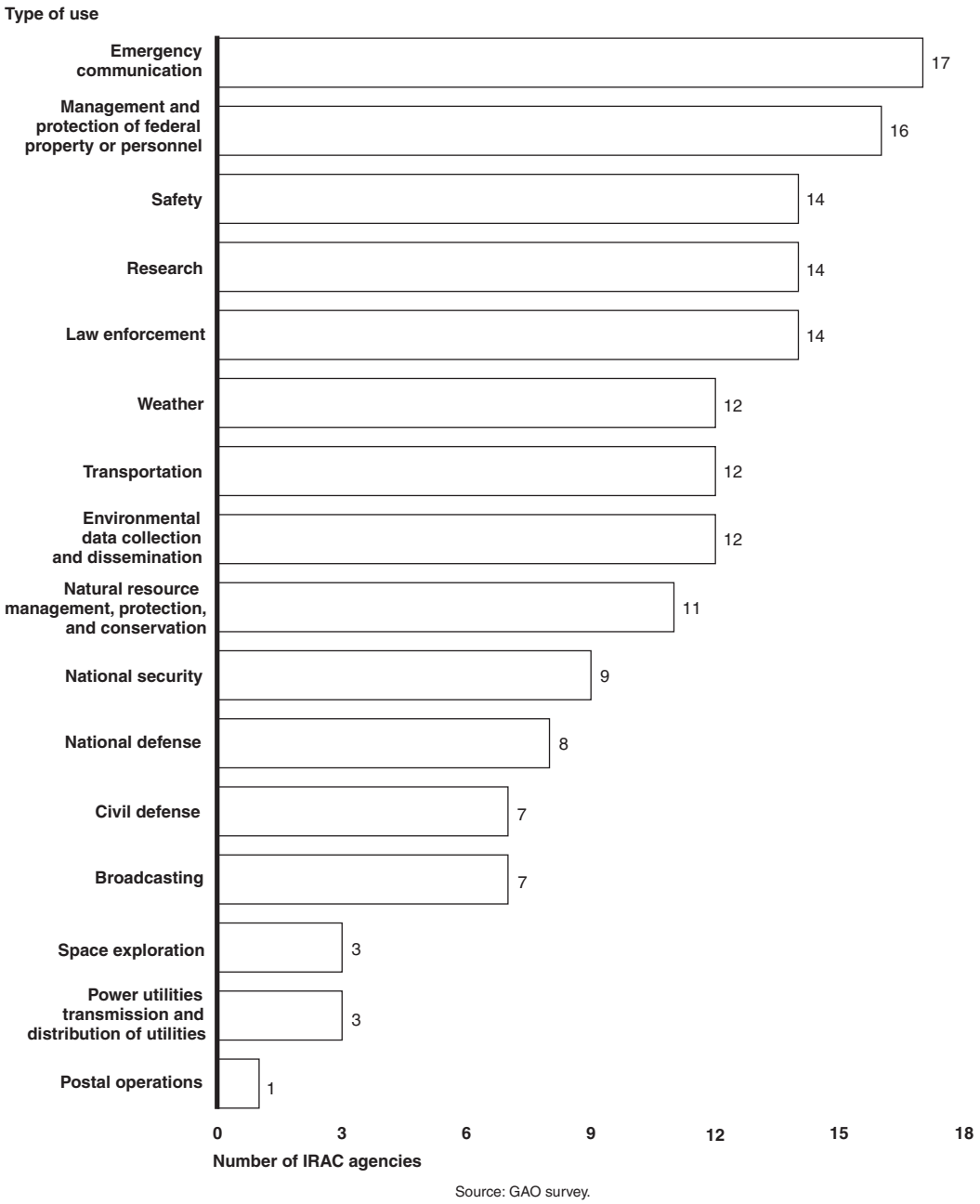


Source: GAO analysis of NTIA GMF spectrum assignment data, September 7, 2010.

Note: In addition, two agencies hold assignments above 300 GHz. Because these assignments comprise of less than 1 percent of all assignments held by federal agencies, they were not included in the figure. Totals do not add up to 100 percent due to rounding.

Through our survey and interviews with federal agency officials, we found that federal agencies use spectrum, including high-valued spectrum, for a wide array of purposes. As illustrated in figure 5, IRAC agencies reported using federally assigned spectrum for emergency communications, managing and protecting federal property or personnel, law enforcement, research, and safety. As an example of use in the high-value range, the Department of the Air Force reported in response to our survey using spectrum for mission-critical military training and education, testing of new equipment, research and development, and disaster response, in concert with other agencies.

Figure 5: Number of Surveyed IRAC Agencies Reporting Various Types of Spectrum Use



Source: GAO survey.

Federal agencies also operate a variety of spectrum-dependent systems and equipment on assigned spectrum. Within the high-value range (300 MHz–3 GHz), IRAC agencies reported operating a wide variety of systems. The most frequently reported systems in that range included land mobile radio systems, fixed microwave systems, and fixed microwave point-to-point radio systems. These systems are typically used for voice and data communication and while they can be operated in other frequency bands outside of the high-value range, this range includes the most commonly used frequencies for these systems.

Federal Agencies Lack Specific Guidance and Requirements from NTIA for Recording and Maintaining Accurate Data

NTIA has not established specific requirements for agencies to justify their needs and to validate and verify data used to evaluate their current and future spectrum needs. Federal spectrum managers we contacted reported that when applying for an assignment, they generally request field program staff to provide a description of how the frequency will be used and the type of equipment needed for the assignment. One federal agency official told us that his office has to trust that assignment application information provided by program staff is accurate. Additionally, 6 out of the 10 federal spectrum managers we contacted told us that while they review an application before submitting it to NITA, their review primarily serves to ensure that sufficient information has been provided to meet the requirements of the Redbook. For example, a federal agency official told us that when examining a frequency assignment application, some of the factors that he reviews are availability of spectrum to be used with a specific technology, potential for interference with other users, and compliance of frequency use with NTIA rules and regulations.

As part of NTIA's Frequency Assignment Review Program, federal spectrum users are required to modify or delete frequency assignments as needed based on the results of the 5-year reviews.[38] However, as with the assignment process, federal spectrum managers are not required to validate or verify that the information the program offices are submitting is accurate. Seven out of 10 federal spectrum managers we contacted reported that they do not have mechanisms in place to verify the accuracy of the information collected during these processes. Similarly, 5 out of 10

[38]For most assignments, NTIA requires that federal agencies conduct 5-year reviews of their assignments. In some cases however, such as for certain space systems, aeronautical, and military assignments, NTIA requires that agencies review the assignment every 10 years. Redbook, § 8.2.6 and Annex F.

federal spectrum managers reported that their agency had not conducted site visits or sample surveys to verify information in their data systems.

Further, federal agency officials expressed various concerns related to the process of obtaining information from field program staff when completing assignment reviews, including concerns about (1) the future availability of spectrum, (2) inaccurate data on existing systems, and (3) resource constraints and staff coordination.

Future Availability of Spectrum

- In our survey, 15 out of 18 IRAC agencies reported that they will face some or great difficulty in the future meeting their critical mission needs because of insufficient spectrum.

- Similarly, 4 out of the 10 federal spectrum managers we contacted told us that while their agency's spectrum needs are increasing, requesting new assignments is becoming increasingly difficult due to the limited availability of additional spectrum. According to these spectrum managers, field program personnel are concerned that if they say they are no longer using an assignment, it will be deleted and the program office will not be able to obtain another assignment for their future spectrum needs. In one specific example, a federal spectrum manager we contacted told us that the agency's border security duties have increased significantly over the last few years, resulting in the agency's increased use and dependence on spectrum for security purposes. However, while the agency's spectrum needs have increased, the availability of spectrum has remained the same, raising concerns about the agency's access to sufficient spectrum to complete operational mission requirements.

Inaccurate Data on Existing Systems

- Of the three agencies we contacted that had previously completed site visits or in-depth reviews of assignment data, federal agency officials from two of these agencies reported uncovering significant inaccuracies in their assignment records. For example, officials from one agency told us that in a recent review of a sample of spectrum assignments in the Detroit, Michigan, metropolitan area, they uncovered that approximately half of the agency's assignment records were inaccurate. In another example, a spectrum manager told us that the agency conducted a review of spectrum assignments and found that 25 percent of assignments in one department (20 assignments) were no longer being used. As a result of this review, the agency returned the assignments. Because the other federal agencies we interviewed did not indicate that they had completed site surveys or in-depth reviews of their assignment records, the extent to which there are data errors in other agencies' assignment data is unknown.

- One agency we met with had difficulty ascertaining whether a program office was operating a system on an assignment. In this case, the agency relocated several systems off of the 1710–1755 MHz band as a result of the Advance Wireless Services auction in 2007.[39] Shortly after the relocation, the agency was contacted by a commercial wireless carrier that had acquired the frequency informing the agency that it still had a system transmitting on the frequency, causing interference. The agency contacted its regional program office and discovered that a transmitter at the identified location had not been actively used by the agency for years but was emitting a carrier signal, which was the source of the interference. Once the transmitter was shut off the interference on that frequency stopped. According to the agency's spectrum manager, regional program officials never notified the agency about the system's existence, and as a result, there was no record of the system in the agency's inventory list. Agency officials acknowledged that had they not been contacted by the commercial wireless carrier, they would not have known that the transmitter was still operating and sending out a carrier signal.

- While OMB Circular No. A-11, §33.4 and NTIA require that federal agencies obtain an authorization to use a spectrum frequency assignment before they purchase spectrum-dependent systems, 5 out of 10 agency spectrum managers that we contacted reported that their agency does not have procedures in place to monitor the agency's procurement of spectrum-dependent systems prior to obtaining an assignment.

