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Report to Congressional Requesters

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TELECOMMUNICATIONS

Better Coordination and Enhanced Accountability Needed to Improve Spectrum Management

GAO-02-906

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Abbreviations

3G	third-generation wireless systems
BOC	Bell Operating Company
CITEL	Inter-American Telecommunication Commission
DOD	Department of Defense
DOE	Department of Energy
EHF	extremely high frequency
FCC	Federal Communications Commission
FRC	Federal Radio Commission
GHz	gigahertz
HF	high frequency
IRAC	Interdepartment Radio Advisory Committee
ITAC	International Telecommunication Advisory Committee
ITS	Institute for Telecommunication Science
ITU	International Telecommunication Union
kHz	kilohertz
LF	low frequency
MF	medium frequency
MHz	megahertz
NTIA	National Telecommunications and Information Administration
SHF	superhigh frequency
UHF	ultrahigh frequency
VHF	very high frequency
VLF	very low frequency
WARC	World Administrative Radio Conference
WRC	World Radiocommunication Conference

G A O
Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

September 30, 2002

The Honorable Conrad Burns
The Honorable Ernest F. Hollings
The Honorable Daniel K. Inouye
The Honorable John F. Kerry
United States Senate

The radiofrequency spectrum is the medium that enables wireless communications of all kinds, such as mobile phone and paging services, radio and television broadcasting, radar, and satellite-based services. As new spectrum-dependent technologies are developed and deployed, the demand for this limited resource has escalated among both government and private sector users. Meeting these needs domestically is the responsibility of the Department of Commerce's National Telecommunications and Information Administration (NTIA) for federal government users and the Federal Communications Commission (FCC) for all other users. One of these agencies' most important tasks is to decide how to allocate (apportion) the spectrum among the different types of wireless services and users—a task that is increasingly difficult as the spectrum becomes more crowded and competition for radiofrequencies intensifies. A further complication is that domestic management and use of the spectrum and its commercial development are greatly affected by international agreements on spectrum use. Our ability to promote our strategic and economic interests internationally has become more difficult as countries vie with the United States for leadership in the multibillion dollar global telecommunications marketplace. As a result of these developments, debate has been intensifying about whether our current approach to spectrum management is adequate to meet the challenges of the wireless age.

As the Congress begins to debate whether fundamental reforms are needed in spectrum management, you asked us to provide an overview of the development of the legal and regulatory framework for spectrum management at the federal level and assess key issues associated with spectrum management at federal agencies. As agreed, we focused on the following issues: (1) the evolution of the current legal and regulatory framework for domestic spectrum management; (2) the current methods for allocating spectrum domestically and planning for its use; (3) the adequacy of the current U.S. preparatory process for the World Radiocommunication Conferences, at which decisions are made on how to allocate spectrum internationally; and (4) the activities used to increase

accountability and encourage the efficient use of spectrum by federal agencies.

In addition to these issues, you 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 use spectrum. Work on this issue is ongoing and will result in a separate report early in 2003, which will also include a discussion of approaches to spectrum management in other countries, such as the use of incentives for efficient spectrum use.

To address the four issues covered in this report, we reviewed major legislative and regulatory developments in spectrum management over the past century, along with relevant agency manuals, policies, and regulations. We interviewed officials responsible for spectrum management at FCC, NTIA, and the Department of State. We also interviewed representatives from the commercial wireless industry. To gain an understanding of how the federal government uses and manages spectrum, we reviewed relevant documents and interviewed officials from the following seven agencies that are major users of this resource: the Department of Energy, the Department of the Interior, the Federal Aviation Administration, the Coast Guard, the Department of Justice, the Federal Emergency Management Agency, and the National Aeronautics and Space Administration.[1] We conducted our review from July 2001 through July 2002 in accordance with generally accepted government auditing standards.

Results in Brief

The current legal framework for domestic spectrum management evolved as a compromise over the questions of who should determine how spectrum is allocated among competing users and what standard should be applied in making this determination. Although all spectrum management was initially placed in the executive branch, concern over concentrating licensing authority in this way led to legislation in 1927 and 1934 that divided this authority between the executive branch for federal government spectrum use and an independent commission for nonfederal

[1]The Department of Defense, one of the largest users of the federal spectrum, was not included in this review because we recently completed a separate report on defense spectrum management. U.S. General Accounting Office, *Defense Spectrum Management: More Analysis Needed to Support Spectrum Use Decisions for the 1755-1850 MHz Band*, GAO-01-795 (Washington, D.C.: Aug. 20, 2001).

spectrum use, currently NTIA and FCC, respectively. Since 1922, the Interdepartment Radio Advisory Committee (IRAC)—composed of the representatives from the federal agencies that use the most spectrum—has been a source of advice and support on the federal government's use of spectrum. Under the divided management framework, no one entity has been given ultimate decision-making power over all spectrum use, and the two agencies must coordinate and cooperate in order to determine how best to accommodate different users competing for spectrum.

Current methods for allocating spectrum face difficulties, and FCC and NTIA's efforts are not guided by a national spectrum strategy. Since nearly all of the usable radio spectrum has been allocated already, accommodating more services and users generally involves redefining current radiofrequency allocations. One method used by FCC and NTIA is to increase the amount of spectrum that is designated for shared use, so that additional types of services or users may be placed within a particular frequency allocation. Another method, called band-clearing, involves relocating a service or user from one area of spectrum to another in order to make room for a new service or user. Both of these methods can sometimes result in lengthy negotiations between FCC and NTIA because redefining allocations can be disruptive and costly for incumbent users who may need to replace their radio equipment to operate at new frequencies. Some government and private sector sources have raised the possibility of designating a third party to arbitrate between FCC and NTIA on hard-to-resolve allocation issues, though no consensus has emerged either on the necessity for this or who the arbiter should be. Congress has twice mandated that FCC and NTIA engage in coordinated planning, which could aid in resolving difficult allocation issues. Although FCC and NTIA have conducted independent planning efforts and are currently engaged in efforts that could provide the basis for improved planning, it is uncertain whether these efforts will result in a clearly defined national spectrum strategy. As a result, we are recommending that FCC and NTIA develop a strategy for establishing a clearly defined national spectrum plan and report the results of this effort to the appropriate congressional committees.

The challenges the United States faces in preparing for World Radiocommunication Conferences, where decisions are made regarding the global and regional allocation of spectrum, have raised questions about the adequacy of the United States' current preparatory process. Under the current structure, FCC and NTIA develop positions on agenda items through separate processes that involve the users of the spectrum they

manage. With the assistance of the Department of State, the positions are then merged into a unified U.S. position. Timely preparation for these conferences is important to give the United States an opportunity to build support with other countries for its position on conference agenda items. In the past, however, the U.S. position on some items has remained unresolved until the eve of the conference, leaving the United States with little time to build preconference support. Another challenge involves the short tenure of the individual selected as the head of delegation, whose role is to help negotiate a unified U.S. position and lead the U.S. delegation at the conference. The President typically confers the personal rank of ambassador in connection with this special mission for a period not exceeding 6 months. There is concern that this leaves the ambassador with insufficient time to prepare for the conference. No consensus has been reached on whether fundamental changes are needed to improve the current preparatory process for World Radiocommunication Conferences. We are recommending all three agencies jointly review the adequacy of the preparation process following the 2003 World Radiocommunication Conference and develop recommendations for any needed changes.

NTIA has several oversight activities to encourage accountability and efficient use of the spectrum by federal agencies, but federal officials stated that the effectiveness of these activities is hindered by staffing and resource shortages. Specifically, NTIA has directed federal agencies to use only as much spectrum as they need and has established frequency assignment and review processes that place primary responsibility for promoting efficiency in the hands of the agencies. As an accountability measure, NTIA requires that agencies justify their initial need for a frequency assignment and periodically review their continued need for the assignment, generally every 5 years. Officials from several federal agencies told us that they have been unable to complete the required 5-year reviews in a timely or in-depth manner because of shortages in experienced spectrum staff and competing agency priorities. Moreover, although NTIA has established monitoring programs to further increase agency accountability, it said that some of these programs are inactive because of staff and funding shortages. NTIA also conducts research and has technical initiatives under way to promote the efficient use of the spectrum. However, several agencies we reviewed reported difficulties implementing an important NTIA initiative for more efficient use of land mobile radio spectrum. Due to these workforce issues, we are recommending that the Department of Commerce conduct an analysis of the human capital needs of federal agencies for spectrum management as well as develop a strategy for enhancing its oversight of federal agencies' use of spectrum.

In commenting on the draft of this report, FCC, the Department of Commerce, and the Department of State were in general agreement with our recommendations. FCC, the Department of Commerce, and the Department of State offered technical comments that were incorporated as appropriate.

Background

To a large degree, spectrum management policies flow from the technical characteristics of the radio spectrum. Although the radio spectrum spans the range from 3 kilohertz to 300 gigahertz, 90 percent of its use is concentrated in the 1 percent below 3.1 gigahertz.[2] 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, numerous satellite communication systems, radars, and aeronautical telemetry systems.

The process known as spectrum allocation has been adopted, both domestically and internationally, as a means of apportioning frequencies among various types of wireless services and users to prevent radio interference. Interference occurs when two or more radio signals 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, and amateur users receive specific frequency assignments or licenses for their wireless operations.[3] The equipment they use is designed to operate on these frequencies. Appendix I provides an

[2]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 term kilohertz (kHz) refers to thousands of hertz, the term megahertz (MHz) refers to millions of hertz, and the term gigahertz (GHz) refers to billions of hertz. The radio spectrum comprises a range of frequencies from 3 kHz to around 300 GHz.

[3]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).

overview of how the major frequency ranges of the spectrum are currently used.

During the last 50 years, developments in wireless technology have increased the number of 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. In June 2002, for example, FCC initiated a proceeding to promote the commercial development of several undeveloped bands in the upper region of the spectrum where new uses for these bands are becoming practical due to technological developments. Nevertheless, the demand for frequencies by both government and the private sector remains high as new technologies that use spectrum are developed and used. An example of this is the unexpectedly rapid growth of mobile phone use in the United States. Subscribers of mobile phone service jumped from 16 million in 1994 to an estimated 137 million in 2002, greatly exceeding even the wireless industry's original projections.

Concern Over Concentrating Authority Led to Divided Structure for Spectrum Management

Our nation's approach to spectrum management evolved in response to technical developments, legislation, court decisions, and policy initiatives.[4] The legal and regulatory framework in place today for allocating radio spectrum among federal and nonfederal users emerged from a compromise over two fundamental policy questions: (1) whether spectrum decisions should be made by a single government official or shared among several decision makers; and (2) whether all nonfederal government users should operate radio services without qualification, or if a standard should be used to license these operators. The resulting structure—dividing spectrum management between the President and an independent regulatory body—reflects both the President's responsibility for national defense and the fulfillment of federal agencies' missions, and the U.S. government's longstanding encouragement and recognition of private sector investment in developing and deploying commercial radio and other communications services.

The need for government regulation of the radiofrequency spectrum became apparent at the beginning of the twentieth century with the application of wireless communications to maritime safety. In 1904,

[4]Appendix II provides a detailed timeline on the evolution of spectrum management in the United States.

President Theodore Roosevelt adopted a recommendation of an interagency board and placed all government coastal radio facilities under the U.S. Navy's control. The first federal statute to establish a structure for spectrum management was the Radio Act of 1912,[5] which was enacted in part to rationalize the burgeoning use of the radio spectrum. The Act required users of the radio spectrum to obtain a license, and it consolidated licensing authority with the Secretary of Commerce.[6] Commerce's practice was to grant licenses for particular frequencies on a first-come, first-served basis.

