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History and Current Issues Related to Radio Spectrum Management

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Mr. Chairman and Members of the Committee:

I am pleased to be here to report on the preliminary observations from our work on radio spectrum management issues. The radio spectrum is the medium that makes possible wireless communications of all sorts, such as cellular and paging services, radio and television broadcasting, radar, and satellite-based services. As new technologies that depend on the radio spectrum continue to be developed and used more widely, managing the spectrum has grown increasingly challenging. The radio spectrum can become congested if too many users operate on it in an uncoordinated manner. Moreover, because spectrum has no geographical boundaries, the domestic management of spectrum is closely tied to international agreements on spectrum use. Therefore, the radio spectrum must be carefully managed, both on a national and international level, to meet the needs of a constantly increasing variety of services and users. One important task of spectrum management is the allocation of spectrum, or the apportionment of spectrum between the different types of uses and users of wireless services. As demand for spectrum has grown, this task has become more difficult, raising complex questions that cannot be easily answered.

At the request of this committee, we have interviewed agency and industry officials and reviewed relevant documents to address the following issues: (1) the evolution of the current legal framework for domestic spectrum management; (2) how well the current U.S. spectrum management structure facilitates the allocation of spectrum; (3) what challenges the United States faces in preparing for World Radiocommunication Conferences (WRC), at which decisions are made on how to allocate spectrum internationally; and (4) how the federal government encourages efficient use of spectrum by federal agencies

Our work is ongoing and will result in a report to be issued this summer. We reviewed the legislative history and relevant agency manuals, policies, and regulations, and interviewed officials responsible for spectrum management from the Federal Communications Commission (FCC), National Telecommunications and Information Administration (NTIA), and Department of State, and key wireless industry representatives. In addition, to determine how the federal government uses and manages spectrum, we interviewed officials from the following seven agencies: the Department of Energy, the Department of the Interior, the Federal Aviation Administration, the Coast Guard, the Department of Justice, the Federal Emergency Management Administration, and the National Aeronautics and Space Administration.

In summary, our preliminary observations are as follows:

- The current legal framework for domestic spectrum management evolved as a compromise over the questions of who should determine the distribution of spectrum among competing users and what standard should be applied in making this determination. Although initially all responsibility for spectrum management was placed in the executive branch, since 1927 this responsibility has been divided between the executive branch for managing federal use (currently, the President has delegated this responsibility to the National Telecommunications and Information Administration), and an independent commission for managing non-federal spectrum use (at first the Federal Radio Commission and since 1934, its successor, the Federal Communications Commission). The standard to be applied in managing non-federal government spectrum is “the public interest.” Under this divided management framework, no one entity has ultimate decision-making power over all spectrum users; the two agencies must coordinate and cooperate in order to determine how to accommodate different users competing for spectrum.
- The current shared U.S. spectrum management structure has processes for allocating spectrum for new uses and users of wireless services, but these processes have occasionally resulted in lengthy negotiations between FCC and NTIA over how to resolve some allocation issues. Since nearly all of the usable radio spectrum has been allocated already, accommodating more services and users often involves redefining spectrum allocations. One method of doing this used by FCC and NTIA is to increase the amount of shared spectrum. In shared spectrum, more than one type of service or user may utilize the frequencies in the allocation. For example, according to NTIA, 56 percent of the spectrum in the 0-3.1 GHz range is now shared between federal and non-federal users. Another method of redefining allocations, called band clearing, involves moving a service or user from one area of spectrum to another in order to make room for a new service or user. Occasionally, these methods are contentious and protracted, such as the continuing efforts to reallocate spectrum for third-generation advanced wireless services. Some government officials and nongovernmental representatives we interviewed discussed the possibility of designating a third party to arbitrate between FCC and NTIA in such circumstances and the need for better planning to help increase coordination between the two agencies in their shared management of this resource.

