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Report to Congressional Committees

November 2011

COMMERCIAL SPECTRUM

Plans and Actions to Meet Future Needs, Including Continued Use of Auctions

GAO-12-118

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GAO Highlights

Accountability * Integrity * Reliability

Highlights of GAO-12-118, a report to congressional committees

Why GAO Did This Study

The radio-frequency spectrum enables an array of wireless communications services that are critical to the U.S. economy and national security, such as wireless broadband. In 2010, a Federal Communications Commission (FCC) task force issued the National Broadband Plan that included recommendations to reform spectrum policy. Since 1994, FCC has used competitive bidding, or auctions, to assign licenses to commercial entities for their use of spectrum; however, its authority to use auctions expires on September 30, 2012.

Among other things, GAO examined (1) the extent to which FCC has made spectrum available for new commercial uses and the time taken to do so, (2) experts' and stakeholders' views on FCC's plans and recent actions to meet future spectrum needs, and (3) experts' and stakeholders' views on the continued use of auctions to assign spectrum. To address these objectives, GAO reviewed FCC's plans, notices, and orders; reviewed six instances in which FCC made spectrum available for new commercial uses; and surveyed 30 experts and 79 industry stakeholders about their views on FCC's efforts to make spectrum available for new uses, its plans and actions to meet future needs, and its continued use of auctions (the survey had a 68 percent response rate).

What GAO Recommends

Given the continued support of FCC's use of auctions, Congress should consider extending FCC's auction authority beyond the current expiration date of September 30, 2012. FCC provided technical comments that were incorporated as appropriate.

View GAO-12-118. For more information, contact Mark Goldstein at (202) 512-2834 or goldsteinm@gao.gov.

What GAO Found

Since 1994, FCC has made over 520 megahertz (a measure of quantity) of spectrum available for new uses, such as wireless broadband, through a process that can be lengthy. Because most of the usable spectrum in the United States has been allocated to existing uses, FCC must change its rules to move spectrum from an existing use to a new use, a process known as repurposing spectrum. Yet, this process can be lengthy—from 7 to 15 years for the six repurposings that GAO reviewed. Four factors contribute to the time it takes FCC to repurpose spectrum: the regulatory nature of the process, which to some extent is guided by statute; opposition of incumbent users, who could be required to vacate spectrum; coordination challenges between FCC and the National Telecommunications and Information Administration (NTIA), which oversees federal agencies' use of spectrum, on the repurposing of federal spectrum for commercial use; and concerns about interference from users of spectrum in adjacent bands of spectrum. FCC has identified voluntary approaches that it thinks could speed the process, but these approaches generally require congressional approval and face some stakeholder opposition.

Experts and stakeholders had mixed views on FCC's plans and recent actions to meet future spectrum needs. The National Broadband Plan included a set of recommendations to FCC, FCC and NTIA jointly, and Congress, aimed at meeting future spectrum needs. Some recommendations garnered broad support, including recommendations to auction certain bands of spectrum and enhance research and development. However, experts' and stakeholders' opinions diverged on other recommendations, such as reallocating a portion of spectrum from television to wireless broadband. Opinions also varied on FCC's progress in implementing the recommendations. In some instances, these conflicting opinions arose from participants' divergent positions in the industry, with, for example, incumbent licensees such as broadcasters opposing recommendations that they believe could impose burdens or costs on their businesses.

Experts and stakeholders GAO contacted strongly supported extending FCC's auction authority, but varied in their opinions on potential changes to auctions. Since 1994, FCC has used auctions to assign mutually exclusive licenses to commercial entities providing certain wireless services. GAO previously reported that auctions were effective in assigning licenses to entities that valued them the most; were quicker, less costly, and more transparent than mechanisms FCC previously used to assign licenses; and were an effective mechanism for the public to realize a portion of the value of a national resource used for commercial purposes. Experts and stakeholders responding to GAO's survey strongly supported extending FCC's auction authority—53 of 65 respondents supported extending FCC's authority. However, experts and stakeholders held varied opinions on potential changes to auctions. For example, respondents generally supported actions that would provide a clear road map detailing future auctions, which could reduce uncertainty. In contrast, a proposal to require winners of auctions to pay royalties based on their revenues rather than the full amount of their winning bids up front garnered the least support.

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Abbreviations

AWS	Advanced Wireless Services
BBA-97	Balanced Budget Act of 1997
BRS	Broadband Radio Service
CLS	Consolidated Licensing System
COALS	Cable Operations and Licensing System
EBS	Educational Broadband Service
ESMR	Enhanced Specialized Mobile Radio
FCC	Federal Communications Commission
GHz	gigahertz
ITU	International Telecommunication Union
kHz	kilohertz
MHz	megahertz
MSS	Mobile Satellite Services
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
PCS	Personal Communications Service
R&D	research and development
TV	television
Wi-Fi	wireless fidelity

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

November 23, 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 used to provide an array of wireless communications services that are critical to the U.S. economy and national security, such as mobile voice and data services, radio and television broadcasting, radar, and satellite-based services. Demand for radio-frequency spectrum has exploded over the past several decades as new technologies and services have been and continue to be brought to the market in the private sector and new mission needs unfold among government users of spectrum, including wireless communications critical for public safety officials responding to natural and man-made disasters. As a result, nearly all parties are becoming increasingly concerned about the availability of spectrum for future needs, because most of the usable spectrum in the United States has already been allocated to existing services and users. These concerns are compounded by evidence that some of the spectrum is currently underutilized. Therefore, to promote more efficient use of this resource and meet future needs, the Federal Communications Commission (FCC)

has increasingly adopted more market-oriented approaches to spectrum management in recent years, including using a competitive bidding process, or auctions, to assign spectrum licenses to commercial users. From 1994, when FCC first implemented its auction authority, through June 30, 2011, FCC held 79 auctions for over 68,000 licenses to select between competing applications for the same license, and generated nearly $52 billion for the U.S. Treasury. In addition, in March 2010, an FCC task force issued the National Broadband Plan aimed at achieving affordability and maximizing the use of broadband, or high-speed Internet access, to advance a range of economic and civic goals.[1] Because broadband access and use is becoming increasingly mobile and wireless, the plan included a set of recommendations aimed at ensuring efficient allocation and use of radio-frequency spectrum for wireless broadband services.[2] In some instances, the plan recommends that FCC change its rules to move certain bands of spectrum from an existing use, such as television broadcasting, to new uses, such as wireless broadband, a process known as repurposing spectrum.

In response to your request to review FCC's management of commercial spectrum,[3] we examined (1) the extent to which FCC has made spectrum available for new commercial uses since it implemented auction authority in 1994 and the time taken to do so, (2) experts' and stakeholders' views on FCC's plans and recent actions to meet future spectrum needs, and (3) experts' and stakeholders' views on the continued use of auctions to assign spectrum. In addition, we examined the extent to which FCC seeks to ensure the quality of its data on commercial spectrum licenses (see app. II).

[1]FCC, *Connecting America: The National Broadband Plan* (Washington, D.C.: Mar. 16, 2010).

[2]Wireless broadband comprises both fixed and mobile wireless communication services. 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.

[3]In April 2011, we issued a report on the National Telecommunications and Information Administration's (NTIA) management of the federal government's use of spectrum. See GAO, *Spectrum Management: NTIA Planning and Processes Need Strengthening to Promote the Efficient Use of Spectrum by Federal Agencies*, GAO-11-352 (Washington, D.C.: Apr. 12, 2011).

To address these issues, we reviewed FCC's plans, notices, orders, and other publications. We interviewed officials at FCC and analyzed FCC's quality control processes for its four spectrum license databases—the Universal Licensing System, the Consolidated Database System, the International Bureau Filing System, and the Experimental Licensing System—and for FCC's database of authorizations of equipment using the radio frequency spectrum, the Equipment Authorization System. We reviewed six instances since 1994 in which FCC made spectrum available by repurposing it for new commercial uses; we limited our analysis to repurposings that involved substantial amounts of spectrum that were repurposed to a higher value use.[4] We reviewed the National Broadband Plan and reports and orders related to FCC's implementation of the plan. We also reviewed industry comments on the plan and FCC's steps to implement the plan. In addition, we surveyed 30 experts and 79 industry stakeholders about their views on FCC's licensing data, the amount of time it takes FCC to reallocate spectrum for new commercial uses, the recommendations in the National Broadband Plan's chapter on spectrum,[5] FCC's steps to implement those recommendations, and the continued use of auctions to assign spectrum. We selected the experts and stakeholders based on their expertise in spectrum policy as represented by presentations or publications, or on their organization's vested interest in spectrum policy. Twenty of the experts and 54 of the stakeholders responded to our survey, representing a 68 percent response rate. Because we selected a nonprobability sample of experts and industry stakeholders, the information we obtained from the survey may not be generalized to all experts and industry stakeholders who have an interest in spectrum policy. We also conducted semistructured interviews with representatives of academia, industry, and public interest groups. (See app. I for additional information on our scope and methodology.) We conducted this performance audit from August 2010 to November 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

[4]The six repurposings we examined met the following criteria: (1) the amount of spectrum repurposed was 5 megahertz (MHz) or more, (2) the repurposing yielded $100 million or more in auction or industry revenue, and (3) reassignment occurred in 1994, when FCC first implemented its auction authority, or later.

[5]We excluded three recommendations that were addressed in our questions about FCC's data quality, fell under the purview of NTIA, or pertained to a narrow population.

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 of 3 kilohertz (kHz) and 300 gigahertz (GHz).[6] It is the medium that makes possible wireless communications and supports a vast array of commercial and governmental services. Commercial entities use spectrum to provide a variety of wireless services, including mobile voice and data, paging, broadcast television and radio, and satellite services. Federal, state, and local agencies use spectrum to fulfill a variety of government missions, such as national defense, air-traffic control, weather forecasting, and public safety.

Spectrum is managed at the international and national levels. The International Telecommunication Union (ITU), a specialized agency of the United Nations, coordinates spectrum management decisions among nations. Spectrum management decisions generally require international coordination, since radio waves can cross national borders. Once spectrum management decisions are made at the ITU, regulators within each nation, to varying degrees, follow the ITU decisions. In the United States, responsibility for spectrum management is divided between two agencies: FCC and the Department of Commerce's National Telecommunications and Information Administration (NTIA). FCC manages spectrum use for nonfederal users, including commercial, private, and state and local government users under authority provided in the Communications Act.[7] NTIA manages spectrum for federal government users and acts for the President with respect to spectrum management issues. FCC and NTIA, with direction from Congress and the President, jointly determine the amount of spectrum allocated to

[6]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 kilohertz (kHz) refers to thousands of Hertz, megahertz (MHz) to millions of Hertz, and gigahertz (GHz) to billions of Hertz. The Hertz unit of measurement is used to refer to both the quantity of spectrum (such as 500 MHz of spectrum) and the frequency bands (such as the 1710–1755 MHz band).

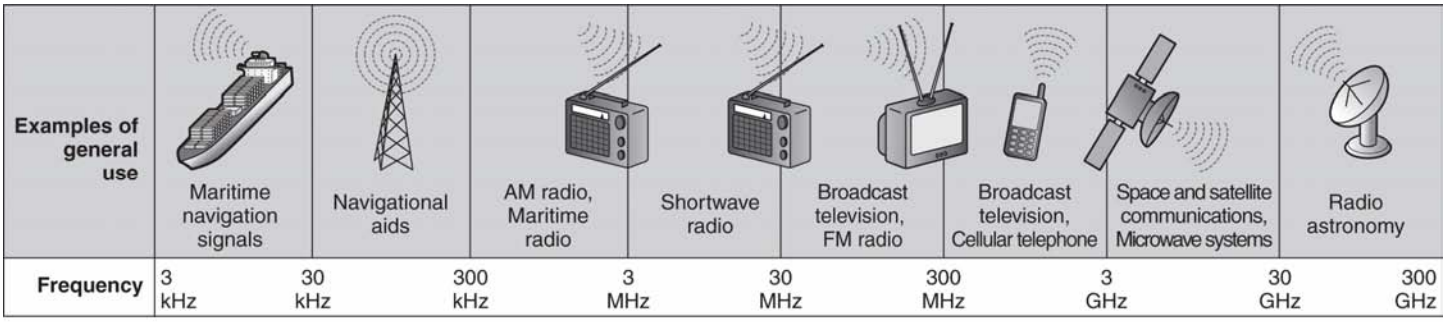
[7]Communications Act of 1934, as amended, 47 U.S.C. § 151 et seq.

federal and nonfederal users, including the amount allocated to shared use.

Historically, concern about interference or crowding among users has been a driving force in the management of spectrum. FCC and NTIA work to minimize interference through two primary spectrum management functions—the "allocation" and the "assignment" of radio spectrum. Specifically:

- 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 from 88 to 108 MHz are allocated to FM radio broadcasting in the United States. (Fig. 1 illustrates examples of services by frequency band.) In addition to allocation, spectrum managers specify service rules, which include the technical and operating characteristics of equipment.

Figure 1: Examples of Services by Frequency Band



Source: GAO analysis of NTIA and industry information.

- Assignment, which occurs after spectrum has been allocated for particular types of services or classes of users, involves providing users, such as commercial entities or government agencies, with a license or authorization to use a specific portion of spectrum. For example, FCC assigned a license for the 88.5 MHz band in Washington, D.C., to American University, for its radio station, WAMU. FCC assigns licenses for frequency bands to commercial enterprises, state and local governments, and other entities, while NTIA makes frequency assignments to federal agencies.

In some frequency bands, FCC authorizes unlicensed use of spectrum—that is, users do not need to obtain a license to use the spectrum. Rather, an unlimited number of unlicensed users can share frequencies on a

noninterference basis. Thus, the assignment process does not apply to the use of unlicensed spectrum. However, manufacturers of unlicensed equipment must receive authorization from FCC before operating or marketing an unlicensed device. Traditional unlicensed equipment consists of low-powered devices that operate in a limited geographic range, such as cordless phones, baby monitors, garage door openers, and wireless access to the Internet.

When FCC assigns a portion of spectrum to a single entity, the license is considered exclusive. When two or more entities apply for the same exclusive license, FCC classifies these as mutually exclusive applications—that is, the grant of a license to one entity would preclude the grant to one or more other entities. Since 1994, FCC has primarily used auctions to assign spectrum for mutually exclusive applications. 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. FCC was provided with authority to use auctions to assign mutually exclusive licenses for certain subscriber-based wireless services[8] in the Omnibus Budget Reconciliation Act of 1993.[9] FCC implemented its auction authority conducting its first auction in 1994.[10] In subsequent years, Congress has modified and extended FCC's auction authority, including exempting some licenses from competitive bidding, such as licenses for public safety radio services and noncommercial educational

[8]A subscriber-based wireless service is one in which the company providing the service sells subscriptions for the service to customers.

[9]The Omnibus Budget Reconciliation Act of 1993 amended the Communications Act of 1934 to allow the use of competitive bidding to issue licenses and to restrict the use of lotteries. Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, § 6002, 107 Stat. 312, 388-92 (1993), as amended by the Balanced Budget Act of 1997, Pub. L. No. 105-33, § 3002-3, 111 Stat. 251, 258-66 (1997) (codified at 47 U.S.C. § 309(j)). The act required the Commission to establish, by regulation, the methodology of the auction and eligibility to bid for those licenses. 47 U.S.C. § 309(j)(3). After setting the methodology for a particular competitive bidding system, the Commission was required to establish the requirements to participate in an auction. 47 U.S.C. § 309(j)(4).

[10]*Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, Second Report and Order, 9 FCC Rcd 2348 (1994).

broadcast services.[11] FCC's auction authority is scheduled to expire on September 30, 2012.[12]

As of June 30, 2011, FCC had conducted 79 auctions to select between competing applications for the same license, which have generated nearly $52 billion for the U.S. Treasury. However, only about 3 percent of licenses have been auctioned. The vast majority of the other 97 percent of licenses were assigned through other means before FCC began using auctions.

In March 2010, an FCC task force issued the National Broadband Plan. Because broadband access and use is becoming increasingly wireless, the plan includes a set of recommendations aimed at ensuring efficient allocation and use of radio-frequency spectrum for wireless broadband services. The plan recommended that FCC make 300 MHz of spectrum newly available for mobile broadband use in the next 5 years and 500 MHz of spectrum for broadband within the next 10 years. In June 2010, the President issued a memorandum with a similar goal for NTIA working in collaboration with FCC.[13]

[11]The Balanced Budget Act of 1997 (BBA-97) amended Section 309(j) of the Communications Act to require the Commission to grant licenses through the use of competitive bidding when mutually exclusive applications for initial licenses are accepted for filing, unless certain specific statutory exemptions apply. BBA-97 § 3002(a) (codified at 47 U.S.C. § 309(j)). Section 309(j)(2) exempts from auctions licenses and construction permits for public safety radio services, digital television service licenses and permits given to existing terrestrial broadcast licensees to replace their analog television service licenses, and licenses and construction permits for noncommercial educational broadcast stations and public broadcast stations described in section 397(6) of the Communications Act.

[12]See 47 U.S.C. § 309(j)(11).

[13]Memorandum for the Heads of Executive Departments and Agencies, Unleashing the Wireless Broadband Revolution (Presidential Memorandum), rel. June 28, 2010, 75 Fed. Reg. 38387, available at http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution.

Since 1994, FCC Has Made Over 520 Megahertz of Spectrum Available for New Uses through a Process That Can Be Lengthy

To accommodate new commercial uses of spectrum, such as wireless broadband, FCC must often change its rules to move certain bands of spectrum from an existing use to the new use, a process known as repurposing spectrum. However, this process can be lengthy—from 7 to 15 years for the six repurposings that we examined. We identified the following factors that contribute to the time it takes FCC to repurpose spectrum: the regulatory nature of repurposing, opposition of incumbent users, FCC and NTIA coordination on the repurposing of federal spectrum, and concerns about interference. FCC identified voluntary approaches that it thinks could speed the process by, for example, avoiding some opposition; however, these approaches generally require congressional approval and face some stakeholder opposition.

FCC Uses a Multiphase Process to Repurpose Spectrum

Since most of the usable spectrum in the United States has been allocated to existing uses, FCC must often repurpose spectrum from an existing use to make it available for new uses. When there are competing interests for specific spectrum, FCC determines which use or uses of the spectrum will best serve the public interest, considering factors such as economic and social value, including importance for public safety. FCC also seeks to ensure that the spectrum is technically suitable for the new use.[14] To repurpose spectrum for a new use, FCC uses a three-phase process:

- *Identification.* As a first step, FCC identifies a spectrum band, or bands, that appear to be good candidates for repurposing. To identify candidate bands, FCC conducts a formal study or releases a notice of proposed rulemaking soliciting industry input, or another party, such as NTIA or Congress, identifies a candidate band.

- *Reallocation.* FCC subsequently reallocates the spectrum by changing the designated use of the spectrum. FCC develops service and other technical rules for the spectrum that define (1) the eligibility criteria for users, (2) the services that users can provide, (3) the time frames and other requirements for users to build the infrastructure required to support the services, and (4) the interference limits.

[14]Different spectrum bands have certain advantages and disadvantages for various applications. For example, the C-band frequencies for satellite service are useful to broadcast television networks distributing video content to local television stations, since this band is less susceptible to degradation from precipitation than other bands.

- *Reassignment or secondary markets.* If the new use entails a licensed use of the spectrum, new users must be assigned, or provided authorization, to use the spectrum. In some cases, FCC reassigns the spectrum to new entities, often using auctions. In other cases, FCC permits incumbent licensees to sell or lease their licenses to other entities, through a process known as secondary market transactions. If the new use entails an unlicensed use of the spectrum, FCC does not need to complete a reassignment.

FCC Has Made Over 520 Megahertz of Spectrum Available for New Commercial Uses

Since 1994, FCC has completed six major repurposings of spectrum, which have made over 520 MHz of spectrum available for new commercial uses.[15] In most instances, FCC repurposed the spectrum to enable mobile broadband service. Five of the six repurposings collectively generated over $47 billion in auction revenues, which provides one measure of the new economic value arising from the repurposing.[16] The former uses of the repurposed spectrum included microwave services, specialized mobile radio services (such as those used in radio dispatch systems), and one-way systems that transmit video (see table 1).

[15]The six repurposings we examined met the following criteria: (1) the amount of spectrum repurposed was 5 MHz or more; (2) the repurposing yielded $100 million or more in auction or industry revenue; and (3) reassignment occurred in 1994, when FCC first implemented its auction authority, or later.

[16]For one of the repurposings, the Mobile Satellite Services S band, FCC did not auction the spectrum but rather reassigned the spectrum to eight companies that applied for licenses.

Table 1: Major Spectrum Repurposings since 1994

Dollars in millions

Spectrum band	Amount repurposed (MHz)	Old use	New use	Auction revenues
Mobile Satellite Services S band (MSS S band)	40	Microwave operations by broadcast stations for transmitting audio and video signals.	Satellite-based mobile voice, data, Internet access, and other communications.	N/A[a]
Broadband Personal Communications Service (PCS)	120	Microwave operations by business users, including petroleum companies, utilities, and railroads.	Primarily digital mobile phones and wireless Internet access.	$13,989
Advanced Wireless Services-1 (AWS-1)	90	Federal government use, including military tactical radios, and commercial fixed-microwave uses.	Third-generation mobile broadband and other advanced wireless services.	13,731
Enhanced Specialized Mobile Radio (ESMR)	14	Mobile radios that communicated directly with other mobile or fixed radios in a dispatch mode, such as taxi fleets, or that interconnected with the public telephone network through the use of a base station.	Cellular-based services including Internet access, two-way acknowledgment paging and inventory tracking, credit card authorization, automatic vehicle location, fleet management, remote database access, and voice mail.	445
Educational Broadband Service / Broadband Radio Service (EBS/BRS)	194	Educational Broadband Service: transmission of instructional material using high-powered systems to accredited educational institutions and other institutions such as hospitals, nursing homes, and training and rehabilitation centers. Broadband Radio Service: primarily high-powered, one-way systems transmitting data and video to fixed locations.	Educational Broadband Service: transmission of instructional services, using low power, broadband systems, as well as high-speed Internet access for students. Licensees may also lease excess capacity to other entities so long as they meet educational programming requirements. Broadband Radio Service: two-way wireless broadband services, including voice, data, and video.	134
700 MHz band	70	Analog broadcast television[b]	Mobile wireless services.	19,108
Total	**528**			**$47,407**

Source: GAO review of FCC documents.

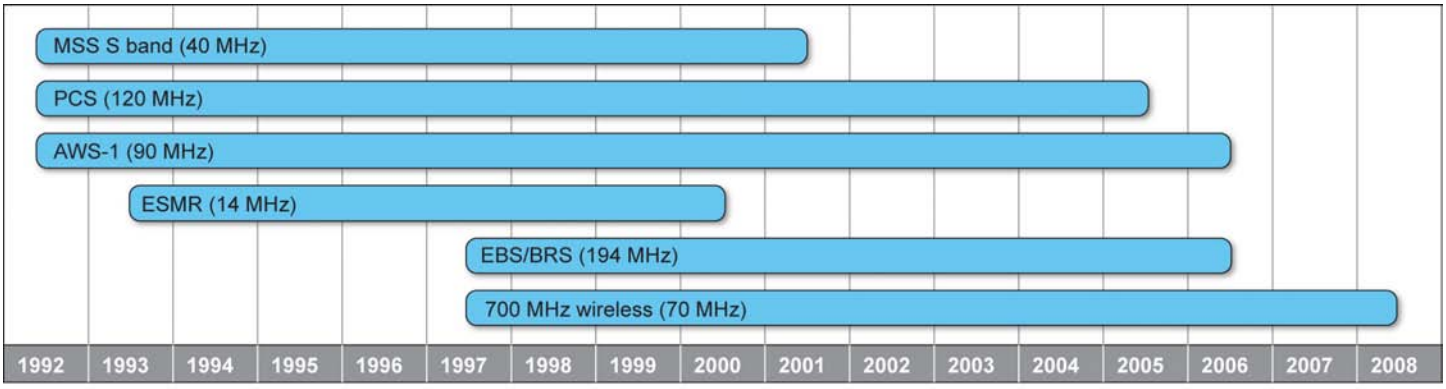
[a]FCC did not use an auction to reassign the Mobile Satellite Services S band; rather FCC reassigned the spectrum to eight companies that applied for licenses. The Satellite Industry Association estimates that Mobile Satellite Services generated over $2 billion in worldwide revenue in 2010.

[b]The 700 MHz Wireless repurposing was enabled by the transition of television from analog to digital service. The transition freed up a portion of the 700 MHz spectrum for new wireless services.

Major Spectrum Repurposings Can Be Time Consuming

The six major repurposings we reviewed took from 7 to 15 years to complete, from the identification through the reassignment phase. For example, the Enhanced Specialized Mobile Radio repurposing took 7 years while three repurposings—Personal Communications Service, Advanced Wireless Services-1, and 700 MHz Wireless—took over 10 years to complete (see fig. 2). Similar to our findings, in the National Broadband Plan, FCC noted that the process of revisiting or revising spectrum allocations has historically taken 6 to 13 years.[17]

Figure 2: Timeline for Major Spectrum Repurposings—Identification to Reassignment



Source: GAO.