This approach proved to be deficient, however, when the burgeoning growth of radio communications in the late 1910s and 1920s led to radiofrequency interference problems. The courts determined that the Secretary of Commerce lacked the authority under the 1912 Act to alleviate these problems by using licensing as a means of controlling radio station operations[7] or by 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. 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. For example,

[5]The Radio Act of 1912, ch. 287, 37 Stat. 302 (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, ch. 379, 36 Stat. 629 (1910), as amended, ch. 250, 37 Stat. 199 (1912), to address a first use of radio—safety of ships at sea.

[6]The Act designated what was then the Department of Labor and Commerce as the licensing authority. When that department was separated into two cabinet departments in 1913, the licensing authority was given to the new Department of Commerce.

[7]The Secretary of Commerce could not refuse to grant a license upon proper application under the Act as held by a court and opinions by two attorneys general. See 29 Op. Att'y Gen. 579 (1912); 35 Op. Att'y Gen. 126 (1926); *Hoover v. Intercity Radio Co., Inc.*, 286 F. 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*, 12 F.2d 614 (N.D. Ill., 1926). The 1912 Act did not regulate broadcasting. See *Tribune Co. v. Oak Leaves Broadcasting Station, Inc.*, (Cir. Ct., Cook County, Ill., 1926) reprinted in 68 Cong. Rec. 216-219 (1926).

at the first national radio conference in 1922, a bill was drafted that was subsequently introduced in the House of Representatives, that would have placed the issuance of licenses under the absolute discretion of the Secretary of Commerce. Subsequent bills introduced in the House and Senate in 1925 took differing approaches to licensing authority. The House bill would have vested licensing authority with the Secretary of Commerce with licensing appeals going to a commission, while the Senate bill would have placed all licensing functions in an independent commission from the start.

The Radio Act of 1927[8] reflected a compromise on a spectrum management framework. In order to allay concerns about vesting all licensing authority in the hands of one person (specifically, the Secretary of Commerce) the new Act reserved the authority to assign frequencies for all federal government radio operators to the President and created the Federal Radio Commission (FRC) to license nonfederal government operators. Under the Act, the FRC was granted licensing authority for one year to resolve interference problems, after which it was to become an appellate body to address disputes with the Secretary of Commerce, who was to assume licensing duties. Composed of five members from five different regions of the country, FRC was empowered to assign frequencies, establish coverage areas, and establish the power and location of transmitters under its licensing authority. Further, the Act delineated that a radio operation proposed by a nonfederal 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.[9]

The FRC's one-year authority over licensing was extended several times by the Congress because the commission needed more time to deal with interference problems. As these problems persisted, the FRC's authority was extended for an indefinite term pending new legislation. By 1930, it was becoming evident that the licensing task was too complex to be conferred permanently on the Department of Commerce, which was perceived as being already overburdened with other issues. New legislation

[8]Ch. 169, 44 Stat. 1162 (1927).

[9]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 Broadcasting Station, Inc.*, (Cir. Ct., Cook County, Ill. 1926), reprinted in 68 Cong. Rec. 216-219 (1926).

was enacted in the form of the landmark Communications Act of 1934.[10] Under this Act, the FRC was abolished and its authorities transferred to the new Federal Communications Commission (FCC), which brought together the regulation of telephone, telegraph, and radio services under one independent regulatory agency. The 1934 Act, however, also retained the authority of the President to assign spectrum to and manage federal government radio operations. For over 75 years, this division in responsibilities has remained the essential feature of U.S. spectrum management, unlike many other countries that chose to concentrate spectrum management within one government entity.

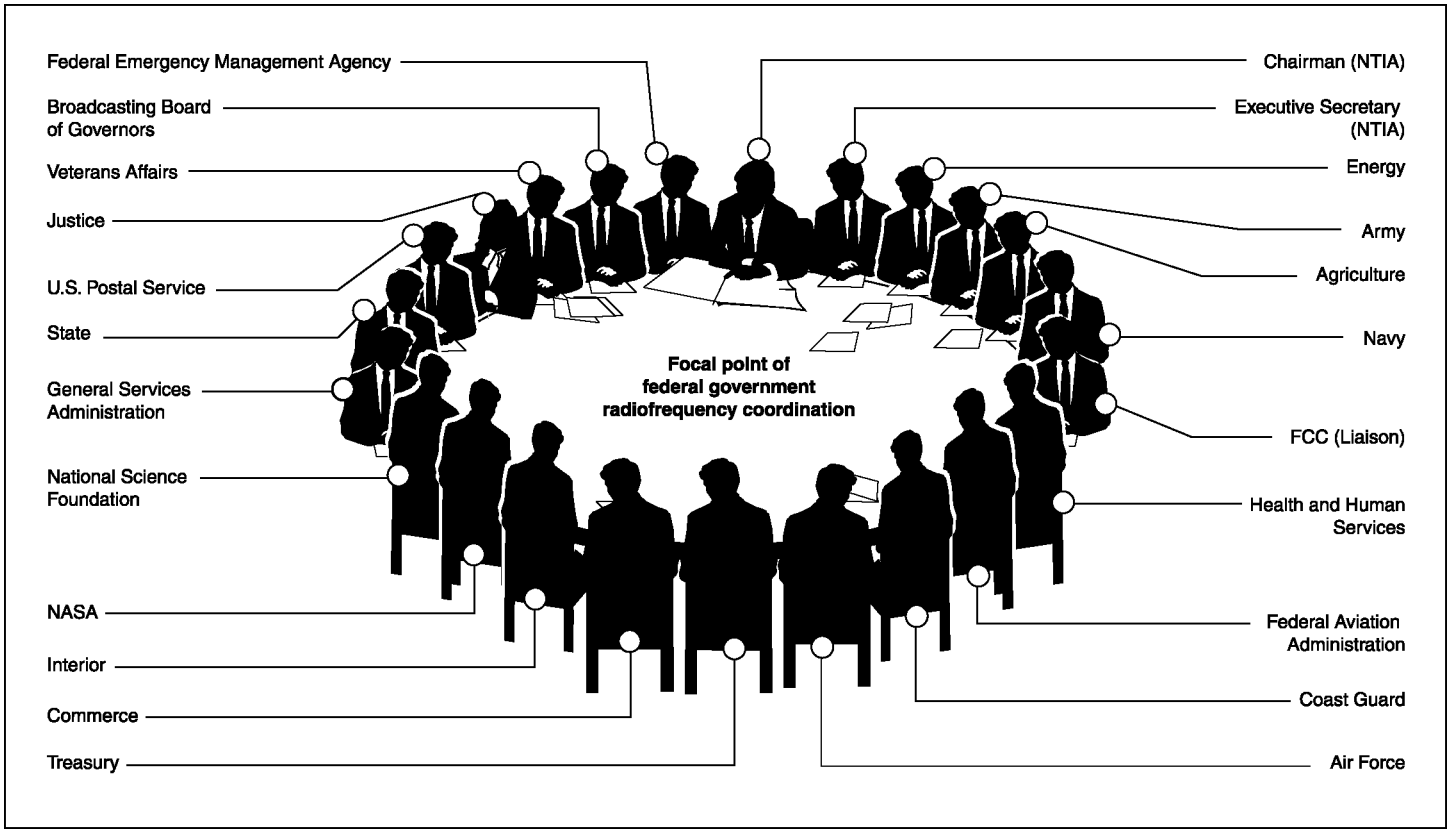
The President's authority for managing federal spectrum has been lodged in various parts of the government since the 1934 Act.[11] However, a source of advice and support on federal government spectrum use during these changes has been IRAC, composed of representatives from federal agencies that use the most spectrum. IRAC was formed in 1922 when Secretary of Commerce Herbert Hoover drew attention to the need for cooperative action in solving problems arising from the federal government's interest in radio use. He invited interested government departments to designate representatives for a special government radio committee. The committee recommended the establishment of a permanent interdepartmental committee. As a result, the Interdepartment Advisory Committee on Governmental Radio Broadcasting (later renamed IRAC) was formed. Over the ensuing decades, IRAC, whose existence and actions were affirmed by the President in 1927, has continued to advise whomever has been responsible for exercising the

[10]Ch. 652, 48 Stat. 1064 (1934)(codified, as amended, at 47 U.S.C. § § 151 *et seq.*).

[11]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 FCC in 1934). In 1940, an interagency 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 Adviser 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); and the Director of the Office of Telecommunications Policy (1970). 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 later codified NTIA and its mission into law. See The Telecommunications Authorization Act of 1992, P.L. 102–538, 106 Stat. 3533 (1992).

authority of the President to assign frequencies to the federal government. Currently, IRAC assists NTIA in assigning frequencies to federal agencies and developing policies, programs, procedures, and technical criteria for the allocation, management, and use of the spectrum. Figure 1 shows IRAC's present membership, which includes FCC in a nonvoting liaison capacity.

Figure 1: Interdepartment Radio Advisory Committee's Membership



Source: NTIA.

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 nonfederal spectrum to promote its effective use. 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 participated in IRAC meetings,[12] and NTIA frequently provides comments in FCC proceedings that affect federal radio operations. As will be discussed 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. As FCC has noted, the basic problem is that demand for spectrum is outstripping the supply.

Methods for Allocating Spectrum Face Difficulties and Are Not Guided by a Coordinated National Plan

Since nearly all of the usable radio spectrum has been allocated already, accommodating more services and users often involves redefining spectrum allocations. The current divided 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. Several, including Congress, have suggested that coordinated planning could help identify and resolve some allocation difficulties. FCC and NTIA have not yet implemented long-standing congressional directives to conduct joint, national spectrum planning although they have conducted independent planning efforts and have recently taken steps to improve coordination.

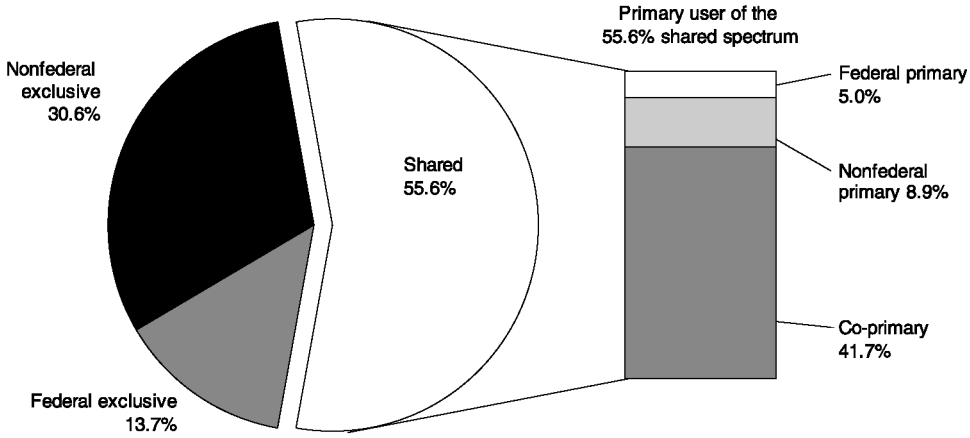
Spectrum Is Allocated through Sharing and Band-clearing

One method to accommodate more services and users is spectrum "sharing," which 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 that 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. As shown in figure 2, more than half of the

[12]Although FCC once served as a voting member of IRAC, its role in IRAC was changed to that of liaison in 1952 after IRAC's responsibilities were augmented to include formulating policies, plans, and actions for the management and use of government radiofrequencies.

spectrum from 9 kHz to 3.1 GHz is shared between federal and nonfederal users.[13] NTIA must ensure that the status assigned to users in shared spectrum (primary/secondary or co-primary) meets users' needs, and that users abide by rules applicable to their designated status.