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- The United States faces challenges in effectively preparing for World Radiocommunication Conferences, at which decisions are made regarding the allocation of spectrum internationally, to ensure that the United States can best serve the interests of domestic spectrum users. Timely preparation has become more important and challenging due to increases in the frequency of conferences, the number of participating nations (each of which has one vote), and the number of items on conference agendas that countries vote on to change the international rules for spectrum use. In addition, regional blocks have emerged, with countries pooling their votes to promote their position on agenda items. Under the current structure, FCC and NTIA develop positions on agenda items through separate processes that involve the users of the spectrum they manage. The positions reached during these two processes must be merged into a unified U.S. position. An ambassador is appointed by the President for a period not exceeding six months to facilitate the development of this unified position and lead the U.S. delegation in negotiating for the adoption of U.S. positions at the World Radiocommunication Conference. In our meetings with government officials and wireless industry representatives, we heard differing opinions about (1) the ability of the United States to develop a unified position early enough to promote that position effectively and (2) the manner in which we appoint an ambassador to head the U.S. delegation.
 - NTIA has several activities to encourage efficient spectrum use by federal agencies, but it lacks assurance that these activities are effective. NTIA is required to promote efficiency in the federal spectrum it manages, which included more than 270,000 federal frequency assignments at the end of 2000. To do this, NTIA directs federal agencies to use only as much spectrum as they need. Because agencies have different mission-based needs and because there are a large number of frequency assignments that require attention, NTIA's frequency assignment and review processes place the primary responsibility for promoting efficiency in the hands of the agencies. NTIA requires that agencies justify their need for spectrum and review most spectrum assignments every 5 years. Officials from the seven federal agencies in our review told us that they attempt to use spectrum as efficiently as possible, but five of them are not completing the required five-year reviews in a timely or meaningful way because of staff shortages and other agency priorities. Moreover, although NTIA has established monitoring programs to verify how agencies are using spectrum, it said that some of these programs are inactive because of staff and funding shortages. NTIA also conducts research and technical initiatives that are designed to promote efficiency by conserving spectrum, but NTIA said some of these efforts have been difficult to implement. In

addition, NTIA states that its spectrum management fees, which were designed to recover part of the costs of NTIA's spectrum management functions, provide agencies with a financial incentive to remove inactive assignments. However, it is not clear that these fees promote efficient use of spectrum because agencies can reduce the number of assignments without returning spectrum.

In addition to these issues, the committee requested that we review how the current rules and regulations governing spectrum holders affect the rollout of new technologies and services and the level of competition in markets that utilize spectrum. As part of this work, we will look at how other countries manage spectrum. Although our review of these issues will not be completed until early 2003, I will briefly discuss our ongoing work at the end of this statement.

Background

To a large degree, spectrum management policies flow from the technical characteristics of radio spectrum. Although the radio spectrum spans nearly 300 billion frequencies, 90 percent of its use is concentrated in the 1 percent of frequencies that are below 3.1 gigahertz.¹ The crowding in this region has occurred because these frequencies have properties that are well suited for many important wireless technologies, such as mobile phones, radio and television broadcasting, and numerous satellite communication systems.

The process known as spectrum allocation has been adopted, both domestically and internationally, as a means of apportioning frequencies among the various types of uses and users of wireless services and preventing radio congestion, which can lead to interference. Interference occurs when radio signals of two or more users interact in a manner that disrupts the transmission and reception of messages. Spectrum 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, such as broadcast television and satellites. Over the years, the United States has designated hundreds of frequency bands for numerous types of wireless services. Within these bands, government, commercial, scientific,

¹ Radio waves are a form of electromagnetic radiation that propagates in space as the result of particle oscillations. The number of oscillations per second is called frequency, which is measured in units of hertz. The terms "kilohertz" refers to thousands of hertz and "gigahertz" to billions of hertz. The radio spectrum comprises a range of frequencies from 3 kilohertz to around 300 gigahertz.

and amateur users receive specific frequency assignments or licenses for their wireless operations.² The equipment they use is designed to operate on these frequencies.

During the last 50 years, developments in wireless technology have opened up additional usable frequencies, reduced the potential for interference, and improved the efficiency of transmission through various techniques, such as reducing the amount of spectrum needed to send information. While this has helped limit congestion within the radio spectrum, competition for additional spectrum remains high. Wireless services have become critically important to federal, state, and local governments for national security, public safety, and other functions. At the same time, the consumer market for wireless services has seen extraordinary growth. For example, mobile phone service in the United States greatly exceeded the industry's original growth predications, as it jumped from 16 million subscribers in 1994 to an estimated 110 million in 2001.

Framework for Spectrum Management

The legal framework for allocating radio spectrum among federal and non-federal users emerged from a compromise over two fundamental policy questions: (1) whether spectrum decisions should be made by a single government official, or a body of decision-makers; and (2) whether all non-federal users should be able to operate radio services without qualification, or if a standard should be used to license these operators. The resulting regulatory framework—dividing spectrum management between the President and an independent regulatory body—is rooted both in the President's responsibility for national defense and in the fulfillment of federal agencies' missions, and the encouragement and recognition by the federal government of the investment made by private enterprise in radio and other communications services.

