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TELECOMMUNICATIONS

Strong Support for Extending FCC's Auction Authority Exists, but Little Agreement on Other Options to Improve Efficient Use of Spectrum



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Highlights

Highlights of [GAO-06-236](#), a report to congressional committees

Why GAO Did This Study

The radio-frequency spectrum is a natural resource used to provide an array of wireless communications services, such as television broadcasting, which are critical to the U.S. economy and national security. In 1993, the Congress gave the Federal Communications Commission (FCC) authority to use competitive bidding, or auctions, to assign spectrum licenses to commercial users.

The Commercial Spectrum Enhancement Act required GAO to examine FCC's commercial spectrum licensing process. Specifically, GAO examined the (1) characteristics of the current spectrum allocation process for commercial uses; (2) impact of the assignment process—specifically the adoption of auctions to assign spectrum licenses—on end-user prices, infrastructure deployment, competition, and entry and participation of small businesses; and (3) options for improving spectrum management.

What GAO Recommends

In 2003, GAO recommended that an independent commission examine spectrum management. In this report, GAO recommends that the Congress consider extending FCC's auction authority beyond the current expiration date of September 30, 2007. FCC provided technical comments on this report and OMB generally agreed with the report.

www.gao.gov/cgi-bin/getrpt?GAO-06-236.

To view the full product, including the scope and methodology, click on the link above. For more information, contact JayEtta Z. Hecker at (202) 512-2834 or heckerj@gao.gov.

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What GAO Found

The current spectrum allocation process is largely characterized as a “command-and-control” process, in which the government largely dictates how the spectrum is used. Many stakeholders we spoke with, along with panelists on our expert panel, identified a number of weaknesses of the existing spectrum allocation process, including that the current process is slow and leads to underutilization of the spectrum. FCC staff have identified two alternative allocation models: the “exclusive, flexible rights” model—which would extend the existing process by providing greater flexibility to spectrum license holders—and the “open-access” (or “commons”) model—which would allow an unlimited number of unlicensed users to share spectrum. While little consensus exists about fully adopting either alternative model, FCC staff, as well as many stakeholders and panelists on our expert panel, recommend a balanced approach that would combine elements of the current process and the two alternative models.

FCC's use of auctions to assign spectrum appears to have little to no negative impact on end-user prices, infrastructure deployment, and competition; evidence on how auctions impact the entry and participation of small businesses is less clear. Additionally, FCC's implementation of auctions has mitigated problems associated with comparative hearings and lotteries, which FCC previously used to assign licenses. In particular, auctions are quicker, less costly, and more transparent. Finally, secondary markets provide an additional mechanism for companies to acquire licenses and gain access to spectrum, and FCC has undertaken actions to facilitate secondary-market transactions, such as streamlining the approval process for leases.

Industry stakeholders and panelists on our expert panel offered a number of options for improving spectrum management. The most frequently cited options include (1) extending FCC's auction authority, (2) reexamining the use and distribution of spectrum—such as between commercial and governmental use—to enhance the efficient and effective use of this important resource, and (3) ensuring flexibility in commercially licensed spectrum bands. Stakeholders and panelists on our expert panel overwhelmingly supported extending FCC's auction authority; however, there was little consensus on the other identified options for improvement.

Images Depicting Common Uses of Spectrum



Source: GAO.

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Abbreviations

CMRS	Commercial Mobile Radio Service
CSIS	Center for Strategic and International Studies
CTIA	Cellular Telecommunications and Internet Association
DARS	Digital Audio Radio Service
FCC	Federal Communications Commission
GAO	Government Accountability Office
GHz	Gigahertz
ITU	International Telecommunication Union
MHz	Megahertz
NTIA	National Telecommunications and Information Administration
OMB	Office of Management and Budget
PCS	Personal Communications Services
SMR	Specialized Mobile Radio

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United States Government Accountability Office
Washington, D.C. 20548

December 20, 2005

The Honorable Ted Stevens
Chairman
The Honorable Daniel K. Inouye
Co-Chairman
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Joe Barton
Chairman
The Honorable John D. Dingell
Ranking Minority Member
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. Historically, concern about interference among users has been a driving force in the management of spectrum. The Federal Communications Commission (FCC)—an independent agency that regulates spectrum use for nonfederal users, including commercial users—and the National Telecommunications and Information Administration (NTIA)—an agency within the Department of Commerce that regulates spectrum for federal government users—have worked to minimize interference through the “allocation” and “assignment” of spectrum. Allocation involves designating “bands” of spectrum for specific types of services or classes of users, such as designating certain bands for commercial or government use. Assignment provides an authorization or license to use a specific portion of spectrum to entities, such as wireless companies; this is referred to as “licensed spectrum.” In contrast, some bands of spectrum are allocated to “unlicensed” use, where an unlimited number of users without licenses share the band of spectrum.¹

Demand for radio-frequency spectrum has exploded over the past several decades as new technologies and services have been—and continue to

¹Mobile telephones and garage door openers are examples of technologies deployed, respectively, in licensed bands of spectrum and in bands that permit unlicensed uses.

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 a more efficient use of this resource and meet future needs, 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. Prior to auctions, FCC used comparative hearings, which were quasi-judicial forums, and lotteries as assignment mechanisms. As of November 30, 2005, FCC has held 59 auctions for over 56,000 licenses to select between competing applications for the same license, and generated over \$14.5 billion for the U.S. Treasury.²

The Commercial Spectrum Enhancement Act required GAO to examine FCC's commercial spectrum licensing process.³ As discussed with the committees of jurisdiction, we examined the (1) characteristics of the current spectrum allocation process for commercial uses; (2) impact of the assignment process—specifically the adoption of auctions to assign spectrum licenses—on end-user prices, infrastructure deployment, competition, and entry and participation of small businesses; and (3) options for improving spectrum management. To address these issues, we reviewed and synthesized relevant economic, legal, and policy-oriented literature, such as the Spectrum Policy Task Force report, a document produced by FCC staff. In addition, we hosted, in conjunction with the National Academies, two balanced and diverse expert panels with 23

²The Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, §6002, 107 Stat. 312, 387-392 (the 1993 Budget Act), added section 309(j) to the Communications Act of 1934, as amended. Section 309(j) authorizes FCC to use competitive bidding to assign licenses for certain services.

³Pub. L. 108-494, 118 Stat. 3986, tit. II (2004). The Act required us to report findings to the committees of jurisdiction by September 19, 2005. In September and October 2005, we briefed the Senate Commerce Committee staffs and provided copies of the briefing material to the House Commerce Committee staffs, respectively. Also, as requested, we issued a report in November that summarized and transmitted the briefing materials to the committees of jurisdiction. See GAO, *Telecommunications: Preliminary Information on the Federal Communications Commission's Spectrum Allocation and Assignment Process*, [GAO-06-212R](#) (Washington, D.C.: Nov. 10, 2005).

experts representing academia, government, and industry. The experts discussed policy issues related to spectrum allocation and assignment, as well as options for improving spectrum management in the future. We also conducted semi-structured interviews with representatives of academia, government, and industry. Finally, we interviewed officials at FCC and analyzed data from FCC's three primary spectrum license databases: the Universal Licensing System, the Consolidated Database System, and the International Bureau Filing System. We conducted our work from March through August 2005 in accordance with generally accepted government auditing standards. (See app. I for additional information on our scope and methodology.)