Figure 2: Percent of Spectrum Shared by Federal and Nonfederal Users (9 kHz to 3.1 GHz)



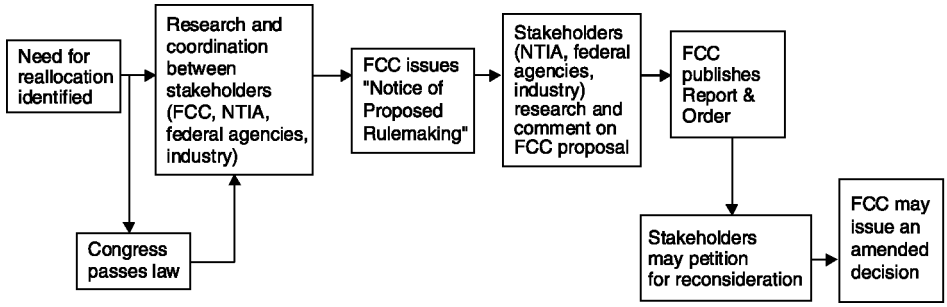
Source: NTIA.

Another method to accommodate new users and technologies is "band-clearing," or reclassifying 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 only nonfederal 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 technically feasible and meets their radio operation needs. In addition, such moves often involve costs to the existing user of the band, who may need to modify or replace existing equipment to operate on new frequencies.

[13]NTIA also reported that 42 percent of the currently shared allocations between federal and nonfederal users in the 0 to 3.1 GHz range are shared on a "co-primary" basis.

The need for spectrum reallocation can originate from many different sources, including the results of international decisions on spectrum use or requests from industry or federal users. Also, the Congress has in the past mandated the reallocation of spectrum from federal to nonfederal use. Once any needed research has been conducted and both FCC and NTIA agree on the proposed reallocation, FCC issues a "Notice of Proposed Rulemaking" to obtain public comments on the proposed allocation change. After the comment period, FCC publishes a *Report and Order* that directs any changes that will be made to the frequency allocation table. Spectrum users who disagree with the *Report and Order* may petition FCC for a change that could result in an amended decision. Figure 3 depicts the primary steps in the process by which the reallocation of a frequency band from a federal to nonfederal government designation would occur if no court challenges arise.

Figure 3: Spectrum Reallocation Process



Sources: FCC and NTIA.

While many such band-clearing decisions have been made throughout radio history, these negotiations can be protracted and contentious. A hotly debated issue today is how to accommodate "third-generation" wireless services, which enable handheld communication devices to provide both voice and high-speed data. In October 2000, President Clinton directed that a plan be developed to select spectrum for third-generation services, but this attempt was unsuccessful. A new task force was established. In July 2002 the Department of Commerce in conjunction with FCC, the Department of Defense (DOD), and other federal agencies released its study that concluded that 90 MHz of spectrum could be allocated for third-generation services without disrupting communication services critical to national security. This 90 MHz of spectrum could be available for third-

generation services no later than December 2008 and would come from both federal and nonfederal bands.

FCC told us that the relationship between FCC and NTIA on spectrum management became more structured since the Congress became active in the 1990s in directing the reallocation of spectrum from federal to nonfederal government use. For example, the Omnibus Budget Reconciliation Act of 1993 (P.L. 103-66, Aug. 10, 1993) directed the reallocation of not less that 200 MHz of spectrum from federal to private sector use. NTIA was directed to identify frequency bands that could be reallocated; use specific criteria in making recommendations for their reallocation; issue a preliminary report upon which public comment on proposed reallocations would be solicited; obtain analyses and comment from FCC; and transfer frequency bands within specified time frames. The Act also required FCC to gradually allocate and assign these frequencies over the course of 10 years. The Balanced Budget Act of 1997 (P.L. 105-33, Aug. 5, 1997) imposed a stricter deadline for NTIA to identify frequency bands for reallocation and required FCC to reallocate, auction, and assign licenses by September 2002 for an additional 20 MHz of spectrum.[14]

Various Options for Facilitating Reallocations Have Been Raised

To deal with the protracted nature of some spectrum reallocation decisions, some officials we interviewed have suggested establishing a third party—such as an outside panel or commission, an office within the White House, or an interagency group—to arbitrate or mediate differences between FCC and NTIA. For example, the United Kingdom has a formal standing committee, co-chaired by officials from the Radiocommunications Agency and the Ministry of Defense, that has authority to resolve contentious spectrum issues.[15] FCC officials noted, however, that an arbitration function would go to the core of the responsibilities currently entrusted to FCC and NTIA in making allocation decisions. Moreover, it is not clear how such a function would be set up or the extent to which the President, who retains spectrum management authority for government users and national defense, would allow this authority to be placed in the

[14]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, 113 Stat. 768 (1999) (codified, as amended, at 47 U.S.C. § 923(b)(3)(A)).

[15]Our continuing spectrum work focuses, in part, on the regulatory structure for spectrum management in approximately 12 other countries. A report that includes this work will be issued in early 2003.

hands of an arbitrator. FCC officials maintain that the handful of issues involving inherently difficult reallocation choices attracts attention and leads to what, in their view, is a mistaken assumption that the current reallocation process is broken. They noted that FCC and NTIA have coordinated successfully on over 50 spectrum-related rulemakings in the past year alone.

Mechanisms for ensuring that incumbent users receive comparable spectrum and are reimbursed for the cost of relocating are also being developed or proposed. The National Defense Authorization Act for Fiscal Year 2000[16] 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, to identify and make available to DOD for its primary use, if necessary, an alternate band(s) of frequency as replacement(s) for the band(s) 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. Under the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999,[17] federal agencies are authorized to accept compensation payments when they relocate or modify their frequency use to accommodate nonfederal users of spectrum. The Act directs NTIA and FCC to develop procedures for the implementation of the relocation provisions. NTIA issued a Notice of Proposed Rulemaking regarding these provisions in January 2001 and a final rule in June 2002. Under this rule, federal agencies would prepare an estimate of their relocation costs. This figure would be provided to potential bidders at future auctions. FCC has stated that the Commission will adopt any additional rules or procedures necessary to supplement NTIA's reimbursement procedures. Under current law, however, federal agencies would be unable to expend these payments without additional congressional action. In July 2002, the Department of Commerce sent to the congressional leadership a draft bill to amend the Communications Act of 1934 to create a Spectrum Relocation Fund to revise the procedures under which federal entities are paid for relocating from spectrum frequencies reallocated for auction to commercial entities. According to NTIA, this fund would benefit both the agencies, by providing

[16]P.L. 106-65, Div. A, Title X, § 1062 (b), 113 Stat. 768 (1999).

[17]P.L. 105-261, 112 Stat. 1920 (1998) (codified at 47 U.S.C. § 923(g)).

greater certainty in recovering their relocation costs, and the private sector, by providing greater certainty on the ultimate price of the licenses they obtain at auction. However, it would be important for the Congress to establish up front what controls it wants to maintain over such a fund. For example, would the Office of Management and Budget control when and how much an agency received in reimbursement or would the Congress maintain control by requiring an agency to obtain an appropriation?

FCC and NTIA Have Not Yet Implemented Congressional Planning Directives

Several U.S. spectrum experts said that one means of improving the spectrum allocation process is to develop coordinated, national spectrum planning and policies that better anticipate future needs and put more predictability into spectrum decision-making. The Congress called for coordinated spectrum planning in the Omnibus Budget Reconciliation Act of 1993, which required NTIA and FCC to conduct joint spectrum planning sessions.[18] Subsequently, 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.[19] Even before these congressional directives, NTIA itself, in a 1991 report, recommended that NTIA and FCC seek to institute a coordinated, strategic, long-range planning process. The output of this process would be a formal joint FCC/NTIA plan that would be periodically updated, with goals, policies, and specific actions to provide for future spectrum requirements and improved spectrum management.[20] The Defense Science Board similarly concluded in November 2000 that the United States lacks a mechanism to formulate a national spectrum policy that balances traditional national

[18] 47 U.S.C. § 922.

[19] P.L. 106-65, Div. A, Title X, § 1062(a), 113 Stat. 767 (1999). The Secretary of Commerce, in coordination with the heads of the affected federal agencies and the Chairman of FCC, was directed to submit a report providing the results of the required review and assessment by October 1, 2000, to the President; the Senate Committees on Armed Services and Commerce, Science and Transportation; and the House Committees on Armed Services, Commerce, and Science. 113 U.S.C. § 768. NTIA issued a report, *Assessment of Electromagnetic Spectrum Reallocation*, in response to these provisions in January 2001. This report summarized past and current spectrum planning activities of both FCC and NTIA, but did not address future spectrum planning.

[20] *U.S. Spectrum Management Policy: An Agenda for the Future*, NTIA Special Publication 91-23, February 1991.

security uses of the spectrum with new commercial uses of the spectrum.[21] According to NTIA, the United States Table of Frequency Allocations, which documents the spectrum allocations for over 40 radio services, along with existing spectrum management processes, constitutes a basic U.S. strategic spectrum plan, which covers all cases of spectrum use. However, as we pointed out in an earlier report, the national allocation table reflects only the current landscape of spectrum use and does not provide a framework to guide spectrum decisions for the future.[22]

FCC and NTIA have each undertaken planning efforts, but they are focused largely on issues involving their separate constituencies and, as such, do not fulfill the requirements of the congressional directives. For example, FCC conducts spectrum planning for nonfederal government use through two staff committees[23] and uses public forums, en banc hearings, advisory committees, and other methods[24] to gather and provide information for its spectrum planning. NTIA's spectrum planning has resulted in several spectrum planning documents over the last 20 years,[25] including the September 2000 *Federal Long-Range Spectrum Plan* that identified current and future federal spectrum uses, along with any unsupported spectrum requirements. In addition, NTIA established the Strategic Spectrum Planning program in 1992, through which it produced several additional reports on spectrum planning, dealing with land mobile spectrum planning options, radio astronomy spectrum planning options, and federal radar spectrum requirements.

Interaction between the two agencies also takes place on an ongoing basis. For example, FCC has liaison status on IRAC and its subcommittees, which

[21]*Report of the Defense Science Board Task Force on DoD Frequency Spectrum Issues*, November 2000. The Board recommended establishing a White House Office of Information Resource Policy to develop the overall U.S. spectrum policy and bring NTIA, FCC, and the Department of State under a common policy framework.

[22]GAO-01-795.

[23]The Spectrum Coordinating Committee is composed of FCC staff involved in spectrum management; the Spectrum Executive Committee is composed of FCC bureau and office chiefs.

[24]FCC officials stated other methods include experimental licensing, inquiries, and policy statements.

[25]*A Long-Range Strategy for Spectrum Management*, NTIA, 1983; and *Long-Range Plan for Management and Use of the Radio Spectrum*, NTIA Special Publication 89-22, June 1989.

provides it with an avenue for commenting on federal government issues. NTIA, for its part, provides comments on FCC proceedings on issues that could affect federal users. In addition, both agencies (along with industry) are involved in preparing the United States' unified position for World Radiocommunication Conferences (WRCs). One FCC official called the consensus-building involved in this preparatory process as being the closest thing the United States has to a national spectrum strategy. However, FCC and NTIA officials acknowledged that these interactions have not fulfilled the congressional mandate for coordinated national spectrum planning. FCC and NTIA officials stated that a key problem in developing a strategy for national spectrum planning is the inherent difficulty of trying to predict future trends in the fast-developing area of wireless services. For example, FCC officials noted that both FCC and wireless industry forecasts greatly underestimated the huge growth of mobile phone service during the 1990s. On the other hand, emerging wireless technologies that appear promising may not develop as planned, resulting in underutilization of spectrum that has been set aside for them.