The first federal statute to establish a structure for spectrum management—the Radio Act of 1912³—consolidated licensing authority

² Part 15 of FCC rules permits the operation of authorized low-power wireless devices without a license from FCC or the need for frequency coordination. The technical standards contained in Part 15 are designed to ensure that there is a low probability that these unlicensed devices will cause harmful interference to other users of the radio spectrum. 47 C.F.R. § 15 (2001).

with the Secretary of Commerce. However, the act proved to be deficient in addressing the burgeoning growth of radio communications and ensuing interference that occurred in the late 1910s and 1920s. Specifically, the Secretary of Commerce lacked the authority to use licensing as a means of controlling radio station operations,⁴ or to take actions to control interference, such as designating frequencies for uses or issuing licenses of limited duration. In recognition of such limitations, deliberations began in the 1920s to devise a new framework for radio spectrum management. Although there was general agreement that licensing should entail more than a registration process, there was debate about designation of the licensing authority and the standard that should govern the issuance of licenses.⁵

The Radio Act of 1927,⁶ reflecting a compromise on a new spectrum management framework, reserved the authority to assign frequencies for all federal government radio operators to the President and created the Federal Radio Commission (FRC) to license non-federal government operators. Composed of five members from five different regions of the country, FRC could assign frequencies, establish coverage areas, and establish the power and location of transmitters under its licensing

³ 37 Stat. 302 (1912). The Radio Act of 1912 was enacted, in part, to fulfill U.S. obligations incurred by the first international radio treaty. Congress had passed an earlier federal statute, the Wireless Ship Act, 36 Stat. 629 (1910), as amended, 37 Stat. 199 (1912), to address a first use of radio—safety of ships at sea. In 1904, President Roosevelt adopted a recommendation of the first known inter-agency board to address radio use by the federal government placing all government coastal radio facilities under the U.S. Navy’s control.

⁴ The Secretary of Commerce could not refuse to grant a license upon proper application under the Act as held by a court and two attorneys general opinions. *See* 29 Op. 579 (1912); 35 Op. 126 (1926); Hoover v. Intercity Radio Co., Inc.; 286 Fed. 1003 (D.C. Cir., 1923). The Secretary had no power to make regulations additional to those in the act. *See* United States v. Zenith Radio Corporation et al., 12 F. (2d) 614 (N.D. Ill., 1926); Carmichael v. Anderson, 14 F. 2d 166 (W.D. Mo. 1926). The 1912 act did not regulate broadcasting. *See* Tribune Co. v. Oak Leaves Broad. Station, Inc., et al., reported in the Congressional Record on December 10, 1926 (Cong. Rec. Vol. 68, Part I, pp. 216-219).

⁵ This debate went on over several years as the Department of Commerce convened four radio conferences (1922-25) attended by manufacturers, broadcasters, civilian and military government users, and other stakeholders to make recommendations addressing overcrowding of the airwaves. Designation of the Secretary of Commerce as the sole licensing authority, one of the recommendations from the conferences, was a matter of contention in congressional debate on new legislation.

⁶ 44 Stat. 1162 (1927). Under the act, the FRC was granted licensing authority for one year to resolve interference problems and then was to become an appellate body to address disputes with the Secretary of Commerce who was to assume licensing duties. However, the FRC’s one-year tenure was extended three times by Congress, the last for an indefinite term pending new legislation.

authority. Further, the act delineated that a radio operation proposed by a non-federal license applicant must meet a standard of “the public interest, convenience and necessity,” and that a license conveyed no ownership in radio channels nor created any right beyond the terms of the license.⁷ FRC’s authorities were subsequently transferred to the Federal Communications Commission (FCC), and the FRC was abolished upon enactment of the Communications Act of 1934, which brought together the regulation of telephone, telegraph, and radio services under one independent regulatory agency. The 1934 act also retained the authority of the President to assign spectrum to and manage federal government radio operations.

The need for cooperative action in solving problems arising from the federal government’s interest in radio use was recognized in 1922 with the formation of the Interdepartment Radio Advisory Committee (IRAC), comprised of representatives from the federal agencies that use the most spectrum.⁸ IRAC, whose existence and actions were affirmed by the President in 1927, has continued to advise whoever has been responsible for exercising the authority of the President to assign frequencies to the federal government.⁹ In 1978, the President’s authority for spectrum management of federal government users was delegated to NTIA, an agency of the Department of Commerce.¹⁰ IRAC assists NTIA in assigning

⁷ Prior to the 1927 Radio Act, an Illinois state court issued a decision to enforce a property right to a radio frequency under the principle of “right of user.” Tribune Co. v. Oak Leaves Broad. Station, Inc., et al., (Cir. Ct., Cook County, Ill. 1926), reprinted in 68 Cong. Rec. 216 (1926).