Results in Brief

FCC's current spectrum allocation process is largely characterized as a "command-and-control" process—that is, the government largely dictates how spectrum is used. In particular, FCC, based on regulatory judgments, determines and limits what types of services—such as broadcast, satellite, or mobile radio—will be offered in different frequency bands by geographic area. In addition, FCC issues service rules to define the terms and conditions for spectrum use within given bands. These rules typically specify eligibility standards as well as limitations on the services that may be offered in different frequency bands and the equipment and power levels that may be used. Many stakeholders we spoke to and panelists on our expert panel identified a number of weaknesses with the command-and-control process. For example, panelists and stakeholders noted that the current process is slow and leads to underutilization of the spectrum, among other things. In its 2002 Spectrum Policy Task Force Report, FCC staff identified two alternative spectrum management models to the command-and-control model: the "exclusive, flexible rights" model and the "open-access" (or "commons") model.⁴ The exclusive, flexible rights model provides licensees with exclusive, flexible use of spectrum, and transferable rights within defined geographic areas; in contrast, the open-access model allows an unlimited number of unlicensed users to share frequencies. Both models are more market-oriented than the command-and-control model—that is, supply and demand for spectrum-based services play a greater role in determining how spectrum is used, or allocated. FCC is currently using elements of each model. For example, in recent years, FCC has provided significant operational and technical

⁴The task force report was a product of FCC staff, and not formally adopted by the full Commission.

flexibility for many commercial radio services, such as Personal Communications Services (PCS). However, there is limited consensus about fully adopting either alternative model in the future. Many stakeholders and members of our expert panel, as well as the Spectrum Policy Task Force, support approaches that would combine elements of all three models. But, the relative mix of these approaches remains an area of little agreement.

Available evidence indicates that FCC's use of auctions as an assignment mechanism for licensed spectrum has had little to no negative impact on end-user prices, infrastructure deployment, and competition; evidence on how auctions impact the entry and participation of small businesses is less clear. According to economic research and many of the industry stakeholders we spoke to, auctions have little to no effect on end-user prices because the auction payments represent a sunk cost,⁵ which does not affect future-oriented decisions, such as pricing decisions. Similar arguments were made for the impact of auctions on infrastructure deployment. In addition, some industry stakeholders told us that companies' drive for a return-on-investment (i.e., they need to earn a return on the auction payment) and competition induces companies to invest and innovate. Thus, rather than diverting resources from investment and innovation, auctions encourage these actions. Many industry stakeholders also told us that auctions generally do not place companies at a competitive or financial disadvantage compared to companies that acquired licenses through means other than auctions. The evidence is less certain regarding the effect of auctions on entry and participation of small businesses. For instance, many industry stakeholders we interviewed stated that auctions limit participation to large companies with extensive financial resources. However, others noted that large companies tended to also dominate the comparative hearing process and that auctions at least make the process transparent; some stakeholders also commented that the capital-intensive nature of the wireless communications industry makes it difficult for small businesses to compete, regardless of the assignment mechanism used. In addition, FCC's implementation of auctions mitigates a number of problems associated with comparative hearings and lotteries. For example, auctions are faster, less costly, and more transparent than these previous assignment mechanisms. Finally, in addition to auctions, companies can obtain access to the spectrum resource on the secondary market, which

⁵"Sunk costs" are costs that have been incurred and cannot be reversed, such as paying for spectrum rights at an auction.

involves the sale of licenses or the leasing of spectrum usage rights among private entities. FCC has recently taken steps to facilitate secondary-market transactions, including streamlining the license transfer approval process as well as the procedures by which parties may enter into spectrum leasing arrangements.

Industry stakeholders and panelists on our expert panel suggested a number of options for improving spectrum management. The most frequently cited options include (1) extending FCC's auction authority, (2) reexamining the use and distribution of spectrum, and (3) ensuring clearly defined rights and flexibility in commercially licensed spectrum bands. Panelists and stakeholders overwhelmingly supported extending FCC's auction authority. For example, 21 of 22 panelists supported extending FCC's auction authority, which is scheduled to expire in 2007.⁶ To gain a good understanding of how much spectrum is currently being used, a few panelists suggested perhaps adopting a "spectrum census" to systematically track usage. A number of panelists also suggested that the government evaluate the relative allocation of spectrum for government and commercial use as well as the allocation of spectrum for licensed and unlicensed purposes, although there was little consensus on the relative allocations between these uses. Some panelists suggested that government better define spectrum users' rights, which would clarify understanding of the rights awarded with a license. Others also thought that government should provide licensees with greater flexibility to determine the type of technology used and services offered, although this flexibility could lead to greater interference and thus greater flexibility would need to be balanced with interference protection. There was no consensus on these options for improvements among stakeholders and panelists on our expert panel, except for extending FCC's auction authority.

To achieve greater consensus for reform of the spectrum management process, we previously suggested that the Congress consider establishing an independent commission that would conduct a comprehensive

⁶At the end of each panel session, we asked the panelists to individually answer a short series of questions about the topics discussed in order to more systematically capture individual panelist views on key dimensions. Twenty-two of the twenty-three panelists responded to the questions we posed at the end of each session.

examination of spectrum management.⁷ To date, such a commission has not been established. In this report, we recommend that the Congress consider extending FCC's auction authority beyond the current expiration date of September 30, 2007. We provided a draft of this report to FCC, NTIA, and the Office of Management and Budget. FCC provided technical comments that we incorporated where appropriate. NTIA had no comments on the draft. The Office of Management and Budget (OMB) concurred with our finding that auctions have mitigated problems associated with comparative hearings and lotteries and noted that the Administration supports the permanent extension of FCC's auction authority. OMB also noted that the Administration has proposed to give FCC authority to use economic mechanisms to promote efficient spectrum use.

Background

The radio-frequency spectrum is the part of the natural spectrum of electromagnetic radiation lying between the frequency limits of 9 kilohertz and 300 gigahertz.⁸ 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. Additionally, some companies use spectrum for private tasks, such as communicating with remote vehicles. Federal, state, and local agencies also use spectrum to fulfill a variety of government missions. For example, state and local police departments, fire departments, and other emergency services agencies use spectrum to transmit and receive critical voice and data communications, and federal agencies use spectrum for varied mission needs such as national defense, law enforcement, weather services, and aviation communication.

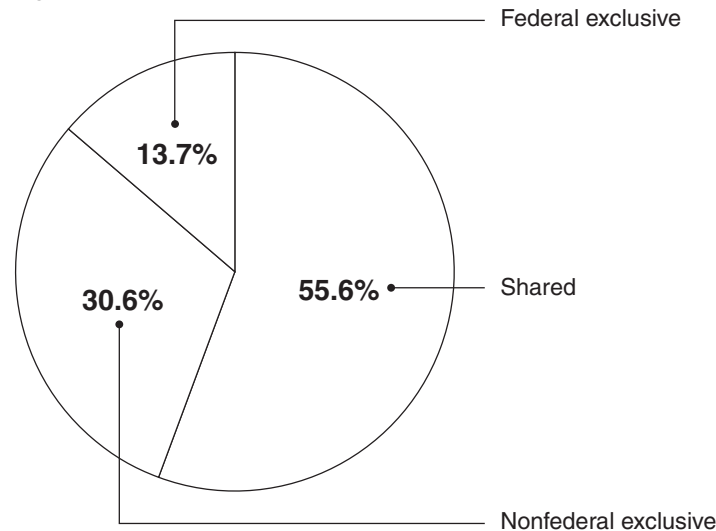
Spectrum is managed at the international and national levels. The International Telecommunication Union (ITU), a specialized agency of the

⁷See GAO, *Telecommunications: Comprehensive Review of U.S. Spectrum Management with Broad Stakeholder Involvement Is Needed*, [GAO-03-277](#) (Washington, D.C.: January 31, 2003).

⁸Radio 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 refers to thousands of Hertz, megahertz (MHz) to millions of Hertz, and gigahertz to billions of Hertz.