In addition to the time required to complete the repurposing process (identification through reassignment), time is needed to relocate existing users and allow new users to construct new wireless networks before new services can be made available using the repurposed spectrum. Typically, existing users must relocate to a new spectrum band or bands, and new users must construct the infrastructure required to support their services. While the participants undertake most of these actions, FCC and other government agencies' actions and decisions can influence the time frames. For example, FCC held the first auction for the Advanced Wireless Services-1 repurposing in 2006, but NTIA expects that it will take until 2013 for all federal agencies to relocate from the spectrum that

[17]In some instances, our start and end dates differ from those FCC identified in the National Broadband Plan. For example, FCC reported that the Personal Communications Service repurposing began in 1989, while we determined that this repurposing began in 1992. Regardless of the specific start and end dates, both FCC's and our analyses found that the process can be lengthy.

was repurposed for commercial use.[18] In addition, FCC allowed licensees 15 years from the inception of their license term to begin providing substantial service.[19] Therefore, substantial service on a widespread basis using the Advanced Wireless Services-1 spectrum appears unlikely before 2013 and, in theory, could extend to 2021, fully 29 years after the beginning of the identification phase, although FCC officials anticipate that carriers will generally provide service sooner in order to meet their business needs.

Large majorities of stakeholders and experts that replied to our survey indicated that the repurposing process takes too long. In particular, 39 of 46 stakeholders and 16 of 20 experts reported that it takes longer than it should from the time FCC or Congress designates a spectrum band for reallocation until the band is available for the new use. Furthermore, 25 of these stakeholders and 11 of these experts reported that it takes much longer than it should.

Several Factors Contribute to the Lengthiness of the Repurposing Process

Based on our review of several completed and ongoing repurposings, the relevant literature, interviews with agency officials and industry participants, and our survey of stakeholders and experts, we identified four factors that contribute to the time it takes FCC to repurpose spectrum. These factors include the regulatory nature of repurposing, opposition of incumbent users, FCC and NTIA coordination on the repurposing of federal spectrum, and concerns about interference.

- *Regulatory nature of repurposing.* FCC's repurposing of spectrum is often an iterative process involving deliberation based on extensive

[18]U.S. Department of Commerce, *Relocation of Federal Radio Systems from the 1710-1755 MHz Spectrum Band: Fourth Annual Progress Report* (March 2011). The report notes that approximately 81 percent of the total systems have been relocated from the 1710-1755 MHz band as of December 2010.

[19]Section 27.14 of title 47 of the Code of Federal Regulations provides that a renewal applicant receives a preference or renewal expectancy if the applicant has provided substantial service during its past license term and has complied with the Communications Act and applicable Commission rules and policies. According to this section, substantial service is defined as "service which is sound, favorable, and substantially above a level of mediocre service which just might minimally warrant renewal." 47 C.F.R. § 27.14(a). Section 27.13 provides that authorizations for the 1710-1755 MHz and 2110-2155 MHz bands will have a term not to exceed 10 years from the date of initial issuance or renewal, except that authorizations issued on or before December 31, 2009, shall have a term of 15 years. 47 C.F.R. § 27.13.

industry participation. As shown in figure 3, the repurposing of spectrum can involve stakeholder coordination efforts, issuance of notices of proposed rulemaking and reports and orders, review of stakeholder comments and reply comments, and multiple rounds of assignment. For example, during the Personal Communications Service repurposing, FCC adopted an order in September 1993, and 67 participants subsequently petitioned FCC for reconsideration because of concerns about the spectrum to be reallocated and the amount of spectrum to be individually licensed.[20] In response, in June 1994, FCC amended the bands to be reallocated and assigned.[21] In 1995, some stakeholders sued the Commission over the rules it established in 1994 pertaining to ownership limitations in the wireless communications industry. In November 1995, the Sixth Circuit Court of Appeals decided against FCC's rules and remanded the matter for further proceeding.[22] In June 1996, FCC issued an order addressing these issues.[23]

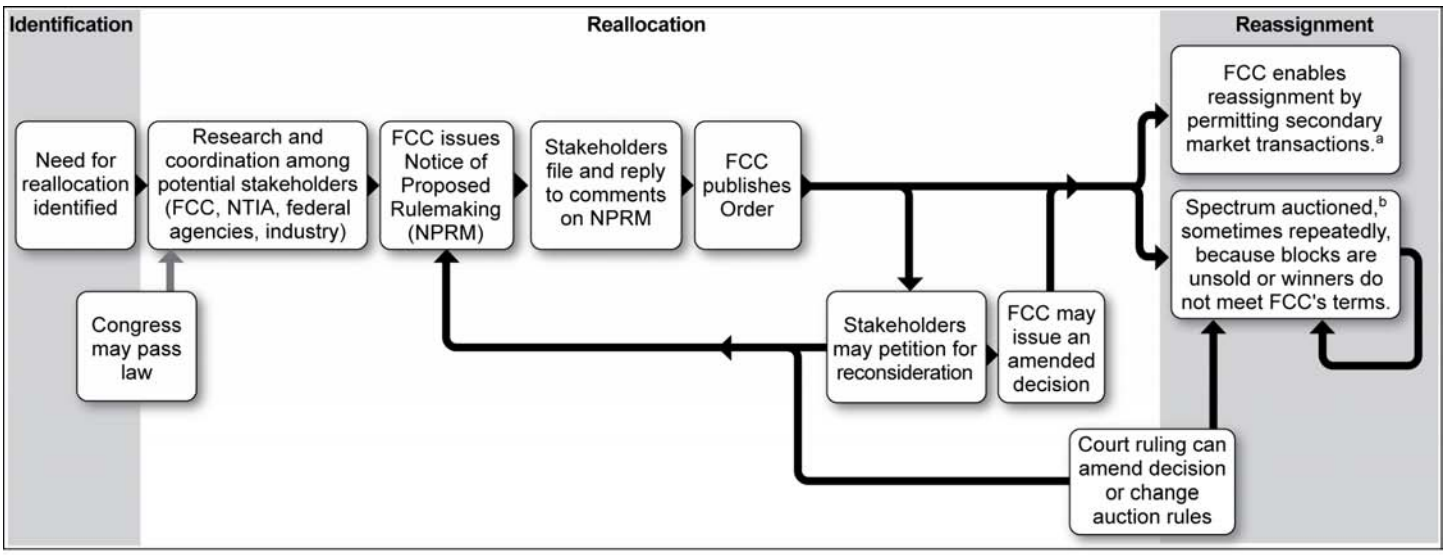
[20]*Amendment of the Commission's Rules to Establish New Personal Communications Services*, Second Report and Order, 8 FCC Rcd 7700 (1993).

[21]*Amendment of the Commission's Rules to Establish New Personal Communications Services*, Memorandum Opinion and Order, 9 FCC Rcd 4957 (1994).

[22]*Cincinnati Bell Telephone Co. v. FCC*, 69 F.3d 752 (6th Cir. 1995).

[23]*Amendment of Parts 20 and 24 of the Commission's Rules—Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap*; *Amendment of the Commission's Cellular/PCS Cross-Ownership Rule*, Report and Order, 11 FCC Rcd 7824 (1996) *aff'd*, 12 FCC Rcd 14031 (1997), *aff'd sub nom. BellSouth Corp. v. FCC*, 162 F.3d 1215 (D.C. Cir. 1999). Throughout the Personal Communications Service repurposing, FCC issued 6 notices of proposed rulemaking and 34 orders, and received over 2,600 filings from interested parties.

Figure 3: Process to Repurpose Spectrum from an Existing Use to a New Use



Source: GAO review of FCC documents.

[a]FCC may permit incumbent licensees to sell or lease their licenses to other entities, a process known as secondary market transactions.

[b]Certain exemptions apply to FCC's auction authority, including exemptions for public safety radio, digital television licenses to replace analog licenses, and noncommercial educational and public broadcast stations.

As also shown in figure 3, the assignment and, in some instances multiple reassignments, of spectrum can lengthen the process of repurposing spectrum. In some cases, prior to an auction and at the direction of Congress or the courts, or the request of licensees and potential bidders, FCC clarifies or revises the auction and relocation rules. For example, in providing auction authority, which occurred during the Personal Communications Service repurposing, Congress directed FCC to expand opportunities for small businesses, minorities,

and women.[24] FCC subsequently adopted competitive bidding rules designed to encourage designated entities participation in Personal Communications Service.[25] However, 3 days before the auction, the U.S. Supreme Court decided that "all racial classifications, imposed by whatever federal, state, or local government actor, must be analyzed by a reviewing court under strict scrutiny" and the Commission subsequently postponed the auction.[26] In other instances, the bankruptcy or default of an auction winner lengthened

[24]In the Omnibus Budget Reconciliation Act of 1993, Congress authorized the competitive bidding of spectrum-based services and mandated that small businesses, rural telephone companies, and businesses owned by members of minority groups and women (collectively known as "designated entities") be ensured the opportunity to participate in the provision of such services. 47 U.S.C. § 309(j)(4)(D); see also id. § 309(j)(3)(B). In the Fifth Report and Order, FCC adopted competitive bidding rules designed to encourage designated entity participation in the broadband Personal Communications Service. 9 FCC Rcd 5532 (1994); recon. *Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, Fifth Memorandum Opinion and Order, 10 FCC Rcd 403 (1994) ("Competitive Bidding Fifth Memorandum Opinion and Order"), erratum, 60 Fed. Reg. 5333 (1995).

[25]Specifically, FCC established "entrepreneurs' blocks" (the C and F frequency blocks allocated for broadband Personal Communication Service) for which eligibility was limited to individuals and entities under a certain financial size. FCC also adopted special provisions for businesses owned by members of minority groups or women and analyzed their constitutionality utilizing the "intermediate scrutiny" standard of review articulated in *Metro Broadcasting, Inc. v. FCC*, 497 U.S. 547, 564-565 (1990). FCC made subsequent changes to the entrepreneurs' block rules and special provisions for designated entities in the Fifth MO&O. Fifth Report and Order, 9 FCC Rcd 5532 (1994) (Fifth R&O), recon. Fifth Memorandum Opinion and Order, 10 FCC Rcd 403 (Fifth MO&O), erratum, 60 Fed. Reg. 5333 (1995).

[26]*Adarand Constructors. Inc. v. Pena*, 515 U.S. 200 (1995).

the repurposing of spectrum.[27] On several occasions, after winners of the original auction declared bankruptcy or defaulted on their payments, FCC repeated auctions. For example, FCC's auctions 10, 22, and 35 included reauctions of licenses won at prior auctions.

- *Opposition of incumbent users.* The completed repurposings we reviewed involved opposition from incumbent users that took time to resolve. Incumbent users are likely to incur costs for relocating but derive little, if any, benefit and are therefore often reluctant to make a move. For example, during the Personal Communications Service repurposing, incumbent microwave users, which included utilities, public safety entities, and petroleum and natural gas companies, raised concerns that an allocation would displace a large number of them, disrupt their operations to the detriment of the public, and require them to purchase new equipment. In the Advanced Wireless Services-1 repurposing, incumbent government agencies had difficulties identifying current users of the spectrum and were reluctant to give up spectrum because they believed the spectrum was critical to fulfilling their mission and that relocating would cause them to incur staff time and expenses for which they had not budgeted. In the 700 MHz Wireless repurposing, television broadcasters raised concerns about the transition from analog to digital television, including their need to use more spectrum for advanced television services and the financial costs of building digital television stations. A law firm with experience in FCC's repurposings characterized reallocations as

[27]For example, NextWave was the high bidder for 95 C, D, E, and F block, broadband Personal Communications Service licenses in auctions held from 1995 to 1997. On June 8, 1998, NextWave filed for Chapter 11 bankruptcy protection in the U.S. Bankruptcy Court for the Southern District of New York. Following extensive litigation, the U.S. Supreme Court held that NextWave's licenses had not automatically cancelled for nonpayment while it was in bankruptcy. *FCC v. NextWave*, 537 U.S. 293 (2003). As part of its reorganization process, NextWave obtained FCC approval to transfer certain of its C and F block PCS licenses to Cingular. *Applications for Consent to the Assignment of Licenses Pursuant to Section 310(d) of the Communications Act from NextWave Personal Communications, Inc., Debtor-in-Possession, and NextWave Power Partners, Inc., Debtor-in-Possession, to subsidiaries of Cingular Wireless, Inc.,* Memorandum Opinion & Order, 19 FCC Rcd 2570 (2004). In April 2004, NextWave entered a settlement agreement with FCC whereby it would retain certain of its C and F block licenses, and would return the remaining licenses to FCC. On May 25, 2004, the bankruptcy court approved this settlement agreement. Order Granting Motion Pursuant to Section 363 of the Bankruptcy Code, In re: *NextWave Personal Communications, Inc. et al.*, 98B21529 (Bankr. S.D.N.Y.) (May 25, 2004).

"contests between incumbent service providers and the new entrants competing to unseat them."

- *FCC and NTIA coordination on the repurposing of federal spectrum*. Government efforts to coordinate the repurposing of federal spectrum to commercial use can take many years; several factors contribute to the lengthy time frame, including the lack of data and resources and the time necessary to relocate existing federal users. For example, the Advanced Wireless Services-1 repurposing, which combined federal and nonfederal spectrum, took over 14 years and the passage of several laws to complete. In 1992, FCC first identified the upper Advanced Wireless Services-1 band, 2110-2150 MHz, for reallocation to services using new and innovative technologies.[28] In 1995, NTIA identified the lower Advanced Wireless Services-1 band, 1710-1755 MHz, for transfer from exclusive use by the federal government to FCC for commercial use.[29] In 1997 legislation was enacted that required NTIA to accelerate the availability of the lower Advanced Wireless Services-1 band, and in 1998 legislation was enacted that sought to encourage the transfer of spectrum from federal government to private use by providing for mandatory reimbursement of government spectrum users required to relocate from their spectrum, including the lower Advanced Wireless Services-1 band.[30]

[28]See *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, First Report and Order and Third Notice of Proposed Rule Making, 7 FCC Rcd 6886 (1992); Second Report and Order, 8 FCC Rcd 6495 (1993); Third Report and Order and Memorandum Opinion and Order, 8 FCC Rcd 6589 (1993); Memorandum Opinion and Order, 9 FCC Rcd 1943 (1994); Second Memorandum Opinion and Order, 9 FCC Rcd 7797 (1994); *aff'd Association of Public Safety Communications Officials-International, Inc. v. FCC*, 76 F.3d 395 (D.C. Cir. 1996) (collectively, "Emerging Technologies proceeding").

[29]NTIA identified the band 1710-1755 MHz for transfer, with certain Federal operations to remain protected indefinitely. See NTIA, *Spectrum Reallocation Final Report, Response to Title VI Omnibus Budget Reconciliation Act of 1993*, NTIA Special Publication 95-32, at App. E and page F-4 (February 1995).

[30]The Balanced Budget Act of 1997 required NTIA to accelerate the availability of the 1710-1755 MHz band to allow auctioning of this spectrum to commence after Jan. 1, 2001, and to be completed by Sept. 30, 2002. See BBA-97, Section 3002(b). The Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, required that funds would be made available by private sector entities receiving spectrum in the band 1710-1755 MHz for the cost of relocating or modifying all federal government radio communications systems required to vacate or modify their operations in the band 1710-1755 MHz after an auction has taken place. Pub. L. No. 105-261, 112 Stat. 1920; 47 U.S.C. § 923(g).

From 2000 through 2002, FCC and NTIA conducted further studies to determine appropriate bands for Advanced Wireless Services-1. Finally, in 2002, NTIA issued a study[31] and FCC issued an order[32] allocating 90 MHz for Advanced Wireless Services.

- *Concerns about interference.* Users in adjacent bands often oppose a repurposing of spectrum because they are concerned that the new service will interfere with their existing service. A good example of this concern arises with the 700 MHz Wireless repurposing, which included the relocation of broadcast television stations; public safety organizations raised the concern that the proposed relocation would result in increased interference between broadcasting and public safety operations. Similarly, with the Advanced Wireless Services-1 repurposing, some stakeholders raised concerns about the potential for interference between Multipoint Distribution Service licensees and Advanced Wireless Services systems.[33]

Resolving issues such as the opposition of incumbent users and concerns about interference lengthens the time necessary to complete the repurposing of spectrum, thereby delaying the introduction of possibly more economically valuable services. As an independent regulatory agency, FCC must follow many, but not all, federal laws related to rulemaking. In particular, the Administrative Procedures Act outlines a multistep process to initiate and develop rules and includes provisions for parties to challenge them, which FCC must follow.[34] Many steps require agencies to provide public notice of proposed or final actions, as well as provide a period of time for interested parties to comment on the notice. Furthermore, the Communications Act outlines procedures for addressing petitions for reconsideration by FCC and appeals to federal court for FCC

[31]U.S. Department of Commerce, NTIA, *An Assessment of the Viability of Accommodating Advanced Mobile Wireless (3G) Systems in the 1710-1770 MHz and 2110-2170 MHz Bands*, report rel. July 22, 2002.

[32]*Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems*, Second Report and Order, 17 FCC Rcd 23193 (2002).

[33]Multipoint distribution service, also known as wireless cable, was generally used for the transmission of data and video programming to subscribers using high-powered systems.

[34]5 U.S.C. § 551, *et seq*.

rules;[35] the U.S. Courts of Appeals have jurisdiction to review all final FCC rules.[36] Given that the spectrum issues are often complicated and controversial, FCC often issues multiple orders in the same proceeding to deal with the many comments it receives and to address petitions for reconsideration, as well as any direction from the courts. In the National Broadband Plan, FCC identified voluntary approaches, such as incentive auctions, that it thinks could speed the process. By incorporating incentives into the process, FCC may avoid some opposition to repurposings and thereby reduce the time necessary to repurpose spectrum. However, these incentive approaches generally require congressional approval and face stakeholder opposition themselves. As we reported in 2003, "while spectrum reform is increasingly being discussed, debated, and reviewed, it does not appear likely that timely reforms can be agreed upon amid the diversity of views held by stakeholders," a situation that appears to hold to this day.[37]

Responding Experts and Stakeholders Had Mixed Views on FCC's Plans and Recent Actions to Meet Future Spectrum Needs

The National Broadband Plan includes recommendations in several areas aimed at meeting future spectrum needs. Most of the recommendations are directed at FCC alone, some are directed at FCC and NTIA jointly, and some are directed at Congress. For our analysis, we group the recommendations directed to FCC into five categories: make more spectrum available for wireless broadband use by 2015, expand incentives and mechanisms to reallocate spectrum, expand opportunities for innovative spectrum access models, enhance the usefulness of spectrum for wireless backhaul, and enhance FCC's spectrum policy making. Discussion of the first three categories follows; appendix III provides additional details on those three categories and also discusses the last two categories.

[35]47 U.S.C. §§ 405 and 402, respectively.

[36]In certain cases, appeals to FCC rules must be made only to the U.S. Court of Appeals for the D.C. Circuit. 47 U.S.C. § 402(b).

[37]GAO, *Telecommunications: Comprehensive Review of U.S. Spectrum Management with Broad Stakeholder Involvement Is Needed*, GAO-03-277 (Washington, D.C.: Jan. 31, 2003).

Responding Experts and Stakeholders Generally Agreed with Making More Spectrum Available for Wireless Broadband Use by 2015

Recommendations in Plan

To meet anticipated increases in demand for wireless broadband services, the plan contained a recommendation that FCC make 300 MHz of spectrum newly available for such services by 2015 and 500 MHz by 2020. These targets were based on an FCC staff forecast of spectrum demand. In the plan, the largest source of spectrum—120 MHz—arises from the repurposing of a portion of the spectrum currently allocated for broadcast television service. Most experts and stakeholders other than television broadcasters responding to our survey supported this recommendation, while most responding broadcasters opposed it (see table 2). Both a wireless device manufacturer and an expert said that the recommendation is consistent with expected increases in demand for spectrum. Two broadcasters said that wireless service providers could meet additional demand by using their existing spectrum more intensively.

To make 300 MHz of spectrum newly available by 2015, the plan included five recommendations related to specific spectrum bands. In addition to repurposing the 120 MHz of spectrum currently allocated to broadcast television, the plan recommended accelerating terrestrial use of Mobile Satellite Services spectrum by providing sufficient flexibility to licensees to increase terrestrial broadband use of the spectrum, auctioning Advanced Wireless Services and the Upper 700 MHz D-Block spectrum,[38] and revising outdated interference rules in the Wireless Communications Services spectrum that largely preclude the use of the spectrum for

[38]The 700 MHz D-Block spectrum was made available for auction through the transition of television from analog to digital service, which freed up a portion of the 700 MHz spectrum for new wireless services. FCC established the Upper 700 MHz D Block to be licensed on a nationwide basis to a single entity via auction. FCC's auction rules required the winning bidder for the D Block to enter into a public/private partnership with the nationwide licensee of the public safety broadband spectrum, a nonprofit entity established by national public safety leadership. That requirement was intended to enable construction of an interoperable broadband network that would serve both commercial and public safety users. This 10 MHz block of spectrum did not receive a winning bid in FCC's 700 MHz auction held in 2008.

broadband. These recommendations, as well as experts' and stakeholders' level of agreement with the recommendations, are shown in table 2; in the table, we sometimes separately report broadcasters to illustrate meaningful differences in their responses.

Table 2: Expert and Stakeholder Respondents' Agreement with National Broadband Plan Recommendations Aimed at Making More Spectrum Available for Wireless Broadband Use by 2015

Recommendation in plan Type of respondent	Agreed	Neither agreed nor disagreed	Disagreed	Total
Overall recommendation:				
Make 300 MHz available by 2015 and 500 MHz by 2020				
Expert	16	0	3	19
Stakeholder - broadcaster	0	2	8	**10**
Stakeholder - nonbroadcaster	28	4	6	**38**
Total	**44**	**6**	**17**	**67**
Recommendations on specific bands:				
Reallocate portion of television spectrum (120 MHz)				
Expert	14	1	3	**18**
Stakeholder - broadcaster	0	0	11	**11**
Stakeholder - nonbroadcaster	27	4	6	**37**
Total	**41**	**5**	**20**	**66**
Accelerate terrestrial deployment in Mobile Satellite Services spectrum (90 MHz)				
Expert	12	2	2	**16**
Stakeholder	23	13	7	**43**
Total	**35**	**15**	**9**	**59**
Auction Advanced Wireless Services spectrum (60 MHz)				
Expert	16	1	1	18
Stakeholder	33	8	5	**46**
Total	**49**	**9**	**6**	**64**
Make Wireless Communications Services spectrum available (20 MHz)				
Expert	16	1	1	**18**
Stakeholder	19	20	6	**45**
Total	**35**	**21**	**7**	**63**
Auction the Upper 700 MHz D Block (10 MHz)[a]				
Expert	16	1	1	**18**
Stakeholder	20	11	12	**43**
Total	**36**	**12**	**13**	**61**

Source: GAO survey.

Note: The total number of responses for each recommendation varied based on the number of respondents that chose to answer the question pertaining to the recommendation. The figures shown under "agreed" include respondents that either strongly agreed or somewhat agreed with the recommendation, and the responses shown under "disagreed" include respondents that either strongly disagreed or somewhat disagreed with the recommendation. Appendix III includes figures for the more detailed response categories, as well for each type of stakeholder.

[a]The 700 MHz D-Block spectrum was made available for auction through the transition of television from analog to digital service, which freed up a portion of the 700 MHz spectrum for new wireless services. FCC established the Upper 700 MHz D Block to be licensed on a nationwide basis to a single entity via auction. FCC's auction rules required the winning bidder for the D Block to enter into a public/private partnership with the nationwide licensee of the public safety broadband spectrum, a nonprofit entity established by national public safety leadership. That requirement was intended to enable construction of an interoperable broadband network that would serve both commercial and public safety users. This 10 MHz block of spectrum did not receive a winning bid in FCC's 700 MHz auction held in 2008.

The majority of responding experts and stakeholders agreed with each of the five recommendations related to specific bands.[39] However, the recommendation on reallocating 120 MHz of television spectrum has generated a significant amount of controversy, and this was reflected in our survey results; the 120 MHz of television spectrum in this recommendation is in addition to the spectrum made available through the transition of television from analog to digital service in 2009. Experts and stakeholders other than broadcasters strongly supported the recommendation, whereas all 11 broadcasters strongly opposed it. FCC, as well as some experts and stakeholders who supported reallocating a portion of the television band, said that the spectrum would have much higher economic value if it were allocated for wireless broadband. FCC, for instance, argues that reallocating television spectrum for mobile broadband would increase its value by roughly a factor of 10. According to FCC, this difference in value reflects, in part, "challenging long-term trends" facing the television broadcasting industry; FCC noted, for example, that the percentage of households viewing television solely through over-the-air broadcasts declined from 24 percent in 1999 to 10 percent in 2010, and since 2005, broadcast television station revenues have declined 26 percent.[40] In contrast, broadcasters responding to our survey cited the following arguments against reallocating a portion of the television spectrum:

[39]In our survey results, we grouped the following types of stakeholders into the "other" category: public interest groups, infrastructure providers, Mobile Satellite Services companies, a private user, a Satellite Digital Audio Radio Service provider, and spectrum data managers.

[40]FCC, *Connecting America: The National Broadband Plan*, page 89.

- Doing so would likely have a significant, negative impact on the public's access to local television broadcasts, both via free over-the-air television and via cable and satellite, because broadcasters use spectrum to provide local broadcasts to viewers both directly over-the-air and indirectly by broadcasting their signals to cable and satellite television providers, which then retransmit the local broadcasts to their subscribers.

- Broadcasters are deploying mobile digital television with their spectrum. This deployment will play a significant role in mobile broadband content delivery and should be encouraged to flourish as it is the most efficient way of distributing video, which Cisco Systems, Inc. says will account for 66 percent of all mobile traffic in 2015.[41]

- A better way to move underutilized broadcast spectrum to mobile carriers would be to allow broadcasters to sell or lease such spectrum to mobile carriers in a private market transaction.