⁸ When originally formed in 1922, the inter-agency committee was known as the “Interdepartment Advisory Committee on Governmental Radio Broadcasting.”

⁹ Under the Radio Act of 1927, the President’s spectrum management authority was delegated—and IRAC reported through—first, the Secretary of Commerce, and then, beginning in 1932, the FRC (replaced by the FCC in 1934). In 1940, an inter-agency Defense Communications Board was formed to coordinate the relationship of all branches of communication to the national defense; IRAC reported directly to the Board as of 1941 until the Board was abolished in 1947. Since 1951, the President’s spectrum management authority, coupled with telecommunications policy advice, has been delegated, and IRAC has reported through: the Telecommunications Advisor to the President (1951); the director of the Office of Defense Mobilization (1953); the director of the Office of Civil Defense Mobilization (1958); the director of Telecommunications Management (1962); the director of the Office of Telecommunications Policy (1970); and NTIA (1978).

¹⁰ President Carter’s Executive Order 12,046, issued in 1978, abolished the Office of Telecommunications Policy, transferred its functions to the Department of Commerce, and established an Assistant Secretary for Communications and Information. Subsequently, the Department formally established NTIA and Congress codified NTIA and its mission into law. *See* The Telecommunications Authorization Act of 1992, 106 Stat. 3533 (1992).

frequencies to federal agencies and developing policies, programs, procedures, and technical criteria for the allocation, management, and use of the spectrum.

Over the past 75 years, since the 1927 act formed our divided structure of spectrum management, there is historical evidence of cooperation and coordination in managing federal and non-federal users to ensure the effective use of spectrum. For example, FCC and IRAC agreed in 1940 to give each other notice of proposed actions that might cause interference or other problems for their respective constituencies. Further, FCC has always participated in IRAC meetings¹¹ and NTIA frequently provides comments in FCC proceedings that impact federal radio operations. And, as I will discuss later, FCC and NTIA also work together with the Department of State to formulate a unified U.S. position on issues at international meetings that coordinate spectrum use regionally and globally. However, as demand for this limited resource increases, particularly with the continuing emergence of new commercial wireless technologies, NTIA and FCC face serious challenges in trying to meet the growth in the needs of their respective incumbent users, while accommodating the needs of new users.

Facilitating Spectrum Allocations

The current shared U.S. spectrum management structure has methods for allocating spectrum for new uses and users of wireless services, but these methods have occasionally resulted in lengthy negotiations between FCC and NTIA over how to resolve some allocation issues. Since nearly all of the usable radio spectrum has been allocated already, accommodating more services and users often involves redefining spectrum allocations.

One method, spectrum “sharing,” enables more than one user to transmit radio signals on the same frequency band. In a shared allocation, a distinction is made as to which user has “primary” or priority use of a frequency and which user has “secondary” status, meaning it must defer to the primary user. Users may also be designated as “co-primary” in which the first operator to obtain authority to use the spectrum has priority to use the frequency over another primary operator. In instances where spectrum is shared between federal and non-federal users—currently

¹¹ Although FCC once served as a representative to IRAC, its role in IRAC was transformed in 1952 to that of liaison.

constituting 56 percent of the spectrum in the 0-3.1 GHz range¹²—FCC and NTIA must ensure that the status assigned to users (primary/secondary or co-primary) meet users’ radio needs, and that users abide by rules applicable to their designated status.

Another method to accommodate new users and technologies is “band-clearing,” or re-classifying a band of spectrum from one set of radio services and users to another, which requires moving previously authorized users to a different band. Band-clearing decisions affecting either only non-federal or only federal users are managed within FCC or NTIA respectively, albeit sometimes with difficulty. However, band-clearing decisions that involve radio services of both types of users pose a greater challenge. Specifically, they require coordination between FCC and NTIA to ensure that moving existing users to a new frequency band is feasible and not otherwise disruptive to their radio operation needs.¹³ While many such band-clearing decisions have been made throughout radio history, these negotiations can become protracted. For example, a hotly debated issue is how to accommodate third-generation wireless services.¹⁴ FCC also told us that the relationship between FCC and NTIA on spectrum management became more structured following the

¹² NTIA also reported that 42 percent of the shared allocations between federal and non-federal users in the 0 to 3.1 GHz range are shared on a “co-primary” basis.