Resource Constraints and Staff Coordination

- Seven out of 10 spectrum managers explained that due to high staff turnover, identifying the appropriate contacts in the field to complete assignment reviews can be difficult. One federal spectrum manager explained that since field program staff are generally located in multiple offices across the country, it is challenging to keep track of all the appropriate contacts in each office every 5 years. Some spectrum managers also noted that resource constraints limit their ability to validate information obtained from program staff. Specifically, through our interviews and IRAC survey, spectrum managers told us that competing mission priorities limit their ability to verify the accuracy of information obtained from program offices. One survey respondent stated that a key challenge to completing frequency assignment reviews is balancing available spectrum management resources with other competing

[39]Spectrum auctions are a market-based mechanism in which FCC assigns a license to the entity that submits the highest bid for specific bands of spectrum. On September 18, 2006, FCC completed an auction of designated federal frequencies in the 1710-1755 MHz band, for commercial use as Advanced Wireless Services (AWS).

priorities. Another spectrum manager stated that validating and verifying the information for each assignment record, which could entail conducting site visits or surveys, would require significant spectrum management resources that federal agencies do not currently have.

- Five out of 10 spectrum managers reported difficulties ensuring that program offices communicated with them before purchasing a spectrum-dependent system. Federal officials from one agency told us that approximately 30 percent of the time, program offices at the agency procure spectrum-dependent equipment without first notifying the agency spectrum managers, and in some cases, before the assignment has been granted.

- In another example, a spectrum manager reported that a program office purchased a spectrum-dependent system to operate on an assignment before receiving authorization to operate on the frequency. The frequency assignment application was eventually denied because the program office had purchased a system that could not be operated on federally assigned spectrum and the agency had to place the equipment in storage where it remained unused.

NTIA Has Taken Steps to Identify Spectrum for Future Wireless Broadband Use, yet NTIA and Federal Agencies Will Face Challenges in Analyzing and Repurposing This Spectrum

NTIA Has Identified Federally Assigned Spectrum to Be Made Available for Future Wireless Broadband Use

In response to the recent initiatives to make a total of 500 MHz of spectrum available for wireless broadband, NTIA has (1) identified 115 MHz of federally allocated spectrum to be made available for wireless broadband use within the next 5 years, referred to as the Fast Track Evaluation, and (2) developed an initial plan and timetable for repurposing additional spectrum for broadband, referred to as the 10-Year Plan.[40]

Fast Track Evaluation. NTIA and the Policy and Plans Steering Group (PPSG)[41] identified and recommended portions of two frequency bands, totaling 115 MHz of spectrum within the ranges of 1695–1710 MHz and 3550–3650 MHz to be made available for wireless broadband use. In November 2010, NTIA publicly released its results. In its final report, NTIA summarized its analysis of four frequency bands: 1675–1710 MHz, 1755–

[40]Wireless broadband is comprised of both fixed and mobile wireless communication sources. Fixed wireless broadband refers to stationary wireless devices or systems that provide high-speed Internet access from a fixed location. Mobile broadband refers to wireless high-speed Internet access through a portable device, such as a cell phone. *See*, Memorandum for the Heads of Executive Departments and Agencies, *Unleashing the Wireless Broadband Revolution*, 75 Fed. Reg. 38387 (2010).

[41]The PPSG consists of the Assistant Secretaries, or equivalent, with spectrum management oversight in agencies that are major stakeholders in the spectrum issues under consideration. It provides advice to NTIA on spectrum- dependent telecommunication policies, strategic plans, planned or revised positions on spectrum issues nationally and internationally, and helps resolve major contentious spectrum policy issues that affect the use of spectrum by federal and nonfederal users.

1780 MHz, 3500–3650 MHz, and 4200–4400 MHz. For these bands, NTIA reviewed the number of federal frequency assignments within the band, the types of federal operations and functions that the assignments support, and the geographic location of federal use. Additionally, NTIA applied the following criteria to identify the 115 MHz of spectrum:

- the band must be able to be made available within 5 years,
- the band must be between 225 MHz and 4400 MHz,
- the decision to recommend bands for repurposing could be made prior to October 1, 2010 (therefore due to time constraints decisions would not require relocation of federal users), and
- opportunities for geographic or other sharing within the bands must have already been successfully proven.

Since clearing these bands of federal users and relocating incumbent federal users to new bands was not an option in the given time frame, the bands that NTIA recommended be made available will be opened to geographic sharing[42] by incumbent federal users and commercial broadband.

10-Year Plan. By a presidential memorandum, NTIA was directed to collaborate with FCC to make available 500 MHz of spectrum over the next 10 years, suitable for both mobile and fixed wireless broadband use, and complete by October 1, 2010, a specific plan and timetable for identifying and making available the 500 MHz for broadband use. NTIA publicly released this report in November 2010.[43] In total, NTIA and the National Broadband Plan identified 2,264 MHz of spectrum to analyze for possible repurposing, of which 639 MHz is exclusively used by the federal government and will be analyzed by NTIA. Additionally, NTIA will collaborate with FCC to analyze 835 MHz of spectrum that is currently located in bands that are shared by federal and nonfederal users. Furthermore, NTIA has stated that it plans to seek advice and assistance

[42]As a form of interference mitigation to maintain incumbent operations, NTIA and FCC will establish geographic exclusion zones which limit where commercial licensees will be able to operate. Within the exclusion zones, wireless broadband use would not be permitted, which would protect existing federal systems.

[43]NTIA, *10 Year Plan and Timetable to Make Available 500 MHz of Spectrum for Wireless Broadband* (2010).

from CSMAC, its federal advisory committee comprised of industry representatives and experts, as it conducts analyses under the 10-Year Plan.

NTIA officials said that they will prioritize the bands identified for evaluation based on the factors in table 3, with the bands that best fulfill this criteria being evaluated for potential repurposing first. Following prioritization, NTIA, with the assistance of the federal agencies, will characterize each band to determine the extent of federal use in the band. After each band is characterized, further analysis will be conducted to evaluate the technical, operational, and cost effects that repurposing would have on the federal agencies.

Table 3: NTIA Criteria for Prioritizing and Characterizing Candidate Bands in the 10-Year Plan

Prioritization criteria
1. Amount of usable bandwidth and contiguous spectrum within band
2. Industry interest in band and expected auction[a] revenue
3. Indirect benefits to the economy
4. Availability of spectrum for relocation of incumbent federal users
5. Estimated costs of relocating federal incumbent users
6. Impact to global services that would require international reallocation
7. Likelihood the band can be repurposed in 10 years
Characterization criteria
1. Description of how the band is currently being used
2. Number and types of different federal systems operating in the band
3. Number of federal agencies in the band
4. Measure or description of the complexity of federal systems in the band
5. Number and types of nonfederal incumbent users in the band
6. Degree to which repurposing might impact federal services and operations

Source: NTIA.

[a]Spectrum auctions are a market-based mechanism in which FCC assigns a license to the entity that submits the highest bid for specific bands of spectrum.

In January 2011, NTIA announced that it had selected the 1755–1850 MHz band as the first priority for detailed evaluation under the 10-Year Plan. According to NTIA, this band was given top priority for evaluation by NTIA and the federal agencies, based on a variety of factors, including industry interest and the band's potential for commercial use within 10 years. Agencies currently operating in this band have been notified of the pending evaluation, and NTIA and PPSG have identified comparable bands

for agency operations. Affected agencies are now conducting analyses to determine which of these comparable bands best meets their needs and will provide NTIA with their input in spring 2011. According to NTIA officials, a decision on how to proceed with its analysis will be made in June 2011. This is not the first time NTIA has studied these bands. These bands were previously evaluated for reallocation, and in 2001, we reported that at the time adequate information was not currently available to fully identify and address the uncertainties and risks of reallocation.[44]

Federal Agencies Reported Difficulties during the Fast Track Evaluation, Raising the Prospect for Future Challenges

Affected federal agencies reported difficulties in providing the impact analysis required for NTIA's Fast Track Evaluation, raising concerns that larger scale future analysis may be impacted. The evaluation required Navy, NOAA, and FAA to analyze and submit a significant amount of detailed impact analyses that were not readily available, according to officials with those agencies. Further, Department of the Navy and U.S. Marine Corps officials said they were required to conduct analyses based on a number of different scenarios to determine what the impact might be for mission performance by making various spectrum bands available for wireless broadband. According to one Navy official, while DOD collects a large amount of data on its spectrum-dependent systems, NTIA's request required DOD to conduct a time-consuming, in-depth analysis on the operational impact of repurposing certain spectrum bands. NTIA officials recognize that completing this analysis required significant agency resources, but they noted that agencies were the only ones with the requisite expertise to complete the analysis.

In response to our survey, the Department of the Navy and the Department of the Air Force expressed concerns over data accuracy as a result of the short time frame given to them to collect the data.[45] One official stated that the speed of identifying available spectrum appeared more important than the accuracy of the data. According to a DOD official, these data requests were time-consuming because they required regional spectrum managers to identify and contact all field program offices using spectrum- dependent systems in the band being analyzed to determine their use of spectrum and how their mission performance would be affected if the band were no

[44]GAO, *Defense Spectrum Management: More Analysis Needed to Support Spectrum Use Decisions for the 1755-1850 MHz Band*, GAO-01-795 (Washington, D.C.: Aug. 21, 2001).

[45]The presidential memorandum was issued on June 28, 2010, and it directed NTIA to report back with its initial plan and timetable by October 1, 2010.

longer available for federal use. Four IRAC agencies that completed our survey—NOAA, Department of the Air Force, Department of the Navy, and Department of the Army—expressed further concerns about the resources required to collect spectrum data for the Fast Track Evaluation.