The Chairman of FCC and the Administrator of NTIA recently commented on the need for coordinated planning, and the agencies are currently engaged in efforts that could provide a basis for improved planning. For example, in early 2002, FCC announced the creation of a Spectrum Policy Task Force to explore how spectrum can be put to the highest and best use in a timely manner. In July 2002, FCC received comments in response to a public notice issued for the Task Force on several spectrum management and use issues including market-oriented allocation and assignment policies, interference protection, spectral efficiency, public safety communications, and international coordination. In August 2002, the Spectrum Policy Task Force held four public workshops addressing spectrum policy issues. Participants included representatives from academia, industry, and government. The Task Force intends to report to the Commission by October 2002.

For its part, NTIA hosted a spectrum summit in early April 2002 that included participants from FCC, NTIA, and federal agency and industry representatives. The summit included several sessions to explore ways to improve the management of the spectrum through planning and technological innovations. In addition, NTIA's 2003 budget request includes over $1 million in funding to develop a plan to review and improve its overall performance of spectrum management duties. In June 2002, NTIA officials stated that FCC and NTIA had recently adopted a "One Spectrum Team" approach to improve interagency communication and take a more

proactive approach to spectrum management. It remains to be seen whether a well-coordinated and clearly defined national spectrum strategy emerges from these efforts.

Issues Have Emerged Regarding the Adequacy of U.S. Preparations for World Radiocommunication Conferences

As noted earlier, the management of our domestic spectrum has been 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) at WRCs.[26] Decisions reached at these conferences can have far-reaching implications for the direction and growth of the multibillion dollar wireless communications industry in this country and abroad. Key officials raised questions about the adequacy of the current U.S. preparatory process, in particular the use of separate processes by FCC and NTIA to develop U.S. positions, and the short tenure of the head of the U.S. delegation to the conferences.

WRCs Are Increasing in Size, Frequency, and Substance

The emergence of new radio applications with international ramifications, such as broadcasting, radio navigation, and satellite-based services, has increased the need for international 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 international radio conferences has risen dramatically—from 9 nations in the first conference held in 1903, to 65 nations in 1932, to 148 nations in 2000—along with the frequency of conferences (now held every 2 to 3 years), and the number of agenda items negotiated at each conference (e.g., 11 in 1979; 34 in 2000). There has also been a movement toward regional alignment at WRCs. Because decisions on agenda items are made by vote of the participating countries—with one vote per country—uniform or block voting by groups of nations has emerged, as areas such as the European Union seek to advance regional positions.

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

Timely Preparation for the WRC Is a Key Challenge for the United States

The Department of State coordinates and mediates the development of the U.S. position for each WRC and leads the U.S. delegation at the conference through an ambassador named 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. 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 nonfederal users, FCC convenes a WRC advisory committee composed of representatives of various radio interests (e.g., commercial, broadcast, private, and public safety users) and solicits comments through a public notice in the *Federal Register*. NTIA and federal government users also participate in FCC's preparatory 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, nonfederal government users may make presentations to IRAC to convey their views on WRC agenda items. In addition, the Department of State solicits input from its International Telecommunication Advisory Committee (ITAC),[27] made up of representatives of government, scientific, and industrial organizations involved in the telecommunications sector. Any differences of opinion between FCC and NTIA on agenda items must ultimately be reconciled into a unified U.S. position. In cases where differences persist, the ambassador who leads the U.S. delegation to the conference acts as a mediator to achieve consensus on a unified U.S. position.

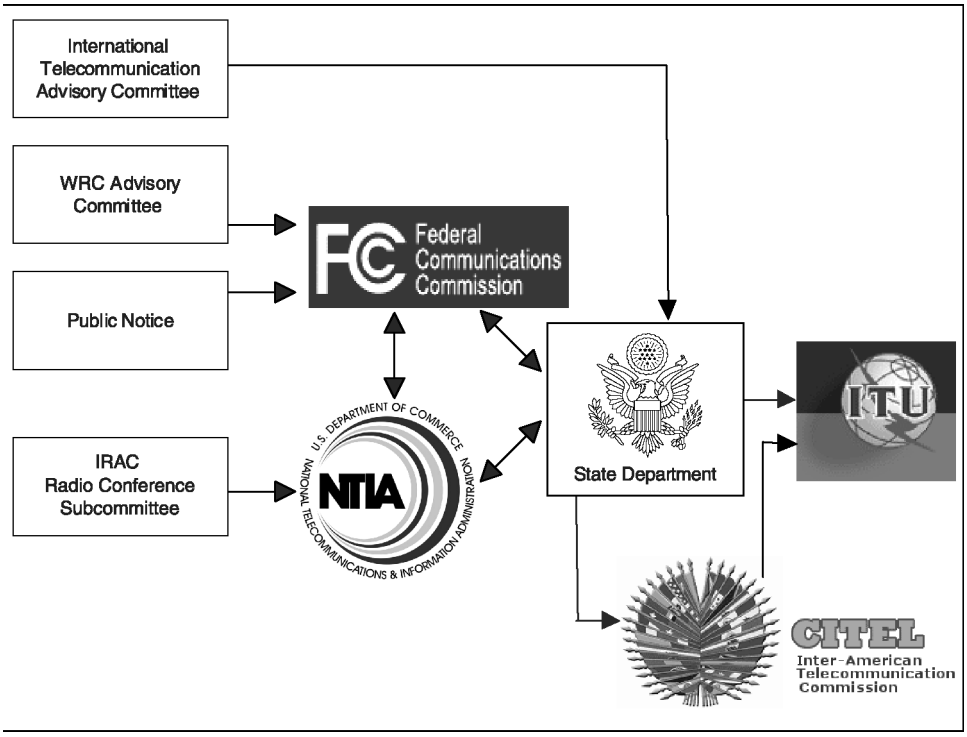
The Department of State ultimately transmits the U.S. position on WRC agenda items to the regional organization of which the United States is a member—the Inter-American Telecommunication Commission (CITEL), which convenes prior to a WRC to build regional consensus on conference agenda items.[28] The department also transmits the U.S. position to ITU,

[27]ITAC aids in the preparation of U.S. positions for meetings of international treaty organizations, develops and coordinates proposed contributions to international meetings, and submits them to the Department of State for consideration.

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

which sponsors the conference. Figure 4 depicts the relationship among the domestic players and these two international organizations in preparing the U.S. position for the WRCs.

Figure 4: Relationship of U.S. Participants in Preparing for World Radiocommunication Conferences



Sources: FCC and NTIA.

Some Experts Have Raised Questions about Adequacy of Current Procedures

We obtained conflicting views on the effectiveness of the U.S. preparatory process for WRCs. Department of State 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 nonfederal parties. In contrast, some industry 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 industry officials said that, because 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, in the past, the U.S. position on some items has remained unresolved until the eve of the conference, leaving the United States with little time to build preconference support for them. 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.[29] However, NTIA said that the separate processes are needed because much of the government side of spectrum policy and use is classified and because NTIA and FCC are responsible for separate groups of constituents. In June 2002, FCC, NTIA, and Department of State officials stated they believed coordination in developing U.S. positions was improving and that most of the 2003 WRC agenda items were close to resolution.

There has been long-standing concern about the length of tenure of the individual who is designated head of the U.S. delegation. The President—under his authority to confer the personal rank of ambassador on an individual in connection with a special mission of a temporary nature—has selected an ambassador to head the U.S. delegation to each WRC for a time period not exceeding 6 months.[30] This authority allows the conferral of the personal rank of ambassador to be made without confirmation by the Senate, subject to appropriate notification. 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, helps to achieve consensus in finalizing U.S. positions, and enhances our negotiating posture with other countries. However, the former U.S. Ambassador also said that the brief tenure of the appointment leaves little time for an ambassador to get up to speed on the issues, solidify U.S. positions, form a delegation, and undertake preconference 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,

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

[30]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 of a temporary nature not exceeding 6 months in duration. The President need only transmit to the Senate Committee on Foreign Relations a written report; confirmation by the Senate is not needed.

in contrast to other nations that are led by high-level government officials who serve longer terms and may represent their nations at multiple conferences. FCC and NTIA officials stated that longer-term leaders of national delegations are perceived by other participants as being more able to develop relationships with their counterparts from other nations, and that this helps them to negotiate and build regional and international support for their positions. Similar observations were made by the Office of Technology Assessment as far back as 1991,[31] but no consensus has emerged to resolve this issue.

Department of State officials said previous administrations have identified the person who was to become the ambassador early so that they could involve that person in conference planning prior to the start of the 6-month term. For example, the 2000 WRC Ambassador knew she would be chosen for the position and was given a temporary telecommunications policy position in the White House 4 months prior to her official selection. This position provided additional time for her to learn the issues and observe WRC preparatory meetings, but she could not lead the meetings until her formal selection about 5 months before the conference. Department officials said that the current administration is also planning to identify the 2003 WRC Ambassador several months before the official selection. Other suggestions for dealing with this issue that have been raised include establishing a telecommunications policy office in the White House, whose head would also be responsible for leading the delegation; extending the length of an ambassador's appointment through a Senate confirmation process; and creating an upper-level career position within the Department of State to provide continuity from one conference to the next and organize WRC preparations.

Federal Officials Said that FCC Has Been Slow to Implement All WRC Agreements Domestically

Officials at the Department of State said that, after a WRC concludes, countries need to implement the agreements reached at the conference—known as the Final Acts. The officials said that NTIA, FCC, and the Department of State share responsibility for implementing the Final Acts in the United States. NTIA and FCC develop an implementation manual that includes all of the necessary changes in U.S. allocations, regulations, and

[31]See the Office of Technology Assessment's two reports, *The 1992 World Administrative Radio Conference: Issues for U.S. International Spectrum Policy—Background Paper*, OTA-BP-TCT-76, November 1991; and *The 1992 World Administrative Radio Conference: Technology and Policy Implications*, OTA-TCT-549, May 1993.

rules. FCC must then implement the changes through its rule-making process. Meanwhile, the Department of State prepares a Memorandum of Law to transmit to the Senate along with the Final Acts of the WRC for ratification.[32]

Officials from NTIA, FCC, and Department of State said that the United States has faced timeliness challenges in implementing the Final Acts over the last 10 years. In July 2002, NTIA officials stated that federal agencies are concerned that WRC allocation decisions of interest to the private sector are often dealt with quickly, while those primarily of interest to the federal government go without action. For example, at the 1997 WRC, the United States sought and gained a primary allocation of spectrum from 5250 MHz to 5350 MHz for an earth exploration satellite service. NTIA officials stated that FCC has still not formally considered their request for a national primary allocation for this service. In addition, one agency said that it had not gained access to two channels designated for its use by the 1997 WRC due to the slowness of the FCC rule-making process. Officials from another agency said that FCC's table of allocations is out of date because it does not reflect some of the government-specific allocation changes made at WRCs over the last 10 years. The officials said that this has led others to seek allocations on some of these bands.