- FCC should not implement this recommendation without completing a full spectrum inventory that also analyzes current utilization. Action, if at all, should be predicated on demonstrated need rather than on assertions of a looming spectrum crisis and after full investigation of whether less disruptive alternatives to reallocation of broadcast spectrum could address demonstrated needs.

In the National Broadband Plan, FCC acknowledges that "over-the-air television continues to serve important functions in our society," by providing, among other things, free access to news, entertainment, and local programming; children's educational programming; coverage of community news and events; reasonable access for federal political candidates; and closed captioning and emergency broadcast information. Therefore, FCC says that the plan's recommendations "seek to preserve [over-the-air television] as a healthy, viable medium going forward," and the plan calls for FCC to "study and develop policies to ensure that its longstanding goals of competition, diversity, and localism [in broadcast television] are achieved." However, these statements do not appear to have assuaged the concerns of broadcasters.

[41]Cisco Systems, Inc. is a supplier of Internet routers, which are hardware devices or software programs that forward Internet and network traffic between networks and are critical to their operation.

Implementation of Recommendations

To implement the plan's recommendations to make more spectrum available for broadband in specific bands, FCC, among other things:

- performed technical analysis and worked with broadcast industry engineers and experts in related fields on how reallocating a portion of television spectrum to broadband could work;
- issued a proposed rule to establish a regulatory framework to facilitate wireless broadband uses of television bands, in anticipation of the Commission's intended future reallocation of this spectrum to broadband;
- granted a waiver to a Mobile Satellite Services provider, LightSquared, allowing it to expand its terrestrial use of its satellite spectrum for broadband, conditional on addressing concerns about interference with Global Positioning System devices;[42]
- added co-primary fixed and mobile terrestrial wireless allocations to the 2 GHz satellite band and gave Mobile Satellite Services licensees the flexibility to lease their spectrum to terrestrial operators via spectrum manager leasing arrangements, both of which FCC sees as steps toward providing flexibility to allow greater use of the band for mobile broadband;
- revised its interference rules in Wireless Communications Services spectrum to facilitate its use for broadband, along the lines recommended by the plan; and
- issued analyses supporting its recommendation to auction the Upper 700 MHz D block; while the plan recommends the auction of this band, several proposals in the 112th Congress, such as the SPECTRUM Act, S.911, and the Public Safety Spectrum and Wireless Innovation Act, H.R. 2482, call for the reallocation of this band for deployment of a nationwide broadband public safety network

[42]LightSquared Subsidiary LLC, *Request for Modification of its Authority for an Ancillary Terrestrial Component*, Order and Authorization, 26 FCC Rcd 566 (2011). See also, *Status of Testing in Connection with LightSquared's Request for ATC Commercial Operating Authority*, Public Notice, DA-11-1537, 2011 FCC LEXIS 3768 (Sept. 13, 2011). FCC, in consultation with NTIA, has determined that additional targeted testing is needed to ensure that any potential commercial terrestrial service offered by LightSquared will not cause harmful interference to GPS operations.

and therefore FCC is waiting to see if any related active legislation is passed before proceeding with implementation of this recommendation.

Experts and stakeholders responding to our survey that supported the plan's overall recommendation to make 300 MHz of spectrum available for wireless broadband by 2015 were fairly evenly split between those satisfied and those dissatisfied with FCC's overall progress in implementing the recommendation (see table 3). In contrast, regarding FCC's progress on the recommendations aimed at specific bands, experts and stakeholders tended to be more satisfied than dissatisfied. For example, experts and stakeholders were generally satisfied with FCC's progress on implementing the recommendation to accelerate terrestrial deployment in Mobile Satellite Services spectrum but were generally dissatisfied with FCC's progress on the Upper 700 MHz D Block; although, as we note above, FCC is waiting on the outcome of pending legislation pertaining to this spectrum band before taking further action.

Table 3: Expert and Stakeholder Respondents' Satisfaction with FCC's Progress in Making More Spectrum Available for Wireless Broadband Use by 2015

Recommendation in plan Type of respondent	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Total
Overall recommendation:				
Make 300 MHz available by 2015 and 500 MHz by 2020				
Expert	7	2	6	**15**
Stakeholder	9	8	9	**26**
Total	**16**	**10**	**15**	**41**
Recommendations on specific bands:				
Reallocate portion of television spectrum (120 MHz)				
Expert	8	2	4	**14**
Stakeholder	16	6	4	**26**
Total	**24**	**8**	**8**	**40**
Accelerate terrestrial deployment in Mobile Satellite Services spectrum (90 MHz)				
Expert	7	2	3	**12**
Stakeholder	15	1	6	**22**
Total	**22**	**3**	**9**	**34**
Auction Advanced Wireless Services spectrum (60 MHz)				
Expert	9	4	2	**15**
Stakeholder	10	7	12	**29**

Recommendation in plan Type of respondent	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Total
Total	**19**	**11**	**14**	**44**
Make Wireless Communications Services spectrum available (20 MHz)				
Expert	8	3	4	**15**
Stakeholder	9	1	8	**18**
Total	**17**	**4**	**12**	**33**
Auction the Upper 700 MHz D Block (10 MHz)				
Expert	4	5	7	**16**
Stakeholder	4	4	9	**17**
Total	**8**	**9**	**16**	**33**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation. The total number of responses for each recommendation varied based on the number of respondents that chose to answer the question pertaining to the recommendation. The figures shown under "satisfied" include respondents that were either very satisfied or somewhat satisfied with FCC's progress, and the responses shown under "dissatisfied" include respondents that were either strongly dissatisfied or somewhat dissatisfied with FCC's progress. Appendix III includes figures for the more detailed response categories, as well for each type of stakeholder.

Respondents expressed a variety of views on FCC's progress. For example, one expert reported that FCC should have auctioned the Upper 700 MHz D block already but was satisfied with FCC's efforts to accelerate terrestrial deployment in Mobile Satellite Services spectrum. Another expert said that FCC's approach to spectrum policy has resulted in the U.S. mobile and fixed wireless broadband industries losing ground to their foreign counterparts. An infrastructure provider responded that FCC is working well with NTIA to free up spectrum for auctions.

Additional details on FCC's actions to implement these recommendations, as well as experts' and stakeholders' views on the recommendations and on FCC's implementation, are contained in appendix III.

Responding Experts and Stakeholders Had Mixed Views on Expanding Incentives and Mechanisms to Reallocate Spectrum

Recommendations in Plan

The National Broadband Plan included four recommendations aimed at expanding incentives and mechanisms to reallocate spectrum. We considered the following three of those recommendations in our review:

- to motivate existing spectrum licensees to voluntarily give up their licenses so that FCC could more quickly reallocate the spectrum to higher valued services, the plan recommended that Congress should consider giving FCC the authority to conduct incentive auctions in which licensees that choose to relinquish their licenses would receive a portion of the proceeds realized by the auction of their licenses;

- to promote the efficient use of spectrum by compelling spectrum licensees to recognize the value to society of their licenses, the plan recommended that Congress consider granting authority to FCC to impose fees on licensees; and

- because of concerns that its rules allowing spectrum licensees to lease their licenses—designed to promote access to underutilized spectrum—are not as effective as they could be, the plan recommended that FCC should identify and address barriers to secondary markets.[43]

The recommendations enjoyed varying levels of agreement from the experts and stakeholders responding to our survey (see table 4). In the table, we sometimes separately report different subgroups of stakeholders to illustrate meaningful differences in their responses.

[43]The plan also included a recommendation that Congress consider building upon the success of the Commercial Spectrum Enhancement Act (Pub. L. No. 108-494, Title II, 118 Stat. 3986) to fund additional approaches to facilitate relocation of incumbent federal users. We did not consider this recommendation in this review because it relates more to NTIA's management of federal spectrum use than to FCC's management of commercial spectrum use.

Table 4: Expert and Stakeholder Respondents' Agreement with National Broadband Plan Recommendations Aimed at Expanding Incentives and Mechanisms to Reallocate Spectrum

Recommendation in plan Type of respondent	Agreed	Neither agreed nor disagreed	Disagreed	Total
Grant authority to conduct incentive auctions				
Expert	18	0	1	**19**
Stakeholder - broadcaster	1	5	5	**11**
Stakeholder - nonbroadcaster	30	2	7	**39**
Total	**49**	**7**	**13**	**69**
Grant authority to impose fees on licensees				
Expert	15	1	4	**20**
Broadcaster	0	0	13	**13**
Wireless device manufacturer	4	2	3	**9**
Wireless service provider	6	1	13	**20**
Other stakeholder	4	3	2	**9**
Total	**29**	**7**	**35**	**71**
Address barriers to secondary markets				
Expert	18	1	1	**20**
Stakeholder	41	4	5	**50**
Total	**59**	**5**	**6**	**70**

Source: GAO survey.

Note: The total number of responses for each recommendation varied based on the number of respondents that chose to answer the question pertaining to the recommendation. The figures shown under "agreed" include respondents that either strongly agreed or somewhat agreed with the recommendation, and the responses shown under "disagreed" include respondents that either strongly disagreed or somewhat disagreed with the recommendation. Appendix III includes figures for the more detailed response categories, as well for each type of stakeholder.

Far more experts and stakeholders other than broadcasters agreed than disagreed with granting FCC authority to conduct incentive auctions, while more broadcasters disagreed than agreed. FCC proposed incentive auctions as a mechanism to free up 120 MHz of spectrum currently allocated to television service, which as we noted above, broadcasters oppose. The experts and stakeholders expressed a variety of views about incentive auctions. For example, one expert commented that Congress should simply allow FCC to pay some of the auction revenues to broadcasters instead of the U.S. Treasury and avoid legislating any details of the auction. An infrastructure provider said that incentive auctions would take years off of FCC's usual repurposing approach, which as we noted earlier has taken from 7 to 15 years. A broadcaster commented that instead of using incentive auctions to reallocate

television spectrum, FCC should allow licensees to sell or lease their licenses to wireless service providers. Another broadcaster commented that incentive auctions would be acceptable so long as (1) participation by broadcasters is truly voluntary and (2) FCC reimburses broadcasters who choose not to participate for the costs they incur to relocate to new frequencies.[44]

Many more experts agreed than disagreed with granting FCC authority to impose fees on licensees, while slightly more wireless device manufacturers and stakeholders in our "other" category agreed than disagreed. All broadcasters disagreed with granting FCC authority to impose fees, and about twice as many wireless service providers disagreed as agreed; as licensees, broadcasters and wireless service providers could be subject to the fees. The experts and stakeholders expressed a variety of views about fees. An expert commented that the value of spectrum is usually far greater than the amount recovered in auctions, and that fees can better capture this value by being adjusted upward if the value of the spectrum appreciates. Similarly, a public interest group commented that annual fees would increase spectrum utilization, give license holders who do not use their spectrum an incentive to return it, and raise far more money for the U.S. Treasury than auctions do. Alternatively, an expert responded that fees would not create incentives for efficient use of spectrum, and suggested that instead FCC allow competitive forces wider scope by permitting licensees to deploy any service, technology, or business model that may be profitable. A range of stakeholders commented that fees should be reduced or waived for current licensees that purchased their licenses at auction or that already pay annual regulatory fees.

Almost all responding experts and most stakeholders agreed with the recommendation that FCC identify and address barriers to secondary markets. An expert responded that addressing barriers to secondary markets would eliminate the need for incentive auctions. Similarly, a broadcaster commented that allowing all current licensees to participate

[44]To ensure that the spectrum freed up in an incentive auction is effectively usable for mobile broadband, FCC will need to assign new frequencies to some television stations through a realignment process sometimes called repacking. According to FCC, because digital technology allows stations to use virtual channel numbers, even if a station's frequency changes through realignment, it can continue to have its same channel number display on television screens and set-top boxes. Further, FCC has said broadcasters will be fully reimbursed for any costs incurred in changing channels.

in secondary markets would enable market forces to determine the best use for spectrum without requiring wholesale reallocation of designated bands. A wireless service provider noted that FCC's secondary market rules have been greatly successful in creating access to spectrum resources by nonlicensees, with leasing arrangements becoming increasingly commonplace.

Implementation of Recommendations

In response to the recommendation on secondary markets, FCC officials told us that the Commission reviewed its secondary markets policies and concluded that it should do more to promote these markets. It also requested public comments on technologies that could enable dynamic sharing of spectrum, including how such technologies could facilitate secondary markets.[45] FCC officials told us that the Commission intended to issue a related order, tentatively by the end of 2011. Among those responding to our survey and that support the recommendation, more experts and wireless device manufacturers were satisfied than dissatisfied with FCC's progress, while more wireless service providers were dissatisfied than satisfied (see table 5).

Table 5: Expert and Stakeholder Respondents' Satisfaction with FCC's Progress in Identifying and Addressing Barriers to Secondary Markets

Type of respondent	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Total
Expert	7	3	5	**15**
Broadcaster	0	5	3	**8**
Wireless device manufacturer	4	2	2	**8**
Wireless service provider	3	4	8	**15**
Other stakeholder	2	6	0	**8**
Total	**16**	**20**	**18**	**54**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation. The figures shown under "satisfied" include respondents that were either very satisfied or somewhat satisfied with FCC's progress, and the responses shown under "dissatisfied" include respondents that were either strongly dissatisfied or somewhat dissatisfied with FCC's progress. Appendix III includes figures for the more detailed response categories.

[45]Dynamic sharing of spectrum, sometimes referred to as "dynamic spectrum access," can be enabled by the use of "cognitive" radios that are able at any moment in time to determine and use spectrum that is unused and available.

Two broadcasters commented that FCC's analysis of barriers to secondary markets must include broadcast spectrum to be credible and effective. An expert questioned the relevance of dynamic spectrum access to secondary markets, and two stakeholders commented that dynamic spectrum access is not yet technically mature enough to support secondary markets.

Responding Experts and Stakeholders Had Mixed Views on Expanding Opportunities for Innovative Spectrum Access Models

Recommendations in Plan

The National Broadband Plan includes four recommendations aimed at expanding opportunities for innovative spectrum access models. Such models provide alternatives to the traditional means of accessing spectrum—exclusive-use licensing. Examples include allowing unlicensed devices to use certain portions of the spectrum without any guarantee of interference protection and dynamic spectrum access. The four related recommendations are as follows:

- FCC, within the next 10 years, should free up a contiguous nationwide band for use exclusively or predominantly by unlicensed devices.
- FCC should move expeditiously to complete new rules permitting unlicensed use of the unused spectrum between television channels, referred to as television "white spaces."
- FCC should spur further development and deployment of opportunistic uses (i.e., dynamic spectrum access) across more radio spectrum.
- FCC should initiate proceedings to enhance research and development (R&D) that will advance the science of spectrum access.

Stakeholders and experts responding to our survey expressed varying levels of support for these recommendations (see table 6). In the table, we sometimes separately report different subgroups of stakeholders to illustrate meaningful differences in their responses.

Table 6: Expert and Stakeholder Respondents' Agreement with National Broadband Plan Recommendations Aimed at Expanding Opportunities for Innovative Spectrum Access Models

Recommendation in plan Type of respondent	Agreed	Neither agreed nor disagreed	Disagreed	Total
Provide spectrum for unlicensed use				
Expert	8	3	5	**16**
Broadcaster	3	3	4	**10**
Wireless device manufacturer	6	1	2	**9**
Wireless service provider	7	2	10	**19**
Other stakeholder	5	1	1	**7**
Total	**29**	**10**	**22**	**61**
Issue rules on television white spaces				
Expert	11	2	5	**18**
Stakeholder - broadcaster	1	4	7	**12**
Stakeholder - nonbroadcaster	22	7	6	**35**
Total	**34**	**13**	**18**	**65**
Spur opportunistic uses of spectrum				
Expert	14	2	3	**19**
Stakeholder	27	9	11	**47**
Total	**41**	**11**	**14**	**66**
Enhance R&D on spectrum access				
Expert	16	0	2	**18**
Stakeholder	32	7	9	**48**
Total	**48**	**7**	**11**	**66**

Source: GAO survey.

Note: The total number of responses for each recommendation varied based on the number of respondents that chose to answer the question pertaining to the recommendation. The figures shown under "agreed" include respondents that either strongly agreed or somewhat agreed with the recommendation, and the responses shown under "disagreed" include respondents that either strongly disagreed or somewhat disagreed with the recommendation. Appendix III includes figures for the more detailed response categories, as well for each type of stakeholder.

More experts, wireless device manufacturers, and stakeholders in our "other" category agreed than disagreed that FCC should free up a nationwide band for the exclusive or predominant use of unlicensed devices, while more broadcasters and wireless service providers disagreed than agreed. Experts and stakeholders expressed a variety of views about unlicensed uses. For example, an expert commented that future demand for rich wireless media cannot be satisfied by licensed

spectrum alone but will require more unlicensed spectrum to provide many more wireless fidelity (Wi-Fi) access points so that wireless traffic can be off-loaded to the wired network.[46] A wireless service provider said that the potential benefit of unlicensed uses is so great that FCC should be aiming to set aside a band for such uses within 2 to 3 years rather than 10 years. In contrast, a Mobile Satellite Services company responded that there is already enough spectrum available for unlicensed uses. Similarly, an expert commented that because there are now affordable devices that can operate effectively over a range of frequencies, FCC should assist the market in using an online database as it is doing for television white spaces so that unlicensed devices can sense available spectrum and use it dynamically, rather than clearing a new band for unlicensed use.

More responding experts and stakeholders other than broadcasters agreed than disagreed that FCC should move expeditiously to complete new rules permitting unlicensed use of television white spaces, while more broadcasters disagreed than agreed. Experts and stakeholders expressed a variety of views on the recommendation. A wireless device manufacturer that supported white spaces noted that white spaces are primarily available in rural areas where spectrum congestion is less common than in densely populated environments like urban areas. But, three broadcasters responded that FCC must ensure that its rules protect incumbent users from interference.[47] Two experts expressed concern that

[46]Wi-Fi networks—which provide wireless broadband service in so-called "hot spots," or areas within a radius of up to 300 feet—can be found in cafes, hotels, airports, and offices. In a Wi-Fi network, a wireless device uses an antenna to transmit data to a router, which then sends the information to the Internet using a wired connection. Some licensed wireless service providers off-load (or transfer) some of their data traffic from the cellular network onto Wi-Fi networks. This benefits users by providing them with much faster service while licensed wireless service providers have less congestion and can deliver a better overall quality of service.

[47]In the past, broadcasters have sought judicial review of FCC's white spaces order, noting that the Commission's decision to allow unlicensed access to the television spectrum would have a direct adverse impact on broadcasters because it would allow harmful interference with the reception of the broadcast signals. The Association for Maximum Service Television and the National Association of Broadcasters filed a petition for review in the U.S. Court of Appeals for the District of Columbia (Case No. 09-1080) on February 27, 2009. This case is currently being held in abeyance. FCC has since issued a follow-up white spaces order and there are petitions for reconsideration pending on this order. *Unlicensed Operation in the TV Broadcast Bands*, Second Memorandum Opinion and Order, 25 FCC Rcd 18661 (2010).

unlicensed use of television white spaces could adversely impact or be in tension with an incentive auction of television spectrum.

Experts and stakeholders generally supported the recommendation on opportunistic uses, and they made a variety of comments on the recommendation. For example, a wireless service provider supported the continued development of dynamic spectrum access but expressed strong opposition to FCC's development of any related rules that would diminish the rights of licensees of exclusive spectrum purchased at auction to control access to their spectrum. A broadcaster also commented that FCC should protect the integrity of existing services; the broadcaster disagreed with the recommendation on opportunistic uses and stated that FCC should free incumbent licensees from technical restrictions that hinder innovation. Similarly, an expert commented that instead of implementing this recommendation, FCC should develop rules that create incentives for competitive processes to create efficient solutions to spectrum shortages. Another expert expressed doubt that mass market technology and the demands of the commercial marketplace will allow for opportunistic uses within the next decade.

Experts and stakeholders generally supported the recommendation on R&D. For example, a wireless service provider commented that, in implementing this recommendation, FCC should leverage work that is currently being done in private industry and in academia. Two other wireless service providers reported that rather than trying to foster R&D directly, FCC should instead focus on ensuring a highly competitive marketplace for wireless services because competition spurs innovation by market participants. A Mobile Satellite Services company responded that spectrum shortages are already providing incentive for licensees to spend their funds on R&D for ways to use spectrum more intensively. An expert also noted that there is no need for FCC to enhance already substantial ongoing R&D efforts by the private sector.

Implementation of Recommendations

To implement the recommendations aimed at expanding opportunities for innovative spectrum access models, FCC has taken or plans to take the following steps:

- *Unlicensed spectrum.* FCC intends to consider making additional spectrum available for unlicensed use in conjunction with NTIA's plan to make available 500 MHz of spectrum for wireless broadband, which addresses both licensed and unlicensed uses.

- *White spaces.* FCC eliminated the requirement that white spaces devices include technology to sense what spectrum is available, and substituted requirements for geo-location technology and the ability to access databases of available spectrum.[48] FCC also conditionally designated and began working with nine companies to develop and administer the databases.

- *Opportunistic uses of spectrum.* FCC requested public comment on how dynamic spectrum access radios and techniques can promote more intensive and efficient use of the radio spectrum.[49]

- *R&D.* FCC issued a proposed rule that would expand the agency's existing Experimental Radio Service rules to promote cutting-edge research and foster development of new wireless technologies, devices, and applications.[50] Specifically, FCC proposed a new type of license, called a "program license," which would give qualified entities broad authority to conduct research without having to seek new approval for each individual experiment.

Among those that agreed with a recommendation aimed at expanding opportunities for innovative spectrum access models, generally more experts and more stakeholders were satisfied than were dissatisfied with FCC's progress on implementing the recommendation (see table 7).

[48]*Unlicensed Operation in the TV Broadcast Bands*, Second Memorandum Opinion and Order, 25 FCC Rcd 18661 (2010).

[49]*Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies*, Notice of Inquiry, 25 FCC Rcd 16632 (2010).

[50]*Promoting Expanded Opportunities for Radio Experimentation and Market Trials under Part 5 of the Commission's Rules and Streamlining Other Related Rules; 2006 Biennial Review of Telecommunications Regulations—Part 2 Administered by the Office Of Engineering and Technology (OET)*, Notice of Proposed Rulemaking, 25 FCC Rcd 16544 (2010).

Table 7: Expert and Stakeholder Respondents' Satisfaction with FCC's Progress on National Broadband Plan Recommendations Aimed at Expanding Opportunities for Innovative Spectrum Access Models

Recommendation in plan Type of respondent	Satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Total
Provide spectrum for unlicensed use				
Expert	5	2	1	**8**
Stakeholder	9	2	9	**20**
Total	**14**	**4**	**10**	**28**
Issue rules on television white spaces				
Expert	7	2	2	**11**
Stakeholder	10	7	6	**23**
Total	**14**	**4**	**10**	**34**
Spur opportunistic uses of spectrum				
Expert	6	3	3	**12**
Stakeholder	7	14	5	**26**
Total	**14**	**4**	**10**	**38**
Enhance R&D on spectrum access				
Expert	10	3	2	**15**
Stakeholder	12	9	5	**26**
Total	**22**	**12**	**7**	**41**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation. The total number of responses for each recommendation varied based on the number of respondents that chose to answer the question pertaining to the recommendation. The figures shown under "satisfied" include respondents that were either very satisfied or somewhat satisfied with FCC's progress, and the responses shown under "dissatisfied" include respondents that were either strongly dissatisfied or somewhat dissatisfied with FCC's progress. Appendix III includes figures for the more detailed response categories, as well for each type of stakeholder.

More experts were satisfied than dissatisfied with FCC's progress on the unlicensed spectrum recommendation, while stakeholders were evenly split. An infrastructure provider said that television white spaces has been the focus of FCC's efforts related to unlicensed use; the provider was concerned that the white spaces will not support devices that work in other countries because other countries use different spectrum bands than the United States for television. A public interest group commented that FCC has not made meaningful progress in this area, and that given the success of unlicensed spectrum in dramatically increasing the public's access to the public airwaves, unlicensed spectrum—rather than spectrum auctions to corporations—should be FCC's priority.

While more experts and stakeholders were satisfied than dissatisfied with FCC's progress on the white spaces recommendation, experts and stakeholders expressed a variety of concerns about FCC's implementation. For example, an expert said FCC's approach is too complicated. A device manufacturer was troubled by FCC's decision to remove the requirement that white spaces devices have sensing technology that could scan the spectrum for available frequencies, which the manufacturer said had been deemed essential for sharing spectrum. A public interest group responded that FCC was moving too slowly.

More experts and stakeholders were satisfied than dissatisfied with FCC's progress on the opportunistic uses recommendation, but they expressed some concerns about FCC's implementation. For example, an infrastructure provider commented that FCC has been too slow to resolve interference issues in the 5 GHz band, which FCC has allowed for use by devices capable of dynamically accessing spectrum. A wireless device manufacturer was dissatisfied that FCC, rather proposing rules to facilitate the use of smart radios, had instead taken the more preliminary step of requesting public comments on how opportunistic uses can promote more intensive and efficient use of the radio spectrum. The manufacturer was also dissatisfied that the plan and the notice of inquiry showed a preference for geo-location database approaches to dynamic access over sensing approaches.