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, will follow the ITU decisions. In the United States, responsibility for spectrum management is divided between two agencies: FCC and NTIA. FCC manages spectrum use for nonfederal users, including commercial, private, and state and local government users under authority provided in the Communications Act. NTIA manages spectrum for federal government users and acts for the President with respect to spectrum management issues.⁹ FCC and NTIA, with direction from the Congress, jointly determine the amount of spectrum allocated to federal and nonfederal users, including the amount allocated to shared use. Figure 1 shows the current allocation of spectrum between federal and nonfederal users.

Figure 1: Distribution of Spectrum Between Federal and Nonfederal Users



Source: NTIA.

Note: Not all spectrum frequencies are equivalent. For example, at higher frequencies, more bandwidth is required to provide communications services. Additionally, licenses can vary considerably in terms of bandwidth, as well as the geographic area and population covered.

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

Historically, concern about interference or crowding among users has been a driving force in the management of spectrum.¹⁰ 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 between 88 and 108 megahertz (MHz) are allocated to FM radio broadcasting in the United States. In addition to allocation, spectrum managers also specify service rules, which include the technical and operating characteristics of equipment.
- **Assignment**, which occurs after spectrum has been allocated for particular types of services or classes of users, involves providing a license or authorization to use a specific portion of spectrum to users, such as commercial entities or government agencies. FCC assigns licenses for frequency bands to commercial enterprises, state and local governments, and other entities, while NTIA makes frequency assignments to federal agencies.¹¹

In some frequency bands, FCC authorizes unlicensed use of spectrum—that is, users do not need to obtain a license to use the spectrum.¹² Rather, an unlimited number of unlicensed users can share frequencies on a non-interference basis. Thus, the assignment process does not apply to the use of unlicensed devices. However, manufacturers of unlicensed equipment must receive authorization from FCC before operating or marketing an unlicensed device.

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

¹⁰Interference occurs when two or more radio signals interact in a manner that disrupts the transmission and reception of messages.

¹¹Additionally, some licenses are assigned through a frequency coordination process. Licenses for geostationary satellite orbit systems are assigned using a first-come, first-served approach.

¹²Traditional unlicensed devices are 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.

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. For mutually exclusive applications, FCC has primarily used the following three assignment mechanisms.

- **Comparative hearings** were quasi-judicial forums in which competing applicants argued why they should be awarded a license, and FCC awarded licenses based on pre-established comparative criteria. FCC principally used comparative hearings from 1934 to 1984. Critics asserted that comparative hearings were time consuming and resource intensive, lacked transparency, and often led to protracted litigation.
- **Lotteries** entailed FCC randomly selecting licensees from a pool of qualified applicants. Congress authorized FCC to use lotteries to assign mutually exclusive licenses in 1981, partially in response to the administrative burden associated with comparative hearings. FCC used lotteries from 1984 to 1993.¹³ Critics contended that lottery winners were not always the best suited to provide services; thus, several years could pass before the licenses were transferred in the secondary market to entities capable of deploying a system and effectively using the spectrum.
- **Auctions** are a market-based mechanism in which FCC assigns a license to the entity that submits the highest bid for specific bands of spectrum. The Congress provided FCC with authority to use auctions to assign mutually exclusive licenses for certain subscriber-based wireless

¹³The Balanced Budget Act of 1997, Pub. L. No. 105-33, 111 Stat. 260, tit. III, § 3002, terminated FCC's authority to assign licenses by lotteries, except with respect to licenses for non-commercial broadcast stations and public broadcast stations. See, 47 U.S.C. § 309(i)(5) and 47 U.S.C. § 397(6).

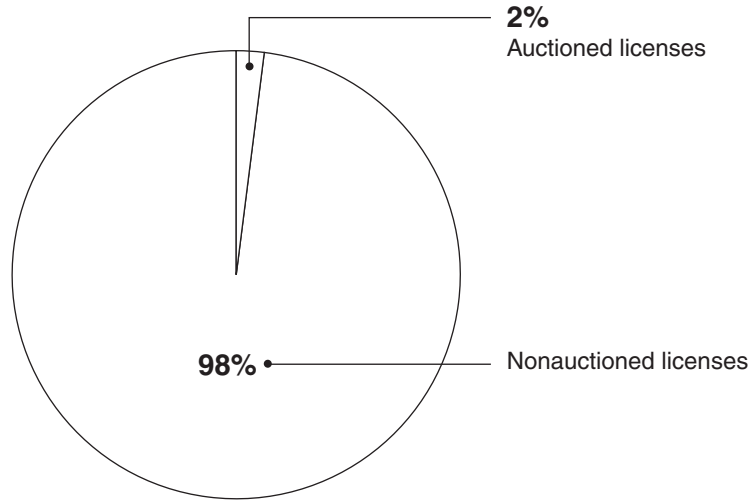
services in the Omnibus Budget Reconciliation Act of 1993.¹⁴ In subsequent years, the Congress has modified and extended FCC's auction authority, including exempting some licenses from competitive bidding, such as licenses for public safety radio services and noncommercial educational broadcast services. Critics of auctions have suggested that auctions raise consumer prices for wireless services, slow the deployment of wireless systems, and are a barrier for small businesses.

As of November 30, 2005, FCC has conducted 59 auctions to select between competing applications for the same license, which have generated over \$14.5 billion for the U.S. Treasury. However, only a very small portion of total licenses has been auctioned. In particular, FCC has auctioned approximately 56,100 licenses—about 2 percent of total licenses. (See fig. 2.) The other 98 percent of licenses have been assigned through other means.¹⁵

¹⁴The 1993 Budget Act established four policy objectives for FCC's use of auctions: (1) the development and rapid deployment of new technologies, products, and services; (2) the promotion of economic opportunity and competition and the dissemination of licenses among a wide variety of applicants, including small businesses; (3) the recovery for the public of a portion of the value of the public spectrum resource; and (4) the efficient and intensive use of spectrum. Additionally, in 1997, the Congress added a fifth objective to ensure that in scheduling auctions FCC allows adequate time for notice and comment, and for potential participants to develop business plans, assess market conditions, and evaluate the availability of equipment. See 47 U.S.C. § 309(j)(3). In the Commercial Spectrum Enhancement Act, Congress added a sixth objective for auctions requiring the recovery of 110 percent of estimated costs to relocate federal users from frequencies transferred to nonfederal use. See 47 U.S.C. § 309(j)(3)(F).

¹⁵For spectrum that is not auctioned, the Administration proposed in its fiscal year 2006 budget to provide FCC authority to use economic mechanisms, such as fees, to promote efficient spectrum use. According to OMB, this proposal would provide FCC the authority to set user fees on unauctioned spectrum licenses based on public-interest and spectrum-management principles, and would promote efficient spectrum use by internalizing the value of spectrum to license holders.

Figure 2: Percent of Licenses Auctioned



Source: GAO analysis of FCC data.

Notes:

To calculate the percentage of licenses that have been auctioned, we divided the number of auctioned licenses by the number of licenses included in FCC's three spectrum license databases.

Not all spectrum frequencies are equivalent. For example, at higher frequencies, more bandwidth is required to provide communications services.

In recent years, two government-led task forces have examined spectrum policy in the U.S. FCC established the Spectrum Policy Task Force, comprised of FCC staff, to assist the Commission in identifying and evaluating changes in spectrum policy that would increase the public benefits derived from the use of spectrum. In November 2002, the task force released a report that contained a number of recommendations, including promoting more market-based mechanisms to allocate spectrum.¹⁶ The Commission subsequently implemented several of the task force's recommendations, including developing rules for leasing spectrum. The Federal Government Spectrum Task Force,¹⁷ comprised of the heads of executive branch departments, agencies, and offices, examined spectrum

¹⁶The task force report was a product of FCC staff, and not formally adopted by the full Commission.