FCC officials told us that some changes to the U.S. allocation table resulting from the WRCs had not been made because FCC had a shortage of engineering staff required to make the changes. For this reason, they said that FCC had to prioritize WRC allocation decisions and defer those changes that they believed had the least impact on spectrum use. These officials added, however, that additional staff recently hired by FCC has allowed FCC to complete the work needed to update the allocation table, and FCC plans to initiate the necessary rulemaking actions in the near future. In addition, the FCC officials stated that they are unaware of any impact the delays have had on planned federal systems.

[32]Department of State has not yet submitted the Final Acts from the WRCs in 1992, 1995, 1997, or 2000 to the Senate for ratification. Department of State officials said that the agency is preparing to send all of these Final Acts to the Senate as one package, and that ratification is not necessary for the United States to implement the agreements.

Federal Officials Said Activities to Encourage Efficient Federal Spectrum Use Are Hindered by Staffing and Resource Problems

NTIA is required to promote the efficient and cost-effective use of the federal spectrum that it manages—over 270,000 frequency assignments as of June 24, 2002—"to the maximum extent feasible."[33] Accordingly, as accountability measures, NTIA has directed federal agencies to use only as much spectrum as they need and has established several processes and activities to encourage efficient spectrum use. However, NTIA does not have assurances that these processes and activities are effective. NTIA and federal agency officials said that key challenges include a shortage of staff with appropriate expertise to support spectrum management activities, as well as staffing and resource problems in implementing spectrum-efficient technologies.

NTIA Depends on Federal Agencies to Determine Their Spectrum Needs

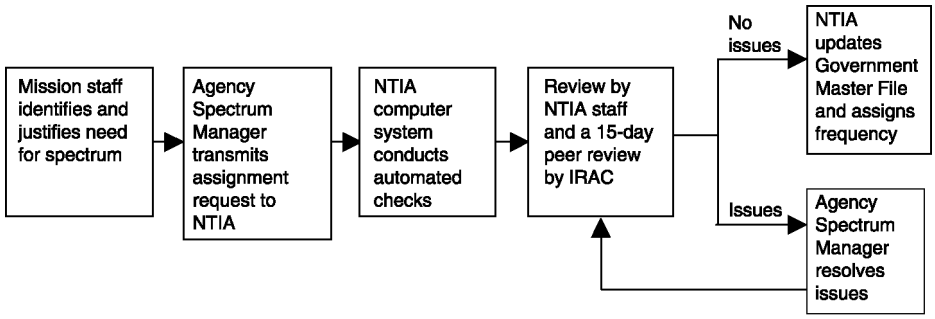
NTIA authorizes federal agency use of the spectrum through its frequency assignment process. Before submitting a frequency assignment application, an agency must justify to NTIA that the frequency assignment will fulfill an established mission need and that other means of communication, such as commercial services, are not appropriate or available.[34] Agencies generally rely on mission staff to identify and justify the need for a frequency assignment and to complete the engineering and technical specifications for the application. Once an application is submitted, it goes through an NTIA review and a 15-day IRAC peer review process. NTIA staff members said they examine assignment applications to ensure that they comply with technical rules, while IRAC members said they primarily look to see whether the assignment could cause interference with other users. If no one at NTIA or IRAC objects, the assignment is automatically approved and added to the Government Master File.[35] The requester can then begin operating on the assigned frequency. Figure 5 illustrates the frequency assignment process.

[33] 47 U.S.C. § 903(d)(1).

[34] NTIA also uses IRAC's Spectrum Planning Subcommittee to hold agencies accountable for ensuring that new equipment being developed and procured for federal use conforms with various policies, such as those designed to ensure adherence with current and future national frequency allocations and to encourage compatible spectrum sharing. Compliance with applicable spectrum standards is also addressed prior to certifying spectrum support for major systems.

[35] The Government Master File is the complete listing of government frequency assignments. It also includes thousands of nonfederal and foreign frequency assignments that must be coordinated with the federal government assignments.

Figure 5: NTIA Frequency Assignment Process



Source: NTIA.

NTIA officials said they are not in a position to independently assess the justification for each frequency request, not only because this would require a detailed understanding of an agency's operational needs, but also because of the high volume of assignment action requests that require attention. On average, NTIA processes between 7,000 and 10,000 assignment action requests—applications, modifications, or deletions—from agencies each month.

To help agencies prepare frequency assignment applications, as well as to help NTIA staff review them, NTIA has implemented a computer-based tool, called Spectrum XXI, to automate the application process. Spectrum XXI is designed to help agencies in a number of ways. For example, Spectrum XXI allows for status tracking and editing of applications. In addition, Spectrum XXI helps in assigning users to the most heavily used channels first, rather than less heavily used ones, in order to minimize the amount of spectrum space used. NTIA officials stated that they are continuing to modify Spectrum XXI to improve the efficiency of the selection of frequencies by new users. One spectrum manager we interviewed stated that Spectrum XXI has greatly reduced the amount of time and work involved in applying for a frequency assignment. However, four of the seven agencies we reviewed were not using this tool for various reasons. For example, spectrum managers from two agencies said that their own spectrum management programs better fit their needs.

Some Agencies Are Not Completing Mandatory Spectrum Reviews, While NTIA Monitoring Activities Have Decreased

NTIA's Frequency Assignment Review Program generally requires all federal users of spectrum to review their frequency assignments every 5 years.[36] The purpose of the reviews is to determine if the frequency assignments are still essential to meeting the agencies' missions, justified correctly, not redundant to other assignments, and up to date. Federal spectrum users are expected to modify or delete frequency assignments as needed based on the results of these reviews. NTIA said that it may delete assignments that have not been reviewed in more than 10 years.

Using its database of federal agencies' frequency assignments, NTIA is to track assignments that are due for review and provide a listing to the respective agencies. NTIA is notified that an agency has completed an assignment review when the agency requests a modification to the database that contains the frequency assignments. These modifications may simply be requesting a change to the date on which the assignment was last reviewed or may indicate technical and operational changes made since the last review. NTIA forwards modification requests to IRAC members for their review. If no member objects to the modification, the user can continue to operate on the frequency assignment for another 5 years.

NTIA has implemented additional requirements for reviews that are significantly overdue—meaning the federal agency has not reviewed the frequency assignment in over 10 years. Every 6 months, NTIA provides IRAC with a list of these overdue assignments for a case-by-case review and recommendation on whether to retain or delete the assignment. NTIA officials said this method of notification works very well in getting the reviews done because federal users recognize that it is easier to review existing assignments than it is to lose the frequency authorizations and start the process over. NTIA does not maintain any information on the number of assignments that have been deleted for noncompliance with the review program.

According to NTIA officials, the Frequency Assignment Review Program "weeds out" assignments that are no longer being used so that they can be returned for use by others. We found, however, that the program relies mainly on self-reported agency information that receives no independent

[36]Certain space systems, aeronautical, and military assignments must be reviewed every 10 years.

verification by NTIA. Comments by spectrum managers at the seven agencies we reviewed raise concerns about how well these reviews are being carried out. Officials from these agencies told us that they attempt to use spectrum as efficiently as possible, but five of them acknowledged that they are not completing the 5-year reviews in a timely or in-depth way. For example, a spectrum manager for a major agency division said that over 1,000 of its frequency assignments have not been reviewed in 10 years or more. According to agency officials, problems with performing timely assignment reviews are occurring due to shortages in qualified staff to complete the reviews and because completing the reviews is a lower priority compared to other agency work. For example, a spectrum manager at one agency noted that all field staff responsible for helping with the 5-year reviews had been eliminated, which impaired the timeliness and quality of the reviews.

Another spectrum manager stated that his agency's central spectrum management staff had operated a comprehensive program of oversight, on-sight inspections, field staff training, and planning until 8 of their 10 full-time positions were eliminated. This official said that he could not ensure all spectrum assignments are being used as authorized. The spectrum manager at another 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 time consuming and of limited benefit. The spectrum manager located at an agency's field office stated that some frequency assignments connected to a single system critical to mission functions had been deleted by NTIA because the agency did not have the staff or time to complete the assignment reviews. This manager stated the agency continued to use these frequencies while staff struggled to find the time to reapply for them.

Aside from the assignment review process, NTIA had established additional programs for overseeing how federal agencies were using their spectrum, but these programs have been scaled back or discontinued. One component of NTIA's Spectrum Measurement Program used van-mounted monitoring equipment by NTIA staff to verify that federal agencies were using assigned frequencies in different geographic locations in accordance with applicable technical regulations. Although NTIA officials recently stated that this program was an invaluable monitoring tool, the van-mounted verification has been discontinued due to a lack of agency resources. Another effort that is no longer active is NTIA's Spectrum Management Survey Program, established in 1965, which included on-site visits by NTIA staff to determine whether federal agencies' transmitters

were being used as authorized, to educate field staff on NTIA requirements, and to improve spectrum management. NTIA said that although this program helped to correct frequency assignment information and provided for an exchange of information, the program is not currently operating because of increased workloads and a shortage of staff.

The issue of reported spectrum staffing shortages at federal agencies has broader ramifications for the general management of spectrum that go beyond the frequency review and monitoring programs. In January 2002, NTIA officials told us that its Office of Spectrum Management was facing serious staffing problems. Specifically, the office had 21 vacancies out of a total of 122 positions. In addition, over 40 percent of the current staff will be eligible for retirement by 2006.[37] NTIA officials said that agencies such as FCC and the Department of State have recently had a number of openings for technical positions at higher salary levels then NTIA currently offers. As a result, their Office of Spectrum Management has lost staff to these agencies.[38] In addition, two other agencies we reviewed have conducted staffing needs assessments that indicate that their current levels of staff are inadequate. First, an internal analysis conducted by the Coast Guard Maritime Radio and Spectrum Management Division showed an immediate need for six additional field staff members and at least one additional headquarters staff to assist with spectrum management. Second, a June 2002 study sponsored by the Department of Energy (DOE) reviewed the resources and management structure of the 12 IRAC member federal agencies that hold more than 1000 frequency assignments. Although the study's analysis focused on agencies with large numbers of assignments, the complete study includes a description of all 20 IRAC agencies' spectrum management organizational structures, reporting chains, and resource allocations, among other spectrum management issues. It concluded that federal and contract staffing for DOE's spectrum management was inadequate when compared to that of other agencies, particularly with regard to planning, homeland security, and spectrum-use initiatives.

[37]Among the current staff of 101, 17 are currently eligible to retire, with an additional 25 staff eligible to retire in 4 years.

[38]NTIA officials stated they planned on using the normal hiring process to replace staff that retire, as well as increase the pay levels for some of the current positions to attract and retain qualified staff.

Although the loss of qualified staff and the need to recruit new staff has been a source of concern for the agencies, no concerted effort has been made to define the federal government's needs in this area or develop a strategy for addressing it. NTIA officials mentioned that they had been working with the Office of Personnel Management to consider establishing a federal job series for spectrum management in order to help attract and retain these specialists. However, they said the effort appears to have lost momentum.

Addressing these perceived human capital issues may help increase accountability. However, even if these problems were addressed, it is unclear that this type of oversight management approach in itself would ensure the efficient use of federal spectrum. NTIA and FCC officials have said that incentives that encourage the efficient use of spectrum by federal users could help further increase the efficiency of the federal government's use of spectrum.