More experts and stakeholders were satisfied than dissatisfied with FCC's progress on the R&D recommendation, and they expressed a variety of views about FCC's implementation. For example, a wireless device manufacturer described FCC's proposed rule as a good step forward. Other stakeholders expressed concerns about the proposed rule. For example, a private user noted that FCC's proposal to expand the Commission's Experimental Radio Service rules should be strengthened to ensure that licensees are aware of experimental operations that may cause harmful interference to them, and that FCC should more strictly enforce against such interference.

For examples of survey participants' comments on FCC's implementation of the recommendation on opportunistic uses of spectrum, see appendix III.

Responding Experts and Stakeholders Strongly Supported Extending FCC's Auction Authority but Varied in Their Opinions on Potential Changes to Auctions

In the Omnibus Budget Reconciliation Act of 1993, Congress provided FCC authority to use auctions to assign certain spectrum licenses. From 1994 through June 30 2011, FCC conducted 79 auctions that have raised nearly $52 billion for the U.S. Treasury. In 2005, we reported that FCC's use of auctions to assign spectrum appeared to have had little to no negative impact on end-user prices, infrastructure deployment, and competition, but that evidence on how auctions impacted the entry and participation of small businesses was less clear.[51] We also reported that FCC's implementation of auctions had mitigated problems associated with comparative hearings and lotteries, which FCC previously used to assign licenses. In particular, auctions were quicker, less costly, and more transparent; were more effective in assigning licenses to entities that valued them the most; and were an effective mechanism for the public to realize a portion of the value of a national resource used for commercial purposes. We recommended that Congress consider extending FCC's auction authority beyond the then current expiration date of September 30, 2007. Subsequent to our report, FCC's auction authority was extended twice, first until September 30, 2011, and then until September 30, 2012.[52] Further, subsequent to our report through June 30, 2011, FCC successfully completed 20 auctions, which raised over $37 billion for the U.S. Treasury.

Experts and stakeholders responding to our survey, by large margins, supported extending FCC's authority to assign mutually exclusive licenses by auction beyond the September 30, 2012, expiration date. In particular, 53 of 65 experts and stakeholders supported extending FCC's auction authority (see table 8). Experts and stakeholders made a variety of comments related to extending FCC's auction authority. For example, a wireless service provider commented that auctions are by far the most efficient way to assign spectrum.

[51]GAO, *Telecommunications: Strong Support for Extending FCC's Auction Authority Exists, but Little Agreement on Other Options to Improve Efficient Use of Spectrum*, GAO-06-236 (Washington, D.C.: Dec. 20, 2005).

[52]Deficit Reduction Act, Pub. L. No. 109-171, § 3003, 120 Stat. 4, 22 (2006); DTV Delay Act, Pub. L. No. 111-4, § 5, 123 Stat. 112, 114 (2009).

Table 8: Expert and Stakeholder Respondents' Agreement with Extending FCC's Auction Authority

Type of respondent	Agreed	Neither agree nor disagreed	Disagreed	Total
Expert	17	1	1	**19**
Stakeholder	36	3	7	**46**
Total	**53**	**4**	**8**	**65**

Source: GAO survey.

Note: The figures shown under "agreed" include respondents that either strongly agreed or somewhat agreed with extending FCC's auction authority, and the responses shown under "disagreed" include respondents that either strongly disagreed or somewhat disagreed with extending FCC's auction authority.

Experts and stakeholders responding to our survey expressed varying levels of support for five potential changes to FCC's auction policies that we asked about (see table 9). In particular, we asked experts and stakeholders about whether FCC should provide a clear schedule for future auctions, allow all-or-nothing bids on multiple licenses (known as "combinatorial auctions"), reduce the geographic areas covered by licenses, modify bidding credits that provide financial benefits to certain auction participants, and implement royalties as the means though which auction winners compensate the government instead of up-front payments.

Table 9: Expert and Stakeholder Respondents' Agreement with Potential Changes to FCC's Auction Policies

Potential change Type of respondent	Agreed	Neither agreed nor disagreed	Disagreed	Total
Provide a clear road map detailing future auctions				
Expert	12	3	4	**19**
Stakeholder	37	2	6	**45**
Total	**49**	**5**	**10**	**64**
Allow all-or-nothing package bids on multiple licenses[a]				
Expert	14	1	2	**17**
Stakeholder	18	10	10	**38**
Total	**32**	**11**	**12**	**55**
Reduce the size of geographic areas covered by licenses[b]				
Expert	6	5	6	**17**
Stakeholder	23	7	11	**41**
Total	**29**	**12**	**17**	**58**

Potential change Type of respondent	Agreed	Neither agreed nor disagreed	Disagreed	Total
Modify bidding credits[c]				
Expert	5	5	9	**19**
Stakeholder	20	8	8	**36**
Total	**25**	**13**	**17**	**55**
Require winners to pay royalties[d]				
Expert	9	2	7	**18**
Stakeholder	15	7	17	**39**
Total	**24**	**9**	**24**	**57**

Source: GAO survey.

Note: The total number of responses for each potential change varied based on the number of respondents that chose to answer the question pertaining to the potential change. The figures shown under "agreed" include respondents that either strongly agreed or somewhat agreed with the potential change, and the responses shown under "disagreed" include respondents that either strongly disagreed or somewhat disagreed with the potential change.

[a]An auction with all-or-nothing bids on combinations of multiple items is known as a "combinatorial auction." According to FCC, this approach allows bidders to better express the value of any benefits from combining complementary licenses and to avoid the risk of winning only part of a desired set of licenses.

[b]FCC auctions licenses in a variety of designated geographic regions, including relatively small multicounty areas (Cellular Market Areas) and large multistate regions (Regional Economic Areas).

[c]Bidding credits are a percentage discount applied to the high bid amount for a license if the bidder meets specific designated entity criteria—designed to make spectrum available to new entrants—established in the auction rules.

[d]With a royalty mechanism, a company would pay the government a percentage of revenue on an ongoing basis, rather than pay the government a one-time fee to obtain a spectrum license.

Among the potential changes we asked survey participants about, reducing uncertainty about future spectrum auctions received the most support. Currently, FCC provides information on scheduled auctions and identifies auctions not yet scheduled. Most experts and stakeholders agreed that FCC should reduce uncertainty by providing a clear road map for future auctions, including their timing and size, so that potential bidders can develop effective strategies. However, experts and stakeholders that did not agree with the recommendation cited several concerns. For example, a broadcaster was concerned that by providing a road map, FCC would limit its flexibility to respond to changing technological solutions and spectrum demand, and an expert was concerned that if spectrum beyond that included in the road map were to become available, the road map could be used by incumbents to protest the release of the additional spectrum, harming consumers.

Most responding experts agreed, and more stakeholders agreed than disagreed, that FCC should allow all-or-nothing package bids on multiple licenses in an auction (referred to as "combinatorial auctions") as opposed to requiring bids on individual licenses. According to FCC, this approach allows bidders to better express the value of any benefits from combining complementary licenses and to avoid the risk of winning only part of a desired set of licenses. However, a broadcaster and a wireless service provider commented that package bidding would unfairly favor large companies that can afford such approaches.

An equal number of responding experts agreed and disagreed, and more stakeholders agreed than disagreed, that FCC should reduce the size of geographic areas covered by licenses to promote the participation of small companies. In 2010, we reported that, according to some small wireless carriers and stakeholders, the size of spectrum blocks has had the effect of pricing small and regional carriers out of auctions, making it difficult for these carriers to enter into new markets or expand their services.[53] However, an expert and a Mobile Satellite Services company expressed concern that if FCC were to implement this recommendation, small companies that get spectrum would sooner or later cash out and sell to larger carriers, which the service provider said would add to licensees' costs without actually fostering competition. However, a wireless device manufacturer said that FCC could avoid this problem by requiring any entity that acquires spectrum and sells it without a network to pay a tax to the U.S. Treasury. Another expert responded that implementation would result in the fragmentation of spectrum and complex secondary market transactions aimed at recombining the spectrum into larger geographic bundles.

More experts disagreed than agreed, while more stakeholders agreed than disagreed, that FCC should modify bidding credits designed to promote the participation of small companies. Bidding credits are a percentage discount applied to the high bid amount for a license if the bidder meets specific designated entity criteria—designed to make spectrum available to new entrants—established in the auction rules. Several experts and stakeholders expressed concerns about FCC's experience with bidding credits. For example, an expert commented that,

[53]GAO, *Telecommunications: Enhanced Data Collection Could Help FCC Better Monitor Competition in the Wireless Industry*, GAO-10-779 (Washington, D.C.: July 27, 2010).

rather than promoting efficiency, bidding credits provide windfalls to the owners of small companies who can use the credits to buy spectrum and then turn around and sell it for a profit at market rates to larger firms. In 2010, we reported that some stakeholders said that, in the past, large national carriers have used entities eligible for the credits as proxies, allowing eligible entities to win certain licenses and then acquiring the desired licenses from them later; a wireless service provider responding to our survey expressed a similar concern.[54] A device manufacturer cited a case in which the Department of Justice, on behalf of FCC, settled with a Wall Street money manager for $130 million to resolve allegations of such abuse. A wireless service provider commented that the credits do not work as intended, and an expert and a device manufacturer felt that FCC should stop using them altogether.

Requiring winners of auctions to pay royalties based on the amount of revenues the winners earn by using the spectrum rather than requiring them to pay the full amounts of the winning bids up front garnered the least support. Both experts and stakeholders were nearly evenly divided on this potential change and expressed several concerns about royalties. For example, a public interest group commented that royalties based on a share of revenues would have the undesirable effect of imposing risk on the government. Similarly, a wireless service provider commented that royalties would have to be paired with penalties for nonuse of spectrum in order to be effective, or else licensees—particularly large incumbents—would have an incentive to buy and not use spectrum to avoid the royalty or to limit competition by smaller competitors and new entrants. Another wireless service provider commented that royalties would create disincentives for licensees to build out quickly, and that it would be difficult for FCC to determine appropriate royalty amounts because of the difficulty of parsing out a licensee's revenue from various spectrum bands, some of which would be covered by a royalty fee and some of which would not.

[54] GAO-10-779.

Conclusions

As commercial enterprises increasingly utilize spectrum to provide consumer services, FCC's ongoing implementation of the spectrum-related recommendations of the 2010 National Broadband Plan is of great importance. Most of the plan's recommendations enjoyed fairly broad support from experts and stakeholders responding to our survey, although some recommendations were strongly opposed by some experts or certain types of stakeholders. For example, the plan's recommendation for incentive auctions, which could speed the lengthy repurposing process, received mixed responses from expert and stakeholder respondents. In some instances, these conflicting opinions arise from participants' divergent positions in the communications industry; for example, incumbent licensees, such as broadcasters, are likely to oppose recommendations that they believe could impose burdens or costs on their businesses. In addition, experts' and stakeholders' satisfaction with FCC's implementation of the recommendations to date tended to be more tempered than their support for the recommendations themselves. Perhaps most challenging, experts and stakeholders expressed a range of views—sometimes conflicting—on how Congress and FCC should proceed. In this respect, little has changed since 2003, when we reported that "it does not appear likely that timely reforms can be agreed upon amid the diversity of views held by stakeholders."[55] One potential step that did achieve broad agreement among experts and stakeholders responding to our survey was extending FCC's auction authority beyond the current expiration date of September 30, 2012. We previously found that spectrum auctions are very effective for assigning licenses for commercial entities.[56] We also previously found that as implemented by FCC, spectrum auctions resolve problems associated with previous assignment mechanisms, while giving rise to little or no problems. Since we issued our last report on auctions in December 2005 through June 30, 2011, FCC has successfully completed an additional 20 auctions, which raised over $33 billion for the U.S. Treasury.

[55]GAO-03-277.

[56]GAO-06-236.

Matter for Congressional Consideration

Given the continued success of FCC's use of auctions, and the overwhelming support among experts and stakeholders for extending FCC's auction authority, Congress should consider extending FCC's auction authority beyond the current expiration date of September 30, 2012.

Agency Comments

We provided a draft of this report to FCC for its review and comment. FCC provided technical comments that we incorporated as appropriate.

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, the Chairman of the Federal Communications Commission, and other interested parties. In addition, the report will be available at no charge on GAO's website at http://www.gao.gov.

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

Mark L. Goldstein
Director, Physical Infrastructure

Appendix I: Scope and Methodology

This report addresses the Federal Communications Commission's (FCC) management of commercial spectrum, including (1) the extent to which FCC has made spectrum available for new commercial uses since it implemented auction authority in 1994, and the time taken to do so; (2) experts' and stakeholders' views on FCC's plans and recent actions to meet future spectrum needs; and (3) experts' and stakeholders' views on the continued use of auctions to assign spectrum. In addition, we examined the extent to which FCC seeks to ensure the quality of its data on commercial spectrum licenses (see app. II).

To address all research questions, we conducted a web-based survey of experts and industry stakeholders. We selected a nonprobability sample of 30 experts and 79 industry stakeholders; we selected the experts and stakeholders based on their expertise in spectrum policy, as represented by presentations or publications, or on their organization's vested interest in spectrum policy. Within the industry stakeholder group, we surveyed 20 representatives of the broadcast industry, 15 representatives of the wireless device manufacturing industry, 26 representatives of the wireless service provider industry, and 18 other industry stakeholders, including satellite, spectrum management, infrastructure, private user, and public interest groups.

We developed and administered the web-based survey through a secure server. We provided participants with unique passwords and usernames and subsequently notified participants on May 25, 2011, when the questionnaire was available. We sent follow-up e-mail messages to those who had not responded, and subsequently contacted all remaining nonrespondents by telephone. The questionnaire was available online until June 28, 2011. We received completed responses from 20 experts and 54 industry stakeholders, representing a 68 percent response rate. Because we selected a nonprobability sample of experts and industry stakeholders, the information we obtained from the survey may not be generalized to all experts and industry stakeholders who have an interest in spectrum policy.

The practical difficulties of conducting any survey may introduce errors, commonly referred to as nonsampling errors. For example, difficulties in interpreting a particular question, sources of information available to respondents, or entering data into a database or analyzing them can introduce unwanted variability into the survey results. We took steps in developing the questionnaire, collecting the data, and analyzing them to minimize such nonsampling error. For example, social science survey specialists designed the questionnaire in collaboration with GAO staff

who had subject matter expertise. Then, we pretested the draft questionnaire with four experts and industry stakeholders; we also reviewed the survey with FCC staff. We conducted these pretests and reviews to ensure that (1) the questions were clear and unambiguous, (2) terminology was used correctly, (3) the questionnaire did not place an undue burden on respondents, (4) the information could be feasibly obtained, and (5) the survey was comprehensive and unbiased. On the basis of the feedback from the pretests and reviews we conducted, we made changes to the content and format of the survey questions. When we analyzed the data, an independent analyst checked all computer programs. Since this was a web-based survey, respondents entered their answers directly into the electronic questionnaire, eliminating the need to key data into a database, minimizing error.

In addition to the survey, to address all research questions we conducted semistructured interviews with a variety of industry stakeholders, experts, and officials with government agencies; for industry stakeholders, we interviewed both associations and individual companies. We interviewed the following types of organizations and individuals: government agencies (FCC and the Congressional Research Service), wireless service providers, wireless device manufacturers, a wireless telecommunications infrastructure company, broadcasters, Mobile Satellite Services companies, a spectrum data manager, academics, public interest organizations, and consultants.

To examine the extent to which FCC seeks to ensure the quality of its data on commercial spectrum licenses, we reviewed the following FCC spectrum-related databases: Universal Licensing System, Consolidated Database System, International Bureau Filing System, Experimental Licensing System, and Equipment Authorization System. To review these databases, we interviewed FCC officials responsible for maintaining the systems about FCC's processes for ensuring the quality of the data, and we compared FCC's processes with GAO guidance on internal controls and information technology. We also interviewed industry stakeholders who use these databases, as well as the Spectrum Dashboard and License View systems that pull data from these systems, and included questions in our survey of experts and stakeholders pertaining to the usefulness, accuracy and completeness, and user-friendliness of FCC's systems. We also reviewed prior FCC audits of records in the Universal Licensing System.

To examine the extent to which FCC has made spectrum available for new commercial uses, we reviewed six instances where FCC repurposed

spectrum from an existing use to a new use. The six repurposings we reviewed involved substantial amounts of spectrum that were repurposed to a higher value use. In particular, these repurposings met the following criteria: (1) the amount of spectrum repurposed was 5 megahertz (MHz) or more; (2) the repurposing yielded $100 million or more in auction or industry revenue; and (3) reassignment occurred in 1994, when FCC first implemented its auction authority, or later. For these repurposings, we reviewed FCC's notices, orders, and auctions; comments filed in the proceedings by industry participants; and relevant court decisions. We also included a question in our survey of experts and stakeholders pertaining to the amount of time it takes from when FCC or Congress designates a spectrum band for reallocation until the band is available for a new use.

To examine FCC's plans and recent actions to meet future spectrum needs, we reviewed the National Broadband Plan and notices of inquiry, reports and orders, and other publications related to FCC's development or implementation of the plan's chapter on spectrum. We reviewed comments filed in various FCC proceedings from industry stakeholders on FCC's development of the plan and FCC's steps to implement the plan. We reviewed publications and presentations from academic and industry consultants and other experts. We included questions in our survey of experts and stakeholders pertaining to the recommendations in the plan's chapter on spectrum and FCC's steps to implement those recommendations. We asked survey participants for their opinion on each recommendation and where appropriate, FCC's steps to implement the recommendation; we excluded three recommendations that were addressed in our questions about FCC's data quality, fell under the purview of the National Telecommunications and Information Administration (NTIA), or pertained to a narrow population.[1]

To examine FCC's continued use of auctions to assign spectrum, we reviewed prior GAO reports that addressed FCC's use of auctions to assign spectrum licenses. We reviewed publications and presentations

[1]These recommendations are (1) Recommendation 5.1: The FCC should launch and continue to improve a spectrum dashboard; (2) Recommendation 5.5: Congress should consider building upon the success of the Commercial Spectrum Enhancement Act to fund additional approaches to facilitate incumbent relocation; and (3) Recommendation 5.17: The FCC should take into account the unique spectrum needs of U.S. Tribal communities when implementing the recommendations in this chapter.

from academic and other experts. Finally, we included questions in our survey of experts and stakeholders pertaining to spectrum auctions. In particular, we asked survey participants for their opinion on whether Congress should extend FCC's auction authority and on five potential changes to FCC's implementation of auctions.

We conducted this performance audit from August 2010 to November 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: Federal Communications Commission's Spectrum-Related Data Systems

In this appendix, we provide information on FCC's spectrum-related data systems. Specifically, we discuss (1) FCC's data systems for spectrum-related records, (2) experts' and stakeholders' views about attributes of FCC's data systems, (3) FCC's quality-control process for its data, and (4) FCC's efforts to improve its spectrum-related data.

FCC Has Several Data Systems for Spectrum-Related Records

We examined seven of FCC's spectrum-related data systems, of which six are related to spectrum licenses, and one is concerned with radio equipment authorizations (see table 10).[1] Four of the six spectrum license-related systems allow (1) entities to apply for a license, (2) existing licensees to apply for a license renewal or to update their license information, and (3) the public to search for information on licenses; these systems are the Universal Licensing System for wireless telecommunications licenses, the Consolidated Database System for broadcasting licenses, the International Bureau Filing System for satellite licenses, and the Experimental Licensing System for experimental use licenses. According to FCC officials, the Universal Licensing System is by far the largest system with the most licenses, and is therefore the system that the public is most likely to interact with. FCC recently implemented the other two systems related to spectrum licenses—Spectrum Dashboard and License View—to provide the public with more user-friendly tools, such as enhanced mapping capabilities, for searching for information on spectrum licenses. These two systems pull data on licenses from FCC's spectrum licensing systems; they do not allow entities to file applications for licenses or update information on their licenses. The Equipment Authorization System allows entities to file applications for authorizations of radio equipment, such as cell phones, and the public to search for information on these authorizations. FCC uses these various systems for multiple purposes, including processing applications for spectrum licenses or radio equipment authorizations and helping to determine where spectrum is available.

[1]We did not examine FCC's Cable Operations and Licensing System (COALS), which pertains to cable operators and multichannel video programming distributors. According to FCC staff, COALS does include some spectrum-related information.

Table 10: Description of FCC Data Systems

System	Authorities covered		Services, frequencies, or equipment covered	Capabilities		
	Spectrum licenses	Radio equipment authorizations		File applications for licenses or authorizations	Search for information on licenses or authorizations	Map information for individual or groups of licenses
Universal Licensing System	✓		Wireless communications services, including cellular telephone, paging, personal communications services, and other commercial and private radio services	✓	✓	✓
Consolidated Database System	✓		Broadcast television and radio	✓	✓	✓
International Bureau Filing System	✓		Satellites and satellite earth stations	✓	✓	
Experimental Licensing System	✓		Experimental uses	✓	✓	
Equipment Authorization System		✓	Radio equipment in all spectrum bands	✓	✓	
Spectrum Dashboard	✓		Frequencies generally deemed appropriate for mobile broadband, including those allocated to wireless communications services, broadcast television, and satellite		✓	✓
License View	✓		All services covered by the Universal Licensing System, the Consolidated Database System, the International Bureau Filing System, the Experimental Licensing System, and FCC's cable licensing system		✓	

Source: GAO analysis of FCC information.

Stakeholders Expressed Mixed Views about Attributes of FCC's Data Systems

Availability of Information

Most users of FCC's spectrum-related data systems responding to our survey reported that the systems generally provide the type of information they are looking for to either a great or moderate extent (see table 11). In particular, for each of the seven systems, large majorities of survey respondents expressed a favorable opinion on the availability of information. However, respondents' opinions varied somewhat across the systems. For example, a large majority of respondents reported a positive evaluation of the Universal Licensing System; 54 of 58 respondents said that the Universal Licensing System provides the type of information they were looking for to a great or moderate extent. Spectrum Dashboard, a system that pulls data from FCC's spectrum licensing systems, had a somewhat lower level of support; 33 of 48 respondents reported that Spectrum Dashboard provides the type of information they were looking for to a great or moderate extent.

Table 11: Summary of Survey Responses of Extent to Which FCC Data System Provides Desired Type of Information

	Extent to which system provides desired types of information				
System	**Great**	**Moderate**	**Little**	**None**	**Total**
Universal Licensing System	31	23	2	2	**58**
Consolidated Database System	14	15	3	3	**35**
International Bureau Filing System	13	10	6	2	**31**
Experimental Licensing System	11	13	4	3	**31**
Equipment Authorization System	9	10	6	3	**28**
Spectrum Dashboard	16	17	11	4	**48**
License View	10	15	8	2	**35**

Source: GAO survey.

Note: The total number of responses for each system varied based on the number of respondents that chose to answer the question pertaining to the system.

Accuracy and Completeness of Information

According to some users of FCC's spectrum-related data systems that responded to our survey, inaccurate and missing data hindered their use of the systems to a great to moderate extent (see tables 12 and 13).[2] Respondents reported such problems most often with the Universal Licensing System. In particular, 19 of 54 respondents and 23 of 55 respondents reported that inaccurate information and missing information, respectively, in the Universal Licensing System hindered their use to a great or moderate extent. Dissatisfaction with inaccurate data rose to a similar level only for the Consolidated Database System; 10 of 29 respondents reported that inaccurate data in the Consolidated Database System hindered their use to a great or moderate extent. In addition to the Universal Licensing System, respondents reported the most difficulties arising from missing information with the Consolidated Database System and the International Bureau Filing System. In particular, almost one-third of respondents reported that missing data in the Consolidated Database System and the International Bureau Filing System hindered their use to a great or moderate extent.

Table 12: Summary of Survey Responses for Inaccurate Data

	Extent to which use is hindered by inaccurate data				
System	**Great**	**Moderate**	**Little**	**None**	**Total**
Universal Licensing System	10	9	14	21	**54**
Consolidated Database System	4	6	11	8	**29**
International Bureau Filing System	4	2	12	9	**27**
Experimental Licensing System	4	0	16	6	**26**
Equipment Authorization System	3	0	16	5	**24**

Source: GAO survey.

Note: The total number of responses for each system varied based on the number of respondents that chose to answer the question pertaining to the system.

[2]Since Spectrum Dashboard and License View pull data from other systems, such as the Universal Licensing System and the Consolidated Database System, we are not reporting survey results about inaccurate and missing data in these systems. FCC officials acknowledge that the quality of data in Spectrum Dashboard and License View is only as good as the quality of data in their underlying systems, including the Universal Licensing System and the Consolidated Database System.

Table 13: Summary of Survey Responses for Missing Data

	Extent to which use is hindered by missing data				
System	**Great**	**Moderate**	**Little**	**None**	**Total**
Universal Licensing System	12	11	18	14	**55**
Consolidated Database System	3	7	16	6	**32**
International Bureau Filing System	2	7	10	9	**28**
Experimental Licensing System	2	5	13	8	**28**
Equipment Authorization System	2	4	11	7	**24**

Source: GAO survey.

Note: The total number of responses for each system varied based on the number of respondents that chose to answer the question pertaining to the system.

User-Friendliness of Systems

For some users, FCC's primary spectrum-related data systems can prove challenging to use. In the National Broadband Plan, FCC noted that the complexity of its data on licensing of spectrum and the lack of transparency and usability of data created impediments to public policy and restricted the development of new technologies, such as dynamic spectrum access, that could utilize spectrum data. Several stakeholders told us that systems, such as the Universal Licensing System, are relatively user-friendly for "expert" users with technical knowledge and experience, but that the systems could pose challenges for other users. Consistent with this view, half or more of respondents reported that the International Bureau Filing System and the Experimental Licensing System were not too or not at all user-friendly, and about one-third of respondents reported similar views of the Universal Licensing System and the Consolidated Database System (see table 14).