¹⁷The President established the Federal Government Spectrum Task Force through an Executive Memorandum in May 2003. See Memorandum on the Spectrum Policy for the 21st Century, 39 Weekly Comp. Pres. Doc. 726 (June 9, 2004).

policy for government use, including homeland security, public safety, scientific research, federal transportation infrastructure, and law enforcement. In June 2004, the Department of Commerce released two reports based on the task force's findings, which contained a number of recommendations for reforms to federal agencies' use of spectrum. For example, the Department of Commerce recommended adopting incentives for more efficient use of spectrum by government agencies. However, as we noted in 2003, the bifurcated responsibility between FCC and NTIA for spectrum management can hinder reform.¹⁸ Specifically, neither FCC nor NTIA has ultimate decision making authority over spectrum management or the authority to impose fundamental reform. Because of the lack of a single decision making point for spectrum reform, we recommended that the Congress consider establishing an independent commission that would conduct a comprehensive examination of spectrum management. To date, such a commission has not been established.

Spectrum Allocation Remains Largely a Command-and-Control Process, But Alternatives Exist

Spectrum allocation remains largely a command-and-control process, although FCC is providing greater flexibility in some instances, particularly as it licenses newly available spectrum. Many stakeholders with whom we spoke and panelists on our expert panel identified a number of weaknesses with the command-and-control process. FCC staff identified two alternative spectrum management models: the exclusive, flexible rights model and the open-access, or commons, model. Under these models, users of spectrum, rather than FCC, would exert a greater influence on the use of spectrum. Although there is limited consensus about fully adopting either alternative model in the future, many stakeholders and members of our expert panel, as well as the Spectrum Policy Task Force, support balanced approaches that would combine elements of all three models.

Spectrum Allocation Is Largely a Command-and-Control Process

FCC currently employs largely a command-and-control process for spectrum allocation.¹⁹ That is, FCC applies regulatory judgments to determine and limit what types of services—such as broadcast, satellite, or mobile radio—will be offered in different frequency bands by geographic area. In addition, for most frequency bands FCC allocates, the agency

¹⁸See [GAO-03-277](#).

¹⁹NTIA employs a similar process for federal government spectrum users.

issues service rules to define the terms and conditions for spectrum use within the given bands. These rules typically specify eligibility standards as well as limitations on the services that relevant entities may offer and the technologies and power levels they may use. These decisions can constrain users' ability to offer services and equipment of their choosing.

FCC has provided greater operational and technical flexibility within certain frequency bands. For example, FCC's rules for Commercial Mobile Radio Service (CMRS), which include cellular and PCS services, are considered less restrictive. Under these rules, wireless telephony operators are free to select technologies, services, and business models of their choosing. In contrast, spectrum users have relatively little latitude for making such choices in frequency bands allocated for broadcast television services.

Despite these efforts, many industry stakeholders and experts with whom we spoke cited a number of weaknesses in the command-and-control process for spectrum allocation. The most frequently cited weakness by our expert panel was the slowness of the allocation process. Because of the regulatory nature of the command-and-control process, arriving at allocation decisions can be a protracted process. The slow moving allocation process delays consumers' access to new technologies. In addition, some panelists noted that the current allocation process leads to underutilization of spectrum. For example, a recent study found that during a four-day period in New York City, only 13 percent of spectrum between 30 MHz and 2.9 GHz was occupied at one time or another.²⁰ Another weakness cited by a number of stakeholders was that the command-and-control process does not systematically allocate spectrum to its highest value uses. As a result, highly valued services may not be fully deployed.

²⁰Mark McHenry and Dan McCloskey, *New York City Spectrum Occupancy Measurements September 2004*, Shared Spectrum Company, subcontract with University of Kansas Center for Research, Inc. (Vienna, VA: Dec. 2004).

FCC's Spectrum Policy Task Force Identified Two Alternatives to the Command-and-Control Allocation Process but Recommends a Balanced Approach

The Spectrum Policy Task Force Report, a document produced by FCC staff, identified two alternative spectrum management models to the command-and-control model: the exclusive, flexible rights model, and the open-access model. The exclusive, flexible rights model extends the existing license-based allocation process by providing greater flexibility to license holders. The open-access model allows an unlimited number of unlicensed users to share frequencies, with usage rights governed by technical standards. Both models allow flexible use of spectrum, so that users of spectrum, rather than FCC, play a larger role in determining how spectrum is ultimately used. FCC's Spectrum Policy Task Force recommended a balanced approach to allocation—utilizing aspects of the command-and-control; exclusive, flexible rights; and open-access models.

The Exclusive, Flexible Rights Model Is a License-Based Approach to Spectrum Allocation

The exclusive, flexible rights model provides licensees with exclusive, flexible use of the spectrum and transferable rights within defined geographic areas. This is a licensed-based approach to spectrum management that extends the existing allocation process by providing greater flexibility regarding the use of spectrum and the ability to transfer licenses or to lease spectrum usage rights. Licensees with exclusive licenses can exclude others from using the spectrum they have been assigned, and with flexible rights they enjoy flexibility to provide the services they wish with their licenses, provided they comply with applicable FCC rules and policies. To a certain extent, the model treats spectrum like real estate, and some have suggested moving far in this direction by turning spectrum licenses into full property rights—an option that existing legislation currently prohibits.²¹ FCC's broadband PCS rules closely resemble this model, in that they provide substantial flexibility to licensees in terms of technology and use of spectrum.

Proponents cite several advantages with the exclusive, flexible rights model. First, proponents argue that this model would promote the economically efficient use of spectrum. For example, advocates typically point to CMRS to support this argument, as CMRS licenses are exclusive and governed by relatively flexible rules; in addition, the market for CMRS services is highly valuable, innovative, and fast-growing. Second, proponents suggest that the model provides certainty for licensees. The model provides a reliable means of protecting commercial users from

²¹Section 301 of the Act provides that the government can authorize the use—but not the ownership—of the spectrum. See, 47 U.S.C. § 301.

interference, allowing them to guarantee quality of service on a wide scale. Third, proponents argue that greater certainty will encourage investment in technology and infrastructure.

Opponents cite several problems with the exclusive, flexible rights model. For example, opponents assert that the model might not promote technically efficient, or intensive, use of spectrum. According to some critics, exclusivity might reduce licensees' incentives to invest in developing more technically efficient technologies as users have guaranteed access to spectrum, thereby deterring innovation. In addition, some opponents assert that the model could encourage "hoarding" of spectrum, as licensees could benefit from blocking access to spectrum by potential competitors. In other words, companies may buy rights to spectrum—with no intention of using the spectrum—to prevent a competitor from acquiring rights to the same spectrum.

The Open-Access Model Is a Non-Licensed Approach to Spectrum Allocation

The open-access model allows a potentially unlimited number of unlicensed users to share frequency bands, with usage rights governed by technical standards, but with no rights to interference protection. This approach does not require licenses, and as such is similar to the current FCC Part 15 rules (which govern unlicensed use in the 900 MHz, 2.4 GHz, and 5.8 GHz bands)—where cordless phones and Wi-Fi technologies operate. As with exclusive, flexible rights, users would have greater latitude in determining how they use spectrum. However, in this case, markets for end-user equipment, rather than for licenses, would determine how different frequency bands are used or allocated. Under this model, commercial spectrum-based service providers would not seek to maximize their return on spectrum licenses, but rather, on the sale of equipment that, once purchased, would allow consumers to enjoy wireless services.

Proponents of the open-access model cite several advantages with this approach to spectrum allocation. For example, proponents assert that the open-access model will promote the technically efficient use of spectrum. In order to avoid interference, users have an incentive to develop smarter equipment that will use the spectrum intelligently. An example of technically efficient equipment is agile radio. Agile radios can determine if a specific frequency is currently in use, emit in that band if it is not, and switch to another band in microseconds if another user begins to emit in

that band.²² In fact, supporters of the open-access model believe that open access to spectrum will foster the development of technologies that will reduce spectrum scarcity, and therefore interference problems, as a new type of wireless architecture becomes possible. According to proponents, the open-access model for spectrum allocation also limits the ability for companies to “hoard” spectrum—that is, since there would be no exclusive use of spectrum in this model, companies could no longer block their competitors from acquiring spectrum by simply acquiring or holding on to spectrum themselves. In addition, since users would no longer need to buy spectrum rights, the open-access model reduces barriers to entry into spectrum-based markets, according to proponents.