¹³ The Strom Thurmond National Defense Authorization Act for the Fiscal Year 1999, P.L. 105-251, Oct. 17, 1998, authorized federal entities to accept compensation payments when they relocate or modify their frequency use to accommodate non-federal users of the spectrum. The National Defense Authorization Act for Fiscal Year 2000, P.L. 106-65, Oct. 5, 1999, specified a number of conditions that have to be met if spectrum in which DOD is the primary user is surrendered. The act requires NTIA, in consultation with FCC, identify and make available to DOD for its primary use, if necessary, an alternate band(s) of frequency as replacement for the band surrendered. Further, if such band(s) of frequency are to be surrendered, the Secretaries of Defense and Commerce, and the Chairman of the Joint Chiefs of Staff must jointly certify to relevant congressional committees that such alternative band(s) provide comparable technical characteristics to restore essential military capability.

¹⁴ For more information on spectrum use decisions for third-generation wireless services, see *Defense Spectrum Management: More Analysis Needed to Support Use Decisions for the 1755-1850 MHz Band* (GAO-01-795, August 20, 2001).

enactment of legislative provisions mandating the reallocation of spectrum from federal to non-federal government use.¹⁵

To address the protracted nature of some spectrum band-clearing efforts, some officials we interviewed have suggested establishing a third party—such as an outside panel or commission, an office within the Executive branch, or an inter-agency group—to arbitrate or resolve differences between FCC and NTIA. In some other countries, decisions are made within one agency or within interagency mechanisms that exist for resolving contentious band-clearing issues. For example, the United Kingdom differs from the U.S. spectrum management structure in that a formal standing committee, co-chaired by officials from the Radiocommunications Agency and the Ministry of Defense, has the authority to resolve contentious spectrum issues.

Another proposed mechanism is the preparation of a national spectrum plan to better manage the allocation process. The Omnibus Budget Reconciliation Act of 1993 required NTIA and FCC to conduct joint spectrum planning sessions.¹⁶ The National Defense Authorization Act of 2000 included a requirement for FCC and NTIA to review and assess the progress toward implementing a national spectrum plan.¹⁷ Top officials from FCC and NTIA said that neither requirement has been fully implemented. However, they indicated their intention to implement these directives.

¹⁵ Omnibus Budget Reconciliation Act, P.L. 103-66, Aug. 10, 1993, mandated that bands of frequencies not less than 200 MHz be transferred from use of the federal government to non-federal users. NTIA was directed to make a report on the identification and recommendation for reallocation of frequency bands; utilize specific criteria in making recommendations; issue a preliminary report upon which public comment on proposed reallocations would be solicited; obtain analyses and comment from FCC on reallocations; and transfer frequency bands within specified time frames. It required FCC to gradually allocate and assign frequencies over the course of ten years. The Balanced Budget Act, P.L. 105-33, Aug. 5, 1997, imposed a stricter deadline for NTIA to identify for reallocation and FCC to reallocate, auction, and assign licenses by September 2002 for an additional 20 MHz of spectrum. (Eight MHz of spectrum was subsequently reclaimed per congressional direction. See section 1062 of the National Defense Authorization Act for Fiscal Year 2000, P.L. 106-65, Oct. 5, 1999.)

¹⁶ 47 U.S.C. § 922.

¹⁷ P.L. 106-65, 113 Stat. 767 (1999).

Challenges in Preparing for World Radiocommunication Conferences

A central challenge for the United States in preparing for WRCs, at which international spectrum allocation decisions are made, is completing the preparatory actions to ensure that the U.S. is able to effectively negotiate for international allocations that best serve the interests of domestic federal and non-federal spectrum users. The management of our domestic spectrum is closely tied to international agreements on spectrum use at regional and global levels. Domestic spectrum allocations are generally consistent with international allocations negotiated and agreed to by members of the International Telecommunication Union (ITU).¹⁸ The spectrum allocation decisions reached at these international conferences can affect the direction and growth of various wireless communications services and have far-reaching implications for the multi-billion dollar wireless communications industry in this country and abroad.