Table 14: Summary of Survey Responses for User-Friendliness

	Level of user-friendliness				
System	**Very**	**Somewhat**	**Not too**	**Not at all**	**Total**
Universal Licensing System	7	27	13	9	**56**
Consolidated Database System	7	14	7	3	**31**
International Bureau Filing System	1	9	9	9	**28**
Experimental Licensing System	4	10	9	5	**28**
Equipment Authorization System	3	7	9	6	**25**
Spectrum Dashboard	16	19	2	5	**42**
License View	8	9	6	6	**29**

Source: GAO survey.

Note: The total number of responses for each system varied based on the number of respondents that chose to answer the question pertaining to the system.

To respond to these concerns; to help ensure greater transparency in spectrum allocation, assignment, and use; and to help promote secondary market transactions; FCC developed the Spectrum Dashboard and License View systems. As discussed earlier, these systems pull and compile data from the primary spectrum-related data systems, such as the Universal Licensing System and the Consolidated Database System, and are designed to present the information in a meaningful, easy-to-use format to the public. In designing these systems, FCC sought a means whereby its data could be leveraged by citizens for greater purposes, and both Commission staff and external parties are better positioned to identify data inaccuracies or inconsistencies. As shown in table 14, over four-fifths of respondents reported that Spectrum Dashboard was very or somewhat user-friendly, thereby meeting FCC's intent of the system while more than half of respondents reported that License View was very or somewhat user-friendly.

FCC Has Processes Aimed at Ensuring the Quality of Its Data; However, Past Audits Identified Some Problems

FCC has commissionwide programs, policies, and procedures for the collection and management of information, which help ensure FCC's compliance with governmentwide laws and regulations pertaining to information collection and management. For example, FCC's records management program is intended partly to control the quantity and quality of records produced by the Commission. In 2010, we reviewed and

reported on 30 information collection systems used by FCC, including those associated with the Experimental Licensing System and the Equipment Authorization System data systems.[3] We found that FCC followed relevant policies and procedures, including those pertaining to quality control. For this report, we examined the processes in place to ensure the quality of data in FCC's five spectrum license and authorization systems. We identified several quality-control features incorporated in the five systems, which we discuss below and illustrate in table 15.

Table 15: Summary of FCC's Data Quality Procedures for Spectrum-Related Data Systems

	Data quality control procedures				
System	**Edit checks: during online filing**	**Edit checks: during batch processing**	**FCC staff review**	**Notify filer of errors after review**	**Track e-mail and phone queries**
Universal Licensing System	Yes	Yes	Yes	Yes	Yes
Consolidated Database System	Yes	Yes	Yes	Yes	Yes
International Bureau Filing System	Yes	No	Yes	Yes	No
Experimental Licensing System	Yes	No	Yes	Yes	No
Equipment Authorization System	Yes	No	Yes	Yes	Yes

Source: GAO analysis of FCC data.

Note: Since Spectrum Dashboard and License View pull data from other systems, such as the Universal Licensing System and the Consolidated Database System, we did not review the processes in place for these systems.

- *Edit checks.* FCC's spectrum-related licensing and authorization systems each incorporate edit checks, which check for missing or anomalous data elements; these edit checks occur either online during the filing process or in batch mode. All five systems incorporate online edit checks, which check the accuracy of data entered by filers in real time and flag potential errors for users. FCC officials said that these online checks are helpful to filers and help ensure data accuracy. In addition, the Universal Licensing System, the Consolidated Database System, and the International Bureau Filing System incorporate edit checks in the nightly batch processing of data submitted by users. Among other things, the edit checks address

[3]GAO, *Telecommunications: Information Collection and Management at the Federal Communications Commission*, GAO-10-249 (Washington, D.C.: Jan. 29, 2010).

acceptable ranges of values, filings from parties with delinquent debts, and accuracy of geographic coordinates.

- *FCC staff review.* Before granting a spectrum license or equipment authorization, FCC checks all information provided by the applicant or licensee using automated or staff reviews. For example, FCC staff scrutinizes all spectrum license renewal applications that require exhibits demonstrating compliance with license requirements. FCC staff seeks correction or clarification of any inaccuracies detected in the information. According to FCC officials, these ongoing staff reviews of applications supplement the automated edit checks. In addition to its own reviews, FCC accepts reports of data discrepancies from members of the public.

- *Filer notification.* According to FCC officials, the Commission in part depends on the applicants for licenses to submit accurate data. FCC believes this is appropriate because entities filing applications are in the best position to know the relevant facts and are often experts and, therefore, the data these entities submit should be of high quality. Furthermore, FCC officials noted that when entities submit applications or renewals, they must certify and affirm the accuracy of the data. When FCC staff discovers errors, the Commission alerts the original filer and solicits correction.

- *Tracking systems.* FCC maintains a help desk, with access via telephone and e-mail. Applicants, licensees, and the general public may use these resources to obtain help with FCC's data systems. In addition, the Universal Licensing System, the Consolidated Database System, and the Equipment Authorization System incorporate systems that track e-mail and phone queries and thus help FCC to identify problems with the data systems.

While these quality-control features can help promote the quality of FCC's spectrum-related data, past Commission audits have uncovered some problems with the timeliness of FCC's data. FCC periodically reviews its systems and data and, from 2001 through 2005, FCC audited licensees in three spectrum bands. FCC conducted these audits because of concerns that some licensees for certain types of services included in the Universal Licensing System were not keeping FCC informed of their operating status. These audits were aimed at determining, for each license, whether the licensed service was operational, and canceling the licenses in cases where service had been discontinued. The audits resulted in the cancellation of the following licenses:

- 220 MHz licenses: 94 licenses cancelled out of 956 licenses audited (10 percent cancelled)
- Paging licenses: 2,076 licenses cancelled out of 7,770 licenses audited (27 percent cancelled)
- Private land mobile radio licenses: 37,448 licenses cancelled out of 420,112 licenses audited (9 percent cancelled)[4]

As these audit results illustrate, FCC's spectrum-related systems may not incorporate the timeliest information. FCC acknowledged that the extent to which its data match real world conditions depends upon the particular rules governing filers and the burden of filing upon industry. For example, since a broadcaster must renew its license once every 8 years, the data on file, as of the most recent renewal, may not remain accurate over time. Although FCC also requires that filers update information about significant events as needed, FCC has no practical way to ensure that filers comply with that requirement. FCC officials said that the Commission could take measures, such as requiring more frequent updates and certification of data in its databases, but such measures must be balanced with the burden placed upon industry. According to FCC officials, the Commission has focused on checking the accuracy of the data submitted to FCC at the time of submission, not on maintaining accuracy over time. But FCC now recognizes that there is a need to ensure that the data in its systems reflect conditions in the real world on an ongoing basis to determine where spectrum is available. Regarding the possibility of future audits, FCC officials said that the Commission does not currently have concerns that would warrant additional audits of license holders but, that if such concerns were to arise, it would consider conducting additional audits.

[4]The private land mobile radio service covers two-way land mobile communications by individuals, organized groups, businesses, and state and local government agencies.

FCC Has Several Efforts Under way with the Potential to Improve Its Spectrum-Related Data

Data Innovation Initiative

Recognizing the need to improve the Commission's information practices, in July 2009, the FCC Chairman initiated a review of FCC's systems and processes for information collection, processing, analysis, and dissemination, and this effort continued with the June 2010 launch of the Data Innovation Initiative.[5] According to FCC staff, the Commission has been working to improve its data collection, analysis, and dissemination practices in order to reduce the reporting burden on outside parties and ensure that the agency has timely, complete, and accurate data on which to base its activities and decisions. As part of this effort, FCC has sought to streamline the processes by which parties supply information, thereby minimizing work and potential errors. Furthermore, FCC is developing data quality analytics to measure its data quality. This effort will assess the accuracy of FCC's data from an input perspective (the quality of information submitted by filers) and from a system perspective (the maintenance of accurate information in FCC's databases, including the extent to which the data reflect conditions in the real world).

Chief Data Officers

Alongside the Data Innovation Initiative, FCC created a Chief Data Officer for the Commission and Chief Data Officers inside each Bureau and Office. The Commission's Chief Data Officer is responsible for improving how the Commission collects, uses, and disseminates data, among other things, and oversees the Data Innovation Initiative. The Wireless Telecommunication Bureau's Chief Data Officer reports directly to the Bureau Chief and, according to FCC officials, has been closely engaged in spectrum-related data analysis, including the identification of spectrum needs.

Consolidation of Databases

In 2009, FCC began an effort to consolidate its numerous, bureau-based, and separately managed licensing systems into a single system known as the Consolidated Licensing System (CLS). According to FCC staff, as currently envisioned, CLS would provide the public with a single portal for access to all FCC licensing systems and would have user-friendly

[5]See FCC, *FCC Launches Data Innovation Initiative*, press release (June 29, 2010), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-299269A1.pdf.

features. In addition, CLS would incorporate enhanced edit check capability, including for example, validation of geographic coordinates for antennas to ensure that the coordinates coincide with the locations of the antennas. FCC staff said that CLS would include information from its legacy databases, such as the Universal Licensing System, and that cost considerations may affect how much legacy information the new system includes; however, FCC believes that the information for the current filings and the previous filings should be sufficient to meet FCC's needs for spectrum management. Because of the complexity and size of this effort, FCC expects to deploy CLS in phases over a period of years.

Appendix III: Expert and Stakeholder Respondents' Views on FCC's Plans and Recent Actions to Meet Future Spectrum Needs

This appendix presents the views of experts and industry stakeholders on the spectrum-related recommendations in the National Broadband Plan and FCC's steps to implement those recommendations.[1] We surveyed 30 experts and 79 industry stakeholders, and 20 of the experts and 54 of the stakeholders responded to our survey, representing a 68 percent response rate (see app. I for additional information on our survey methodology). For each recommendation from the National Broadband Plan covered by our survey, we provide the following:

- the text of the recommendation;
- a summary of the rationale for the recommendation presented in the National Broadband Plan;
- data on experts' and stakeholders' level of agreement with the recommendation;
- excerpts from experts' and stakeholders' comments on the recommendation;[2]
- a description of FCC's progress on implementing the recommendation through May 2011;
- data on experts' and stakeholders' level of satisfaction with FCC's progress on implementing the recommendation through May 2011 (for those recommendations directed at FCC); and
- excerpts from experts' and stakeholders' comments on FCC's progress on implementing the recommendation.

[1]We excluded three recommendations that were addressed in our questions about FCC's data quality, fell under the purview of NTIA, or pertained to a narrow population.

[2]All excerpts of experts' and stakeholders' comments included in this appendix are verbatim reproductions of the comments provided in response to our survey, except for corrections of spelling and grammatical errors. Any other clarifications we made to comments are shown in brackets or in table notes. We selected comments in order to present a range of views, while aiming to minimize repetition of views within a category of stakeholders.

National Broadband Plan Recommendations Aimed at Making More Spectrum Available for Wireless Broadband Use by 2015

Make 300 MHz of Spectrum Available by 2015 and 500 MHz by 2020

Recommendation

FCC should make 500 MHz newly available for broadband use within the next 10 years, of which 300 MHz between 225 MHz and 3.7 GHz should be made newly available for mobile use within 5 years.

Rationale

FCC believes that additional spectrum should be made available to help meet anticipated increases in demand for wireless broadband services. The targets were based on an FCC staff forecast of spectrum demand.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	10	0	4	15	5	**34**
Somewhat agree	6	0	2	2	0	**10**
Neither agree nor disagree	0	2	1	1	2	**6**
Somewhat disagree	1	1	1	1	1	**5**
Strongly disagree	2	7	1	2	0	**12**
Total	**19**	**10**	**9**	**21**	**8**	**67**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Expert (strongly agree)	I believe that this approach will align with market demands.
Expert (somewhat agree)	I strongly agree with the direction of change (more licensed spectrum), and the amounts are not trivial - but 'still more' is the correct answer.
Expert (somewhat disagree)	If the need for data is increasing by 25x (only the next five years, I would expect it to continue to increase if the report of the increase is accurate) then how is a 2x improvement in spectrum going to fix the problem. Cellular works because of spectral reuse, not because of spectrum.
Expert (strongly disagree)	(1) This is an unrealistic objective for many reasons including the fact that there are no mechanisms in place that have even a remote chance of success. (2) This is a dangerous objective since its promise will result in a false sense of complacency that will keep the FCC and NTIA from stimulating the REAL solution to the broadband spectrum problem - stimulation of technologies that can multiply spectrum capacity rather than just add increments and (3) even if the objective succeeds, the problem will not be solved.
Expert (strongly disagree)	This…plays into the pocket books of the big incumbents. Broadband is not in the desert southwest or Appalachia because it is not now and never will be financially workable. …Instead, the FCC should require incumbent reporting of fallow spectrum so the FCC can identify chunks of [spectrum] to be licensed to small enterprises whose primary business is not telecommunications (such as trucking companies, agriculture, tourism) so that they can use programmable wireless devices to bring broadband to niche markets in a way that promotes entrepreneurism in those markets, such as the desert southwest and Appalachia.
Broadcaster (strongly disagree)	Need for more spectrum is a result of wireless provider's OWN CHOICE on not reducing cell size; cheaper to buy more spectrum.
Broadcaster (strongly disagree)	The FCC has not provided a sufficient justification for its spectrum reallocation goals, and the amount of spectrum sought is an arbitrary number. Such demand-based projections should be technology agnostic, identifying the most efficient spectrum allocations to satisfy the marketplace. The efficiency of broadcasting's 'one-to-many' approach is an important factor in managing the so-called 'spectrum crisis.'

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (strongly disagree)	This plan does not adequately take into account that (1) over 2/3 of the spectrum currently held for mobile broadband has not yet been deployed, (2) femto/pico cell and wifi offloading can have a substantial role, (3) that 66% of mobile broadband traffic will be video, and MDTV broadcasting should be used to deliver that high-volume data. The approach of simply shifting spectrum in this manner only serves to consolidate more spectrum in the hands of fewer gatekeepers, rather than creating more bandwidth for users by understanding the usage patterns and applying the proper technology/spectrum combination. Spectrum is not a panacea and this approach will ultimately create a recurring scenario of "spectrum crisis" every few years with the inevitable calls for more spectrum.
Wireless device manufacturer (strongly agree)	It is well-documented that mobile broadband use is increasing dramatically and will outstrip the supply of available bandwidth in the near future.
Wireless service provider (strongly agree)	Additional spectrum that is made available for auction must come with an assurance of device interoperability across each band of spectrum auctioned. Without this assurance via license requirement or other mechanism, future spectrum will be subject to the same sort of balkanization into proprietary bandclasses by carriers large enough to influence or control the specifications of devices or network equipment, as has been the case in the 700 MHz spectrum.
Wireless service provider (somewhat disagree)	Although additional spectrum is needed, this [recommendation] appears biased towards mobile broadband while underestimating the spectrum needed for fixed wireless broadband [by] up to 48 million citizens with no broadband option [in their] homes today…
Wireless service provider (strongly disagree)	This spectrum will be hoarded by the large carriers and further squeeze the small rural carriers out of the market. This will further eliminate competition in the wireless industry.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

Our survey asked respondents how satisfied they were overall with FCC's progress on this recommendation, which had five subrecommendations. However, rather than providing an overall description of FCC's progress, our survey referred respondents to the descriptions of FCC's progress contained within the survey's questions on the subrecommendations. Those descriptions are shown in this appendix under the other recommendations in this section of the appendix.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

Level of satisfaction	Experts	Stakeholders				Total
		Broadcasters	Wireless device manufacturers	Wireless service providers	Others	
Very satisfied	1	-	0	1	0	**2**
Somewhat satisfied	6	-	2	5	1	**14**
Neither satisfied nor dissatisfied	2	-	2	4	2	**10**
Somewhat dissatisfied	4	-	2	3	0	**9**
Strongly dissatisfied	2	-	0	3	1	**6**
Total	**15**	**-**	**6**	**16**	**4**	**41**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question. Since no broadcasters strongly agreed or somewhat agreed with the recommendation, no figures are shown for broadcasters.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	Comment excerpts
Expert (somewhat satisfied)	[FCC] should have auctioned [the] D block already, but [FCC] is working hard on MSS.
Expert (neither satisfied nor dissatisfied)	The Congress is in the leadership role on the auctions [that are needed to implement several of the components of this recommendation].
Expert (somewhat dissatisfied)	… progress in this area is very difficult and complex. FCC has been under extreme resource challenges. Would like process to move faster, but recognize that this may not be reasonable. …
Expert (strongly dissatisfied)	… FCC is falling well behind other international markets in its efforts to avail spectrum resources for the US to attain a leadership position in mobile and fixed broadband.
Infrastructure provider (somewhat satisfied)	… FCC is working well with NTIA to free up other spectrum for traditional auction.
Wireless device manufacturer (somewhat satisfied)	The Commission established an aggressive timetable for implementation, not anticipating the political environment and Congressional limbo on incentive auction authority.
Wireless service provider (somewhat satisfied)	[FCC will not meet its 5-year target] if steps are not taken soon to accelerate the reallocation of suitable federal spectrum for commercial provider use, to repurpose significant amounts of TV broadcast and MSS spectrum for terrestrial broadband use under incentive auctions, and to auction the 700 MHz D Block or otherwise provide for public/private commercial mobile uses of excess capacity on [this] spectrum.

Type of commenter (level of satisfaction)	Comment excerpts
Wireless service provider (somewhat satisfied)	The FCC has issued an item seeking comment on NTIA-identified bands—a good initial step.

Source: GAO survey.

Reallocate Portion of Television Spectrum (120 MHz)

Recommendation

FCC should initiate a rulemaking proceeding to reallocate 120 MHz from the broadcast television bands.

Rationale

FCC believes that spectrum currently allocated for over-the-air television broadcasting would have much higher economic value if it were allocated for wireless broadband.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	Experts	Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Strongly agree	12	0	4	15	3	**34**
Somewhat agree	2	0	3	0	2	**7**
Neither agree nor disagree	1	0	0	2	2	**5**
Somewhat disagree	2	0	1	0	0	**3**
Strongly disagree	1	11	1	3	1	**17**
Total	**18**	**11**	**9**	**20**	**8**	**66**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Expert (strongly agree)	Perhaps the single most important step the government can take to improve US wireless broadband is to let the FCC auction off broadcast TV spectrum. It is beyond argument that broadcasters do not need everything they have and that the national interest—jobs, public discourse, economic growth, improved health care service—is with expanding wireless broadband.
Expert (strongly agree)	TV has been the blatant abuser of spectrum so this is righting a wrong.
Expert (strongly agree)	[FCC] should also have considered reallocation with leasing rights.
Expert (somewhat agree)	Reallocating the TV band spectrum toward more market-based approach is important.
Expert (strongly disagree)	The FCC could solve this problem immediately by: (1) de-zoning broadcast spectrum and allowing other uses and expanding secondary markets; (2) reorganizing remaining broadcast licensees in each market into more compact bands and reclaiming broadcast spectrum that is not licensed.
Broadcaster (strongly disagree)	More US citizens use and rely on the broadcast spectrum than any other spectrum category being considered. Broadcasters are also deploying MDTV with this spectrum. This deployment will play a significant role in mobile broadband content delivery and should be encouraged to flourish as it is the most efficient way of distributing video, which Cisco says will account for 66% of all mobile traffic in 2015.
Broadcaster (strongly disagree)	The solution to moving underutilized broadcast spectrum to mobile carriers is to lift the FCC rules that prevent broadcasters from selling or leasing such spectrum to mobile carriers in a private market transaction. Applying the FCC's secondary markets policy to broadcast spectrum would enable the parties to clear the spectrum where needed, on a voluntary basis, without government involvement. If a checkerboard of spectrum is freed up (that is, non-adjacent channels), the FCC could streamline its channel-change and channel-swap procedures for the new mobile licensees just like the FCC did about 10 years ago to clear the 700 MHz band of broadcasters. By the way, it is not entirely clear that mobile operators really need two adjacent 6 MHz channels. Qualcom has a new chip that uses just one 6 MHz channel for two-way mobile data, and Sprint has argued that adjacent channels are not necessary for 4G systems.
Broadcaster (strongly disagree)	The proposal to reallocate 120 MHz of spectrum from the TV band is likely to have a significant impact on the public's access to free over the air television. Any reallocation must be based on fair data and after a full evaluation of spectrum use and public need.

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (strongly disagree)	The digital transition has just been completed. Disruption of the spectrum based on speculative need is inappropriate. As is the FCC concluding that broadcast spectrum is "less valuable" based on a wireless per pop analysis. Broadcast spectrum serves a different function and should not be valued using the same metrics as another service. …
Broadcaster (strongly disagree)	This recommendation should not be implemented absent compelling data, and absent a full and complete spectrum inventory that also analyzes current utilization. Action, if at all, should be predicated on demonstrated need rather than on bare assertions of a "looming spectrum crisis," and after full investigation of whether less disruptive alternatives to reallocation of broadcast spectrum could address demonstrated needs. This proposal, if implemented, will impose real and substantial costs on broadcasters and will have a significant negative impact on the public's access to free over-the-air television.
Wireless device manufacturer (strongly disagree)	The incumbents say they need this right away when they don't use 50-90% of what they already control at all, let alone efficiently. The FCC approved white space and then decided to do incentive auction. This is crazy policy. Make the carriers show how much they use and how efficiently before you do anything.
Wireless service provider (strongly disagree)	Allocating 120 MHz to mobile broadband completely eviscerates the needs of fixed wireless broadband. At least 42 MHz of unlicensed TV band spectrum must be preserved to allow fixed wireless broadband providers to provide broadband for citizens who have NO AVAILABLE TERRESTRIAL BROADBAND options today.
Public interest group (strongly disagree)	This process will directly undermine dynamic spectrum access technologies (e.g., television white space devices), killing one of the most innovative new spectrum utilization ideas we've seen in a generation. Instead, the FCC will continue using much the same remarkably inefficient system of spectrum licensure that has lead to current artificial scarcities and inefficiencies. Bribing license holders to vacate from bands is a horrible idea.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

- In June 2010 FCC issued a technical paper providing more detail than the National Broadband Plan on how reallocating a portion of the television bands might work. It presented an analysis of bandwidth requirements of various video streams, data to support the assertion that two television stations could voluntarily share a single six-MHz channel and continue to broadcast their primary video streams in high

definition, and an initial look at the television allotment optimization model being developed by the FCC.[3]

- In June 2010, FCC held a "Broadcast Engineering Forum" with broadcast industry engineers and technical experts in related fields regarding future rulemakings on reallocating spectrum from the broadcast television bands, including rule-makings regarding service areas, distance separations, and channel-sharing.
- In November 2010, FCC issued a Notice of Proposed Rulemaking (NPRM) to establish a regulatory framework to facilitate wireless broadband uses of the UHF and VHF television bands, while maintaining current license assignments in the band.[4]
- In March and April 2011, FCC held a series of web-based seminars with state broadcasting associations to describe how FCC thinks an incentive auction might work and give broadcasters a chance to ask questions.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	3	-	3	2	1	**9**
Somewhat satisfied	5	-	1	7	2	**15**
Neither satisfied nor dissatisfied	2	-	1	4	1	**8**
Somewhat dissatisfied	2	-	2	1	1	**6**
Strongly dissatisfied	2	-	0	0	0	**2**
Total	**14**	**-**	**7**	**14**	**5**	**40**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question. Since no broadcasters strongly agreed or somewhat agreed with the recommendation, no figures are shown for broadcasters.

[3]FCC, *Spectrum Analysis: Options for Broadcast Spectrum*, Omnibus Broadband Initiative Technical Paper No. 3 (June 2010).

[4]*Innovation in the Broadcast Television Bands: Allocations, Channel Sharing, and Improvements to VHF*, Notice of Proposed Rulemaking, 25 FCC Rcd 16498 (2010).

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	Comment excerpts
Expert (very satisfied)	Good example of how to do it right.
Expert (strongly dissatisfied)	My dissatisfaction is with Congress, not the FCC. This should move faster and the broadcasters should stop trying to derail this process.
Expert (strongly dissatisfied)	Congress is the big problem here.
Wireless device manufacturer (very satisfied)	We believe that the FCC is doing everything in its power to move along the 120 MHz reallocation, but believe that FCC progress will only continue if Congress lets the FCC do its job.
Wireless device manufacturer (very satisfied)	… it is very important that the Congress empowers the FCC with the ability to implement voluntary incentive auctions, as this is the mechanism that will provide the opportunity to ensure this valuable spectrum is put to its most highly valued uses.
Wireless device manufacturer (somewhat dissatisfied)	Unfortunately the need for incentive auction authority lays at the hands of congress.
Wireless service provider (somewhat satisfied)	The prospect of the FCC holding auctions to license as much as 120 MHz of repurposed TV Broadcast spectrum in the 2012-2013 timeframe as originally proposed in the FCC's NBP is increasingly problematic. Legislation authorizing incentive auction authority has been proposed but passage is uncertain. In addition, numerous requirements have been proposed to be included in such legislation which, if adopted, would substantially reduce the amount of repurposed spectrum available for auction.

Source: GAO survey.

Accelerate Terrestrial Deployment in Mobile Satellite Services Spectrum (90 MHz)

Recommendation

FCC should accelerate terrestrial deployment in 90 MHz of Mobile Satellite Services spectrum.