In addition to the challenges that federal agencies reported in gathering data, making the 115 MHz of spectrum available for wireless broadband will have operational effects on agencies. For example, according to NTIA's Fast Track Evaluation, as a result of the decision to make the 1695–1710 MHz band available for wireless broadband, NOAA will have to redesign its next generation of Geostationary Operational Environmental Satellite-R series (GOES-R) satellites.[46] According to NOAA, this redesign will increase costs and delay implementation. Additionally, NTIA does not expect DOD to experience any immediate operational impacts due to the repurposing of the 3550–3650 MHz band; however, such a repurposing based on exclusion zones will limit DOD's future flexibility to implement new systems or operate at new locations. As table 4 illustrates, NOAA and DOD will be the primary agencies affected by the decision to make this spectrum available.

[46]For additional information on these satellites, see GAO, *Geostationary Operational Environmental Satellites: Improvements Needed in Continuity Planning and Involvement of Key Users*, GAO-10-799 (Washington, D.C.: September 1, 2010).

Table 4: Status and Outcome of Bands Evaluated for Fast Track Repurposing

Band[a]	Primary agency operating in band[b]	Primary use	NTIA decision	Challenges federal agencies, industry, and NTIA will face	Potential impacts reported by agencies
1675–1710 MHz	NOAA	Meteorological aid and satellite service	Make a portion of the band available to wireless broadband access within 5 years. (1695–1710 MHz)	Delays and costs associated with redesigning next generation of GOES-R satellites. Exclusion zones surrounding satellite downlink stations may reduce industry interest. Band is not used internationally for mobile broadband. Will require international agreement at 2016 World Radio Conference.	NOAA will redesign the GOES-R emergency weather satellite downlink transmission planned for 1697.4 MHz to a frequency below 1695 MHz.
1755–1780 MHz	Multiple	Multiple	NTIA could not reach a conclusion as to whether the band could be made available for broadband use within 5 years. NTIA will continue to analyze the issue as part of 10 year plan.	An industry priority but not rigorously analyzed by NTIA as part of the Fast Track Evaluation and not selected to be made available for wireless broadband.	Might require relocation of incumbent federal users.
3500–3650 MHz	DOD	Navy shipboard radar and DOD land training facilities	Will make portion of the band available to wireless broadband access within 5 years. (3550–3650 MHz)	Will limit future flexibility of DOD to implement new systems and operate in new locations. Minimal industry interest in bands above 3 GHz for mobile broadband applications.	Does not require alteration of current military operations. May limit ability to expand operations.
4200–4220 and 4380–4400 MHz	Multiple—FAA manages band	Radio altimeters on aircraft (civil and government)	Cannot make available for broadband use within 5 years. Will begin taking action now to gain international agreement by 2016.	Reallocation would require international agreement and reconfiguration on civil and government aircraft. FAA has not reported complete usage data for altimeters in this band.	FAA will have to coordinate a study to determine if use of altimeters can be prevented in band segments. Will require international reallocation.

Source: GAO analysis of NTIA data.

[a]The 1675–1710, 3500–3560, 4200–4220 and 4380–4400 MHz bands were identified by NTIA with advice from the PPSG. The 1755–1780 MHz band was identified in the *National Broadband Plan* for potential reallocation to allow for nonfederal broadband use. In January 2011, NTIA announced that it would evaluate the 1755–1850 MHz bands as part of the 10-Year Plan.

[b]Although multiple agencies operate on each of these bands, we have listed only the primary agencies operating in each band that have regulatory authority over the band.

Further, data- and resource-related challenges could affect implementation of NTIA's 10-Year Plan. As experienced in previous relocations, inaccurate and incomplete data submitted by agencies can impact the transition time from federal to commercial use once reallocated spectrum has been auctioned by FCC and purchased by commercial users. During the relocation of federal users as a result of the Advance Wireless Service spectrum auction in 2006, according to a winning bidder of the spectrum, some agencies submitted inaccurate inventory data to NTIA and OMB causing delays in the transition from federal to commercial use. As previously discussed, federal agencies faced resource challenges in providing NTIA data on system inventory, operational use, and operational impacts. These challenges raise concerns because the Fast Track Evaluation focused on only 115 MHz of spectrum, while NTIA is now expecting to evaluate 1,474 MHz of spectrum, meaning these challenges could be magnified.

Without adequate and timely funding for agencies to conduct research and planning, the goals of the 10-Year Plan and timetable may not be achieved. In previous auctions, as part of the Commercial Spectrum Enhancement Act (CSEA),[47] agencies have been reimbursed for their relocation costs through the Spectrum Relocation Fund.[48] CSEA does not provide agencies with up-front funding to conduct detailed analysis during the spectrum evaluation phase. The lack of funding may delay analysis and band characterization for repurposing, as agencies have limited staff and resources to dedicate to data collection and band analysis. This can be problematic because agencies have reported significant costs associated with collecting the data and conducting the analysis requested by NTIA. For example, a DOD official told us he committed 400 staff hours to

[47]On December 23, 2004, President Bush signed into law the Commercial Spectrum Enhancement Act (Title II of Pub.L. No. 108-494) that created the Spectrum Relocation Fund to provide a centralized and streamlined funding mechanism through which federal agencies can recover the costs associated with relocating their radio communications systems from certain spectrum bands, which were authorized to be auctioned for commercial purposes. Under the terms of the CSEA, funds for compensation are only available when the federal entities relocate from spectrum awarded to nonfederal entities through a competitive bidding, or auction process. A portion of the revenues obtained in the auction of the spectrum to nonfederal entities is then credited to the Spectrum Relocation Fund to pay the relocation costs of federal entities.

[48]According to OMB, costs associated with relocation of federal users in the auction of the 1710–1755 MHz band were estimated at $ 1.009 billion. These costs included necessary infrastructure and systems modifications to relocate federal users to different frequencies and the transition of some agencies from analog to digital communications to improve communications efficiency and compatibility.

collecting operational impact data for the Fast Track Evaluation for two affected DOD systems; under the 10-Year Plan, the official expects to have to collect and prepare operational impact data for 120 systems. To address this funding issue, NTIA stated in the Fast Track Evaluation analysis that changes to expand the CSEA would be needed to provide agencies with up-front funding for analysis and planning related to repurposing. According to NTIA officials, without this funding, agencies will not be able to conduct adequate analysis for the 10-Year Plan, and currently NTIA does not have a plan to address these challenges if this funding is not made available.

Industry Stakeholders Expressed Concerns with the Usefulness of the Identified Spectrum

Industry stakeholders, including wireless service providers, representatives of an industry association, and a think tank representative we contacted expressed concerns over the usefulness of the spectrum identified by NTIA in the Fast Track Evaluation, since most of the spectrum identified (100 of the 115 MHz) is outside the range considered to have the best propagation characteristics for mobile broadband.[49] Overall, there has been limited interest in the bands above 3 GHz for mobile broadband use because, according to industry stakeholders, there have been minimal technological developments for mobile broadband in bands above 3 GHz and no foreseeable advances in this area at this time.

According to industry representatives, the 1755–1780 MHz band that NTIA considered as part of the Fast Track Evaluation has the best characteristics for mobile broadband use, and it is internationally harmonized for this use. NTIA did not select this band to be made available in the 5-year time frame due to the large number of federal users currently operating there. Recently, however, NTIA has identified it as the first band to be analyzed under the 10-Year Plan to determine if it can be made available for commercial broadband use.

An industry stakeholder has stated that the 1695–1710 MHz band identified by NTIA in the Fast Track Evaluation is the second-best alternative for wireless broadband if the 1755–1780 MHz band were not made available; however, the 1695–1710 MHz band is not currently used internationally for wireless broadband, which may reduce device manufacturers' incentive for developing technology that can be used in these frequencies.

[49]As mentioned previously, spectrum between 300 MHz and 3 GHz is generally considered to be the best suited for mobile broadband.

Additionally, an industry stakeholder also expressed concern over the exclusion zones established by NTIA in the 1695–1710 MHz band, which would make the band unavailable for wireless broadband in select major cities across the United States that account for over 12 percent of the U.S. population. Similarly, one industry stakeholder has also noted that the exclusion zones NTIA has established for the 3550–3650 MHz band would prevent wireless broadband access along the entire East and West coasts. Considering the geographic exclusion zones and the location of the spectrum above 3 GHz, an industry stakeholder we contacted said that they are not as immediately interested in this spectrum as they are in the 1755–1780 MHz band, which, according to one industry stakeholder, may impact future spectrum auction prices. On March 8, 2011, FCC released a Public Notice seeking comment on steps the Commission can take to best promote wireless broadband deployment in the 1695-1710 MHz and 3550-3650 MHz bands. Amongst other things, FCC sought comment on the extent to which these bands could be made available for broadband deployment; how the conditions placed on the bands, such as the exclusion zones, could affect their usefulness for broadband deployment; and whether broadband technologies are readily available to operate on these bands.[50]

While spectrum auctions can generate substantial funds for the U.S. Treasury—for example, the Advance Wireless Services auction that took place in September 2006 fetched over $13.7 billion, a portion of which went to the U.S. Treasury—if industry participants are not as interested in the spectrum being auctioned, lower bids would be expected. Agencies are currently reimbursed with funding from auction revenue for data collection, analysis, and planning-related costs, after costs for relocating federal users have been paid. Lack of industry interest in spectrum above 3 GHz creates concerns as to whether large amounts of spectrum will be able to meet the minimum price at auction, which the CSEA has set at 110 percent of federal relocation costs. Since relocating federal users is likely as part of the 10-Year Plan, if the reserve is not met, agencies may not be reimbursed for their data collection, analysis, and planning costs. As previously stated, NTIA officials have raised concerns that without this funding, agencies will not be able to conduct adequate analysis for the 10-

[50]*Spectrum Task Force Requests Information on Frequency Bands Identified by NTIA as Potential Broadband Spectrum*, Public Notice, DA 11-444 (2011). In this Public Notice, FCC also sought comments to inform ongoing assessment of the 1755-1850 MHz, 4200-4220 MHz and 4380-4400 MHz bands, and other bands identified by NTIA as candidates for commercial use.