Opponents cite several problems with the open-access model. One cited problem is that an open-access approach could lead to the overuse of spectrum. Specifically, opponents believe that the technologies that could end spectrum scarcity are years away from realization. Without such technologies, an unlimited number of unlicensed users would result in the overuse of spectrum and interference. Moreover, opponents argue that the uncertainty about interference would inhibit investment. Another cited problem is the potential irreversibility of this model—that is, once consumers have the equipment, it would be difficult to prevent them from accessing the spectrum if the spectrum were needed for some other purpose in the future. One only need to imagine the difficulties involved with trying to prevent people from using their garage door openers—which operate in some bands under Part 15 rules—to understand this potential challenge.

FCC’s Spectrum Policy Task Force Advocated a Balanced Approach

The Spectrum Policy Task Force report recommended a balanced approach to spectrum allocation—utilizing aspects of the command-and-control; exclusive, flexible rights; and open-access models. In particular, FCC’s task force recommended the following:

- moving away from the command-and-control model, except for limited exceptions such as public safety or to conform to treaty requirements;
- using the exclusive, flexible rights model where scarcity of spectrum is a concern and transaction costs are low; and

²²For more information on these technologies, see Gerald R. Faulhaber and David Farber, “Spectrum Management: Property Rights, Markets, and the Commons” (Washington, D.C.: 2002).

-
- using the open-access model where scarcity is a lesser concern and transaction costs are relatively high.

Little Consensus Exists about the Future Management of Spectrum

We found little consensus on the future management of spectrum. As noted above, there is disagreement about the merits of the exclusive, flexible rights and open-access models. However, many industry stakeholders we spoke with and panelists on our expert panel support a mixed approach, which incorporates spectrum use under an exclusive, flexible rights licensed model and an open-access model. For example, those who favor open access do not all believe that licensing should suddenly be done away with, but that different approaches ought to be tested and compared before any policy decision is made. Similarly, a number of industry stakeholders we spoke with who favor providing spectrum users with flexible rights in licensed bands also believe that unlicensed spectrum is, at the minimum, appropriate for use by certain devices within certain bands.

Auctions Have Little to No Negative Impact on the Wireless Industry and Are More Efficient than Previous Assignment Mechanisms

Auctions have little to no negative effect on end-user prices, infrastructure deployment, or competition, although the effect on entry and participation of small businesses is less certain. FCC's implementation of auctions has also mitigated problems arising with comparative hearings and lotteries. In addition to auctions, secondary markets provide another means for entities to acquire licenses or lease spectrum in order to gain access to spectrum.

Auctions Have No Negative Impact on the Wireless Industry

Some critics of spectrum auctions have suggested that auctions negatively impact the wireless industry. Since auctions require licensees to pay for licenses, and in some instances the payments can represent a significant outlay, these critics believe that auctions (1) raise consumer prices as entities seek to recoup their auction payments, (2) slow infrastructure deployment by diverting financial resources to the government, (3) distort competition by creating an environment where some entities that acquired licenses via auction compete with other entities that previously acquired licenses via other means, and (4) deter entry and hinder small business participation in the wireless industry by necessitating large payments prior to the issuance of licenses.

We found that FCC's implementation of auctions has no negative impact on end-user prices, infrastructure deployment, and competition; the evidence on the impact on entry and participation of small businesses is less clear. In particular:

- **End-user prices.** We found that auctions have little to no impact on end-user prices. Economic research suggests that auction payments do not affect end-user prices, since these payments represent a sunk cost, which do not affect future-oriented decisions. For example, using data on cellular prices from 1985 to 1998, one author empirically found that auctions had no effect on prices.²³ Additionally, industry stakeholders we spoke to and panelists on our expert panel noted that competition ultimately affects end-user prices. Thus, regardless of a company's desire to recoup its auction payment, the company will select prices that maximize future profits based on competition in the market. Among the panelists on our expert panel, a majority said that auctions do not affect end-user prices. Specifically, 10 panelists said that auctions do not affect end-user prices, 3 said that auctions decrease prices, and 5 said that auctions increase prices.²⁴
- **Infrastructure Deployment.** We found that auctions have little to no impact on infrastructure deployment. Similar to the argument for end-user prices, economic research suggests that auction payments do not deter infrastructure deployment; companies will make decisions about infrastructure deployment based on the future profit potential of those investments. Some industry stakeholders with whom we spoke, and panelists on our expert panel, mentioned that auction payments may in fact stimulate infrastructure deployment. In particular, since an auction payment represents an investment, the company will seek a return on that investment. To earn that return, a wireless company will sell subscriber services, which are made possible through the deployment of wireless networks. Among panelists on our expert panel, eight said that

²³See Evan Kwerel, "Spectrum Auctions Do Not Raise the Price of Wireless Services: Theory and Evidence," (Washington, D.C.: 2000), http://wireless.fcc.gov/auctions/default.htm?job=papers_studies (downloaded Dec. 14, 2005).

²⁴At the end of each panel session, we asked the panelists to individually answer a short series of questions about the topics discussed in order to more systematically capture individual panelist views on key dimensions. Twenty-two of the twenty-three panelists responded to the questions we posed at the end of each session. The number of panelists responding to particular questions ranged from 17 to 22.

auctions increase investment, five said that auctions had no effect on investment, and seven said that auctions decrease investment.

- **Competition.** We found little evidence that auctions affect the competitive environment. Many stakeholders told us that auctions generally do not place companies at a competitive or financial disadvantage compared to companies that acquired licenses through other, non-auctioned, means that might not have involved payment for the licenses, such as lotteries. These stakeholders noted that (1) companies acquired non-auctioned licenses many years ago, (2) many non-auctioned licenses have subsequently been sold and paid for, and (3) companies that acquired non-auctioned licenses have subsequently acquired additional licenses via auction. Therefore, any competitive advantage these companies gained by obtaining licenses through means other than auctions has dissipated. Among our panelists, 11 said that auctions increase the degree of competition, while 3 said that auctions had no effect on competition, and 4 said that auctions decrease competition.
- **Entry and participation of small businesses.** Some industry stakeholders we interviewed stated that auctions limit participation to large companies with extensive financial resources.²⁵ These stakeholders assert that small companies are unable to acquire the financial resources necessary to successfully compete in FCC's auction process. However, others noted that large companies also tended to dominate the comparative hearing process. In addition, some stakeholders noted that the capital intensive nature of the wireless industry—not the assignment mechanism—makes it difficult for small businesses to participate. Expert opinion diverged on this issue: among our expert panelists, eight said that auctions increase entry while another eight said that auctions decrease entry, and three panelists said that auctions had no effect on entry.

²⁵In authorizing FCC to use competitive bidding, the Congress mandated that FCC “ensure that small businesses, rural telephone companies, and businesses owned by members of minority groups and women are given the opportunity to participate in the provision of spectrum-based services.” See 47 U.S.C. § 309(j)(4)(D). In addition, the Communications Act requires that in establishing eligibility criteria and bidding methodologies, FCC disseminate licenses among a wide variety of applicants. See 47 U.S.C. 309(j)(3)(B).