Rationale

To address what FCC now believes are overly-burdensome requirements that it set for Mobile Satellite Services operators before they could deploy terrestrial networks to enhance coverage in areas where their satellite signal is weakened or unavailable, the plan recommends accelerating terrestrial deployment by providing sufficient flexibility to licensees to increase terrestrial broadband use of Mobile Satellite Services spectrum,

while preserving market-wide capability to provide unique mission-critical Mobile Satellite Services.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	9	0	5	8	4	**26**
Somewhat agree	3	1	1	4	0	**9**
Neither agree nor disagree	2	6	2	4	1	**15**
Somewhat disagree	1	2	0	2	1	**6**
Strongly disagree	1	0	0	1	1	**3**
Total	**16**	**9**	**8**	**19**	**7**	**59**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Expert (strongly agree)	FCC is doing everything it can to move MSS spectrum into terrestrial wireless market. [The provisional waiver that FCC granted to] LightSquared is unexpectedly complicated due to GPS interference, but FCC definitely seems to be on the right track with the 40 MHz of S Band spectrum.
Expert (strongly agree)	Having spectrum set aside for satellite use is potentially a very inefficient use of spectrum and unlocking the value of that spectrum could be very beneficial.
Expert (somewhat disagree)	The business case and public interest is not clear; [FCC] should identify and develop more alternatives.
Broadcaster (somewhat disagree)	Making terrestrial allocations in this band has increased interference to uses adjacent to that band (e.g., ENG facilities in 2Ghz band); interference criteria should be strengthened and strictly adhered to.
Wireless device manufacturer (strongly agree)	[The best approach would be to u]se … incentive auctions in this band to allow deployment of terrestrial mobile broadband systems.
Wireless service provider (strongly agree)	[We strongly agree with this recommendation s]o long as no harmful interference occurs to wireless carriers and public safety from LightSquared operations.
Wireless service provider (strongly agree)	Good spectrum, cleared and ready to use. But FCC can do little as this spectrum is trapped in bankruptcy proceedings. It will be very difficult for FCC to change the rules for ultimate new licensees after they pay value in bankruptcy.

Type of commenter (level of agreement)	Comment excerpts
Wireless service provider (somewhat disagree)	Interference concerns regarding locating a terrestrial band next to a space-based band were well-founded. Testing has already proved substantial interference will occur with GPS systems. Other MSS spectrum may not share these same problems (i.e. not near GPS L1), but the FCC needs to move cautiously.
Public interest group (strongly agree)	There are certainly complexities with this approach, but it is worthwhile - this is valuable, useful spectrum.
Mobile Satellite Services company (neither agree nor disagree)	[Our level of agreement with the recommendation] would be very different depending on whether the recommendation was interpreted to mean accelerate removal of MSS players to allow for terrestrial deployment, or simply accelerate ongoing progress to manage both satellite and terrestrial deployment in the bands.
Private user group (somewhat disagree)	Terrestrial deployment in MSS bands raises significant technical issues that require careful study and should not be rushed.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

- In July 2010, FCC issued an NPRM to add co-primary Fixed and Mobile allocations to the 2 gigahertz (GHz) band, consistent with the International Table of Allocations. This allocation modification is a precondition for more flexible licensing of terrestrial services within the band. FCC also proposed to apply its secondary market policies and rules applicable to terrestrial services to all transactions involving the use of Mobile Satellite Services bands for terrestrial services in order to create greater predictability and regulatory parity with bands licensed for terrestrial mobile broadband service.
- In July 2010, FCC requested comment in a notice of inquiry on further steps it could take to increase the value, utilization, innovation, and investment in Mobile Satellite Services spectrum generally.
- In January 2011, FCC granted a waiver to LightSquared allowing it to expand its terrestrial use of its satellite spectrum, conditional on, among other things, addressing concerns regarding interference with Global Positioning System devices to FCC's satisfaction.
- In April 2011, FCC issued a Report and Order adopting the proposals in its July 2010 NPRM.

- In May 2011, FCC solicited input on approaches to maximize terrestrial mobile broadband use of 2 GHz range spectrum that is allocated for fixed and mobile use.[5]

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	3	-	2	2	2	**9**
Somewhat satisfied	4	-	2	6	1	**13**
Neither satisfied nor dissatisfied	2	-	0	1	0	**3**
Somewhat dissatisfied	3	-	2	2	0	**7**
Strongly dissatisfied	0	-	0	1	1	**2**
Total	**12**	**-**	**6**	**12**	**4**	**34**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question. Since no broadcasters strongly agreed or somewhat agreed with the recommendation, no figures are shown for broadcasters.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Expert (somewhat dissatisfied)	I have some concerns regarding interference with existing spectrum used for other systems such as GPS.
Infrastructure provider (very satisfied)	The LightSquared GPS interference issues aside, this is an important block of spectrum that would be better utilized for terrestrial networks, provided the interference issue with GPS can be managed.

Source: GAO survey.

[5]FCC issued this solicitation on May 20, 2011, after we finalized the questionnaire for our survey.

Auction Advanced Wireless Services Spectrum (60 MHz)

Recommendation

FCC should make up to 60 megahertz available by auctioning Advanced Wireless Services (AWS) bands, including, if possible, 20 megahertz from federal allocations.

Rationale

The plan noted that FCC has already allocated spectrum for AWS, and called for FCC to expeditiously resolve the future of this spectrum.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broad-casters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	12	2	8	11	3	**36**
Somewhat agree	4	2	1	3	3	**13**
Neither agree nor disagree	1	4	1	2	1	**9**
Somewhat disagree	0	1	0	1	0	**2**
Strongly disagree	1	0	0	3	0	**4**
Total	**18**	**9**	**10**	**20**	**7**	**64**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Expert (strongly agree)	Congress should learn from the unexpectedly slow AWS transition from government to commercial use and just compensate government agencies for transition costs to accelerate the repurposing.
Expert (strongly disagree)	These changes will cost $B in DoD and DHS which is not resourced to address the changes.
Wireless device manufacturer (strongly agree)	To the greatest extent possible, the allocations also should be globally harmonized to promote economies of scale, which will drive benefits to network operators and ultimately consumers in the form of lower priced equipment and devices.
Wireless device manufacturer (somewhat agree)	H block will create interference concerns to existing PCS band. J block downlink should be aggregated with AWS-3 and paired with Federal spectrum bands 1755-1780 MHz to expand the existing AWS-1 band.

Type of commenter (level of agreement)	Comment excerpts
Wireless service provider (strongly agree)	Had FCC moved quickly on this—or on D Block auction—T-Mobile would not have agreed to be acquired by AT&T because it would have better spectrum opportunities. So … there is a direct line between [this] FCC failure to act quickly … and likely creation of a wireless/wireless duopoly that cannot easily be undone.
Wireless service provider (strongly agree)	NTIA should reallocate 25 MHz of spectrum (1755-1780 MHz) to pair with AWS-3 and Upper AWS-2 J Block.
Wireless service provider (strongly agree)	We support the pairing of 25 MHz of Federal spectrum including 1755-1780 MHz with 2155-2180 MHz (combining the AWS-3 band with upper J Block spectrum). We also support the reallocation of additional Federal spectrum, 1695-1710 MHz, to be paired with unspecified Federal or possibly non-Federal spectrum.
Wireless service provider (somewhat disagree)	Until rules are in place that facilitate efficient and complete use of currently licensed spectrum (e.g., device interoperability requirements across all blocks of paired spectrum in each band), there is not an urgent need for more to be auctioned. Moreover, without the assurance of such things as device interoperability, small operators and new entrants are unlikely to participate in future auctions—reducing the number of bidders and, therefore, reducing auction revenues.
Wireless service provider (strongly disagree)	Interoperability needs to be resolved first on current spectrum. The device ecosystem is of paramount importance to carrier buildouts and lack of interoperability has many carriers on hold. We need to effectively use current spectrum first. This also needs to be part of any and all future auctions or it will limit interest to only the Tier 1 carriers.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

- In July 2010, FCC requested comment in a Notice of Inquiry on whether the opportunity to integrate the AWS-2 J Block and 2 GHz of Mobile Satellite Spectrum would help attract new investment and utilization.
- FCC consulted with NTIA on the 10-year "Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband" and the "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" (also referred to as the "Fast Track Evaluation"), both of which NTIA issued in November 2010.
- FCC officials told us that the Commission intends to take further steps to implement this recommendation, in consultation with NTIA as

appropriate, after NTIA completes its assessment of the suitability of the 1755-1850 MHz band for repurposing.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	1	0	1	0	0	**2**
Somewhat satisfied	8	0	3	4	2	**17**
Neither satisfied nor dissatisfied	4	1	2	2	2	**11**
Somewhat dissatisfied	2	1	3	4	0	**10**
Strongly dissatisfied	0	1	0	2	1	**4**
Total	**15**	**3**	**9**	**12**	**5**	**44**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Expert (very satisfied)	1755 to 1850 MHz is critically important to the commercial wireless sector. Steps should be taken as soon as possible to begin moving in that direction.
Expert (somewhat satisfied)	AWS-3 pairing in the hands of executive branch. Makes sense to hold off on AWS-2.
Infrastructure provider (somewhat satisfied)	Kudos to the FCC for pressing ahead. NTIA has known for a while how important this spectrum is, and clearly wanted to avoid having to move federal users, some of whom would be moved for the second time. Without legislative improvements in federal relocation process, moving users is difficult.
Mobile Satellite Services company (neither satisfied nor dissatisfied)	Significant interference issues and [emissions] into adjacent bands must be considered to effectively integrate the AWS-2 J block with the 2GHz MSS band.
Public interest group (strongly dissatisfied)	Nothing meaningful has been implemented.
Wireless device manufacturer (neither satisfied nor dissatisfied)	The holdup is NTIA to allow pairing of [the] 1755-1780 [MHz band] with FCC's AWS-3 band.
Wireless device manufacturer (somewhat dissatisfied)	NTIA manages spectrum the same way they did 20 years ago. … [T]hey protect the status quo.

Type of commenter (level of satisfaction)	Comment excerpts
Wireless service provider (somewhat satisfied)	Good progress at discussion level but execution and timing will be critical.
Wireless service provider (somewhat dissatisfied)	Need quicker review and reallocation of the 1755-1850 MHz band.
Wireless service provider (strongly dissatisfied)	Progress has not been rapid enough to meet the near-term needs of regional and local commercial providers for additional mobile broadband spectrum.

Source: GAO survey.

Make Wireless Communications Services Spectrum Available (20 MHz)

Recommendation

FCC should make 20 megahertz available for mobile broadband use in the 2.3 GHz Wireless Communications Service band, while protecting neighboring federal, nonfederal Aeronautical Mobile Telemetry and satellite radio operations.

Rationale

Since FCC first auctioned Wireless Communications Service spectrum in 1997, a number of new and robust wireless telecommunications technologies have been successfully introduced. Such technologies, coupled with the exploding demand for broadband services, suggest that the Wireless Communications Service spectrum may provide fertile ground for the provision of high-value mobile broadband services to the public. In order to realize this potential FCC needs to revise outdated rules intended to protect against interference from use of the spectrum.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	11	0	4	4	2	**21**
Somewhat agree	5	1	2	4	2	**14**
Neither agree nor disagree	1	8	2	8	2	**21**
Somewhat disagree	1	0	1	2	1	**5**
Strongly disagree	0	0	1	1	0	**2**
Total	**18**	**9**	**10**	**19**	**7**	**63**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Expert (somewhat agree)	[The recommendation] should have been 25-30 Megahertz … rather than just 20 megahertz.
Expert (somewhat disagree)	The 2.3GHz band offers a lot of potential for mass market services. … the mass market will provide more than enough economic incentive to reallocate incumbent systems.
Wireless device manufacturer (strongly disagree)	Aligning this band with global allocation for mobile [broadband] was the right thing to do. However, the imposed duty-cycles on the technologies to operate in this band negatively impact the business case because the rules do not allow the right ratio of downlink to uplink when using [time division duplexing]. Also there are issues with the stringent [out-of-band emissions] and power limits.
Wireless device manufacturer (somewhat disagree)	This spectrum should be made available for mobile broadband, and while neighbors should be protected the FCC should not go further than absolutely necessary or else risk diminishing the value of this 20 megahertz.
Wireless service provider (strongly agree)	At least 25 Megahertz should be made available for mobile broadband under technology-neutral rules, and neighboring services should be protected to appropriate (but not excessive) levels.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

In May 2010, FCC adopted rules that will make available 25 MHz of spectrum for mobile broadband service in much of the United States, while protecting adjacent satellite radio and aeronautical mobile telemetry operations.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	2	0	0	1	1	**4**
Somewhat satisfied	6	1	3	2	1	**13**
Neither satisfied nor dissatisfied	3	0	1	0	0	**4**
Somewhat dissatisfied	2	0	1	5	1	**9**
Strongly dissatisfied	2	0	0	0	1	**3**
Total	**15**	**1**	**5**	**8**	**4**	**33**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Expert (neither satisfied nor dissatisfied)	Processes to accomplish this take a long time and nothing has been done to change that. … the amount of spectrum is infinitesimal in the context of the demand.
Expert (somewhat dissatisfied)	Too slow.
Expert (strongly dissatisfied)	Spectrum is not available for broadband use because FCC has not completed rules or addressed licensing issues.
Mobile Satellite Services company (somewhat dissatisfied)	Absence of consensus by WCS and [satellite digital audio radio] licensees negates the effectiveness of FCC decision on technical rules.
Public interest group (strongly dissatisfied)	The FCC has still not implemented anything meaningful.
Wireless device manufacturer (neither satisfied nor dissatisfied)	Too early to determine whether rules will result in effective deployment of mobile broadband in this spectrum.
Wireless service provider (somewhat dissatisfied)	Petitions for reconsideration filed in this proceeding raise questions about whether the band can actually be used to provide mobile broadband service.

Type of commenter (level of satisfaction)	Comment excerpts
Wireless service provider (somewhat dissatisfied)	The FCC could have been more aggressive by placing more of the burden on SDARS.
Wireless service provider (somewhat dissatisfied)	While FCC's May 2010 decision was a useful first step, petitions for reconsideration filed by WCS interests illustrate material flaws in technical rules and performance requirements that jeopardize the prospects for the band actually being used for the offering of broadband services to the public.

Source: GAO survey.

Auction the Upper 700 MHz D Block (10 MHz)

Recommendation

FCC should auction the 10 MHz Upper 700 MHz D Block for commercial use that is technically compatible with public safety broadband services.

Rationale

To realize the high potential value that FCC believes the 10 MHz Upper 700 MHz D Block has for commercial broadband while supporting the simultaneous development of public safety broadband capability through equipment development, roaming, and priority access.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	Experts	Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Strongly agree	13	2	5	6	0	**26**
Somewhat agree	3	1	1	4	1	**10**
Neither agree nor disagree	1	5	2	2	2	**12**
Somewhat disagree	1	1	0	2	1	**5**
Strongly disagree	0	0	1	6	1	**8**
Total	**18**	**9**	**9**	**20**	**5**	**61**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (somewhat disagree)	The past has proven that auctioning the spectrum for public/private use is not workable. If the FCC intends to pursue this type of mixed use it needs to adopt rules to incentivize not discourage bidding and such mixed use.
Expert (strongly agree)	Long overdue is the approach to make a commercial system that can serve emergency needs but that is viable in normal times. The FCC should set a low auction minimum for this service since it is more risky for the commercial operator but the public safety requirement is crucial.
Expert (somewhat disagree)	Congress has not adequately addressed public safety for the past 10 years. FCC is trying to solve on its own, and it does not have either the authority or the resources adequately to do so.
Expert (strongly agree)	The original premise of the D-Block for the 2008 auction was sound. The lack of definition in the interaction with public safety entities created uncertainty and thus made the auction not viable. Define the rules and interactions explicitly and this can work.
Expert (somewhat agree)	This 10 Megahertz and the public safety aspect are well informed and have the potential to support the public interest. Watch out for the "Motorola-ization" of this band where hardware providers manipulate the 3,000 local government entities into spending way too much on hardware. This stuff should be available at BestBuy, not from Motorola, Johnson, or whoever. That will happen if the usage is liberalized and low power (femtocell class) devices are allowed (e.g., per police car and fire truck) as well as by homeowners. First responders should have a code that allows them to use the bandwidth, basically unnoticed by home owners, of the Internet access points when there is a police, fire, or rescue operation within radio distance of the home. This could be done securely.
Infrastructure provider (neither agree nor disagree)	The FCC doesn't control this—Congress does and Congress needs to decide what to do: whether to combine with public safety spectrum.
Public interest group (strongly disagree)	A single-use national public safety network will simply not work. It is impossible to build a network to the level of robustness required for anything less than a half-trillion dollars. Thus, this entire endeavor is destined for failure and should be ceased before we spend additional public funding for something that will simply not work. We should concentrate instead on building mixed-use communications infrastructure with a public safety priority during declared emergencies.
Wireless device manufacturer (strongly disagree)	Give this to public safety at local county level and let them put it to use in their own way and their cost and structure.

Type of commenter (level of agreement)	Comment excerpts
Wireless service provider (somewhat agree)	While we believe that the presence of additional commercial competitors in the 700MHz spectrum would help to break the stranglehold AT&T and Verizon currently have over device and equipment development in that spectrum, an auction of the D-block without an assurance of interoperability would do little to benefit the public interest. Device interoperability is necessary to bring the benefits of scale to the 700 MHz market: reducing the costs of consumer and public safety devices, as well as enabling roaming across networks by both consumers and public safety.
Wireless service provider (strongly agree)	The right thing to do, but a lost cause. Reallocation to public safety is more likely at this point. Our concerns assuming reallocation then go to interoperability and fair commercial opportunity to be part of partnerships and solutions — rather than see the D Block go by default to partnerships with the Twin Bells.
Wireless service provider (strongly disagree)	Public safety needs 20 MHz to deploy an efficient LTE network.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

- In May 2010, FCC issued the results of its analysis indicating that a stand-alone public safety network would be substantially more expensive than a network constructed under an incentive-based partnership approach, under which public safety network operators would partner with commercial operators or systems integrators to construct and operate the network using the 10 MHz of dedicated spectrum currently allocated to public safety.

- In June 2010, FCC issued a paper concluding that the 10 MHz of dedicated spectrum currently allocated to public safety will provide the capacity and performance necessary for day-to-day communications and serious emergency situations; that dedicating the 10 MHz Upper 700 MHz D Block for public safety, or even 30 MHz, may not be sufficient to support public safety broadband communications in a major emergency; and that instead public safety should be given priority access and roaming capability across the commercial broadband wireless spectrum. FCC said that such access will make at least 50 or 60 MHz of additional spectrum immediately available.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

Level of satisfaction	Experts	Stakeholders				
		Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Very satisfied	2	0	0	1	0	**3**
Somewhat satisfied	2	0	2	1	0	**5**
Neither satisfied nor dissatisfied	5	2	0	1	1	**9**
Somewhat dissatisfied	4	0	1	2	0	**7**
Strongly dissatisfied	3	1	1	4	0	**9**
Total	**16**	**3**	**6**	**9**	**1**	**33**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	Comment excerpts
Expert (somewhat dissatisfied)	The FCC is concluding that the peak use of public safety operations may be many orders of magnitude greater than normal use. This conclusion indicates that allocations should be commensurate with normal use and policy should address access for peak use.
Expert (strongly dissatisfied)	This approach is excellent but practical implementation will take much planning, negotiation, and governmental vision. little of this has yet to be done.
Broadcaster (neither satisfied nor dissatisfied)	A stand-alone public safety network will be much more expensive initially and over the life of the system. It will also be prone to technical deficiencies as technology evolves. A priority access approach makes much more sense.
Wireless device manufacturer (somewhat satisfied)	The debate in Congress on whether the spectrum should be auction or reallocated has create[d] uncertainty in the FCC to take action on this band.
Wireless service provider (strongly dissatisfied)	FCC was correct; but 5.8.2 is dead. FCC missed opportunity to start rulemaking proceedings a year ago for D Block auction. FCC has been marginalized and is no longer a player on this issue. So 5.8.2 is no longer relevant.
Wireless service provider (strongly dissatisfied)	The FCC has completely failed to follow its own National Broadband Plan and federal statute to commercially auction this vital block of spectrum.

Source: GAO survey.

National Broadband Plan Recommendations Aimed at Expanding Incentives and Mechanisms to Reallocate Spectrum

Grant FCC Authority to Conduct Incentive Auctions

Recommendation

Congress should consider expressly expanding FCC's authority to enable it to conduct incentive auctions in which incumbent licensees may relinquish rights in spectrum assignments to other parties or to FCC.

Rationale

To motivate existing spectrum licensees to voluntarily give up their licenses so that FCC could more quickly reallocate the spectrum to higher valued services.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	15	0	7	13	4	**39**
Somewhat agree	3	1	0	4	2	**10**
Neither agree nor disagree	0	5	1	0	1	**7**
Somewhat disagree	0	0	0	0	1	**1**
Strongly disagree	1	5	1	4	1	**12**
Total	**19**	**11**	**9**	**21**	**9**	**69**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Expert (strongly agree)	Incentive auctions will give the FCC the ability to repurpose spectrum from inefficient service-specific allocations to more flexibile allocations in an efficient manner.
Expert (strongly agree)	Congress should simply grant the FCC the ability to pay some of the revenues to broadcasters instead of the Treasury and avoid legislating any details of the auction.
Expert (strongly disagree)	Receipts from government auctions should go to the government. The FCC is not an consignment auction house auctioning the assets of third parties like Christies or Southebys.
Broadcaster (neither agree nor disagree)	VOLUNTARY auctions may be acceptable so long as resulting repacking costs of remaining users are guaranteed.
Broadcaster (neither agree nor disagree)	If Congress authorizes incentive auctions, it should make clear that the Commission must not take any actions in its implementation that could harm existing licensees (e.g., involuntary repacking into VHF band, loss of coverage areas and/or increased interference).
Broadcaster (strongly disagree)	The FCC should allow licensees to sell or lease to mobile operators directly and immediately.
Infrastructure provider (strongly agree)	A voluntary incentive auction is a market-based mechanism that will allow spectrum to be transitioned from one use to a new use, and should take years off the current process.
Public interest group (strongly disagree)	… Incentive auctions will dramatically increase spectrum hoarding and make further band clearing far more difficult.
Wireless device manufacturer (strongly disagree)	(FCC) should force and recover spectrum from those who have not used what they have before going after spectrum used by broadcasters and recent (television) white spaces rulings. (This would) actually (take) away from new innovative spectrum use.
Wireless service provider (strongly agree)	The primary reason spectrum identification and reallocation takes so long is political pressure from incumbents. Incentive auctions would reduce this pressure and allow the government to move more quickly.
Wireless service provider (somewhat agree)	OK to have as another tool in the spectrum management toolbox, but very uncertain how effective it will be in bringing commerically valuable amounts of spectrum to market to support wireless broadband.

Source: GAO survey.

Grant FCC Authority to Impose Fees on Licensees

Recommendation

Congress should consider granting authority to the FCC to impose spectrum fees on license holders.[6]

Rationale

Fees may help to free spectrum for new uses with potentially higher value than current uses, since licensees who use spectrum inefficiently may reduce their holdings once they bear the opportunity cost of spectrum.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	12	0	1	2	3	**18**
Somewhat agree	3	0	3	4	1	**11**
Neither agree nor disagree	1	0	2	1	3	**7**
Somewhat disagree	3	2	0	4	2	**11**
Strongly disagree	1	11	3	9	0	**24**
Total	**20**	**13**	**9**	**20**	**9**	**71**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Expert (strongly agree)	The value of spectrum is far greater, in most cases, than is recovered in auctions. Spectrum fees can be based on the appreciating value of spectrum.
Expert (strongly agree)	Spectrum fees are a critical market-based mechanism used in the UK to ensure that government spectrum is used efficient[ly] or repurposed for commercial use. US should do the same.

[6]This recommendation also said that Congress should consider granting authority to NTIA to impose spectrum fees on users of government spectrum, but we did not include that part of the recommendation is our survey because our focus was on FCC.

Type of commenter (level of agreement)	Comment excerpts
Expert (strongly agree)	Without the ability to impact the bottom line, the FCC is less effective than otherwise. However if the incumbents write the legislation as is the current practice, it will come out that the FCC will have the power to fine the little guys and the big guys will have many loopholes and time wasters. If, however, the FCC were to work with the NTIA, DOD, and DHS regarding criteria for imposing fees so that the FCC could shape the behavior of the huge incumbents in a meaningful way without accidentally or unfairly penalizing the smaller entrepreneurs, then the public interest would be served.
Expert (strongly agree)	It is ridiculous to give some spectrum away and charge for others. It is equally ridiculous to have a one time payment that provides rights into perpetuity.
Expert (somewhat agree)	Only if the FCC cannot grant flexible rights whereby the licensees realizes the opportunity cost of the spectrum it uses … or the licensee is in a shared band, then fees are one tool to provide more accurate price signals about the cost of using the spectrum.
Expert (strongly disagree)	Spectrum fees on private parties do not create incentives for efficiency. At best (worst?) a fee that makes a particular license unprofitable will result in the license going back to the government — that does not create value, but reduces output. The way to create value is to allow competitive forces wider scope, permitting the licensee to deploy any service, technology, or business model that may be profitable.
Broadcaster (strongly disagree)	Payment is already made in the context of required public interest responsibilities of broadcasters.
Broadcaster (strongly disagree)	Broadcasters already pay for their spectrum in the form of public interest obligations that exceed those for any other privately-held spectrum. Congress should recognize the public value of these obligations and the cost to broadcasters of complying with them.
Broadcaster (strongly disagree)	Broadcasters already pay enormous "regulatory fees" and absorb regulatory costs not imposed on others.
Broadcaster (strongly disagree)	The FCC already collects annual regulatory fees. Moreover, there is no elaboration of how such fees would be assessed or for what purpose such collected fees would be used. Further any use of spectrum fees to encourage licensees to give up their spectrum for other purposes disserves the public interest.
Broadcaster (somewhat disagree)	We disagree in terms of applying fees to spectrum holders that are actively using their spectrum for the intended purpose. These fees should *only* be applied to license holders that are squatting or allowing their spectrum to sit unused.
Public interest group (strongly agree)	Yearly spectrum fees will increase spectrum utilization and incent license holders who do not use their bands to return them. Furthermore, over time, yearly license fees raise far more money for the public treasury than one-off auctions and are thus a superior and more fiscally responsible choice.