While the first international radio conferences were aimed at interference avoidance for early radio uses, such as maritime safety, meeting this same objective has become increasingly challenging throughout the last century with the proliferation of services and the number of nations adopting communications that utilize the radio frequency spectrum. For example, the emergence of new radio applications with international ramifications, such as broadcasting, radio navigation, and satellite-based services, has increased the need to reach agreements to prevent cross border signal interference and maximize the benefits of spectrum in meeting global needs, such as air traffic control. At the same time, the number of participating nations in these negotiations has risen dramatically—from 9 nations in the first conference held in 1903, to 65 nations in 1932, to 148 at the conference held in 2000—along with the frequency of conferences (now held every 2 to 3 years), and the number of agenda items negotiated at a conference (e.g., 11 in 1979; 34 in 2000). There has also been a movement toward regional cooperation at WRCs. Because decisions on WRC agenda items are made by vote of the participating countries—with one vote per country—uniform or block voting of nations in regional alignment has emerged to more effectively advance regional positions.¹⁹

¹⁸ ITU is a United Nations specialized agency. The federal government considers the ITU the principal competent and appropriate international organization for the purpose of formulating international treaties and understandings regarding certain telecommunications matters.

¹⁹ One of the U.S. delegation's objectives stemming from its experience at the 2000 WRC is to work more closely with participating countries in our own region in preparing for the 2003 conference.

The State Department coordinates and mediates the U.S. position for the WRC and leads the U.S. delegation to the conference through an ambassador appointed by the President. We found strong agreement among those we interviewed that it is important for the United States to develop its position in advance of the conference in order to have time to meet with other nations to gain international support for our positions. However, we heard differences of opinion about the United States' preparatory process for the conferences. U.S. positions on WRC agenda items are developed largely through separate processes by FCC and NTIA with the involvement of their respective constituencies. To obtain input from non-federal users, FCC convenes a federal advisory committee comprised of representatives of various radio interests (e.g., commercial, broadcast, private, and public safety users), and solicits comment through a public notice in the *Federal Register*. NTIA and federal government users can and do participate in the FCC process. To obtain the views of federal spectrum users, IRAC meets to provide NTIA with input on WRC agenda items. Although IRAC's WRC preparatory meetings are closed to the private sector due to national security concerns, non-federal government users may make presentations to IRAC to convey their views on WRC agenda items. Any differences of opinion between FCC and NTIA on the U.S. position must ultimately be reconciled into a unified U.S. position on each WRC agenda item. In cases where differences persist, the ambassador acts as a mediator to achieve consensus to form a position.

State Department and FCC officials told us that the work of FCC and NTIA with their respective constituencies and with each other in preparation for a conference leads to U.S. positions on WRC agenda items that are thoroughly scrutinized, well reasoned, and generally supported among federal and non-federal parties. In contrast, some non-federal officials told us that the NTIA process does not allow the private sector adequate involvement in the development of U.S. positions for the WRC. Also, some federal and non-federal officials said that since each agency develops its positions through separate processes, it takes too long to meld the two toward the end of the preparatory period. For example, to speed up our preparatory process, the former U.S. Ambassador to the 2000 WRC recommended merging the separate FCC and NTIA preparatory groups to

get an earlier start at working with industry and government users to reach a consensus on U.S. positions regarding WRC agenda items.²⁰

Differing views also have been expressed on how we appoint an individual to head the U.S. delegation. Since the early 1980s, the President has appointed an ambassador to head the U.S. delegation to WRCs for a time period not exceeding six months.²¹ The former U.S. Ambassador to the 2000 WRC said that ambassador status is generally believed to confer a high level of support from the administration, and it is viewed as helping to achieve consensus in finalizing U.S. positions and enhancing our negotiating posture. However, the former ambassador also said that the brief tenure of the appointment leaves little time for the ambassador to get up to speed on the issues, solidify U.S. positions, form a delegation, and undertake pre-conference meetings with heads of other delegations to promote U.S. positions. In addition, the ambassador said there is concern about the lack of continuity in leadership from one conference to the next, in contrast to other nations that are led by high-level government officials who serve longer terms and may represent their nations through multiple conferences. Leaders of national delegations with longer terms are perceived as being more able to develop relationships with their counterparts from other nations, helping them to negotiate and build regional and international support for their positions. On the other hand, NTIA officials expressed the view that the ambassador's negotiating skill was of equal importance to the duration of the appointment.

Encouraging Efficient Federal Spectrum Use

NTIA has several activities to encourage efficient spectrum use by the federal government, but does not have assurance that these activities are effective. NTIA is required²² to promote the efficient and cost-effective use of the federal spectrum that it manages—over 270,000 federal frequency assignments at the end of 2000—“to the maximum extent feasible.” NTIA has directed agencies to use only as much spectrum as they need.