Auctions Mitigate Many Problems Associated with Previous Assignment Mechanisms

As mentioned earlier, comparative hearings and lotteries—the two primary assignment mechanisms employed until 1993—suffered from several problems. Comparative hearings were generally time consuming and resource intensive, as entities employed engineers and lawyers to prepare applications and FCC dedicated staff to evaluating applications based on pre-established comparative criteria. Further, decisions arising from comparative hearings lacked transparency and often led to protracted litigation. While lotteries were less time consuming and resource intensive, they did not necessarily assign licenses to the entities that were best suited to provide services. Thus, several years could pass before the licenses were transferred in the secondary market to entities capable of deploying a wireless system and effectively using the spectrum. Further, neither comparative hearings nor lotteries provided a mechanism for the public to financially benefit from commercial entities using a valuable national resource.²⁶

FCC's implementation of auctions mitigates a number of problems associated with comparative hearings and lotteries. For example:

- Auctions are a relatively quick assignment mechanism. With auctions, FCC reduced the average time for granting a license to less than one year from the initial application date, compared to an average time of over 18 months with comparative hearings.
- Auctions are administratively less costly than comparative hearings. Entities seeking a license can reduce expenditures for engineers and lawyers arising from preparing applications, litigating, and lobbying; and FCC can reduce expenditures associated with reviewing and analyzing applications.
- Auctions are a transparent process. FCC awards licenses to entities submitting the highest bid rather than relying on possibly vague criteria, as was done in comparative hearings.

²⁶There are several instances where the public captures some value arising from commercial entities using government-controlled resources. For example, the federal government auctions offshore oil and gas drilling rights, collects royalties for mineral extraction on federal lands, and collects grazing fees.

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- Auctions are effective in assigning licenses to entities that value them the most. Alternatively, with lotteries, FCC awarded licenses to randomly-selected entities.
 - Auctions are an effective mechanism for the public to realize a portion of the value of a national resource used for commercial purposes. Entities submitting winning bids must remit the amount of their winning bid to the government, which represents a portion of the value that the bidder believes will arise from using the spectrum. As mentioned earlier, auctions have generated over \$14.5 billion for the U.S. Treasury.

Many industry stakeholders we contacted, and panelists on our expert panel, stated that auctions are more efficient than previous mechanisms used to assign spectrum licenses. For example, among our panelists, 11 of 17 reported that auctions provide the most efficient method of assigning licenses; no panelist reported that comparative hearings or lotteries provided the most efficient method. Of the remaining panelists, several suggested that the most efficient mechanism depended on the service that would be permitted with the spectrum.²⁷

Secondary Markets Provide an Additional Mechanism for Companies to Acquire Licenses and Gain Access to Spectrum

While FCC's initial assignment mechanisms provide one means for companies to acquire licenses, companies can also acquire licenses or access to spectrum through secondary market transactions. Through secondary markets, companies can engage in transactions whereby a license or use of spectrum is transferred from one company to another. These transactions can incorporate the sale or trading of licenses. In some instances, companies acquire licenses through the purchase of an entire company, such as Cingular's purchase of AT&T Wireless. Ultimately, FCC must approve transactions that result in the transfer of licenses from one company to another.

In recent years, FCC has undertaken actions to facilitate secondary-market transactions. FCC authorized spectrum leasing for most wireless radio licenses with exclusive rights and created two categories of spectrum leases: Spectrum Manager Leasing—where the licensee retains legal and working control of the spectrum—and *de Facto* Transfer Leasing—where the licensee retains legal control but the lessee assumes working control of

²⁷For example, some panelists do not support using auctions to assign spectrum licenses for public safety services.

the spectrum. FCC also streamlined the procedures that pertain to spectrum leasing. For instance, the Spectrum Manager Leases do not require prior FCC approval and *de Facto* Transfer Leases can receive immediate approval if the arrangement does not raise potential public interest concerns.²⁸ While FCC has taken steps to facilitate secondary market transactions, some hindrances remain. For example, some industry stakeholders told us that the lack of flexibility in the use of spectrum can hinder secondary market transactions.

Secondary markets can provide several benefits. First, secondary markets can promote more efficient use of spectrum. If existing licensees are not fully utilizing the spectrum, secondary markets provide a mechanism whereby these licensees can transfer use of the spectrum to other companies that would utilize the spectrum, thereby increasing the amount of available spectrum and reducing the perceived scarcity of spectrum.²⁹ Second, secondary markets can facilitate the participation of small businesses and introduction of new technologies. For example, a company might have a greater incentive to deploy new technologies that require less spectrum if the company can profitably transfer the unused portion of the spectrum to another company through the secondary market. Also, several stakeholders we spoke to noted that secondary markets provide a mechanism whereby a small business can acquire spectrum for a geographic area that best meets the needs of the company.

²⁸The public interest concerns arise as a result of FCC policies pertaining to (1) eligibility and use of the license and spectrum, (2) foreign ownership limitations, (3) designated entity and entrepreneur benefits, and (4) competition. See *Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets*, WT Docket No. 00-230, Second Report and Order, Order on Reconsideration, and Second Further Notice of Proposed Rulemaking, 19 FCC Rcd. 17503 (2004).

²⁹FCC has also established rules that allow licenses in many wireless services to partition or disaggregate their licenses. Partitioning involves subdividing the geographic area a licensee serves and disaggregation involves subdividing the spectrum associated with the licenses.

Industry Stakeholders and Panelists Suggested Several Options to Improve Spectrum Management

Industry stakeholders and panelists on our expert panel offered a number of options for improving spectrum management. The most frequently cited options include (1) extending FCC's auction authority, (2) reexamining the distribution of spectrum—such as between commercial and government use—to enhance the efficient and effective use of this important resource, and (3) ensuring clearly defined rights and flexibility in commercially licensed spectrum bands. There was no consensus on these options for improvements among stakeholders we interviewed and panelists on our expert panel, except for extending FCC's auction authority.

Extend FCC's Auction Authority

Panelists on our expert panel and industry stakeholders with whom we spoke overwhelmingly supported extending FCC's auction authority. For example, 21 of 22 of panelists on our expert panel indicated that the Congress should extend FCC's auction authority beyond the September 30, 2007 expiration date. As mentioned earlier, panelists and stakeholders believe that auctions are more efficient than previous mechanisms used to assign spectrum licenses; moreover, auctions are viewed as being faster, less costly, and more transparent than the previous mechanisms. Additionally, extending FCC's auction authority could generate significant revenues for the government.³⁰ However, panelists and stakeholders also noted that the government should use spectrum auctions to promote the efficient use of spectrum, not necessarily to maximize revenues for the government.

While panelists on our expert panel overwhelmingly supported extending FCC's auction authority, a majority also suggested modifications to enhance the use of auctions.³¹ However, there was little consensus on the suggested modifications. The suggested modifications fall into the following three categories:

- **Better define license rights.** Some industry stakeholders and panelists indicated that FCC should better define the rights accompanying spectrum licenses, as these rights can significantly affect

³⁰For example, the Congressional Budget Office recently estimated that an auction of 60 MHz of spectrum currently used by broadcasters would generate auction revenues of \$10 billion. See Congressional Budget Office, *Cost Estimate: Digital Transition and Public Safety Act of 2005* (Washington, D.C.: October 24, 2005).