Some Technical Research and Initiatives to Promote Efficient Spectrum Use Face Implementation Challenges

NTIA stated that it has conducted technical research and introduced a number of additional initiatives to promote the efficient use of federal spectrum, but some of these efforts face challenges related to measurement, resources, equipment, and costs. For example, NTIA's Institute for Telecommunication Science (ITS), established in 1977, operates the primary telecommunications research laboratory in the United States involved in the development and application of radio wave propagation measurements, studies, and prediction models. ITS provides the tools, analysis, and data that enable studies of spectrum use, efficiency, coverage, and interference analysis. ITS has participated in antenna studies that may result in a substantial increase in the "carrying capacity" of a radio system (or piece of spectrum) by providing multiple beams to independently link to different users on the same channel. In addition, ITS has been assisting the public safety community in increasing spectrum efficiency by examining and implementing system improvements to support increased voice and data traffic. Working with IRAC, NTIA also strives to establish standards that are equal to or better than private sector standards at aiding in the conservation of spectrum. For example, NTIA officials have noted that federal radar standards are among the tightest radar spectrum standards in the world and are currently under review for further refinements.

NTIA officials said that, when applicable, NTIA uses the definition of spectrum efficiency described by ITU, namely the ratio of communications

achieved to the spectrum space used, which has practical value for many types of commercial communications systems. The specific technical measurement may take different forms, depending on the system. For example, the spectrum efficiency of a commercial wireless system might be measured in terms of subscribers served per megahertz of spectrum used per square kilometer of service area. NTIA officials cautioned, however, that many or most of the systems used by the federal government, including radars, navigation, military tactical, and scientific systems, do not fall within the scope of this type of measure of spectrum efficiency and that no effective measure for spectrum efficiency has been identified for these latter types of systems.

Implementing more spectrum-efficient technologies at federal agencies can be challenging. For example, around 1990, NTIA began exploring the use of "narrowbanding" because of concerns over its ability to continue to meet federal agencies' land mobile communications needs. Narrowbanding is a technique for reducing the amount of spectrum (bandwidth) needed to transmit a radio signal, thereby freeing up spectrum to meet future growth. In 1992, the Congress directed NTIA to adopt and implement a plan for federal agencies with existing mobile radio systems to use more spectrum-efficient technologies.[39] With the approval of IRAC, NTIA required all federal agencies to upgrade their existing land-based mobile systems so as to reduce the bandwidth needed per channel from 25 kHz to 12.5 kHz. NTIA set deadlines for the narrowbanding requirement, which is to be completed in two stages by 2008.[40]

All federal agencies need to meet the narrowbanding requirement in order to prevent harmful interference. NTIA officials stated that any agency not meeting the narrowbanding requirements would be responsible for eliminating the harmful interference. NTIA officials also stated that no acceptable justifications for not adopting narrowbanding have been proposed or developed. Spectrum managers from the seven agencies we reviewed presented a mixed picture about their ability to meet this

[39]47 U.S.C. § 903(d)(3). In 1993, NTIA provided the Congress with a report that included the narrowbanding plan: *Land Mobile Spectrum Efficiency: A Plan for Federal Government Agencies to Use More Spectrum-Efficient Technologies*.

[40]There are three frequency bands involved in this effort: 138-150.8 MHz, 162-174 MHz, and 406.1-420 MHz. The narrowbanding deadline for the 162-174 MHz band is 2005. A 2008 deadline applies to the 138-150.8 MHz and 406.1-420 MHz bands. After January 1, 1995, most new land mobile systems were required to meet the narrowband requirements.

deadline. While some believed that they were on track, others stated that they were either having difficulty meeting the deadlines or would not meet the deadlines at all. The Chief Information Officer in one agency compared the requirement to an unfunded mandate; he said the agency had not been provided with the financial resources needed to make system design changes, buy new equipment, and maintain current equipment until the transition was finalized. He stated that his office could not compete with other agency priorities for funding. Officials at other agencies stated that shortages in qualified staff were affecting their ability to meet the narrowbanding deadlines. For example, they said additional staff are needed to design systems using the smaller amount of bandwidth and to find and request the needed frequencies. Finally, several officials stated that the commercial sector would be unable to provide them all the narrowbanding equipment and support needed to continue their operations even if the money was available. On June 26, 2002, NTIA requested that federal agencies provide the status of their compliance with the narrowbanding requirements.

Another example of problems in implementing spectrum-efficient technologies involves a technique known as trunking. Trunking systems conserve spectrum by enabling users to share a common set of voice radio channels rather than have their own dedicated channels that may not be heavily used at all times. NTIA sponsored a pilot trunking program for federal agencies in the early 1990s that included six cities. According to NTIA, some agencies resisted the program because, although spectrum could be conserved, the agencies found that it was more costly to participate in trunking than it was to use their own channels. In addition, some agencies said the trunking systems did not meet their mission needs.[41] In 1993, NTIA insisted that the contracted system be used unless a waiver had been approved for an economic and/or technical exemption.[42]

[41]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. (John H. Anderson to the Honorable Frank R. Wolf, memorandum, 1 July 1998, *Your letter regarding our report on NTIA's contract with FEDSMR* [GAO/RCED-98-116R, April 13, 1998])

[42]NTIA has denied frequency assignment requests for "stand-alone" radio communication systems when it was clear that the existing trunked radio system could serve the applicants' needs. For example, NTIA denied requests from the National Archives and Bolling Air Force Base to build and operate their own trunked radio systems in the Washington, D.C. area. Instead of using new frequencies, these agencies joined the NTIA sponsored area-wide trunking system.

NTIA noted that the program has only been successful in Washington, D.C., where agency demand for frequency assignments, and therefore spectrum congestion, is extremely high.

Unclear Whether Spectrum Management Fees Provide an Incentive for Efficient Spectrum Use

NTIA told us that the congressionally-mandated spectrum management fees agencies pay help promote spectrum efficiency by providing federal users with an incentive to return frequency assignments that they no longer need. 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.[43] 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 of cost to the agencies. For example, basing the fee on the amount of bandwidth used would have resulted in the Air Force paying the majority of the fees because of the large amount of spectrum used by the radar systems they operate.

Although NTIA officials said that spectrum fees provide an incentive for agencies to relinquish assignments, it is not clear how much this promotes efficient use of spectrum. Officials from two agencies said that the financial costs were not high enough to cause them to decrease the number of frequency assignments they retained. Specifically, officials from one of the agencies said that the amount of money paid in spectrum fees was a small share of the money needed to operate a radio system. In addition, 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 affected 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.

Other countries are moving toward using payment mechanisms for government spectrum users that are specifically designed to encourage efficiency, rather than to recover the cost of managing the spectrum. Both Canada and the United Kingdom are reviewing their administrative fee

[43]NTIA was first authorized to charge and retain fees for federal spectrum management services under the Omnibus Consolidated Rescission and Appropriations Act of 1996 (P.L. 104-134, 110 Stat. 1321 [1996]).

structures at this time with the intent of encouraging spectrum efficiency. Our work on this issue is ongoing and will be addressed in our report that will be completed in early 2003.

Conclusions

The divided structure of U.S. spectrum management, coupled with the increasing difficulty of accommodating new services and users, has heightened the importance of coordinated national spectrum planning. Although FCC and NTIA have recently taken steps to better coordinate spectrum management, it is unclear whether these steps will result in a national spectrum strategy. The absence of such a strategy may make it more difficult for FCC and NTIA to avoid contentious, protracted negotiations when providing for future spectrum requirements.

Similarly, the United States' ability to promote its strategic and economic interests at WRCs has become increasingly important and difficult as spectrum has grown more congested and countries vie for advantage in the multibillion dollar global telecommunications marketplace. The ongoing debate about the effectiveness of the United States' preparatory process for WRCs has raised concerns that the U.S. delegation may not be in the best position to promote U.S. positions as effectively as possible. While the Department of State, FCC, and NTIA maintain that they have improved preparations for the 2003 WRC through better coordination, key issues remain unresolved, including the use of separate processes by FCC and NTIA to develop U.S. positions and the short tenure of the head of the delegation.

Because of the large number of federal frequency assignments, NTIA's processes for promoting the efficient use of federal spectrum are heavily dependent on the federal agencies that use the spectrum. However, some federal agencies are not conducting comprehensive reviews of their frequency assignments. Compounding this problem is NTIA's discontinuation of two spectrum-monitoring programs that helped promote accountability by verifying that federal agencies were using their spectrum assignments as specified. Federal agencies and NTIA primarily attributed the lack of comprehensive reviews and the discontinuation of NTIA monitoring programs to staffing and resource issues. The result of these limitations is that the federal government does not have the information necessary to assure that federal agencies are using only as much spectrum as needed to fulfill their mission requirements. Moreover, even if additional resources became available to enable agencies to conduct reviews to determine how effectively they are using spectrum available to them, it is

unclear if this alone could ensure the efficient use of hundreds of thousands of federal spectrum assignments. Other countries are moving toward using incentives such as payment mechanisms for government spectrum users to encourage conservation of spectrum. In follow-on work, we will be looking at the types of incentives that are being employed to encourage both government and nongovernment users to conserve spectrum.

Recommendations for Executive Action

In order to improve U.S. spectrum management, we are making the following recommendations:

- The Secretary of Commerce and the Chairman of FCC should establish and carry out formal, joint planning activities to develop a clearly defined national spectrum strategy to guide domestic and international spectrum management decision making. The results of these planning activities should be reported to the appropriate congressional committees.

- Following the 2003 WRC, the Secretary of State, the Secretary of Commerce, and the Chairman of the Federal Communications Commission should jointly review the adequacy of the process used to develop and promote the U.S. position, including the separate processes used by FCC and NTIA, and the short tenure of the head of delegation, and prepare a report containing any needed recommendations for making improvements. The report should be provided to the appropriate congressional committees.

- To strengthen the management and accountability of the federal government's use of spectrum, the Secretary of Commerce should direct NTIA, assisted by IRAC and the Office of Personnel Management, to analyze the human capital needs of federal agencies for spectrum management and develop a strategy for addressing any identified shortcomings. This analysis should be linked to near-term and long-term human capital issues that may be identified as part of the development of a national spectrum strategy.

- The Secretary of Commerce should develop a strategy for enhancing its oversight of federal agencies' use of spectrum, such as revitalizing its former monitoring programs, and define the Department of Commerce's human capital needs for carrying out this strategy.

Agency Comments

We provided a draft of this report to FCC, the Department of Commerce, and the Department of State for a review and comment. They were in general agreement with our recommendations. FCC said that both it and the Department of Commerce have initiated processes to review and improve spectrum management. FCC also said that it would be beneficial for the Department of State, Department of Commerce, and FCC to further review the U.S. preparatory process following the 2003 WRC. FCC also offered some technical comments that we incorporated into the report where appropriate. FCC's written comments appear in appendix III.

The Department of Commerce said it is time for the United States to take a broad look at the organizational structures and processes the United States has built both nationally and internationally to manage and plan spectrum use. The Department of Commerce also said that NTIA and FCC participate together in spectrum planning activities, as evidenced by NTIA's Spectrum Summit in April 2002 and FCC's spectrum policy workshops, but that spectrum planning and interagency coordination could be improved. With regard to WRCs, the Department of Commerce agreed that the Department of State, FCC, and NTIA should jointly review the adequacy of the preparation process following the 2003 WRC. The Department of Commerce also said that it would review its human capital needs and current resources in spectrum management and develop a strategy for addressing any shortcomings. The Department will also encourage other agencies that are members of IRAC to conduct a similar analysis. The Department also offered some technical comments that we incorporated into the report where appropriate. The Department of Commerce's written comments appear in appendix IV.

The Department of State said that it would consult with the Department of Commerce and FCC after the conclusion of the 2003 WRC, and it offered a technical comment that we incorporated into the report. The Department of State's written comments appear in appendix V.