Year Plan. Currently NTIA does not have a plan to address these challenges if this funding is not made available.

Conclusions

Radio frequency spectrum is a scarce national resource that enables wireless communications services vital to the U.S. economy and to a variety of government functions, yet NTIA has not developed a strategic, governmentwide vision for managing federal use of this valuable resource. NTIA's spectrum management authority is broad in scope, but NTIA's efforts do not align with its authorities. Its focus is on the technical aspects of spectrum management, such as ensuring new frequency assignments will not cause interference to spectrum-dependent devices already in use, rather than on whether new assignments should be approved based on a comprehensive evaluation of federal spectrum use from a governmentwide perspective. NTIA officials noted that due to limited resources, the agency has put its strategic planning activities on hold and has instead turned its focus to recent initiatives directed by the Obama Administration. However, lacking an overall strategic vision, NTIA cannot ensure that spectrum is being used efficiently by federal agencies.

Agencies are supposed to review all their spectrum assignments every 5 years and delete any assignments not essential to their missions; however, we found that these reviews are often perfunctory. Furthermore, agencies have concerns about not having access to sufficient spectrum in the future to meet mission-critical needs and therefore might be reluctant to relinquish any assignments for fear they will be unable to get more spectrum in the future. The absence of requirements for agencies to submit justifications for their spectrum use combined with NTIA's limited oversight of the agencies has led to decreased accountability and transparency in how federal spectrum is actually being used and whether the spectrum-dependent systems the agencies have in place are necessary. However, federal agency officials face challenges—such as staff turnover and resource constraints—when coordinating with field program staff to obtain the information necessary for the frequency assignment applications and reviews. Given that verifying the information for each frequency assignment record could require significant spectrum management resources that federal agencies might not currently have, it would be beneficial for NTIA to consider options for a different approach to obtain critical assignment information from the agencies. Approaches may include efforts such as requiring agencies to conduct site surveys of their spectrum-dependent systems, attesting to the accuracy of the data provided to NTIA, or making changes to the structure of the 5-year review program.

As part of its spectrum management processes, NTIA depends primarily on an antiquated data collection system and does not have a mechanism in place to validate and verify the accuracy of spectrum-related data submitted by the federal agencies. The data management system also lacks transparency and internal controls, which are essential for ensuring accountability for government resources and for achieving effective and efficient results. Although NTIA is developing its new FSMS, full implementation is still years away. In the meantime, without meaningful data validation requirements, NTIA has limited assurance that the agency-reported data it collects are accurate and complete. As NTIA begins the arduous task of identifying 500 MHz of spectrum that can be repurposed for broadband services, incomplete or inaccurate data might adversely impact NTIA's ability to make sound decisions regarding the current and future spectrum needs of agencies.

Recommendations for Executive Action

To facilitate the effective governmentwide management of federal spectrum use, the Assistant Secretary of Commerce for Communications and Information should take the following actions:

- To ensure NTIA's previous efforts to develop a federal strategic plan are not diminished, develop an updated plan that includes key elements of a strategic plan, as well as information on how spectrum is being used across the federal government, opportunities to increase efficient use of federally allocated spectrum and infrastructure, an assessment of future spectrum needs, and plans to incorporate these needs in the frequency assignment, equipment certification, and review processes.

- To help ensure federal agencies are managing current and future spectrum assignments efficiently, in consultation with IRAC, examine the 5-year assignment review processes and consider best practices to determine if the current approach for collecting and validating data from federal agencies can be streamlined or improved.

- To provide the assurance that accurate and reliable data on federal spectrum use are collected, take interim steps to establish internal controls for management oversight of the accuracy and completeness of currently reported agency data. In developing the new Federal Spectrum Management System, incorporate adequate internal controls for validating the accuracy of agency-reported information submitted during the assignment, certification, and frequency assignment review processes.

Agency Comments and Our Evaluation

We provided a draft of this report to the Department of Commerce for its review and comment. Commerce provided written comments, which are reprinted in appendix IV.

In commenting on the draft report, Commerce noted that as the spectrum manager for federal users, NTIA has several spectrum management duties, such as fulfilling federal agency spectrum requirements, preventing interference among federal users, and undertaking other spectrum-related assignments or initiatives related to federally assigned spectrum. According to Commerce, given funding limitations and resource constraints, NTIA must determine how to prioritize its various spectrum-related responsibilities without impairing its primary mission of responding to agencies' spectrum assignment requests in a timely manner.

With respect to our recommendations, Commerce concurred with one and partially concurred with the other two. Specifically, Commerce concurred with our recommendation to examine the 5-year assignment review processes and consider best practices to determine if the current approach can be improved. Commerce stated that NTIA, in consultation with IRAC, would review the current assignment process with agencies to determine what improvements could be implemented. Commerce partially concurred with our recommendation to develop an updated strategic plan, stating that NTIA will have to weigh updating strategic plans against other spectrum management needs and directives and determine priorities. Commerce agreed that key elements of strategic planning are central to NTIA's work, but stressed that given funding limitations, NTIA must consider our recommendation in light of its other spectrum-related obligations and fundamental spectrum mission. We recognize that NTIA has been tasked with responding to other spectrum management directives, but lacking an overall strategic vision, NTIA cannot ensure that its spectrum management decisions reflect the overall best use of federally allocated spectrum. Moreover, without an understanding of how spectrum is being used across the federal government, NTIA cannot ensure that spectrum is being used efficiently by federal agencies or that spectrum management decisions will meet the current and future needs of the agencies, as well as the federal government as a whole. We believe a strategic plan is a key element for NTIA to respond to recent directives from the President regarding repurposing spectrum assigned to federal agencies for commercial broadband. Commerce also partially concurred with our recommendation related to establishing internal controls for management oversight of currently reported agency data, noting its concurrence to the extent that such controls could be adopted with existing and anticipated resources. Commerce stated that NTIA would

take steps to establish internal controls for federal spectrum use data and work with agencies to determine what new processes could be implemented that would lead to more accurate and reliable data, including the establishment of procedures for agency validation of submitted data.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees and the Secretary of Commerce. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or 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. Contact information and major contributors to this report are listed on appendix V.

Mark L. Goldstein
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

This report focuses on the federal use of spectrum and examines (1) the extent to which the National Telecommunications and Information Administration's (NTIA) spectrum management oversight and policy addresses governmentwide spectrum needs, (2) how federal agencies are using assigned spectrum and the extent to which they manage their spectrum use, and (3) what steps NTIA and the federal agencies have taken to meet the requirements and expectations of the *National Broadband Plan* and presidential memorandum to repurpose spectrum for commercial broadband and what challenges these efforts face.

To determine the extent to which NTIA's spectrum management oversight and policy addresses governmentwide spectrum needs, we examined documents, consulted relevant spectrum literature, and conducted interviews. Specifically, we reviewed NTIA's *Manual of Regulations and Procedures for the Federal Radio Frequency Management* (commonly referred to as the Redbook) and other documentation of NTIA's current processes, policies, and procedures to determine (1) NTIA's legal authorities for managing federal users of spectrum, (2) how NTIA works with federal agencies to manage spectrum, (3) how NTIA collects data on federal agency spectrum assignments and usage, (4) limitations, if any, with NTIA's current procedures for collecting data on federal agency spectrum assignments and usage, and (5) NTIA's actions, if any, to address these limitations. We also reviewed NTIA's data collection procedures and policies to ensure the data reliability of information contained in the Government Master File (GMF) database. In addition, we interviewed representatives from NTIA's Office of Spectrum Management to gather information about their spectrum management policies and procedures. We also interviewed or obtained written comments from a variety of experts and industry stakeholders, including academics, industry representatives, and think-tank organizations (as shown in table 5) to obtain their views on options available for increasing the efficiency of federal spectrum use and management and associated tradeoffs. We selected the experts and industry stakeholders to interview based on prior published literature, stakeholders' recognition and affiliation with spectrum management industry, and NTIA and other stakeholders' recommendations. Finally, we conducted a literature review of spectrum studies. Our literature search covered studies published from 2005 onward and was largely drawn from major electronic databases in telecommunications, academic, economics, and other fields (e.g., SNL Kagan, EconLit, Academic OneFile, ProQuest, and other databases) and from our past work on spectrum-related issues. We used the studies obtained from this literature review to obtain background information on spectrum issues.

Table 5: List of Experts and Industry Stakeholders We Contacted

Stakeholder groups	Stakeholder
Academic experts	Stanford Institute for Economic Policy Research
	Interdisciplinary Telecommunications Program, University of Colorado
Think tank research	Open Technology Initiative at New America Foundation
	Public Knowledge
Industry stakeholders	Shared Spectrum
	CTIA, the Wireless Association
	Verizon
	Motorola
	T-Mobile
	AT&T

Source: GAO.

To identify how federal agencies use assigned spectrum and the extent to which agencies manage their spectrum use we conducted a Web-based survey of all 19 Interdepartment Radio Advisory Committee (IRAC) federal agency representatives. We surveyed federal agencies on the IRAC because these agencies collectively hold over 90 percent of all federally assigned spectrum. The survey was conducted from November 1, 2010, to January 21, 2011. The survey included questions on (1) how federal agencies use spectrum assignments; (2) federal agency interaction with NTIA; (3) federal agencies' spectrum management policies and procedures; (4) the extent to which federal agencies share spectrum with other users and use of commercial services; and (5) federal agencies' views on the extent to which agencies have the resources and information they need to manage their spectrum. The results of our survey can be found in appendix III.