²⁰ *Recommendations to Improve United States Participation in World Radiocommunication Conferences*, Ambassador Gail S. Schoettler, U.S. Head of Delegation, World Radiocommunications Conference 2000, June 27, 2000.

²¹ 22 U.S.C. § 3942. This provision of law enables the President to confer the personal rank of ambassador on an individual in connection with a special mission for the President not exceeding six months in duration. The President need only transmit to the Senate Committee on Foreign Relations a written report on the appointment; confirmation by the Senate is not needed.

²² 47 U.S.C. § 903(d)(1).

NTIA's process for assigning and reviewing spectrum places primary responsibility for promoting efficiency in the hands of the individual agencies because the determination of agencies' spectrum needs depends on an understanding of their varied missions. Moreover, the large number of frequency assignments that require attention (NTIA processes between 7,000 and 10,000 assignment action requests—applications, modifications, or deletions—from agencies every month on average) makes it necessary to depend heavily on the agencies to justify and review their assignment needs.

NTIA authorizes federal agency use of the spectrum through its frequency assignment process. As part of this process, NTIA requires an agency to justify on its application that it will use the frequency assignment to fulfill an established mission and that other means of communication, such as commercial services, are not appropriate or available. In turn, agencies generally rely on mission staff to identify and justify the need for a frequency assignment and complete the engineering and technical specifications for the application. NTIA and IRAC review the application to ensure, among other things, that the assignment will not interfere with other users. Once NTIA has authorized spectrum use by agencies, it requires that the agencies review their frequency assignments every 5 years to determine that the assignments are still needed and meet technical specifications.²³ NTIA said that it may delete assignments that have not been reviewed for more than 10 years.

Officials from the seven federal agencies in our review told us that they attempt to use spectrum as efficiently as possible, but five of them are not completing the required five-year reviews in a timely or meaningful way. According to agency officials, this is due to shortages of staff available to complete the review or because completing the reviews are a low agency priority. For example, a spectrum manager for a major agency division has over 1,000 frequency assignments that have not been reviewed in 10 years or more. A spectrum manager in another agency said that the agency has eliminated all field staff responsible for assisting with the five-year reviews, which has impaired the timeliness and quality of the reviews. The spectrum manager for a third federal agency said that he was sure that the agency was not using all of its frequency assignments, but he added that conducting a comprehensive review would be cost prohibitive and

²³ Certain aeronautical and military frequency assignments are required to be reviewed every 10 years.

generate limited benefits to the agency. However, we note that although the agencies may not reap benefits from conducting these reviews, if these reviews result in the release of unused or underutilized spectrum, other federal and non-federal users could benefit.

Although NTIA's rules and procedures also include NTIA monitoring programs designed to verify how spectrum is used by federal agencies, NTIA no longer conducts these programs as described. For example, at one time, the Spectrum Management Survey Program included NTIA site visits to verify if agency transmitters were being used as authorized. NTIA said that although this program helped correct frequency assignment information and educate field staff on NTIA requirements, it is not currently active due to NTIA staff shortages. In addition, the Spectrum Measurement Program made use of van-mounted monitoring equipment to verify that federal agencies were utilizing assigned frequencies in accordance with the assignment's requirements. NTIA said that although this program provided useful information, the van-mounted verification has been discontinued due to lack of resources. As a result of the limited nature of the assignment and review programs and decreased monitoring, NTIA lacks assurance that agencies are only using as much spectrum as they need.²⁴

NTIA also seeks to promote efficiency by advocating spectrum conservation through research and technical initiatives, but some of these activities face implementation problems. Two examples illustrate the potential and the limitations of these types of efforts. First, NTIA, with the approval of IRAC, has required all federal agencies to upgrade land-based mobile radios by setting deadlines for halving the spectrum bandwidth used per channel (in essence, freeing up half of each band currently in use) for radios in certain highly congested bands—a process called narrowbanding.²⁵ This requirement has the potential to greatly expand the spectrum available for land mobile telecommunications, but some agencies said that they are struggling to meet the deadline due to a lack of

²⁴ The issue of unused spectrum is not exclusive to federal agencies. A recent self-reported survey of some private radio bands by FCC resulted in the return of over 30,000 unused spectrum licenses.