Type of commenter (level of agreement)	Comment excerpts
Mobile Satellite Services company (strongly agree)	Spectrum fees are preferable to auctions or any other regulatory method for ensuring that spectrum is used reasonably efficiently. There never would have been auctions if the broadcast industry was not unalterably opposed to spectrum fees in the 1980s.
Satellite radio service provider (somewhat agree)	Spectrum fees should be tied to how a licensee acquired its spectrum. Licensees that paid fair market price through an auction should pay less in usage fees than those licensees in bands that initially acquired licenses through means other than auctions.
Infrastructure provider (neither agree nor disagree)	No clear economic evidence that fees leads to more efficiency. So if the goals is improved spectrum policy, this would fail to support the goal.
Wireless device manufacturer (somewhat agree)	However, such fees should not be imposed on licensees that obtained their spectrum license through competitive bidding mechanisms.
Wireless service provider (strongly agree)	This assumes these fees are for either non-auctioned spectrum and/or spectrum that is not licensed for flexible use.
Wireless service provider (somewhat disagree)	If already paid for spectrum in an auction, then no. Ultimately increases prices to consumers.

Source: GAO survey.

Address Barriers to Secondary Markets

Recommendation

FCC should evaluate the effectiveness of its secondary markets policies and rules to promote access to unused and underutilized spectrum.

Rationale

FCC believes that the performance of secondary markets under the Commission's current policies has been mixed and is concerned that unused or underutilized spectrum is possibly not be being made available to smaller providers, especially in rural areas where spectrum goes unused.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	15	5	6	10	3	**39**
Somewhat agree	3	4	3	5	5	**20**
Neither agree nor disagree	1	2	0	1	1	**5**
Somewhat disagree	0	0	0	3	0	**3**
Strongly disagree	1	0	1	1	0	**3**
Total	**20**	**11**	**10**	**20**	**9**	**70**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Broadcaster (strongly agree)	The FCC should update and revise its secondary markets policy to include all spectrum to allow all current licensees to participate in a secondary market so long as their primary spectrum uses remain intact. This will allow market forces to determine the best use for spectrum without requiring wholesale reallocation of designated bands for other purposes.
Expert (strongly agree)	A reasonable suggestion that obviates the need for incentive auctions.
Expert (strongly agree)	FCC has been doing a good job, but should consider a legislation to form a private public interest company or FFRDC to create the secondary spectrum databases and to assist and support spectrum use. The German Fraunhofer model requires 1/3 industry funding, and that is a good model for responsiveness to industry (vs. the US FFRDC model which has little such incentives)
Expert (strongly disagree)	Secondary markets, as conceived by regulators, involve the sale of 'naked licenses.' In fact, those markets are robust — over 50,000 CMRS licenses have been aggregated into a small number of national and regional cellular networks — all through secondary transactions. But the far more active trading of spectrum rights is done not by buying/selling stand-alone spectrum, but "wireless services." The bundle — spectrum + mobile network access — is sold in wholesale and retail markets. That is the efficient way to package the product, and (because the buyers and sellers internalize transaction costs) that is the way the market organizes the use of spectrum. Trying to get owners of liberally licensed spectrum to sell their "excess" in a naked bandwidth trade is like trying to induce homeowners to rent out spare bedrooms. Yes, homes are not at fully occupied, and many rooms are rented out. But by and large, families prefer not to do so, forgoing the opportunity available. Wireless carriers often "sell" access, as to retail customers, MVNOs, or other networks

Type of commenter (level of agreement)	Comment excerpts
	(roaming agreements), and they frequently buy/sell licenses. But once they construct a network to use particular airwaves, they find it inefficient to split off spectrum rights and lease them to other networks. This reflects efficiency; the premise of the "do more for secondary markets" policy is that such markets are failing. But they are not; they work in a matter that is often misunderstood.
Infrastructure provider (somewhat agree)	The FCC's policies here are good, and are being used, but further evaluation is helpful.
Public interest group (neither agree nor disagree)	[FCC] needs to avoid creating transaction costs that undermine the utility of secondary markets.
Mobile Satellite Services company (strongly agree)	All secondary market tools - spectrum leasing, partitioning, disaggregating, etc, should be available to all licensed wireless services, including satellite.
Wireless device manufacturer (strongly agree)	… I … suggest mandatory spectrum leasing of spectrum that has not been built out for 5 years. Cognitive Radio could put this to use and return it to incumbents if they ever decide to build out. …
Wireless device manufacturer (strongly agree)	FCC should … expand the applicability of secondary markets policies to all spectrum-based services and bands. While it has proposed this for certain mobile satellite bands, FCC (and NTIA) should also apply the same leasing policies and procedures (including the notion of "private commons") to the broadcasting, other satellite and Federal bands. It should also lift restrictions on shared channels in the private land mobile radio … bands below 512 MHz in connection with the 10-channel limitation and leasing restrictions.
Wireless service provider (somewhat agree)	It is not secondary markets policies that are the problem. They work well with carriers that want to make spectrum available. Problem is warehousing by carriers attempting to keep spectrum from competitors. Not a secondary markets problem, but an FCC enforcement problem.
Wireless service provider (somewhat agree)	While in general there are mechanisms that facilitate secondary market transactions, the FCC should create greater incentives for license holders that are not using their spectrum to sell/lease it to entities that will.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

FCC officials told us that the Commission conducted an internal review of its secondary markets policies that concluded that it should do more to promote secondary markets. Toward that end, in November 2010, FCC issued a Notice of Inquiry on dynamic spectrum access technologies that have the potential to enable sharing of spectrum in common locations, including how such technologies could facilitate secondary markets. In January 2011 FCC officials told us that the Commission was assessing

the input it received in response to that inquiry, and that it intended to issue a related order, tentatively by the end of calendar year 2011.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	2	0	1	0	0	**3**
Somewhat satisfied	5	0	3	3	2	**13**
Neither satisfied nor dissatisfied	3	5	2	4	6	**20**
Somewhat dissatisfied	5	0	1	7	0	**13**
Strongly dissatisfied	0	3	1	1	0	**5**
Total	**15**	**8**	**8**	**15**	**8**	**54**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Expert (somewhat satisfied)	This efforts needs a definition of what DSA must meet as potential for interference. Without a definition of "harmful", it will be hard to deploy any DSA.
Expert (neither satisfied nor dissatisfied)	No evidence that dynamic spectrum access technologies would promote secondary markets. On the other hand, removing any barriers that arbitrarily block dynamic access technologies would be good even if it had no effect on secondary markets.
Expert (somewhat dissatisfied)	FCC's slowness in Docket 04-186 shows its ambivalence in this area. This is a very technical area and FCC as presently structured doesn't deal well with such issues.
Broadcaster (strongly dissatisfied)	[FCC's] analysis must include broadcast spectrum to be credible and effective.
Infrastructure provider (neither satisfied nor dissatisfied)	Dynamic spectrum access is [in its] very early days and will probably not be important for years.
Wireless service provider (neither satisfied nor dissatisfied)	FCC policies on dynamic sharing may do more harm than good. More testing regarding the potential for interference and the economic case is necessary before making any decisions.
Wireless service provider (somewhat dissatisfied)	Dynamic spectrum access is a small subset of secondary markets. The FCC can promote secondary markets by reducing barriers to these transactions and speeding up the approval process for license transfers and leases and by increasing flexible use for licensed spectrum allocations.
Wireless service	• Revitalize management agreements — The FCC should

Type of commenter (level of satisfaction)	Comment excerpts
provider (somewhat dissatisfied)	clarify whether "management agreements" or other non-leasing arrangements are still permitted and, if so, whether the former Intermountain Microwave factors are still applicable or whether other guidelines would apply. If not permitted, then the FCC could consider permitting a lower cost means for licensees to facilitate build-out with third party managers or partners, possibly with notice to the FCC about the relationship. • Establish an FCC "warehouse" of unused spectrum — The FCC can aggregate its unsold or returned PCS, AWS, 700 MHz and other spectrum licenses it still holds and enable parties to petition to serve these areas using procedures similar to the existing Section 22.949 process for unserved cellular areas (with short-term build-out requirements). Or, parties could "lease" this spectrum from the FCC under this approach, paying annual lease fees to the government. • Facilitate streamlined leasing arrangements through FCC-certified brokers — The FCC could incentivize carriers to contribute unused spectrum, especially in rural and underserved areas, to the FCC's spectrum warehouse or to third party "brokers" that would be certified by the FCC to maintain an inventory of spectrum available for lease under pre-approved short-form agreements at low cost to all parties involved (with streamlined FCC rules). (The FCC could also get some of the lease revenue from this approach.) • Adopt leasing incentives — Incentives to contribute spectrum to a certified broker or to lease directly to a third party could include avoidance of non-use fees or use-it-or-lose-it rules, or bidding credit eligibility or limited exemptions from the FCC's spectrum screen for carriers that contribute spectrum to the FCC or to a certified broker for possible lease. • Develop new tools and agency agreements — The FCC could adopt a new "hybrid agency agreement" or service agreement approach, similar to a resale agreement, as a new secondary market tool. • Develop an FCC spectrum buy-back program — The FCC could use auction proceeds or lease revenues (see above) to "buy back" spectrum in unserved or underserved areas and then recoup some of the cost of this program by selling or leasing this spectrum to rural carriers interested in serving these areas. • Develop a spectrum "homesteading" or finder's preference program — The FCC could establish a small rural mobile development office where parties interested in serving unserved or underserved areas could go to determine what unused spectrum may be available in these markets from the FCC or from licensees, and the FCC staff could facilitate leasing arrangements through discussions with the existing licensees. Enabling entities to build-out and

Type of commenter (level of satisfaction)	Comment excerpts
	establish "squatter's rights" (with a later right to a partitioned/disaggregated license where they are serving customers) on unused spectrum in limited identified areas, and only if the licensee has not agreed to contribute the spectrum for leasing,might incentivize greater leasing. • Streamline current spectrum leasing rules — The FCC could eliminate unnecessary spectrum manager lease filings (arguably no filings should be necessary for short-term spectrum manager leases, and only a notification filing for long-term spectrum manager leases when they begin and end); eliminate lease renewal filings; act on all long-term de facto transfer leases within 21 or 15 days, etc.
Wireless service provider (strongly dissatisfied)	It should not take one year to assess the input obtained from the Dynamic Spectrum Access NPRM.

Source: GAO survey.

National Broadband Plan Recommendations Aimed at Expanding Opportunities for Innovative Spectrum Access Models

Provide Spectrum for Unlicensed Use

Recommendation

FCC, within the next 10 years, should free up a new, contiguous nationwide band for unlicensed use.

Rationale

To enable innovators to try new ideas to increase spectrum access and efficiency through unlicensed means and to enable new unlicensed providers to serve rural and unserved communities.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	8	1	4	2	3	**18**
Somewhat agree	0	2	2	5	2	**11**
Neither agree nor disagree	3	3	1	2	1	**10**
Somewhat disagree	2	3	0	6	1	**12**
Strongly disagree	3	1	2	4	0	**10**
Total	**16**	**10**	**9**	**19**	**7**	**61**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Expert (strongly agree)	No amount of licensed spectrum will ever satisfy the future demand for rich wireless media, so the FCC needs to ensure that wireless carriers and others have access to enough [un]licensed spectrum for many more wi-fi access points to move wireless traffic onto the wired network at the earliest opportunity in the transmission session.
Expert (strongly agree)	essential to promoting competition and innovation in wireless services
Expert (neither agree nor disagree)	… the success of unlicensed systems depends on global coordination and therefore allocations in the US alone will not achieve the necessary dividends.
Expert (somewhat disagree)	There is an opportunity cost to making unlicensed spectrum available and it may not be the most efficient use of spectrum — there should be a price tag put on this so that people realize the oppotunity cast and potential inefficiency of allocating more spectrum for unlicensed use.
Expert (strongly disagree)	Contiguity no longer is needed because of the emergence of affordable devices where, say a 2 GHz device can operate effectively and affordably between 1.3 and 2.3 GHz (and similarly in other bands). Unlicensed chunks in different parts of the spectrum can be effectively hybridized via heterogeneous spectrum management, promoting market entry of new small to medium product suppliers. FCC should assist the market in using [an] on-line database like for [television white spaces] so that unlicensed devices can learn about available spectrum and use it dynamically versus clearing a new band for unlicensed use. A 60 MHz band around 1 GHz in bandwidth for indoor use would be a significant contribution to the development of unlicensed markets.

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (somewhat disagree)	Strict interference protection standards will be crucial in any such initiative.
Infrastructure provider (strongly agree)	Where spectrum is sorely needed is to support Wi Fi technologies at 5 GHz. An increased footprint of "shared" spectrum is required to meet future needs and support next generation Wi Fi technologies.
Mobile Satellite Services company (somewhat disagree)	There is already plenty of spectrum available for unlicensed use. This is a low priority.
Wireless device manufacturer (somewhat agree)	There is substantial amount of unlicensed spectrum that has been recently allotted which remains vacant. After this spectrum has systems, more spectrum may need to be made available.
Wireless service provider (strongly agree)	… an appropriate amount of unlicensed spectrum should be made available that is dedicated exclusively to unlicensed outdoor fixed wireless broadband delivery and NOT shared with consumer-type (i.e., Wi-Fi) devices.
Wireless service provider (somewhat disagree)	Spectrum is not an unlimited resource. Priority should be given to reallocation of available spectrum subject to auction under exclusive licensing.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

FCC intends to consider making additional spectrum available for unlicensed use in conjunction with NTIA's "Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband," which addresses both licensed and unlicensed uses.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	Experts	Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Very satisfied	2	0	1	1	0	**4**
Somewhat satisfied	3	0	2	2	3	**10**
Neither satisfied nor dissatisfied	2	0	1	1	0	**4**
Somewhat dissatisfied	1	0	1	3	1	**6**
Strongly dissatisfied	0	2	1	0	1	**4**
Total	**8**	**2**	**6**	**7**	**5**	**28**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	Comment excerpts
Expert (somewhat dissatisfied)	Too slow.
Infrastructure provider (somewhat dissatisfied)	The FCC's focus has been white spaces, which provides 6 MHz channels and will never be a global footprint (other countries have different channelization for TV). The FCC has not proposed, for example, opening up more spectrum at 5 GHz for shared use.
Public interest group (strongly dissatisfied)	There has been no meaningful progress on this recommendation. Currently, unlicensed is an afterthought in both planning the by FCC and the Obama administration …. Given the success of unlicensed in dramatically increasing the public's access to the public airwaves, it should be the priority; spectrum auctions to corporations rich enough to buy exclusive use to the public airwaves should be secondary.
Wireless service provider (somewhat dissatisfied)	We believe that creating a new nationwide unlicensed band will result in very substantial economic benefits for the nation as a whole. For this reason, we support rapid action FCC to create this band. 10 years is too long to wait. We would like to see this band created within the next 2 to 3 years.

Source: GAO survey.

Issue Rules on Television White Spaces

Recommendation

FCC should move expeditiously to conclude the television white spaces proceeding.

Rationale

To accelerate the introduction of new innovative products and services that would use the television white spaces.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	Experts	Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Strongly agree	8	0	5	6	4	**23**
Somewhat agree	3	1	2	5	0	**11**
Neither agree nor disagree	2	4	1	3	3	**13**
Somewhat disagree	2	3	1	2	0	**8**
Strongly disagree	3	4	1	2	0	**10**
Total	**18**	**12**	**10**	**18**	**7**	**65**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Expert (somewhat agree)	The database aspect is inviting abuses, many unintentional. When people measure spectrum use, patterns appear, some of which compromise law enforcement, privacy, etc. Thus, the [database] should not be public but should be administered by a public trust corporation with security clearances that will redact information that compromises the public interest such as law enforcement, personal privacy, etc.
Expert (strongly disagree)	TV white spaces proceeding moves in the wrong direction; more efficient to reorganize spectrum in each market and auction off unlicensed spectrum rather than white spaces.
Expert (strongly disagree)	The conclusion of the white spaces could impact other spectrum decisions, including the incentive auctions and repacking and it can be very hard to undo unlicensed uses.
Broadcaster (neither agree nor disagree)	The FCC must have adequate rules for the database administrators to ensure accuracy and avoid unnecessary interference.
Broadcaster (somewhat disagree)	The FCC should move only as expeditiously as it can based on sound engineering and spectrum principles. The FCC must ensure its rules for white space use fully protect incumbent users and do not cause interference to viewers.
Wireless service provider (somewhat disagree)	The FCC needs to ensure that actions it takes do not create potential future issues with additional TV spectrum identified for reallocation to mobile broadband use.
Wireless service provider (strongly disagree)	… Too much interference risk. … [FCC] should allow this good propagation spectrum to be used for broadband backhaul.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

- In September 2010, FCC issued an opinion and order that: (1) eliminates the requirement that television bands devices that incorporate geo-location and database access must also include sensing technology to detect the signals of television stations and low-power auxiliary service stations (wireless microphones); (2) requires wireless microphone users who seek to register in the television bands databases to certify that they will use all available channels from 7 through 51 prior to requesting registration; and (3) reserves two vacant UHF channels for wireless microphones and other low power auxiliary service devices in all areas of the country while maintaining a reasonable separation distance between television white space devices and wireless microphone usage.

- In January 2011, FCC conditionally designated nine companies to develop and administer the databases that new unlicensed wireless devices would use to identify available channels.

- FCC conducted three workshops with the database administrators, one each in March, April, and May 2011. The workshops covered development, security, and testing of the databases. FCC plans to hold additional workshops towards final approval of the database administrators.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	2	0	2	0	0	**4**
Somewhat satisfied	5	1	3	2	2	**13**
Neither satisfied nor dissatisfied	2	0	0	6	1	**9**
Somewhat dissatisfied	0	0	2	3	0	**5**
Strongly dissatisfied	2	0	0	0	1	**3**
Total	**11**	**1**	**7**	**11**	**4**	**34**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Public interest group (somewhat satisfied)	The process has taken longer than it could have, I believe.
Public interest group (strongly dissatisfied)	The FCC's current plan is to kill off the utility of TV white space technologies … [b]y auctioning off these bands to the highest bidder [via incentive auctions].
Wireless device manufacturer (very satisfied)	This is perhaps the only segment in wireless we are actually leading the world. More resource should be applied to this endeavor to make improvements. Next Gen Wi Fi....
Wireless device manufacturer (somewhat satisfied)	The removal of the sensing requirement is somewhat troubling because it was deemed essential in the sharing of spectrum. As the FCC continues to support sharing in other bands, it is troubling, that the FCC may define sharing based on technology that is unsuitable or unavailable commercially.

Source: GAO survey.

Spur Opportunistic Uses of Spectrum

Recommendation

FCC should spur further development and deployment of opportunistic uses across more radio spectrum.

Rationale

To significantly increase the efficiency of spectrum utilization by enabling radios to access and share available spectrum dynamically.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	11	2	5	4	2	**24**
Somewhat agree	3	3	2	6	3	**17**
Neither agree nor disagree	2	3	2	4	0	**11**
Somewhat disagree	1	1	0	3	2	**7**
Strongly disagree	2	1	1	3	0	**7**
Total	**19**	**10**	**10**	**20**	**7**	**66**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Broadcaster (strongly disagree)	The FCC must protect the integrity of existing services while encouraging innovation. The FCC should free incumbent licensees from technical restrictions that hinder such innovation.
Expert (strongly agree)	But opportunistic uses should be prioritzed based upon intelligent technical analysis, i.e., a spectrum technology road map.
Expert (strongly disagree)	This is precisely the sort of thing that regulators should not do. They should focus on something distinct: creating rules that yield optimal incentives for competitive processes to create efficient solutions.
Expert (strongly disagree)	I do not believe that mass market technology and the demands of the commercial marketplace will allow for these techniques within the next decade
Expert (somewhat disagree)	[In implementing this recommendation], FCC should adopt policies that facilitate agreements among private parties.

Type of commenter (level of agreement)	Comment excerpts
Mobile Satellite Services company (somewhat disagree)	If the FCC does this, there will be more interference complaints. The FCC has to commit to devote resources to investigating and resolving interference complaints quickly.
Wireless device manufacturer (somewhat agree)	Cognitive radio is promising; however generally speaking the technology needs further development before appropriate for many bands; in any event, should be commercially driven not as a regulatory mandate.
Wireless device manufacturer (strongly agree)	It is great that the … NBP recognized that "[o]pportunistic sharing arrangements offer great potential to meet increasing market demand for wireless services by promoting more efficient use of radio spectrum." [This recommendation] is absolutely correct in stating that "'opportunistic'" or 'cognitive' technologies can significantly increase the efficiency of spectrum utilization by enabling radios to access and share available spectrum dynamically." However, this recommendation over-emphasized the unproven and inefficient database approach to advanced sharing and disregarded spectrum sensing (detect-and-avoid) and hybrid sensing/geolocation approaches. The FCC's preference for geolocation approaches is apparently based on its lack of information regarding spectrum sensing, its decision in the TV White Spaces proceeding to eliminate the sensing requirement and recent enforcement issues (unrelated to sensing capabilities) in the 5 GHz U-UNII band in which sensing is required to share with radar operations. Hopefully, the record developed in the FCC's DSA NOI proceeding (ET Docket No. 10-237) and NTIA's spectrum sharing test bed should provide additional information on sensing.
Wireless service provider (somewhat agree)	We support … dynamic spectrum access … shared and secondary market access to spectrum capacity but would strongly oppose FCC adoption of rules or policies which diminish the rights of the licensees of exclusive spectrum purchased at auction to control and/or to exclude access to their spectrum.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

In November 2010, FCC issued a Notice of Inquiry seeking comment on how dynamic spectrum access radios and techniques can promote more intensive and efficient use of the radio spectrum.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

Level of satisfaction	Experts	Stakeholders				
		Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Very satisfied	1	0	1	0	1	**3**
Somewhat satisfied	5	1	2	1	1	**10**
Neither satisfied nor dissatisfied	3	4	2	7	1	**17**
Somewhat dissatisfied	1	0	1	0	1	**3**
Strongly dissatisfied	2	0	1	1	1	**5**
Total	**12**	**5**	**7**	**9**	**5**	**38**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	Comment excerpts
Private user group (somewhat satisfied)	This direction holds some promise as long as the inherent limitations of dynamic spectrum access techniques are taken into account and are not relied upon inappropriately.
Wireless device manufacturer (strongly dissatisfied)	DSA has a place in providing communications solutions however there is a concern that the FCC is unaware of the state of technology and how it operates to provide solutions. So mandating solutions may delay the usage of the bands considered for DSA.
Wireless service provider (strongly dissatisfied)	Additional study is needed as dynamic spectrum access radios technologies have not been proven yet.

Source: GAO survey.

Enhance Research and Development on Spectrum Access

Recommendation

FCC should initiate proceedings to enhance research and development that will advance the science of spectrum access.

Rationale

A robust research and development pipeline is essential to ensuring that spectrum access technologies continue to evolve and improve.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

Level of agreement	Experts	Stakeholders				
		Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Strongly agree	11	2	7	5	4	**29**
Somewhat agree	5	4	2	7	1	**19**
Neither agree nor disagree	0	3	0	3	1	**7**
Somewhat disagree	0	1	0	2	1	**4**
Strongly disagree	2	1	1	2	1	**7**
Total	**18**	**11**	**10**	**19**	**8**	**66**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (somewhat agree)	While it is good to stimulate research and development, the FCC should not assume that government should direct the effort.
Expert (strongly disagree)	There is no need for government efforts to "enhance" R&D in this area. Substantial efforts already in place.
Expert (somewhat agree)	Not clear what role there is that isn't already met by private sector; eliminating barriers would be good.
Mobile Satellite Services company (strongly disagree)	Spectrum shortages have provided enough incentive for licensees to spend their funds on research and development of ways to use spectrum more intensively. The government does not have to be involved in this. It will only stifle development.
Wireless service provider (somewhat disagree)	If guidelines were in place that assured a competitive marketplace among wireless carriers of various sizes and new entrants, then competitive carriers and new entrants would accomplish this innovation in the marketplace. Such grant-funded innovation becomes necessary when there is a lack of competition within the market.
Wireless service provider (strongly agree)	The FCC should leverage work that is currently being done both in private industry … or by academic institutions ….