We received completed responses from 18 of the 19 IRAC representatives, for a 95 percent response rate. We did not receive a completed survey from the Department of State IRAC representative despite our multiple attempts to obtain the information. Because we selected a nonprobability sample of federal agencies with assigned spectrum to survey, the information we obtained from the survey may not be generalized to all federal agencies with assigned spectrum. However, because the IRAC member agencies that we included in our sample survey hold the vast majority of all federally assigned spectrum, the information we gathered from these agencies provided us with a general understanding of federal agencies' spectrum management policies. In addition, we took steps in the

development of the survey, the data collection, and the data analysis to minimize nonsampling errors. For instance, a survey specialist designed the survey and the draft survey was pre-tested with IRAC representatives from three federal agencies. We conducted these pre-tests to ensure that (1) the questions and possible responses were clear and thorough, (2) terminology was used correctly, (3) questions did not place an undue burden on the respondents, (4) the information was feasible to obtain, and (5) the questionnaire was comprehensive and unbiased. On the basis of the feedback from the three pre-tests we conducted, we made changes to the content and format of the survey questions.

To supplement data obtained from the survey and to gather in-depth information on the roles and responsibilities of federal agencies in managing their assigned spectrum, we obtained documents from and conducted interviews with a sample of federal agencies to provide detailed examples of how federal agencies are managing their spectrum. We prepared comprehensive profiles for each of these agencies which included data from our IRAC survey, our review of federal agency planning documents including federal agencies' spectrum management policies and procedures and strategic spectrum plans, other literature, and structured interviews with spectrum management officials at selected federal agencies. The agencies we met with included the Department of Defense, Department of Homeland Security, Department of Labor, Environmental Protection Agency, National Oceanic and Atmospheric Administration, the U.S. Coast Guard, Federal Aviation Administration, Health and Human Services, Housing and Urban Development, and the Department of the Treasury. We selected federal agencies for our comprehensive profiles to achieve a mix of the following characteristics:

- large spectrum holdings (more than 5,000 assignments) and small spectrum holdings (less than 1,000 assignments);
- IRAC and non-IRAC member agencies to ensure that we had representative views from both groups; and
- assignments located in different spectrum bands and used for different mission needs.

We also consulted internal stakeholders, experts, associations, and NTIA officials to assist us in identifying potential agencies to interview. Although using these criteria allowed us to obtain information from a diverse mix of federal agencies, the findings from our in-depth profiles

cannot be generalized to all federal agencies because they were selected as part of a non-probability sample.

To determine what steps NTIA and federal agencies have taken to meet the requirements and expectations of the June 28, 2010, presidential memorandum and what challenges these efforts will face, we reviewed pertinent documents related to their efforts, such as *NTIA's Assessment of Spectrum Bands That Could Possibly be Repurposed for Wireless Broadband* (referred to as the Fast Track Evaluation) and 10-Year Plan. We also conducted interviews with NTIA and federal agency officials. Through our interviews, we collected up to date information on actions being taken to make spectrum available for wireless broadband including information on what criteria NTIA is using to make these decisions, how NTIA and federal agencies are collaborating on identifying spectrum, and what potential challenges they may face in reallocating federal spectrum. We also contacted four wireless service providers to obtain their viewpoints and opinions on (1) NTIA's process and methodology for identifying additional spectrum to be made available for commercial broadband use, (2) the level of private sector demand for the spectrum identified by NTIA, and (3) the potential value of spectrum that NTIA has identified for analysis as part of its Fast Track Evaluation and 10-Year Plan.

We conducted this performance audit from May 2010 to April 2011 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.

Appendix II: Summary of NTIA Projects Focused on Reforming Governmentwide Federal Spectrum Management and Increasing the Efficiency and Effectiveness of Federal Spectrum Use

Project	Tasks	Deliverable	Target date	Status as of February 2011
Improve stakeholder participation and maintain high qualifications of spectrum managers	1. Establish a Commerce Spectrum Management Advisory Committee (CSMAC)	Establish CSMAC	May 2005	Completed on time
	2. Establish a high-level interagency group	Establish PPSG	January 2005	Completed on time
	3. Resolve intergovernmental spectrum disputes through the existing White House Policy Coordinating Committee (PCC) and process and revise the NTIA/FCC Memorandum of Understanding (MOU) to provide an additional minimum 15 business days to accommodate the PCC process	MOU between NTIA and FCC to provide additional minimum 15 business days to accommodate PCC process	March 2006	NTIA submitted proposed MOU language to FCC in May 2008; incomplete with no anticipated date for completion
	4. Expand the role of FCC Defense Commissioner	MOU between NTIA and FCC to expand the role of FCC Defense Commissioner	March 2006	NTIA submitted revised proposed language to FCC in May 2008; Incomplete with no anticipated date for completion
	5. Promote a career development program and spectrum management training	No deliverables	September 2007	Program reactivated in Jan. 2008.
Reduce International Barriers to U.S. Innovations in Technologies and Services	1. Improve U.S. preparations for World Radio Communication Conferences	Study and recommendations on improvements to U.S. preparations	May 2005	Completed on time
	2. Improve international spectrum management and regulatory environment	Study and recommendations on impact of international spectrum management policies and regulatory environment	June 2006	Report issued in 2008

Project	Tasks	Deliverable	Target date	Status as of February 2011
Modernize Federal Spectrum Management Processes with Advanced Information Technology	1.Implement advanced information management system	The Federal Spectrum Management System will utilize advanced information technology to develop a Web-based process for preparing and processing applications for system certification and frequency assignments. It will consolidate existing paper-based and multiple software systems, including Spectrum XXI and El-Cid.	Ongoing	Ongoing project; system will be developed by a contract system integrator in conjunction with NTIA staff and with input from the federal agency user community
Satisfy Public Safety Communication Needs and Ensure Interoperability	1. Spectrum sharing between federal and nonfederal agencies	Assessment of feasibility of spectrum sharing between federal and nonfederal public safety entities	December 2006	Completed Report on Federal/nonfederal spectrum and infrastructure sharing and published Jun.2007
Enhance Spectrum Engineering and Analytical Tools	1. Develop analytical approaches, software tools, and engineering techniques for evaluating and improving the efficiency and effectiveness of federal spectrum use	A series of reports that make recommendations for improving spectrum efficiency. Develop a Spectrum-efficiency recommendationsreport that includes an approach and time frame for implementing the recommendations.	September 2007	Incomplete with no anticipated date for completion
	2. Develop and promote recognition in the spectrum management community for best practices in spectrum engineering	Best Practices Handbook	November 2007	Incomplete with no anticipated date for completion
	3. Conduct a pilot program to evaluate approaches and techniques to increase spectrum sharing between federal and nonfederal spectrum users	Establish, conduct, and evaluate results of use of devices and technologies to facilitate sharing through Spectrum Sharing Innovation Test-Bed	Pilot program to be completed by June 2006; results and recommendations of the pilot program are to be completed by September 2008	Stage 1 testing Started in 2nd Quarter 2009. Results and recommendations not reported
	4. Develop and promote the use of modern analytic tools for spectrum engineering	Prepare initial spectrum management models and tools catalog for use by federal spectrum users	December 2006	Incomplete with no anticipated date for completion
Promote Efficient and Effective Use of Spectrum	1. Improve the technical planning process	Recommendations for changes to the NTIA Manual with respect to the Spectrum Certification process	December 2006	Incomplete with no anticipated date for completion

Project	Tasks	Deliverable	Target date	Status as of February 2011
Improve Long-term Planning and Promote Use of Market-based Economic Mechanisms in Spectrum	1. Improve the processes for federal agencies' spectrum planning and produce a national spectrum plan	*Federal Strategic Spectrum Plan* published biannually; *National Strategic Spectrum Plan*	*Federal Strategic Spectrum Plan* to be completed by May 2006; *National Spectrum Plan* to be completed by December 2007	*Federal Strategic Spectrum Plan* published in March 2008; letter to FCC seeking participation in *National Strategic Spectrum Plan sent in June* 2008; incomplete with no anticipated date for completion
	2. Improve federal agencies' processes and procedures to better consider the economic value of spectrum when investing in spectrum-dependent systems	Guidance to the federal agencies on compliance with Section 33.4 of OMB Circular A-11 on considering spectrum value when seeking funding for major spectrum-dependent systems	Not stated—OMB added section 33.4 to Circular A-11 in November 2004	Completed by OMB in November 2004
	3. Develop a plan to identify and implement incentives for improving efficiency in federal agencies' spectrum use	Guidance to the federal agencies concerning integration of spectrum planning with capital and strategic planning Incentives Implementation Plan; workshop on economic and other incentives for efficient use of spectrum; study on international practices with respect to incorporation of market mechanisms into spectrum management	November 2005	Incentives Implementation Plan forwarded to the White House in March 2006 and Published in November 2008; workshop on the use of economic or other incentives to increase the efficiency in federal agencies' spectrum use conducted in February 2006; unpublished study examining international practices that incorporate market mechanisms into more efficient spectrum use completed in 2006
	4. Promote the implementation of a wide range of incentives to improve the efficiencies of both government and private sector spectrum use	Contractor-produced study providing unit of consumption for spectrum use; revised structure for current OSM cost-recovery fee for federal agency spectrum use; study on federal spectrum value and development of fees to promote efficient use of spectrum; draft legislation to implement spectrum use fees; study on sharing between federal agencies and nonfederal unlicensed systems; study on federal spectrum rights; proposals to provide federal agency more flexible rights with respect to spectrum to enable sharing with other federal agencies and nonfederal entities	Not stated	Incomplete with no anticipated date for completion

Source: GAO review of NTIA data.