²⁵ In 1992, Congress directed NTIA to adopt and implement a plan for federal agencies with existing mobile radio systems to use more spectrum-efficient technologies. 47 U.S.C. § 903(d)(3). In 1993, NTIA provided Congress with a report—*Land Mobile Spectrum Efficiency: A Plan for Federal Government Agencies to Use More Spectrum-Efficient Technologies*—that included the narrowbanding plan.

sufficient staff and funding. Several agencies in our review said they will not complete the upgrades before the deadline. For example, the Chief Information Officer for one agency that is a member of IRAC compared the requirement to an unfunded mandate, and indicated that his office did not have the financial resources needed to upgrade the tens of thousands of radios that fall under the requirement.

A second example of a technological initiative is a NTIA-sponsored pilot program for federal agencies in six cities in the early 1990s to establish a spectrum sharing method for voice radio communications, called trunking, which conserves spectrum by putting more users on each radio channel. According to NTIA, some agencies resisted the program because it was more costly for agencies to participate in trunking than it was for them to use their own channels. In addition, some agencies said the trunking systems did not meet their mission needs.²⁶ NTIA added that the program was only completely successful in Washington, DC, where agency demand for frequency assignments, and therefore spectrum congestion, is extremely high. We found efforts to encourage this technology in other countries as well. In the United Kingdom, providers of emergency services are being encouraged to join a trunking system. Once the new system has proved to be capable of meeting their needs, certain public safety users will incur financial penalties if they do not use this system. Additionally, in one province in Canada, a variety of public safety users have voluntarily begun developing a trunking system in order to use their assigned spectrum more efficiently in light of the fees they must pay for this resource.

NTIA also told us that the congressionally-mandated spectrum management fees agencies must pay also help to promote the efficient use of spectrum. These fees are designed to recover part of the costs of NTIA's spectrum management function. The fees began in 1996 and amounted to about \$50 per frequency assignment in 2001. NTIA decided to base the fee on the number of assignments authorized per agency instead of the amount of spectrum used per agency because the number of assignments better reflects the amount of work NTIA must do for each agency. Moreover, NTIA stated that this fee structure provides a wider distribution

²⁶ In addition to cost constraints, federal agencies can choose not to use an existing land mobile system if the agency can justify that it needs its own system to meet its mission requirements. For example, GAO agreed with NTIA that the Navy was in the best position to assess whether it needed its own land mobile system to meet its mission.

of cost to the agencies.²⁷ Although NTIA officials said that spectrum fees provide an incentive for agencies to relinquish assignments, it is not clear that this promotes efficient use of spectrum, in part because agencies may be able to reduce assignments without returning spectrum. For example, a spectrum manager for a federal agency said that the spectrum fee has caused the agency to reduce redundant assignments, but that it has not impacted the efficiency of the agency's spectrum use because the agency did not return any spectrum to NTIA as a result of reducing its assignments.

We have learned that other countries are moving toward using payment mechanisms for government spectrum users that are specifically designed to encourage government users to conserve their use of spectrum, rather than to recover the cost of managing the spectrum. Both Canada and the United Kingdom are reviewing their administrative fee structures at this time with the intent of encouraging spectrum efficiency.

Additional GAO Work on Spectrum Management

We are conducting additional work on the management of the radio spectrum to determine how the current rules and regulations governing spectrum holders affect the rollout of new technologies and services and the level of competition in markets that utilize spectrum. To address these and other related issues, we are building on the information presented here today concerning U.S. rules and regulations governing spectrum management. We are interviewing an array of providers of mobile telephone, satellite, paging services, broadcasters, NTIA, other federal agencies, and public safety representatives. Tomorrow we are hosting a panel with experts from several of these sources to elicit additional input on these and other issues.

We are also collecting information from spectrum managers in approximately 12 other countries. We are interested in learning about their regulatory structure, including their assignment processes, the amount of flexibility allowed spectrum users, the existence of secondary markets, and their rules regarding interference. In addition, we are interested in determining what incentives—market-based or administrative—are employed to encourage government and non-government users to

²⁷ A bandwidth-based approach would have forced the Air Force to pay the majority of the fees because of the large amount of spectrum the radars they operate use. However, each radar transmitter requires only one assignment.

conserve spectrum. We will also seek to determine what impact these regulators think their actions are having on consumer prices, the deployment of new technology, the rollout of new services, and the level of competition. From this work, we hope to summarize alternative approaches to spectrum management used around the world and to identify similarities and differences between these approaches and those used in the United States.

Mr. Chairman, this concludes my prepared remarks. I would be pleased to answer any questions you or other members of the committee may have.

Contact and Acknowledgments

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