We are sending copies of this report to the appropriate congressional committees. We are also sending this report to the Secretary of State, the Chairman of the Federal Communications Commission, and the Secretary of Commerce. We also will 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.

If you or your staff have any questions concerning this report, please contact me on (202) 512-2834 or at guerrerop@gao.gov. Individuals making key contributions to this report include Dennis Amari, Karin Bolwahnn, Keith Cunningham, John Finedore, Rahul Gupta, Peter Ruedel, Terri Russell, Tanya Tarr, Dr. Hai Tran, Mindi Weisenbloom, and Alwynne Wilbur.

Peter F. Guerrero
Director, Physical Infrastructure Issues

Major Parts of the Radiofrequency Spectrum and Their Uses

Different parts of the radiofrequency spectrum have different technical characteristics that make them better-suited for some types of communications than others. For example, the most technically suitable spectrum for mobile communications is below 3 gigahertz because this part of the spectrum provides the best match for spectrum propagation characteristics (such as distance, capacity, and reliability) required for mobile communications. The major parts and uses of the spectrum are as follows:

- The lower frequency waves (including very low frequency [VLF], low frequency [LF], and medium frequency [MF]) are located from 3 kilohertz (kHz) to 3 megahertz (MHz). They tend to travel along the ground and penetrate water and solid objects. Uses include submarine communication and AM radio.

- High frequency (HF) waves are located from 3 MHz to 30 MHz. They travel along the ground and into the sky where they are reflected back to earth by the ionosphere. By using this reflection to extend range, devices in the HF bands can transmit over long distances on relatively low power. Amateur Radio (Ham), Citizens Band Radio Service (CB), military tactical radio, and maritime communications are found in this frequency range.

- Very high frequency (VHF) waves are located from 30 MHz to 300 MHz. They follow the ground less and will pass through the ionosphere, which makes satellite communication possible. To operate in the VHF range, transmitters require less power but larger antennas relative to higher frequencies. Broadcast television, FM radio, federal government, public safety, and private mobile radio services are some of the applications that operate in this frequency range.

- Ultrahigh frequency (UHF) waves are located from 300 MHz to 3 gigahertz (GHz). The combination of smaller antenna and lower power requirements for device operation make this frequency range ideal for many wireless telecommunication applications. Broadcast television, first and second-generation mobile telephones, satellites (such as the global positioning system [GPS] and commercial satellites), federal and nonfederal radio systems, and numerous military applications—like the Ballistic Missile Early Warning System—operate in UHF bands.

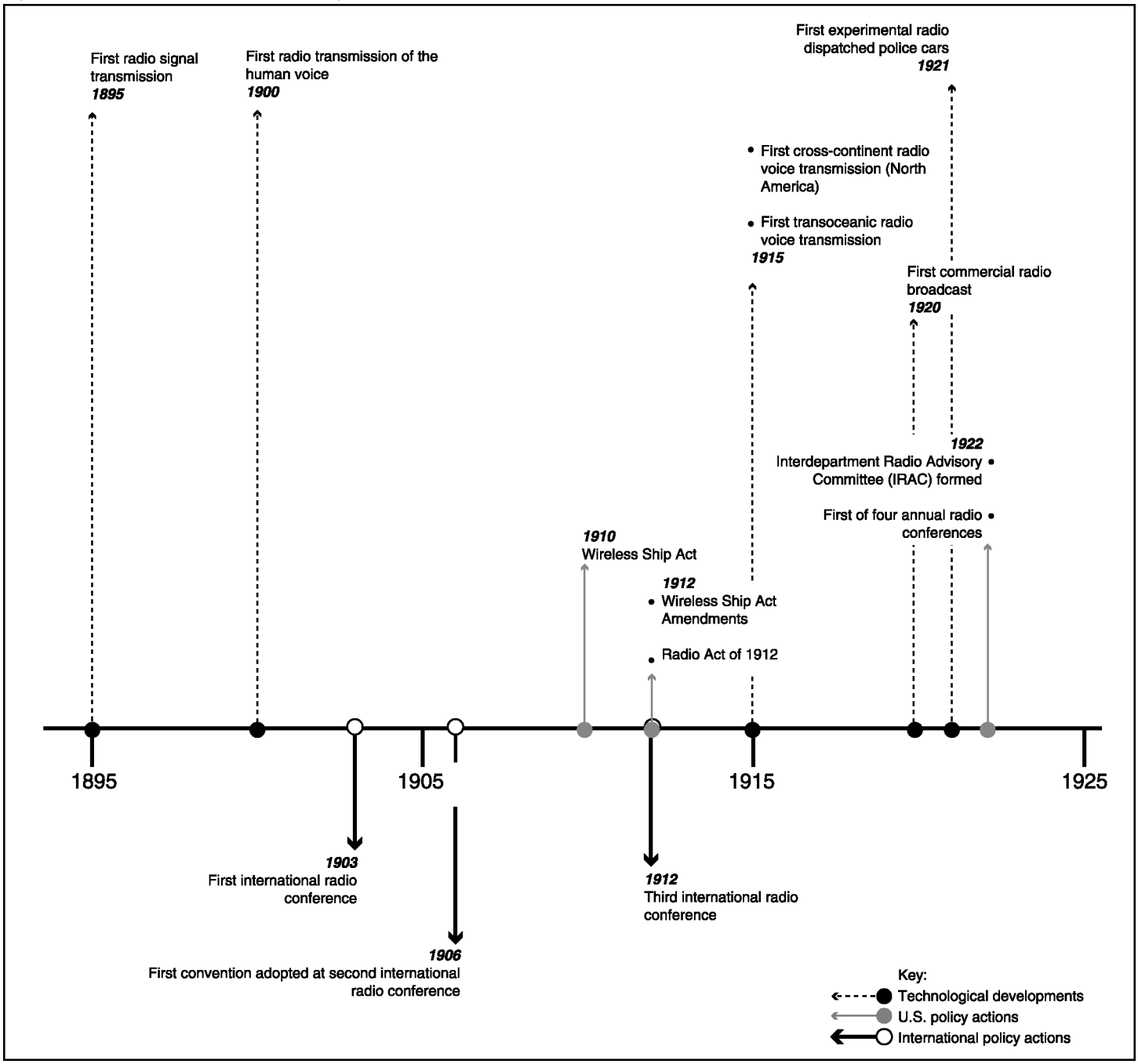
- Superhigh frequency (SHF) waves are located from 3 GHz to 30 GHz, and extremely high frequency (EHF) waves are located from 30 GHz to

300 GHz. These waves require more power to operate and are affected by rain and clouds, especially at the higher frequencies. Numerous military and commercial satellites, aeronautical radio altimeters, radars (such as Terminal Doppler Weather Radar), and fixed microwave links occupy these frequency bands. Some of the highest bands are allocated for certain uses but remain unused due to cost and technical constraints of using those frequencies.

Timeline of Spectrum Management

Numerous legislative, regulatory, legal, and policy decisions and actions have shaped the United States' management and use of the radiofrequency spectrum. This appendix provides supplemental information and major milestones in the development of the divided structure for domestic spectrum management and on international conferences on global spectrum issues. Figures 6, 7, 8, and 9 throughout this appendix illustrate the interplay of wireless technological advances with key international and domestic policy events.

Figure 6: Timeline of Spectrum Management (1895–1925)



Source: GAO.

1895

Radio Signal Transmission—Guglielmo Marconi became the first person to succeed in sending a message in telegraphic code over a distance of 1 1/4 miles using electricity without wires.

Early 1900s

Ships at Sea—Radio's most important initial use was at sea where it reduced the isolation of ships during emergencies. By 1904, according to a report of the President's Board on Wireless Telegraphy, there were 24 radio-equipped naval ships and 10 more planned; 20 naval coastal stations had been established, and equipment for 10 more had been ordered; 6 stations were operated by the U.S. Army; 2 stations were operated by the Weather Bureau; 5 private companies were operating coastal stations (one serving the Pacific coast); and a total of 200 additional stations on shore or at sea had been planned.

1903

First International Conference—The First International Radio Telegraphic Conference was held in Berlin, Germany, with the governments of Austria, France, Germany, Great Britain, Hungary, Italy, Russia, Spain, and the United States represented. The conference drafted a protocol to address the exchange of messages from coastal stations with ships regardless of the system of radiotelegraphy used. The protocol served as the basis for the first agreement on the use of radiotelegraphy, which occurred in 1906.

1904

Roosevelt's Interdepartmental Board—At the recommendation of the Secretary of Navy, President Theodore Roosevelt appointed an Interdepartmental Board of Wireless Telegraphy to consider "the entire position of wireless telegraphy in the service of the National Government." Among matters addressed by the Board were the control of interference between radiotelegraph stations in general and nonduplication of coastal stations by government departments. The Board recommended that all government coastal radio facilities be placed under control of the Navy, and that all private stations be licensed by the Department of Commerce and Labor.

1906

First International Convention—A second International Radiotelegraphy Conference was convened in Berlin, Germany, with 28 countries represented. The conference adopted a convention that followed closely the protocol of the first conference. The main provisions of the convention were: requiring that messages by all coastal stations and ships be accepted regardless of the system used; establishing priority for distress calls from ships; and creating a bureau to gather and distribute information

about the radiotelegraphy systems and coastal station installations in each country. The convention also addressed tariffs for international radio communications and regulations prescribing specific wavelengths from which commercial entities were excluded. Technical and operational standards for radio communications in the form of "Service Regulations" were included in an appendix. A precursor to the International Table of Allocations, the regulations distinguished two service categories (1) "general public service" with an exclusive allocation of the 187-500 kHz band; and (2) "long-range or other services" which could be assigned to other frequencies.

1910

Wireless Ship Act—The first instance of U.S. government regulation of radio technology and services, this act required any U.S. or foreign oceangoing ship with 50 or more passengers to be equipped with an operator of and an apparatus for radio communications equipment. The Department of Commerce and Labor was designated to provide for its execution.

1912

Wireless Ship Act Amended—Three months after the sinking of the Titanic, Congress quickly passed amendments to the Wireless Ship Act of 1910. Among the amendments to the law were requirements that ships carry an auxiliary power supply capable of enabling radio apparatus to be operated continuously for at least 4 hours at a minimum range of 100 miles, day or night; that ships carry two or more persons skilled in the use of radio apparatus; and that ships traversing the Great Lakes comply with provisions of the Act.

Radio Act of 1912—The Radio Act of 1912 was the first domestic statute that addressed spectrum allocation. It was enacted, in part, to comply with obligations under the international convention of 1906. The Act required every operator of radio to obtain a license from the Secretary of Commerce and Labor. (When the Department of Labor was separately established in 1913, these powers were retained by the Department of Commerce.) Any person that operated any apparatus for radio communication without a license was guilty of a misdemeanor, and the offending apparatus was subject to forfeiture. Licenses were subject to detailed regulations contained in the Act itself, with certain additional and supplementary regulations promulgated by the Secretary of Commerce. The Act also provided for the protection of federal government radio operations and gave the President special authority over radio communications in emergencies.

Third International Conference—Although the United States was a signatory to the 1906 international convention, the U.S. Senate did not ratify the treaty until after its adhering members withdrew an invitation to the United States to attend the third international conference scheduled for June 1912 in London, England. Soon thereafter, and only 2 months before the start of the conference, the Senate ratified the 1906 convention resulting in a renewed invitation to the United States to attend the London conference.

In light of the sinking of the Titanic earlier that year, the use of radiotelegraphy for safety of ships at sea dominated this conference. The resulting convention was ratified in the United States by the Senate in 1913.