³¹Fifteen of twenty-two panelists suggested modifications to enhance the use of auctions.

the value of a license being auctioned. For example, some industry stakeholders express concern with FCC assigning overlay and underlay rights to frequency bands when a company holds a license for the same frequency bands.³²

- **Enhance secondary markets.** Industry stakeholders we contacted and panelists on our expert panel generally believe that modifying the rules governing secondary markets could lead to more efficient use of spectrum. For example, some panelists on our expert panel said that FCC should increase its involvement in the secondary market. These panelists thought that increased oversight could help to both ensure transparency in the secondary market and also promote the use of the secondary market. Additionally, a few panelists said that adoption of a “two-sided” auction would support the efficient use of spectrum. With a two-sided auction, FCC would offer unassigned spectrum and existing licensees could make available the spectrum usage rights they currently hold.
- **Reexamine existing small business incentives.** The opinions of panelists on our expert panel and industry stakeholders with whom we spoke varied greatly regarding the need for and success of FCC’s efforts to promote economic opportunities for small businesses. For example, some panelists and industry stakeholders do not support incentive programs for small businesses. These panelists and industry stakeholders cited several reasons for not supporting these incentives, including (1) the wireless industry is not a small business industry; (2) while the policy may have been well intended, the current program is flawed; or (3) such incentives create inefficiencies in the market. Other industry stakeholders suggested alternative programs to support small businesses. These suggestions included (1) having licenses cover smaller geographic areas, (2) using auctions set aside exclusively for small and rural businesses, and (3) providing better lease options for small and rural businesses. Finally, some industry stakeholders with whom we spoke have benefited from the small business incentive

³²Underlay rights allow unlicensed users to operate in the same spectrum bands as licensees, as long as the unlicensed users do not cause undue interference for licensees. For example, ultra-wideband technology operates at very low power levels over a very wide range of spectrum, and thus might avoid interfering with licensed spectrum users in the same spectrum bands. Overlay rights allow unlicensed users to operate in licensed spectrum bands during times or in geographic areas where licensees are not using the spectrum.

programs, such as bidding credits,³³ and believe that these incentives have been an effective means to promote small business participation in wireless markets.

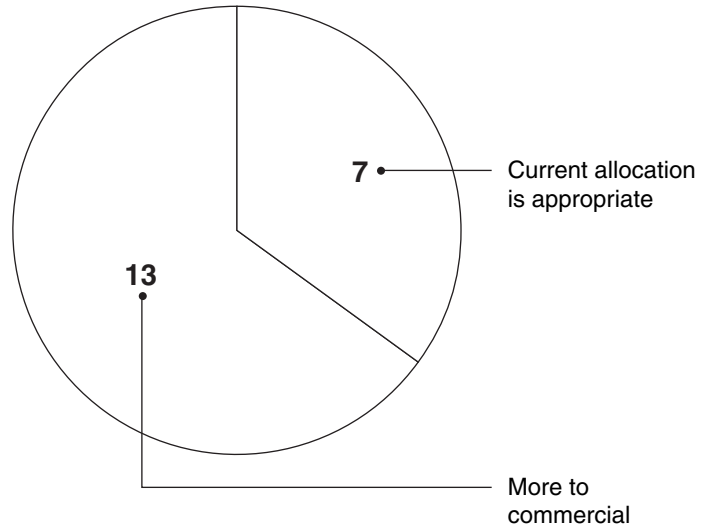
Reexamine the Use and Distribution of Spectrum

Panelists on our expert panel suggested a reexamination of the use and distribution of spectrum to ensure the most efficient and effective use of this important resource. One panelist noted that the government should have a good understanding of how much of the spectrum is being used. To gain a better understanding, a few panelists suggested that the government systematically track usage, perhaps through a “spectrum census.” This information would allow the government to determine if some portions of spectrum were underutilized, and if so, to make appropriate allocation changes and adjustments.

A number of panelists on our expert panel also suggested that the government evaluate the relative allocation of spectrum for government and commercial use as well as the allocation of spectrum for licensed and unlicensed purposes. While panelists thought the relative allocation between these categories should be examined, there was little consensus among the panelists on the appropriate allocation. For instance, as shown in figure 3, 13 panelists indicated that more spectrum should be dedicated to commercial use, while 7 thought the current distribution was appropriate. No panelists thought that more spectrum should be dedicated to government use. Similarly, as shown in figure 4, nine panelists believed that more spectrum should be dedicated to licensed uses, six believed more should be dedicated to unlicensed uses, and five thought the current balance was appropriate.

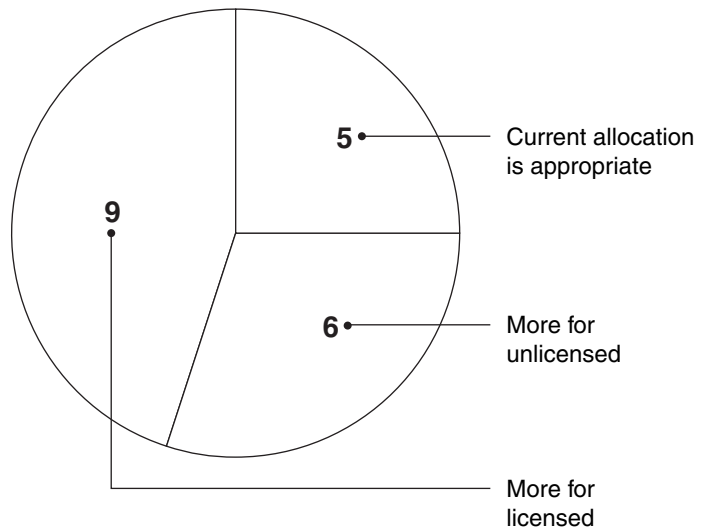
³³A bidding credit is a percentage discount applied to the high bid amount if the bidder meets designated entity criteria established in the auction rules.

Figure 3: Panelists' Views on the Allocation of Spectrum between Commercial and Government Use



Source: GAO.

Figure 4: Panelists' Views on the Allocation of Spectrum between Licensed and Unlicensed Use



Source: GAO.

Ensure Clearly Defined Rights and Flexibility

Similar to a suggested modification of FCC's use of auctions, some panelists on our expert panel suggested better defining users' rights and increasing flexibility in the allocation of spectrum. Better defining users' rights would clarify the understanding of the rights awarded with any type of license, whether the licensees acquired the license through an auction or other means. In addition, some panelists stated that greater flexibility in the type of technology used—and service offered—within frequency bands would help promote the efficient use of spectrum. In particular, greater flexibility would allow the licensee to determine the efficient and highly valued use, rather than relying on FCC-based allocation and service rules. However, some panelists on our expert panel and industry stakeholders with whom we spoke noted that greater flexibility can lead to interference, as different licensees provide potentially incompatible services in close proximity.³⁴ Thus, panelists on our expert panel stressed the importance of balancing flexibility with interference protection.

Conclusions

As commercial enterprises and government agencies increasingly utilize spectrum to provide consumer services and fulfill important missions, the management of spectrum to ensure its efficient use takes on greater importance. Many industry stakeholders and panelists on our expert panel told us that the current command-and-control process for allocating spectrum is less effective than other approaches. As a result, they stated that spectrum is not being fully utilized at all times and perhaps not being used for its highest-value purposes. Yet, few stakeholders or experts agree on how to improve the process. To achieve greater consensus for reform of the spectrum management process, we previously suggested that the Congress consider establishing an independent commission that would conduct a comprehensive examination of spectrum management.³⁵

One aspect of spectrum management that appears very effective is the use of auctions for assigning licenses for commercial entities. As implemented by FCC, spectrum auctions resolve problems associated with previous assignment mechanisms, while giving rise to little or no problems. Most stakeholders and experts with whom we spoke support extending FCC's

³⁴With the current allocation process, FCC attempts to keep incompatible service separated to avoid interference. With licensees exerting greater control, this protection could be reduced.

³⁵[GAO-03-277](#).

auction authority beyond the current expiration date of September 30, 2007.

Matter for Congressional Consideration

Given the success of FCC's use of auctions and the overwhelming support among industry stakeholders and experts for extending FCC's auction authority, the Congress should consider extending FCC's auction authority beyond the current expiration date of September 30, 2007.