Appendix III: Survey of IRAC Agencies

The questions we asked in our survey of IRAC agencies are shown below. Our survey was comprised of closed- and open-ended questions. In this appendix, we include all the survey questions and aggregate results of responses to the closed-ended questions; we do not provide information on responses provided to the open-ended questions. For a more detailed discussion of our survey methodology see appendix I.

Background Information:

1. Which Interdepartment Radio Advisory Committee (IRAC) agency do you represent?

Q1	Response
Broadcasting Board of Governors	YES
Department of Agriculture	YES
Department of Commerce	YES
Department of Energy	YES
Department of Homeland Security	YES
Department of Justice	YES
Department of Air Force	YES
Department of Army	YES
Department of the Interior	YES
Department of the Navy	YES
Department of Treasury	YES
Department of Transportation	YES
Department of Veterans Affairs	YES
Federal Aviation Administration	YES
National Aeronautics and Space Administration	YES
National Science Foundation	YES
United States Coast Guard	YES
United States Postal Service	YES
Department of State	NO

2. What component agency or department do you work for?

   [Open-ended]

3. What is your job title?

   [Open-ended]

4. Please briefly describe your key responsibilities as they relate to spectrum management.

   [Open-ended]

5. Do you have other responsibilities in addition to spectrum management? If so, please describe.

   [Open-ended]

6. How long have you been working in federal spectrum management? (Please include in your estimate experience throughout your career not just in your current position)

Q6	Percent
5 years to less than 10 years	27.78
10 years to less than 15 years	22.22
20 years or more	50.00

Federal Agency Frequency Assignments:

7. Currently, how many frequency assignments in each of the following frequency band ranges does the IRAC agency you represent have?

   [Open-ended]

8. For what general purpose does the IRAC agency you represent use spectrum assigned in the 300 MHz to 3 GHz range? If you do not have any spectrum assigned in the 300 MHz to 3 GHz range, please skip toQ9

   [Open-ended]

9. For the IRAC agency you represent, which of the following usage categories has your assigned spectrum been designated? (Select one for each row.)

	Response				
Question	Yes	No	Don't know	No response/not applicable	Total responses
9a. Broadcasting	7	10		1	18
9b. Civil defense	7	9	1	1	18
9c. Emergency communication	17	1			18
9d. Environmental data collection and dissemination	12	5		1	18
9e. Law enforcement	14	4			18
9f. Management and protection of federal property or personnel	16	1			17
9g. National defense	8	9	1		18
9h. National security	9	8	1		18
9i. Natural resources management, protection, and conservation	11	6	1		18
9j. Postal operations	1	17			18
9k. Power utilities transmission and distribution of utilities	3	15			18
9l. Research	14	4			18
9m. Safety	14	4			18
9n. Space exploration	3	14			17
9o. Transportation	12	6			18
9p. Weather	12	6			18
9q. Other	7	5	1	4	17

The next series of questions asks about the types of technologies your agency operates within specific spectrum band ranges.

10. For the IRAC agency you represent, please indicate whether your agency operates *fixed microwave systems* within any of these frequency ranges. (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
10a. Below 3 kHz		16	2	18
10b. 3.1 - 30 kHz		16	2	18
10c. 30.1 - 300 kHz		16	2	18
10d. 300.1 - 3 MHz	1	15	1	17
10e. 3.1 - 30 MHz	2	15	1	18
10f. 30.1 - 300 MHz	3	14	1	18
10g. 300.1 MHz - 3 GHz	14	4		18
10h. 3.1 GHz - 30 GHz	15	3		18
10i. 30.1 GHz - 300 GHz	7	11		18
10j. Above 300 GHz		16	1	17

11. For the IRAC agency you represent, please indicate whether your agency operates *fixed transportable systems* within any of these frequency ranges. (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
11a. Below 3 kHz	1	15	1	17
11b. 3.1 - 30 kHz	2	14	1	17
11c. 30.1 - 300 kHz	2	14	1	17
11d. 300.1 - 3 MHz	8	8	1	17
11e. 3.1 - 30 MHz	7	9	1	17
11f. 30.1 - 300 MHz	11	6		17
11g. 300.1 MHz - 3 GHz	12	4		16
11h. 3.1 GHz - 30 GHz	10	6	1	17
11i. 30.1 GHz - 300 GHz	3	13	1	17
11j. Above 300 GHz		17		17

12. For the IRAC agency you represent, please indicate whether your agency operates *land mobile radio systems* within any of these frequency ranges. select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
12a. Below 3 kHz		17	1	18
12b. 3.1 - 30 kHz		17	1	18
12c. 30.1 - 300 kHz	1	16	1	18
12d. 300.1 - 3 MHz	4	14		18
12e. 3.1 - 30 MHz	7	11		18
12f. 30.1 - 300 MHz	18			18
12g. 300.1 MHz - 3 GHz	18			18
12h. 3.1 GHz - 30 GHz	2	16		18
12i. 30.1 GHz - 300 GHz		18		18
12j. Above 300 GHz		18		18

13. For the IRAC agency you represent, please indicate whether your agency operates *maritime mobile radio systems* within any of these frequency ranges. (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
13a. Below 3 kHz		15	3	18
13b. 3.1 - 30 kHz	1	14	3	18
13c. 30.1 - 300 kHz	1	13	3	17
13d. 300.1 - 3 MHz	6	10	2	18
13e. 3.1 - 30 MHz	6	10	2	18
13f. 30.1 - 300 MHz	10	6	2	18
13g. 300.1 MHz - 3 GHz	5	11	2	18
13h. 3.1 GHz - 30 GHz	1	15	2	18
13i. 30.1 GHz - 300 GHz		16	2	18
13j. Above 300 GHz		16	2	18

14. For the IRAC agency you represent, please indicate whether your agency operates *fixed microwave point to point radio systems* within any of these frequency ranges. (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
14a. Below 3 kHz		16	2	18
14b. 3.1 - 30 kHz		16	2	18
14c. 30.1 - 300 kHz		15	2	17
14d. 300.1 - 3 MHz		16	2	18
14e. 3.1 - 30 MHz		16	2	18
14f. 30.1 - 300 MHz	2	14	2	18
14g. 300.1 MHz - 3 GHz	14	4		18
14h. 3.1 GHz - 30 GHz	14	4		18
14i. 30.1 GHz - 300 GHz	2	16		18
14j. Above 300 GHz		18		18

15. For the IRAC agency you represent, please indicate whether your agency operates *digital microwave systems* within any of these frequency ranges. (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
15a. Below 3 kHz		16	2	18
15b. 3.1 - 30 kHz		16	2	18
15c. 30.1 - 300 kHz		16	2	18
15d. 300.1 - 3 MHz		16	2	18
15e. 3.1 - 30 MHz		15	2	17
15f. 30.1 - 300 MHz	1	15	2	18
15g. 300.1 MHz - 3 GHz	11	7		18
15h. 3.1 GHz - 30 GHz	15	3		18
15i. 30.1 GHz - 300 GHz	4	14		18
15j. Above 300 GHz		18		18

16. For the IRAC agency you represent, please indicate whether your agency operates *satellite systems* within any of these frequency ranges. (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
16a. Below 3 kHz		15	3	18
16b. 3.1 - 30 kHz		15	3	18
16c. 30.1 - 300 kHz		15	3	18
16d. 300.1 - 3 MHz		15	3	18
16e. 3.1 - 30 MHz		15	3	18
16f. 30.1 - 300 MHz	5	9	3	17
16g. 300.1 MHz - 3 GHz	10	6	2	18
16h. 3.1 GHz - 30 GHz	10	6	2	18
16i. 30.1 GHz - 300 GHz	5	11	2	18
16j. Above 300 GHz	1	15	2	18

Spectrum Management Resources:

17. For the IRAC agency you represent, what is/was the federal agency's budget for managing spectrum for each of the following years? (Note: for this question, do not include administrative fees paid to NTIA.)

    [Open-ended]

18. For the IRAC agency you represent, how much did you pay NTIA in administrative fees for each of the following years?

    [Open-ended]

19. In general, how satisfied or dissatisfied is the IRAC agency you represent with the following resources available at your agency to manage spectrum? (select one for each row)

	Response							
Question	Very satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied	Don't know	No response/not applicable	Total responses
19a. Number of staff at your agency working on spectrum management issues	3	4	2	7	2			18
19b. Funding available for spectrum management purposes	3	4	3	5	3			18
19c. Ability to collect data on your spectrum use	3	7	4	3		1		18
19d. In-house technical expertise on spectrum management issues	11	5	2					18
19e. Access to technical expertise outside of your agency (i.e., technical consultants, experts at other agencies)	5	6	5			1	1	18
19f. Research at your agency dedicated to improving interference issues	2	6	5	3		1	1	18
19g. Spectrum management training opportunities	4	4	5	3	2			18
19h. Agency specific spectrum management guidance	5	5	5	1			2	18
19i. Other					1		11	12

20. What additional resources, if any, would the IRAC agency you represent like to have to manage your spectrum?

[Open-ended]

NTIA Guidance and Coordination:

21. Excluding the guidance you received from NTIA's Manual of Regulations and Procedures for Federal Radio Frequency Management (the Redbook), how satisfied or dissatisfied are you with the current quality of the other NTIA guidance you receive to manage your federal spectrum? (select one for each row)

	Response							
Question	Very satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied	Guidance not provided	No response/not applicable	Total responses
21a. Conducting spectrum usage measurements of your assigned spectrum	2	1	5	1		8	1	18
21b. Determining your agency's current spectrum needs	1	5	2	2		7	1	18
21c. Determining your agency's future spectrum needs	1	3	3	2		8	1	18
21d. Submitting data to NTIA's Government Master File database	4	6	3	1	3		1	18
21e. Completing your agency's biennial federal spectrum strategic plan		7	7			1	2	17
21f. Completing the spectrum certification process for a new or upgraded spectrum system	3	6	2	4	2		1	18
21g. Addressing interference issues	4	6	4	1	1	1	1	18

22. To what extent, if at all, does the IRAC agency you represent coordinate with NTIA on the following spectrum management issues? (select one for each row)

	Response					
Question	Great extent	Moderate extent	Some or little extent	No extent	No response/not applicable	Total responses
22a. Obtaining new frequency assignments	14	4				18
22b. Completing the spectrum certification process for a new or upgraded spectrum system	10	4	2		2	18
22c. Addressing interference issues	2	8	6	2		18
22d. Coordinating sharing agreements with other entities	3	6	8			17
22e. Other					9	9

23. What comments or concerns, if any, do you have with NTIA's efforts to identify and make available 500 MHz of spectrum suitable for both mobile and fixed wireless broadband use?