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

In November 2010, FCC issued an NPRM that seeks to expand the Commission's existing Experimental Radio Service rules to promote cutting-edge research and foster development of new wireless technologies, devices, and applications. Specifically, FCC proposed a new type of license, called a "program license," which would give qualified

entities broad authority to conduct research without the need to seek new approval for each individual experiment.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	2	0	2	1	1	**6**
Somewhat satisfied	8	1	2	4	1	**16**
Neither satisfied nor dissatisfied	3	3	3	3	0	**12**
Somewhat dissatisfied	1	0	1	2	1	**5**
Strongly dissatisfied	1	0	0	0	1	**2**
Total	**15**	**4**	**8**	**10**	**4**	**41**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Expert (strongly dissatisfied)	This NPRM is mostly PR. In reality big firms … already have the equivalent of a "program license."
Private user group (somewhat dissatisfied)	The existing Experimental Radio Service rules do not bar progress but should be strengthened to ensure that licensees are aware of experimental operations that may cause harmful interference to them.
Wireless device manufacturer (neither satisfied nor dissatisfied)	A lot of questions remain, including the scope of eligible entities — the private sector should not be excluded.
Wireless service provider (somewhat dissatisfied)	The FCC proposed to exclude non-public entities under blanket licenses. For the type of experimental license available to commercial entities, it was stated the licenses are not intended for commercial campuses. No explanation for either of these arbitrary exclusions were provided in the NPRM. Further, the FCC proposes to shift the burden of discovering potential interference to the existing licensee, which will discourage experimental use.

Source: GAO survey.

National Broadband Plan Recommendations Aimed at Enhancing FCC's Spectrum Policymaking

Measure Spectrum Utilization

Recommendation

FCC and NTIA should create methods for ongoing measurement of spectrum utilization.

Rationale

To provide policymakers and the public with important information on how, where, and when spectrum is being used.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	13	10	7	10	3	**43**
Somewhat agree	3	1	2	5	4	**15**
Neither agree nor disagree	1	0	0	2	0	**3**
Somewhat disagree	1	0	1	3	0	**5**
Strongly disagree	2	1	0	1	2	**6**
Total	**20**	**12**	**10**	**21**	**9**	**72**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (strongly agree)	This should be an objective measurement, not subjective based upon content in the use.
Broadcaster (somewhat agree)	The FCC and NTIA should complete a comprehensive inventory of how spectrum is currently allocated, who is using it, and how it is being used before proceeding with any steps related to spectrum reallocation.
Broadcaster (strongly disagree)	Measurement is not an effective means of finding unused spectrum.
Broadcaster (strongly agree)	Without identified and peer reviewed methods there is no certainty that any measurement of spectrum utilization measurement will be accurate or will provide the information the agency needs to evaluate how spectrum is currently being used.
Expert (strongly agree)	Use does not necessarily equate to active transmissions.
Expert (strongly agree)	Spectrum utilization has been on on-going and contentious issue. Without specific information the arguments become very subjective. Understanding how this resource is being used would provide significant insights PRIOR to making new policy decisions. It appears that many policy decisions are not based upon the technical facts but more on subjective analysis.
Expert (strongly agree)	The data is measured by licensees to manage their own bands, so FCC could require reporting vs "measuring" per se or to complement and validate measurements.
Expert (neither agree nor disagree)	It's a good idea in principle, but it's not clear how to meaningfully define "spectrum utilization."
Expert (strongly agree)	Target towards bands with likely usage issues; not cellular, broadcast.
Infrastructure provider (strongly disagree)	If by "spectrum utilization" the meaning is to measure how RF emissions are being used to transport information, the recommendation would yield an outcome that is meaningless from a policy perspective. "Use" of the spectrum depends on the service, and if commercial, whether the licensee has placed the spectrum into service. There might be a few bands where this type of analysis is helpful, but this should not be the way forward for spectrum policy. Rather, the way forward is to understand the technologies under development, their spectrum requirements and capabilities, likely use cases/demand, and expectations for innovation (how will the technology change over time). This is knowable from standards bodies and the vendor community.
Private user group (somewhat agree)	Meaningful spectrum utilization measurement is very difficult. Examples: How does one measure the spectrum utilization of passive radioastronomy? There may not be many transmissions on a distress and calling frequency, but this does not mean it can be made available for other uses in between. Typical spectrum monitoring will not detect utilization by services that habitually use low signal levels such as the amateur radio service.

Type of commenter (level of agreement)	Comment excerpts
Public interest group (strongly agree)	NTIA and FCC spectrum utilization records should include allocation information, assignment information, and actual use measurements from the field and at a level of granularity allowing informed decisions at the local (census block) level.
Satellite radio service provider (somewhat agree)	Spectrum utilization is rarely a binary question of whether spectrum is or is not being "used" by having transmissions in the spectrum. For example, in order for spectrum to be "utilized," it should be used in a meaningful way to serve the public or the intended government/business use; this is far different from just testing whether signal is being transmitted to preserve the license, as can be the case with wireless spectrum. In the public safety context, spectrum can be used if it is unused but available for use during the next public emergency. In the context of broadcast spectrum, the question of whether spectrum is being used might even consider whether the station is being operated in a manner that serves the public interest.
Mobile Satellite Services company (strongly disagree)	… This is impossible without drastically increasing the number of government employees and the number of regulated company employees who would have to monitor and report. This cannot be done in any reasonably efficient manner. There would never be agreement on what to measure and how.
Wireless device manufacturer (somewhat disagree)	Usage is only one consideration; the main consideration is the ROI.
Wireless service provider (somewhat agree)	The key is to measure in spectrum bands where there are no market incentives to efficiently use spectrum, e.g., government and restricted use bands.
Wireless service provider (somewhat agree)	Very complex subject; spectrum use varies by time of day, weather, events, etc. Such results can be misused so measuring methods needs to be carefully developed and results properly calibrated and interpreted.
Wireless service provider (somewhat disagree)	It depends what is meant by "utilization" data. If it means only transmissions using spectrum, it would be relatively useless. Such data would only be relevant if it included data regarding the economic value of the spectrum use at issue, the amount of time that has passed since the relevant rules were put in place, the applicable of secondary markets rules, and potential alternative uses.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

In the National Broadband Plan, FCC presented its estimate that it would cost approximately $10 million to $15 million to deploy measurement equipment nationally. FCC also stated in the plan that one way these measurements could be accomplished is by frequency scanners installed on a fleet of vehicles. FCC officials told us that the Commission will not implement this recommendation unless it receives adequate funding.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	2	0	0	1	0	**3**
Somewhat satisfied	2	0	2	1	0	**5**
Neither satisfied nor dissatisfied	4	5	2	6	0	**17**
Somewhat dissatisfied	6	2	3	2	2	**15**
Strongly dissatisfied	1	2	2	1	4	**10**
Total	**15**	**9**	**9**	**11**	**6**	**50**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Broadcaster (somewhat dissatisfied)	… FCC should be directed to evaluate the costs of contracting this function to a knowledgable engineering firm experienced in spectrum matters, such as a frequency coordinator or consulting engineering firm, and the FCC should be required to measure spectrum utilization on an ongoing basis.
Expert (somewhat dissatisfied)	The objective could be achieved by having spectrum users measure their usage using methods and criteria specified by the FCC with spot checks by the FCC. This would reduce cost of measuement and provide order of magnitudes more data.
Expert (strongly dissatisfied)	Require reporting. This is just like CALEA. FCC should not waste money on the generation of data that incumbents already have or must have in order to provide services in existing spectrum. FCC should order that they report it and should fine licensees who do not report or who do not report accurately.
Public interest group (strongly dissatisfied)	The FCC has a mandate to collect the information it needs to make informed policy. It also has the ability to either reprioritize existing funding or raise additional funding through license fees in order to implement [this] recommendation.

Type of commenter (level of satisfaction)	Comment excerpts
Wireless device manufacturer (somewhat dissatisfied)	The scope and scale of such a project need not be this broad (nationally), but FCC (and NTIA) should conduct an initial series of spectrum occupancy studies at a diverse set of 10 to 20 fixed locations across the country, augmented by mobile data collections, in urban and rural areas over several days or weeks. Some or all of this effort could be contracted out to independent third parties or academic institutions in coordination with the National Science Foundation who is already funding some similar data collection efforts. See NTIA CSMAC Report, Spectrum Inventory Working Group (May 2010) at pp. 6, 13 (spectrum measurements initially will best serve as an auditing function for certain assignments/licenses in the inventory). The sensors used in the UK study referenced by the FCC would likely cost tens of thousands of dollars (and spectrum analyzers are even more costly). However, spectrum sensor equipment and software could cost below $1,000 per unit in the near future.

Source: GAO survey.

Maintain a Strategic Spectrum Plan

Recommendation

FCC should maintain an ongoing strategic spectrum plan including a triennial assessment of spectrum allocations.

Rationale

To ensure, now and in the future, that spectrum is allocated to support the growth of broadband services and to accommodate new technologies that deliver it.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	Experts	Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Strongly agree	12	4	6	10	5	**37**
Somewhat agree	5	6	2	10	2	**25**
Neither agree nor disagree	1	0	1	0	2	**4**
Somewhat disagree	1	2	1	0	0	**4**
Strongly disagree	1	0	0	0	0	**1**
Total	**20**	**12**	**10**	**20**	**9**	**71**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (somewhat agree)	We support the concept of developing a strategic spectrum plan. However, the FCC and NTIA should complete a comprehensive inventory of how spectrum is currently allocated, who is using it, and how it is being used before proceeding with any steps related to spectrum reallocation. Moreover, given the complex and dynamic nature of spectrum use and demand, spectrum allocations should not be reassessed every three years pursuant to an arbitrary timetable; instead, the FCC should consider spectrum reallocations on a case-by-case basis and only when presented with an extremely compelling justification and detailed cost/benefit analysis.
Broadcaster (somewhat agree)	Trienniel re-assessment may be too disruptive, but some regular approach is a good idea.
Expert (strongly disagree)	The main thrust for spectrum policy ought not be to "plan the market," which is what "a strategic spectrum plan" explicitly, through "triennial assessments," seeks to do. Instead it should provide as much spectrum to the market as possible. This means that it should create generic, exclusive use rights — similar to CMRS licenses — that allow licensees to flexibly use spectrum. That releases bandwidth to existing applications seeking to expand, or to new wireless services attempting to compete. The government should not be attempting to wage how much one application needs vs. others, but allowing demands to be registered via price bids in a spectrum market.
Expert (somewhat agree)	… FCC should focus on getting spectrum to its highest value uses by facilitating the working of the market through flexibile and tradable rights, not by measuring "use" of spectrum.
Expert (somewhat agree)	The FCC should play a much smaller role in allocations. A triennial assessment would make sense if it is part of an overall strategy along these lines.
Private user group (somewhat agree)	In general, triennial assessment is too ambitious and creates too much uncertainty. Spectrum utilization planning requires a longer timeline.
Wireless device manufacturer (strongly agree)	Strongly agree that FCC should maintain an ongoing spectrum plan, however, biennal/triennial/quadrennial reviews are cumbersome for both industry and the FCC and often result in little or no action.
Wireless service provider (somewhat agree)	Triennial is probably too often. First, the task is Herculean. Second, the gestation period for new spectrum uses is often much longer than 3 years. The rules for wi-fi spectrum were put into place in the mid 1980's but it took until the late 1990's before the wi-fi standard was complete. Nearly everyone would agree that Wi-Fi is very useful, but if a triennial review of those spectrum rules had been conducted and the use changed, we wouldn't have Wi-Fi. Cellular telephone took a similar amount of time to develop and deploy. A detailed assessment every ten years would be better.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

In March 2010, FCC issued its current strategic spectrum plan and assessment of spectrum allocations in the form of the National Broadband Plan's chapter on spectrum. FCC officials told us that the Commission plans to complete an update of its strategic spectrum plan in consultation with NTIA in 18 months.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	1	0	2	0	0	**3**
Somewhat satisfied	5	1	4	7	3	**20**
Neither satisfied nor dissatisfied	3	2	1	6	2	**14**
Somewhat dissatisfied	3	1	0	4	0	**8**
Strongly dissatisfied	2	6	1	2	1	**12**
Total	**14**	**10**	**8**	**19**	**6**	**57**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Broadcaster (strongly dissatisfied)	The approach of drafting a staff plan with limited input from stakeholders has created confusion and a lack of transparency.

Source: GAO survey.

Identify Additional Spectrum for Wireless Broadband Use

Recommendation

FCC and NTIA should develop a joint road map to identify additional candidate federal and nonfederal spectrum that can be made accessible for both mobile and fixed wireless broadband use, on an exclusive, shared, licensed and/or unlicensed basis.

Rationale

The specific bands identified in the National Broadband Plan will only partially meet future needs for wireless broadband use.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

Level of agreement	Experts	Stakeholders				
		Broadcasters	Wireless device manufacturers	Wireless service providers	Others	Total
Strongly agree	13	4	8	10	8	**43**
Somewhat agree	5	5	0	6	0	**16**
Neither agree nor disagree	0	1	1	2	0	**4**
Somewhat disagree	0	2	0	2	0	**4**
Strongly disagree	0	0	1	1	0	**2**
Total	**18**	**12**	**10**	**21**	**8**	**69**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (somewhat agree)	The US needs a comprehensive plan that involves all stakeholders, including carriers, broadcasters, commercial providers, consumer electronics, academia, etc. The road map needs to be more comprehensive than just spectrum and should include usage patterns, trends and technologies to meet those demands.
Broadcaster (somewhat disagree)	The FCC must first complete a comprehensive spectrum usage review to determine what spectrum is already in use for mobile/wireless broadband, what is coming online in the next several years and what the actual realistic needs will be based on predicted usage and predicted technological advances.
Private user group (strongly agree)	Close cooperation between the two entities is essential.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

- FCC consulted with NTIA on a plan to make available 500 MHz of spectrum for wireless broadband over the next 10 years, which NTIA issued in November 2010. The plan identified over 2,200 MHz of candidate spectrum; the exclusively commercial portion consisted of 280 MHz identified in the National Broadband Plan and 500 MHz from 3.7 GHz to 4.2 GHz. At the same time, NTIA presented the results of its first evaluation of some of the candidate spectrum, which recommended that 115 MHz from various federal bands be made available in some parts of the nation for wireless broadband within 5 years.
- In March 2011, FCC issued a public notice inviting comment on these bands, one additional federal band, and the 500 MHz plan.

- FCC officials told us that the Commission is trying to identify additional candidate nonfederal spectrum through its ongoing review of spectrum allocations, using the following criteria: (1) bands should be suitable for ubiquitous, wide-area systems or networks, namely, from 225 MHz to 3.7 GHz; (2) bands should be sizeable, contiguous blocks of spectrum in order to accommodate the high bandwidths of current and emerging wireless technologies; and (3) bands should be of sufficient size and be in a part of the spectrum that encourages competition by allowing multiple providers and new entrants. For example, bands at higher frequencies require more cell sites, and hence greater investment, making it harder for small companies or new entrants to compete. Bands at lower frequencies require larger antennas in devices, which make them less desirable to consumers.

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	0	0	0	1	2	**3**
Somewhat satisfied	6	2	6	5	1	**20**
Neither satisfied nor dissatisfied	5	2	1	7	3	**18**
Somewhat dissatisfied	4	0	0	1	0	**5**
Strongly dissatisfied	0	2	1	1	1	**5**
Total	**15**	**6**	**8**	**15**	**7**	**51**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with the recommendation and that chose to answer the question.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	**Comment excerpts**
Broadcaster (no response)	In reviewing spectrum allocations, the FCC must continue to recognize and appreciate the inherent technical differences between higher band and lower band frequencies. In this regard, broadcasters should not be forced to relocate from a UHF channel to a VHF channel under any scenario.
Expert (neither satisfied nor dissatisfied)	Fundamentally lower frequencies are more desireable for coverage, higher frequencies for capacity. For this reason, low/high frequencies should be paired and if possible availed simultaneously (such as occured in Germany for 800MHz/2.5GHz bands).

Type of commenter (level of satisfaction)	Comment excerpts
Public interest group (neither satisfied nor dissatisfied)	The agenda is right and many of the right steps are being taken. However, the lack of better data on actual utilization of spectrum will continue to complicate efforts to identify the most suitable bands for repurposing.
Wireless device manufacturer (strongly dissatisfied)	The FCC has identified many of the important characteristics needed to provide a wide-area mobile terrestrial system that supports data bandwidth intensive services. Unfortunately NTIA may not have the same goals as industry and the NBP. The spectrum it has identified in unpaired, fragmented or above 3 GHz (this can be used but will not serve at the macro layer of a wireless network), and has many operational exceptions because the spectrum being presented is usually considered only for shared use.
Wireless service provider (somewhat satisfied)	Both the FCC and NTIA should focus on spectrum that has the best physical characteristics for mobile broadband rather than on just "getting spectrum out there." For example, the 100 MHz identified by NTIA between 3550-3650 MHz is suboptimal for mobile broadband and includes exclusion zones that cover at least half the US population, which makes this spectrum generally unsuitable for commercial use.

Source: GAO survey.

Promote Innovative Approaches to Global Spectrum Allocation

Recommendation

FCC should promote within the International Telecommunication Union (ITU) innovative and flexible approaches to global spectrum allocation that take into consideration convergence of various radio communication services and enable global development of broadband services.

Rationale

Consumers want to use many applications offered on wireline and fixed radio communication systems on mobile terminals. The next generation of mobile terminals encompasses multiple radio communication services functions (e.g., fixed, mobile, broadcasting, and even radio determination) that provide for voice, data and video as well as positioning (i.e., convergence). The ITU's current radio regulations, however, may not be sufficiently flexible to accommodate these technological changes.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	11	2	5	7	4	**29**
Somewhat agree	5	6	3	6	0	**20**
Neither agree nor disagree	1	2	1	0	0	**4**
Somewhat disagree	1	0	1	1	1	**4**
Strongly disagree	0	1	0	1	1	**3**
Total	**18**	**11**	**10**	**15**	**6**	**60**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Broadcaster (somewhat agree)	But the FCC and US Government should, in reaching international positions, carefully consider and take into account broadcasting spectrum and needs of US domestic television distribution. Positions seem to promote broadband at expense of existing television distribution uses.
Expert (neither agree nor disagree)	The ITU has never been a vehicle for progress. Often a better way to initiate reforms is for the FCC to act on its own, as it did with international settlement rates. On the other hand, it doesn't hurt to push for it within the ITU even if nothing comes of it that way.
Expert (strongly agree)	So long as it does not create excessive multiband support requirements.
Private user group (somewhat disagree)	"Flexible" has a down side. There are significant benefits to be had from global standards and common allocations.
Wireless device manufacturer (neither agree nor disagree)	Radios are becoming so agile that we don't need harmonization like before.
Wireless device manufacturer (somewhat disagree)	Convergence of services is necessary but the FCC could have done more with WRC 2012 Agenda item 1.2. The flexibility aspect can be deceptive in that it can also introduce regulatory uncertainty. For example if the duplex direction is not specified, deployed solutions could have different rules where transmission could be adjacent in frequency to receivers. This lowers overall network performance and creates confusion and dissatisfaction with the offered services.
Wireless service provider (strongly agree)	Spectrum harmonization internationally is critical to economies of scale.

Source: GAO survey.

National Broadband Plan Recommendations Aimed at Enhancing the Usefulness of Spectrum for Wireless Backhaul

Revise Rules to Allow for Increased Spectrum Sharing

Recommendation

FCC should revise Parts 74, 78, and 101 of its rules to allow for increased spectrum sharing among compatible point-to-point microwave services.

Rationale

Many wireless providers increasingly rely on microwave to connect their wireless infrastructure to the telephone network (referred to as "wireless backhaul"), especially in rural areas. Therefore, FCC should take steps to ensure that sufficient microwave spectrum is available to meet current and future demand for wireless backhaul, especially in the prime bands below 12 GHz.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	10	1	5	11	4	**31**
Somewhat agree	4	3	2	3	1	**13**
Neither agree nor disagree	0	2	1	1	1	**5**
Somewhat disagree	0	3	1	2	0	**6**
Strongly disagree	1	3	0	2	0	**6**
Total	**15**	**12**	**9**	**19**	**6**	**61**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	Comment excerpts
Broadcaster (somewhat disagree)	Strong interference standards must be established and adhered to in order to safeguard the respective services and maximize interference protection.
Expert (strongly disagree)	Secondary markets, not FCC rules, can handle sharing more efficiently.
Expert (strongly agree)	Wireless backhaul enables progression of cyberspace/ broadband into rural and unserved areas and thus is commendable; the technology has been available for a decade. Sustainment after government loans is the key issue.
Wireless device manufacturer (strongly agree)	90 percent of backhaul in europe and uk is microwave. we need flexibility and we need competition in special access as it is a monopoly today and limited in speed to T1 's mostly.
Wireless device manufacturer (strongly agree)	Also need dedicated licenses, but increasing access to bands is good.
Wireless service provider (strongly agree)	We support the FCC proposal to make an additional 750 MHz available for Fixed Service by allowing sharing with bands reserved for Broadcast Auxiliary Service and Cable TV relay service. We would note that formalized frequency coordination procedures will be necessary for operations within this band to ensure non-interference.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

FCC's progress and experts' and stakeholders' satisfaction with FCC's progress are described under the following recommendation, which FCC is implementing jointly with this recommendation.

Revise Rules to Allow for Greater Flexibility and Cost-Effectiveness

Recommendation

FCC should revise its rules to allow for greater flexibility and cost-effectiveness in deploying wireless backhaul.

Rationale

FCC's Part 101 microwave rules are intended to enable a high level of service reliability, but they may also limit deployment flexibility in coverage- or capacity-limited situations. Therefore, the FCC should commence a proceeding to update these rules to reduce the cost of backhaul in capacity-limited urban areas and range-limited rural areas.

Expert and Stakeholder Respondents' Level of Agreement with the Recommendation

		Stakeholders				
Level of agreement	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Strongly agree	12	2	6	13	3	**36**
Somewhat agree	4	2	3	3	2	**14**
Neither agree nor disagree	0	3	0	1	1	**5**
Somewhat disagree	0	2	0	0	1	**3**
Strongly disagree	0	1	0	2	0	**3**
Total	**16**	**10**	**9**	**19**	**7**	**61**

Source: GAO survey.

Expert and Stakeholder Comments on the Recommendation

Type of commenter (level of agreement)	**Comment excerpts**
Broadcaster (somewhat disagree)	Any action in pursuit of this recommendation should thoroughly study and address interference issues and require adequate protection standards.
Expert (somewhat agree)	However, I advise the FCC to consider public interest versus private interest. It is not the FCC's job to enhance profits of big incumbents under the guise of cost-effectiveness. I like profits … but the argument needs to be for competition to improve quality while keeping costs low vs one size fits all solution that only one or two big incumbents can supply.
Expert (strongly agree)	I agree in the respect that wireless backhaul is critical for future services.
Mobile Satellite Services company (somewhat disagree)	Part 101 prior coordination rules must be retained to protect incumbent licensees. The Commission should not allow operation of distributed radiating elements (DREs) as proposed by Wireless Strategies Inc without part 101 frequency coordination.
Wireless device manufacturer (strongly agree)	The government should consider what Australia is doing with NBN.

Source: GAO survey.

FCC's Progress on Implementing the Recommendation through May 2011

In August 2010, FCC issued an NPRM and a Notice of Inquiry proposing to remove regulatory barriers to the use of microwave spectrum for wireless backhaul, in order to increase flexibility, capacity, and cost-effectiveness of microwave bands.[7]

Expert and Stakeholder Respondents' Level of Satisfaction with FCC's Progress

		Stakeholders				
Level of satisfaction	**Experts**	**Broadcasters**	**Wireless device manufacturers**	**Wireless service providers**	**Others**	**Total**
Very satisfied	2	0	3	1	0	**6**
Somewhat satisfied	7	2	2	7	2	**20**
Neither satisfied nor dissatisfied	2	0	1	5	0	**8**
Somewhat dissatisfied	1	0	1	0	1	**3**
Strongly dissatisfied	0	0	0	0	1	**1**
Total	**12**	**2**	**7**	**13**	**4**	**38**

Source: GAO survey.

Note: Figures include only respondents that strongly agreed or somewhat agreed with both recommendations on wireless backhaul.

[7]Subsequent to our survey, in August 2011 FCC issued a Report and Order, Further Notice of Proposed Rulemaking, and Memorandum Opinion and Order in its Wireless Backhaul proceeding [*Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees; Petition for Rulemaking filed by Fixed Wireless Communications Coalition to Amend Part 101 of the Commission's Rules to Authorize 60 and 80 MHz Channels in Certain Bands for Broadband Communications*, Report and Order, Further Notice of Proposed Rulemaking, and Memorandum Opinion and Order, FCC 11-120, 53 Comm. Reg. (P&F) 1099, 2011 LEXIS 3243 (rel. Aug. 9, 2011)]. By this action, FCC updated its rules to (1) permit fixed microwave operation in several spectrum bands previously reserved for specialized microwave services, (2) enable microwave licensees to take advantage of the latest technology to maintain the reliability of critical links, and (3) provide broadcasters with increased flexibility to use fixed microwave links. FCC also sought comment on additional proposals for making microwave communications more flexible and cost-effective.

Expert and Stakeholder Comments on FCC's Progress

Type of commenter (level of satisfaction)	Comment excerpts
Wireless service provider (somewhat satisfied)	The speed of the rulemaking proceeding is a concern. Item is not that controversial and we are still awaiting an order after almost a year.
Wireless service provider (somewhat satisfied)	While in general flexibility is desirable in spectrum management, the FCC should ensure that its rules do not create new interference or efficiency concerns, e.g., the harms of using auxiliary stations outweigh their benefits.

Source: GAO survey.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

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