Agency Comments

We provided a draft of this report to FCC, NTIA, and the Office of Management and Budget for their review and comment. FCC provided technical comments that we incorporated where appropriate. NTIA had no comments on the draft. OMB concurred with our finding that auctions have mitigated problems associated with comparative hearings and lotteries and noted that the Administration supports the permanent extension of FCC's auction authority. OMB also noted that the Administration has proposed to give FCC authority to use economic mechanisms to promote efficient spectrum use.

We are sending copies of this report to the appropriate congressional committees. We are also sending this report to the Secretary of Commerce, Chairman of the Federal Communications Commission, and the Director of the Office of Management and Budget. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

Should you have any questions about this report, please contact me at 202-512-2834 or heckerj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Individuals making key contributions to this report include

Amy Abramowitz, Stephen Brown, Emilie Cassou, Michael Clements, Nikki Clowers, Kate Magdalena Gonzalez, Eric Hudson, Terri Russell, Mindi Weisenbloom, and Alwynne Wilbur.

A handwritten signature in black ink, appearing to read "JayEtta Z. Hecker". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

JayEtta Z. Hecker,
Director, Physical Infrastructure Issues

Scope and Methodology

The Commercial Spectrum Enhancement Act required us to review the Federal Communications Commission's (FCC) commercial spectrum licensing process. The objectives of our study included examining the (1) characteristics of the current spectrum allocation process for commercial uses; (2) impact of the assignment process—specifically the adoption of auctions to assign spectrum licenses—on end-user prices, infrastructure deployment, competition, and entry and participation of small businesses; and (3) options for improving spectrum management.

To address all three objectives, we conducted a comprehensive, structured literature review of economic, legal, and public policy material relevant to spectrum issues. Our literature review included domestic studies on spectrum management that were published in the last 25 years. To identify articles for our literature review, we searched a number of databases, including LexisNexis, Hein Online, Westlaw, and ProQuest, using key terms such as “spectrum,” “assignment,” and “license.” We eliminated articles and studies from our literature review that did not directly relate to our objectives or did not provide original analysis. We also considered the methodological soundness of the articles and studies included in our literature review; we determined that the findings of these studies were sufficiently reliable for our purposes.

We also extracted data from FCC's license databases (Universal Licensing System, Consolidated Database System, and International Bureau Filing System) to determine the distribution of active licenses among different segments of the wireless industry and to identify the largest holders of licenses. To assess the reliability of the information from these databases, we interviewed FCC officials responsible for the databases about their data collection and verification policies, and procedures for license information. We also electronically tested the databases. We concluded that information from FCC's license databases was sufficiently reliable for the purposes of this report. In addition, we interviewed FCC, National Telecommunications and Information Administration, and Office of Management and Budget officials and conducted semi-structured interviews with representatives from academia and the wireless industry to obtain a broad range of perspectives on spectrum allocation and assignment issues. We selected representatives from academia and the wireless industry based on their organization's vested interest in spectrum policy, or their expertise in spectrum policy as represented by presentations or publications. (Table 1 lists the companies, academic institutions, or other entities of the representatives we interviewed.)

Table 1: List of non-government interviewees

Alaska Native Broadband 1 License, LLC
Arraycomm
Bear Stearns
Brattle Group
Cingular
Consumers Energy Company
CSIS
CTIA
Dobson
Enterprise Wireless Allocation
Hogan and Hartson LLP
Information Technology Industry Council
Intel
Lockheed Martin
Lucent Technologies
Manhattan Institute
Metro PCS
Mobile Relay Associates
Motorola
National Association of Broadcasters
New America Foundation
New Skies Satellites
Nextel
Prudential Financial
Stanford University
Sprint PCS
T-Mobile
United Telecom Council
University of California, Berkley
University of Maryland
University of Pennsylvania
Verizon Wireless
Yale Law School

Source: GAO.

We also contracted with the National Academies to convene a balanced, diverse panel of experts to discuss spectrum allocation and assignment

issues and options to improve spectrum management in the future. We worked closely with the National Academies to identify and select 23 panelists who could adequately respond to our general and specific questions about spectrum allocation, assignment processes, and options for improvement. In keeping with National Academies policy, the panelists were invited to provide their individual views, and the panel was not designed to reach a consensus on any of the issues that we asked them to discuss. The panelists convened at the National Academies in Washington, D.C., on August 9 and 10, 2005. Twelve panelists participated on the panel on August 9, 2005; eleven panelists participated on the panel on August 10, 2005. (See table 2 for the list of panelists on each day.) The agendas and questions were identical for both days. To start each day, the panel moderators provided an overview of the issues to be discussed; during the remainder of the day, the panelists addressed the questions we had provided for their consideration. At the end of the each session, we asked the panelists to individually answer a short series of questions about the topics discussed in order to more systematically capture individual panelists' views on key dimensions. We did not verify the panelists' statements, although we did ask the panelists, in some instances, to clarify certain details. The views expressed by the panelists do not necessarily represent the views of GAO or the National Academies.

Table 2: Panelists on GAO/National Academies expert panel

Name	Affiliation
August 9, 2005	
Dale Hatfield (moderator)	Independent consultant and Adjunct Professor, University of Colorado, Boulder
Peter Cramton	Professor, University of Maryland, College Park
David Donovan	President, Association for Maximum Service Television, Inc.
Gerald Faulhaber	Professor, The Wharton School, University of Pennsylvania
Bruce Franca	Deputy Chief, Office of Engineering and Technology, Federal Communications Commission
Ellen Goodman	Associate Professor, Rutgers School of Law, Camden
Mark McHenry	President, Shared Spectrum
William Moroney	President and CEO, United Telecom Council
Charla Rath	Executive Director, Spectrum and Public Policy, Verizon Wireless

(Continued From Previous Page)

Name	Affiliation
David Reed	Fellow, HP Labs and Adjunct Professor, Massachusetts Institute of Technology
Steve Sharkey	Director, Spectrum and Standards Strategy, Motorola, Inc.
Badri Younes	Director, Spectrum Management, Department of Defense
August 10, 2005	
Gregory Rosston (moderator)	Deputy Director, Stanford Institute for Economic Policy Research, Stanford University
Paul Besozzi	Attorney, Patton Boggs, LLP
Diane J. Cornell	Vice President, Regulatory Policy, Cellular Telecommunications and Internet Association
Joe Gattuso	Senior Policy Advisor, Office of the Assistant Secretary, National Telecommunications and Information Administration
Kalpak Gude	Vice President, Government Regulatory Affairs and Associate General Counsel, PanAmSat
Thomas W. Hazlett	Professor of Law and Economics, George Mason University
Dewayne Hendricks	CEO, The Dandin Group
Kevin Kahn	Intel Senior Fellow, Communications Technology Lab, Intel Corporation
David Sidall	Attorney, Paul, Hastings, Janofsky & Walker, LLP
Jennifer Warren	Senior Director, Trade & Regulatory Affairs, Lockheed Martin
Jimmy R. "Rusty" Williams	Infrastructure Services Manager, Planning & Engineering, Southern Company Services

Source: GAO.

After the expert panel was conducted, we analyzed a transcript of the panel's discussion and survey responses in order to identify principal themes and panelists' views. The results of the expert panel should be interpreted in the context of two key limitations and qualifications. First, although we were able to secure the participation of a balanced, highly qualified group of experts, there are other experts in this field who could not be included because of the need to limit the size of the panel. Although many points of view were represented, the panel was not representative of all potential views. Second, even though we conducted preliminary research, in cooperation with The National Academies, and heard from national experts in their fields, two panels cannot represent the current practice in this vast arena. More thought, discussion, and research must be done to develop greater agreement on what is really known, what needs to be done, and how to do it. These two key limitations and qualifications provide contextual boundaries. Nevertheless, the panel provided a rich

dialogue on spectrum allocation and assignment issues, as well as options for improving spectrum management in the future; the panelists also provided insightful comments in responding to the questions posed to the panel.

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