[Open-ended]

Agency Management and Planning Processes and Procedures:

24. Does the IRAC agency you represent have internal policies, protocols, or procedures in place to complete the following spectrum management activities. (select one for each row)

	Response				
Question	Yes, protocols or procedures are in place	No, protocols or procedures are not in place	No, protocols or procedures are not in place, but agency is in the process of developing protocols or procedures	No response/not applicable	Total responses
24a. conducting the 5-year reviews of your federal agency's frequency assignments reflected in the Government Master File (GMF) Database	17		1		18
24b. conducting internal reviews of your federal agency's future spectrum needs	10	4	4		18
24c. conducting measurements of actual spectrum use (such as geographic location of use, and duration and extent of use)	6	1	10	1	18
24d. collecting and maintaining data on how your agency uses spectrum	12	4	2		18
24e. using spectrum efficient technologies	9	5	3	1	18
24f. coordinating spectrum use across program offices/departments within your agency	15		2	1	18
24g. Other	2		1	9	12

25. Within the last 5 years, how many applications for frequency assignments has your agency submitted to the Frequency Assignment Subcommittee (FAS)?

    [Open-ended]

26. Within the last 5 years, how many spectrum certification applications for major spectrum dependent systems has your agency submitted to the Spectrum Planning Subcommittee (SPS)?

    [Open-ended]

27. What factors did the IRAC agency you represent consider when determining whether to classify a system as a "major spectrum dependent system" requiring a spectrum certification review?

    [open-ended]

28. To what extent does the IRAC agency you represent rely on unlicensed spectrum? (select one for each row)

Q28	Frequency	Total responses
Great extent	2	2
Moderate extent	6	8
Some or little extent	9	17
No extent	1	18

29. When did the IRAC agency you represent *last* complete a review or analysis of your *future spectrum needs*? (select one for each row)

Q29	Frequency	Total responses
In the last 6 months	3	3
More than 6 months ago, but less than 1 year ago	2	5
More than 1 year ago, but less than 2 years ago	5	10
More than 2 years ago, but less than 5 years ago	4	14
More than 5 years ago	2	16
Do not know	2	18

30. How much, if at all, do you see your agency's need for spectrum increasing in the next 2-3 years? (select one for each row)

Q30	Frequency	Total responses
Greatly increasing	6	6
Moderately increasing	2	8
Slightly increasing	8	16
Not increasing	1	17

31. In your opinion, will your agency have difficulty in the future meeting its critical mission needs because of insufficient spectrum? (select one for each row)

Q31	Frequency	Total responses
Yes, there will be great difficulty	8	8
Yes, there will be some difficulty	7	15
No, there will be no difficulty	3	18

32. What factors does the IRAC agency you represent consider when making decisions about how much spectrum the agency will need in the future?

    [Open-ended]

33. On average, how often is your agency able to meet the 5-year review requirement of your agency' spectrum frequency assignments reflected in the Government Master File Database?

Q33	Frequency	Total responses
All the time	5	5
Most of the time	9	14
Some of the time, but not most of the time	4	18

34. Please describe below some of the general challenges, if any, that your agency faces in reviewing your spectrum frequency assignments reflected in the Government Master File Database, by the 5-year deadline as required by NTIA:

    [Open-ended]

35. During *the last year*, approximately how many *modifications* to an existing spectrum frequency assignment did the IRAC agency you represent make?

    [Open-ended]

36. Please describe below the general reasons for why your agency *modified* an existing spectrum frequency assignment during *the last year:*

    [Open-ended]

37. During the *last year*, approximately how many *deletions* to an existing spectrum frequency assignment did the IRAC agency you represent make?

    [Open-ended]

38. Please describe below the general reasons for why your agency *deleted* an existing spectrum frequency assignment during *the last year:*

    [Open-ended]

39. Does the IRAC agency you represent currently conduct measurements of any of the following types of usage? (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
39a. Occupancy rates of assigned frequencies	3	14	1	18
39b. Geographic location of frequency use	11	6	1	18
39c. Temporal usage measurements (either clock or calendar)	1	15	2	18
39d. Number of frequencies assigned	11	5	2	18
39e. Other	3	3	7	13

40. Which of the following reasons explains why your agency does not conduct spectrum usage measurements? (select one for each row)

	Response			
Question	Yes	No	No response/not applicable	Total responses
40a. Lack of technology or equipment to conduct measurements	7	6	5	18
40b. Lack of in-house expertise to conduct measurements	1	12	5	18
40c. Conflicting mission priorities	8	5	5	18
40d. Limited resources to conduct measurements	11	3	4	18
40e. Other factors	8	2	5	15

Spectrum sharing and use of commercial services:

41. Does the IRAC agency you represent currently share spectrum with any of the following users? (select one for each row)

	Response				
Question	Yes	No	Don't know	No response/not applicable	Total responses
41a. Other federal users	17	1			18
41b. Across program offices/ departments within your federal agency	15	1		2	18
41c. State governments (including public safety)	13	3	1	1	18
41d. Local governments (including public safety)	13	4	1		18
41e. Private industry users	9	9			18
41f. Non-profit organizations	2	12	3	1	18
41g. Universities and other educational institutions	13	5			18
41h. Other	3	4		6	13

42. If your agency shares spectrum, please provide examples.

[open-ended]

43. If your agency shares spectrum, how much of an influence, if any, were the following factors in the agency's decision to share spectrum? (select one for each row)

	Response					
Question	Strong influence	Moderate influence	Little influence	No influence	No response/not applicable	Total responses
43a. Interoperability with other federal users	13	2		1	2	18
43b. Interoperability with nonfederal users	10	3	1	1	3	18
43c. Improved mission performance	10	3			3	16
43d. Promoting greater spectrum efficiency	8	5	2	2	1	18
43e. Lower costs	5	4	4		4	17
43f. Other	4			2	6	12

44. Does the IRAC agency you represent, utilize any of the following spectrum sharing technologies? (select one for each row)

Question	Response			Total responses
	Yes	No	No response/not applicable	
44a. Software defined radios	4	13		17
44b. Dynamic frequency selection devices	6	11		17
44c. Cognitive radios	2	15		17
44d. Trunked radio systems	14	3		17
44e. Other		2	8	10

45. Please describe below the challenges, if any, impact your agency's ability to use technologies that promote spectrum sharing (such as software defined radios, dynamic frequency selection devices, cognitive radios, or trunked radio systems):

[Open-ended]

46. If your agency does not share spectrum, how much of an influence, if any, were the following factors in the agency's decision to not share spectrum? (select one for each row)

Question	Response					Total responses
	Strong influence	Moderate influence	Little influence	No influence	No response/not applicable	
46a. Concerns over interference	6	3			8	17
46b. Uncertainty over use/priority	7	2			8	17
46c. Lack of economic incentives	3		3	2	9	17
46d. Lack of staff/expertise			1	8	8	17
46e. Current technology being used at the agency does not permit sharing	6	1	1	1	8	17
46f. Lack of guidance/support from NTIA			4	5	8	17
46g. Existing laws and regulations	3	2	1	3	8	17
46h. Other	1			1	12	14

47. Does the IRAC agency you represent currently rely on commercial network service providers to fulfill any of the following services for mission critical needs and/or administrative needs? (select one for each row)

	Response				
Question	Yes	No	Don't know	No response/not applicable	Total responses
47a. Administrative needs	16	1	1		18
47b. Mission critical needs	14	3	1		18
47c. Other	3	3		7	13

48. How much of an influence, if any, were the following factors in the agency's decision to use commercial services to provide your spectrum related needs? (select one for each row)

	Response						
Question	Strong influence	Moderate influence	Little influence	No influence	Don't know	No response/not applicable	Total responses
48a. Increased technical efficiency	4	3	3	5	1	2	18
48b. Reduced costs	8		4	3	1	2	18
48c. Upgraded technology	3	4	4	3	1	2	17
48d. Frequency assignments were deleted		2	3	9	1	3	18
48e. NTIA requirement	2	2		10	2	2	18
48f. Other	5			2		7	14

49. How much of an influence did the following concerns have in the agency's decision not to use commercial network services for mission critical needs? (select one for each row)

	Response						
Question	Strong influence	Moderate influence	Little influence	No influence	Don't know	No response/not applicable	Total responses
49a. Security concerns	9	2	1	2	1	3	18
49b. Lack of support/guidance from NTIA			4	10	1	3	18
49c. Cost	2	6	2	3	1	4	18
49d. Budget	4	3	2	4	1	3	17
49e. Lack of private sector capabilities	5	3	4	2	1	3	18
49f. Concerns over coverage and network reliability	7	3	3	1	1	3	18
49g. Other	1			1		11	13

50. If you have any additional comments or views regarding federal spectrum management issues that you'd like to share with us, please do so below.

Appendix IV: Comments from the Department of Commerce

UNITED STATES DEPARTMENT OF COMMERCE
The Secretary of Commerce
Washington, D.C. 20230

March 25, 2010

Mr. Gene L. Dodaro
Comptroller General
Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Dodaro:

Thank you for the opportunity to comment on the Government Accountability Office's (GAO) draft report, "Spectrum Management: NTIA Planning and Processes Need Strengthening to Promote the Efficient Use of Spectrum by Federal Agencies" (GAO-11-352). GAO examined (1) the extent to which National Telecommunications and Information Administration's (NTIA) spectrum management oversight and policy address government-wide spectrum needs, (2) how federal agencies are using assigned spectrum and the extent to which they manage their spectrum use, and (3) what steps NTIA and the federal agencies have taken to meet the requirements and expectations of the National Broadband Plan and Presidential Memo to repurpose spectrum for broadband, and the challenges these efforts face.

The GAO Report provides a useful perspective on NTIA's critical role as the spectrum manager for Federal users. As the report recognizes, a multitude of Federal agencies rely on spectrum in fulfilling a variety of critical Federal missions including national defense, law enforcement, emergency relief, scientific research, space, and maritime and air traffic control. Over 60 Federal agencies receive spectrum assignments from NTIA, which is authorized by statute to make spectrum assignments to Federal agencies and establish policies concerning such assignments.[1] Because mission-critical Federal operations depend on prompt NTIA action on agency spectrum requests, NTIA's primary spectrum management mission is to fulfill Federal agency spectrum requirements.

The Report observes that NTIA's processes focus on interference mitigation. Interference mitigation is NTIA's top spectrum management priority for two reasons. First, prevention of interference is essential to ensure that critical Federal missions are not impaired. Second, by working with the agencies to prevent interference and promote inter-agency operational coordination on spectrum matters, NTIA ensures that Federal agencies efficiently share use of scarce spectral resources. Effective interference mitigation requires not only NTIA resources but those of the agencies' spectrum offices and field operations, which all work

[1] See 47 U.S.C. 902 (b)(2)(A) and (K).

cooperatively through the Interdepartment Radio Advisory Committee (IRAC) and its subcommittees to coordinate Federal use of spectrum.

As the GAO Report reflects, from time to time NTIA is called upon by the Administration to undertake other spectrum-related assignments. President Bush's 2004 Presidential Memorandum,[2] which is the subject of the GAO Report, is but one example. While NTIA was in the process of updating the 2008 Federal Strategic Plan in accordance with President Bush's November 30, 2004, Presidential Memorandum, President Obama directed the Department of Commerce (Department), working through NTIA, to develop by October 1, 2010, a Ten Year Plan and Timetable to repurpose 500 MHz of Federal and commercial spectrum for wireless broadband use.[3]

NTIA was also directed by the National Economic Council and White House Office of Science and Technology Policy to determine by October 1, 2010, whether any spectrum used by Federal agencies could be repurposed for commercial broadband use within five years.[4] Most recently, on February 10, 2011, the President announced a National Wireless Initiative which, among other things, is aimed at bringing 4G wireless service to 98% of Americans and deploying a nationwide, interoperable wireless communications network for public safety.[5]

Given funding limitations, NTIA must determine how to prioritize the various initiatives without impairing its fundamental spectrum mission of responding to the agencies' spectrum assignment requests in a manner that is both timely and ensures that the agencies can operate in an interference-free environment. NTIA, as the GAO Report notes, must also rely on the agencies' spectrum management offices and field operations to help address these initiatives.

It is in this context that we consider the GAO recommendation that NTIA engage in "holistic spectrum management," in addition to its other spectrum-related obligations. We understand that such an approach would, for example, require NTIA to assess every Federal operation and mission to determine which ones could be performed more efficiently using non-spectrum resources. To date, and as the Report recognizes, NTIA has not undertaken such

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[2] *See* Memorandum for the Heads of Executive Departments and Agencies, *Improving Spectrum Management for the 21st Century,* 49 Weekly Comp. Pres. Doc. 2875 (Nov. 29, 2004).

[3] *See* Memorandum for the Heads of Executive Departments and Agencies, *Unleashing the Wireless Broadband Revolution,* 75 Fed. Reg. 38387 (2010), available at http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution; *See also* Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband, U.S. Department of Commerce, Oct. 2010, (available at http://www.ntia.doc.gov/reports/2010/TenYearPlan_11152010.pdf).

[4] *See* An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands, U.S. Department of Commerce, Oct. 2010, (available at http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation_11152010.pdf).

[5] See Press Release, *President Obama Details Plan to Win the Future through Expanded Wireless Access,* February 10, 2011, (available at http://www.whitehouse.gov/the-press-office/2011/02/10/president-obama-details-plan-win-future-through-expanded-wireless-access).

efforts to analyze individual agencies' decisions as to how best to accomplish their respective missions. NTIA's expertise in those substantive areas (e.g., defense, health care, transportation, or energy) is considerably less than the expertise of the agencies responsible for developing and executing policy in those areas. Lacking the manpower and fiscal resources necessary, NTIA relies on agencies to evaluate their needs and, as noted, seeks to ensure efficient Federal use of spectrum by focusing its efforts on interference mitigation.

Similarly, because of budget and resource limitations, NTIA as a historical matter does not police Federal agency spectrum use or Federal agency spectrum reporting. In a constrained budget environment, we believe the best use of limited Federal resources is to continue the current practice of agency self-reporting. Agency field offices procure and use the equipment for which they seek authorization. They have the specialized expertise and knowledge necessary to provide the needed technical information and they have no incentive to provide inaccurate information. Further, we believe agencies have every incentive to provide accurate information in order to protect their critical missions and operations from interference from other users of spectrum—both Federal and commercial.

We very much appreciate the analysis and recommendations set forth in the GAO Report, particularly the manner in which it illuminates the challenges involved in coordinating use of spectrum by the scores of Federal agencies that depend on spectrum to execute their core missions.

The Department's response to each of GAO's specific recommendations is set forth below. GAO's recommendation appears in italics and the Department's response follows in regular text.

Recommendation 1: To ensure NTIA's previous efforts to develop a federal strategic plan are not diminished, develop an updated plan that includes key elements of a strategic plan, as well as information on how spectrum is being used across the federal government, opportunities to increase efficient use of federally allocated spectrum and infrastructure, an assessment of future spectrum needs, and plans to incorporate these needs in the frequency assignment, equipment certification, and review processes.

Response: We partially concur with this recommendation regarding the need to engage in strategic planning with respect to NTIA's spectrum processes. To be sure, key elements of strategic planning are central to the work that NTIA's Office of Spectrum Management performs on a regular basis. For example, as noted above, while NTIA was in the process of updating the 2008 Federal Strategic Plan, President Obama directed the Department, working through NTIA, to develop a Ten Year Plan and Timetable to repurpose 500 MHz of Federal and commercial

spectrum for wireless broadband use.[6] NTIA completed the Ten Year Plan and Timetable and is now engaged in implementing the Ten Year Plan and Timetable, as well as the President's National Wireless Initiative.[7]

NTIA will weigh the strategic plan updating requirements against other spectrum management needs and directives and determine priorities. At the same time, NTIA's review of spectrum certification requests and its initial Federal strategic spectrum plan have not revealed new Federal spectrum demands that have required alteration of the spectrum allocation table. Moreover, NTIA, through the IRAC and its subcommittees, assesses future Federal spectrum needs on a continuing basis.

Recommendation 2: To help ensure federal agencies are managing current and future spectrum assignments efficiently, in consultation with IRAC, examine the 5-year assignment review processes and consider best practices to determine if the current approach for collecting and validating data from federal agencies can be streamlined or improved.

Response: We concur with this recommendation. NTIA, in consultation with IRAC, will review the current assignment process with the agencies to determine what improvements it can implement

Recommendation 3: To provide the assurance that accurate and reliable data on federal spectrum use are collected, take interim steps to establish internal controls for management oversight of the accuracy and completeness of currently reported agency data. In developing the new Federal Spectrum Management System, incorporate adequate internal controls for validating the accuracy of agency-reported information submitted during the assignment, certification, and frequency assignment review processes.

Response: We partially concur with this recommendation to the extent it can be adopted with existing and anticipated resources. The migration to the Frequency Spectrum Management System (FSMS) to enhance NTIA's operational and planning capabilities is a multi-year process. NTIA will work with the agencies to determine what new processes could be implemented that would lead to more accurate and reliable data, including the establishment of procedures for agency validation of submitted data. This work will include evaluating the existing data collection process as well as the future FSMS.

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[6] *See* Presidential Memorandum on Spectrum Policy for the 21st Century, 69 Fed. Reg. 1568 (Jan. 9, 2004); *See* also Memorandum for the Heads of Executive Departments and Agencies, *Unleashing the Wireless Broadband Revolution,* 75 Fed. Reg. 38387 (2010), available at http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution., *See* Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband, U.S. Department of Commerce, Oct. 2010, (available at http://www.ntia.doc.gov/reports/2010/TenYearPlan_11152010.pdf).

[7] *See* Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband, U.S. Department of Commerce, Oct. 2010, (available at http://www.ntia.doc.gov/reports/2010/TenYearPlan_11152010.pdf).

Again, thank you for the opportunity to respond to the draft Report. The Department is committed to working with the Federal agencies in reviewing these recommendations and taking appropriate action.

Sincerely,

Gary Locke

Gary Locke

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the contact named above, Sally Moino, Assistant Director; Amy Abramowitz; Tida Barakat; Richard Brown; Colin Fallon; Nick Jepson; Maria Mercado; Josh Ormond; Kelly Rubin; Andrew Stavisky; Hai Tran; and Mindi Weisenbloom made key contributions to this report.

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