1917

Legislation on Radio Operations Considered by Congress—In the late 1910s, legislation was considered by Congress to maintain government control of all radio stations and prohibit the construction of any new commercial stations. An alternative to government control was proposed—the establishment of a privately-controlled company operating as a government-authorized monopoly. These proposals were advocated in response to Great Britain's dominance in wireline communications and the pursuit of dominance by British nationals in radio communications. While neither proposal was adopted in the United States, in 1920 Congress did act on a recommendation of the Navy to authorize the use of naval stations for a temporary 2-year period for the transmission and reception of private commercial messages at locations that lacked adequate commercial facilities. This authority was extended again in 1922 and 1925 and, ultimately, made permanent by an act of Congress in 1927.

1920

Devising a New International Union—Representatives of the Allied nations of World War I met in Washington, D.C., to create a new international union and simplify communications by bringing all methods of electrical transmission, as far as practicable, under the same rules. A convention and regulations were drafted setting forth basic international institutional features for telecommunications. Although a consensus was not reached, provisions of these documents were used at the next international radiotelegraph conference held in 1927 and, ultimately, served as the basic structure of the International Telecommunication Union (ITU), which was established in 1932.

Introduction of Commercial Radio—Westinghouse, one of the leading radio manufacturers, devised a means of selling more radios by offering radio programming. Dr. Frank Conrad, who had played records over the

airwaves for his friends, was asked by Westinghouse to establish a station in Pittsburgh, Pennsylvania, that would regularly transmit programming. The Department of Commerce licensed the station to operate on 833.3 kHz and awarded it the call letters KDKA. On the night of November 2, 1920, KDKA made what is claimed to be the nation's first commercial radio broadcast. The commercial radio business grew quickly; within 4 years, there were nearly 600 commercial radio stations licensed in the United States.

1921

Public Safety Use of Land Mobile Radio—Among the first known experimental uses of land mobile radio was by the Police Department of Detroit, Michigan, for emergency dispatch in patrol cars. The Detroit Police Department implemented a police dispatch system using a frequency band near 2 MHz. This service proved to be so successful that the channels allocated in the band were soon used to their full capacity. Police and emergency services' communications needs are said to have been critical to the development of mobile radio telephone services.

1922

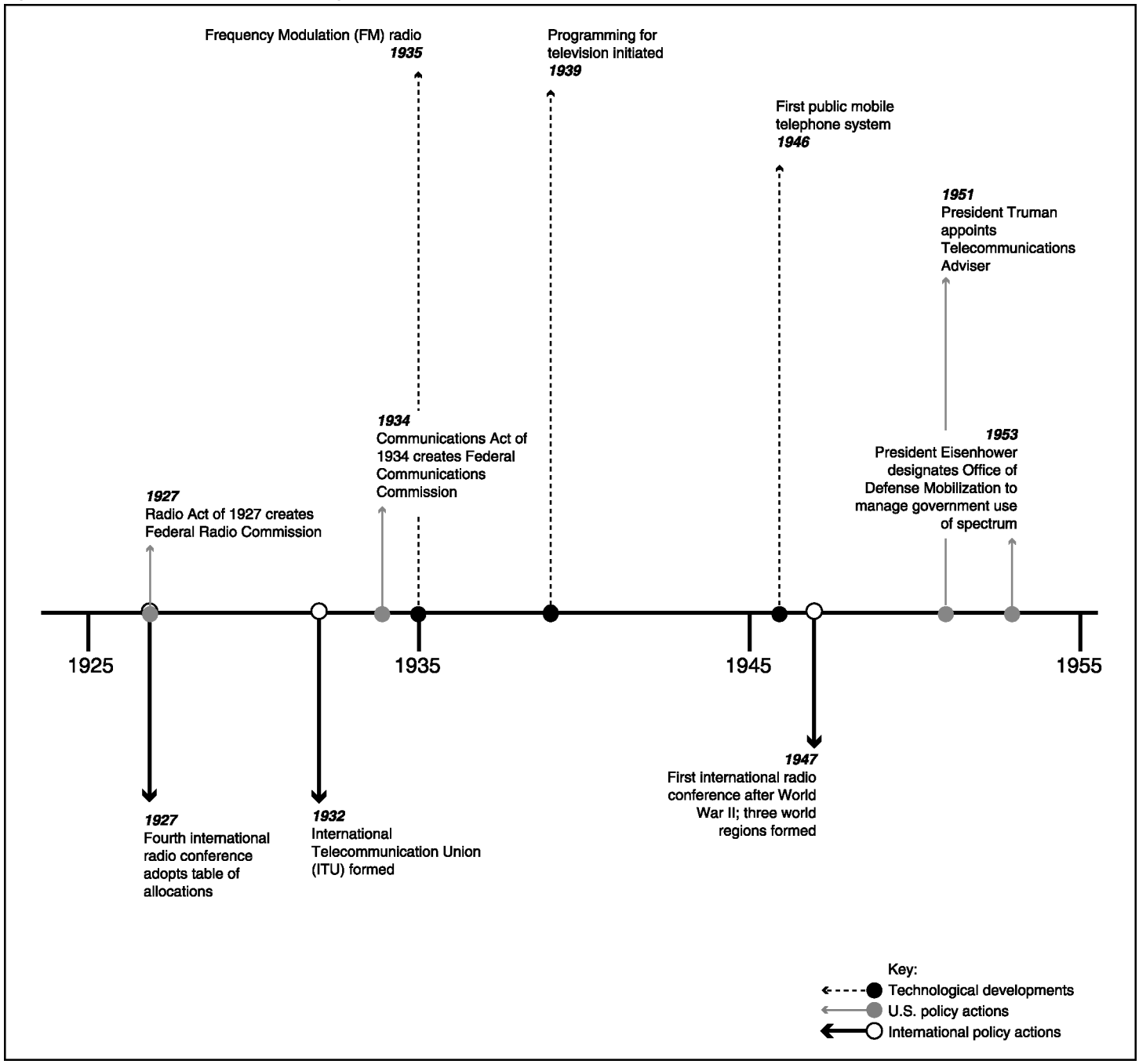
First National Annual Radio Conference—Because radio interference had become so chaotic, with the rise of radio broadcasting and the limitations of the Radio Act of 1912, Secretary of Commerce Herbert Hoover convened a conference of manufacturers, broadcasters, amateur radio representatives, and civilian and military government radio communications personnel to study the problem and make recommendations to alleviate the overcrowding of the radio waves. Three subsequent conferences were held in each of the following years.

Legislation was introduced to implement various recommendations of the national radio conferences throughout this period. There was disagreement as to whether the Secretary of Commerce or a new commission should be given regulatory authority over spectrum use. However, it was not until 1927 that a compromise was reached on a framework for the management of radiofrequency spectrum by the federal government.

Formation of IRAC—To enable the most effective use of spectrum by government, the Interdepartment Advisory Committee on Governmental Radio Broadcasting (later renamed the Interdepartment Radio Advisory Committee, or IRAC) was formed. The 1922 national radio conference awakened several of the federal government departments to the need for cooperative action in solving problems arising from the federal government's interest in radio use. Secretary Hoover invited interested government departments to designate representatives for a special

government radio committee. When they met, the committee recommended that a permanent interdepartment committee be formed. The committee agreed that its scope should extend beyond broadcasting and should be advisory to the Secretary of Commerce in all matters of government radio regulation.

Figure 7: Timeline of Spectrum Management (1925–1955)



Source: GAO.

1926

Legal Decisions on the Secretary's Powers under the 1912 Act— Several key court decisions and opinions of the Attorney General regarding the power of the Secretary of Commerce were made following enactment of the Radio Act of 1912. For example:

- In 1912, the Attorney General stated in an opinion to the Secretary of Commerce and Labor that the Secretary did not have discretion in the matter of granting or refusing radio licenses and was not given general regulative powers under the Radio Act of 1912.

- In *Hoover v. Intercity Radio Co., Inc.*, 286 F. 1003 (D.C. Cir., 1923), the Secretary of Commerce was denied authority to use his discretion to refuse a radio license on the grounds that he "had been unable to ascertain a wave length for use by Plaintiff, which would not interfere with government and private stations." The court pointed out that the Radio Act of 1912 necessarily contemplated interference between stations, that the Secretary had no discretion to refuse the license, and that the issuance of licenses was a ministerial act.

- The court held in *U.S. v. Zenith Radio Corporation*, 12 F.2d 614 (N.D.Ill., 1926), that the Secretary of Commerce had no power to make regulations additional to those found in the Radio Act and that it was, at best, ambiguous on whether the Secretary could impose a limitation on the hours of operation of a radio licensee.

- In *Carmichael v. Anderson*, 14 F.2d 166 (W.D.Mo. 1926), the court held that while the Secretary of Commerce had the right to grant licenses with restrictions agreed upon by multiple applicants—such as time sharing by two radio operators using the same frequency—the Secretary may have no right to impose restrictions other than those contained in the Radio Act of 1912.

- In the case *Tribune Co. v. Oak Leaves Broadcasting Station, Inc.*, (Cir. Ct., Cook County, Ill. 1926) reprinted in 68 Cong. Rec. 216–219 (1926), the court held that the novelty of broadcasting did not prevent an established station from asserting a right to be free from interference and the destruction of its operations by a newcomer. In the court's view, the "priority of time"—obtaining a license first—created a superior right.

- In 1926, the Acting Attorney General issued an opinion stating that a broadcasting station could not operate under the Act without a license,

but the Secretary had no discretion to refuse a license upon a proper application. Moreover, the Secretary had no power to designate the frequency within the broadcast band at which a broadcasting station might operate, nor to prescribe the hours of operation, to limit the power of stations, or to issue licenses of limited duration.

1927

Radio Act of 1927—The Radio Act of 1912 proved to be totally inadequate in coping with the spectrum of the rapidly growing radio broadcasting industry. Further, Congress had become concerned with other issues related to spectrum use, such as vested rights in the spectrum, the basis or criteria for granting licenses, and the potential monopoly in radio equipment manufacturing. Five years in the making, the Radio Act of 1927 was enacted with two key provisions: the creation of a new government commission to manage nongovernment spectrum use, and the adoption of the "public interest, convenience, and necessity" standard for licensing.

Concerns about placing all regulatory authority for radio licensing in one individual, such as the Secretary of Commerce, led to the adoption of a compromise—the creation of the Federal Radio Commission (FRC), a five-member independent regulatory agency with licensing authority for nongovernment stations for a period of one year.[44] After 1 year, as originally enacted, licensing authority would revert back to the Secretary of Commerce and the FRC would serve as an appellate body. Among the responsibilities assigned to the FRC were the following: issuing station licenses, classifying radio stations, assigning frequencies, describing types of service, preventing interference, establishing power and location of transmitters, and establishing coverage areas. The Act reserved to the President authority over all government radio stations. The "public interest, convenience, and necessity" standard was not defined in the Act.

First International Table of Frequencies—Representatives from nations around the world met in Washington, D.C. for the third international radiotelegraphy conference, agreeing to many of the proposals discussed at the 1920 Washington meeting. The conference agreed to a request made at the 1925 Paris Telegraph Conference to consider the unification of the radiotelegraph and telegraph conventions into a single international instrument. In addition, the conference resulted in agreement on the first International Table of Frequency Allocations. The

[44]FRC's authority was repeatedly renewed by the enactment of legislation until the Communications Act of 1934 was enacted into law.

following services were given exclusive or shared use of various frequency bands between 10 kHz and 40 MHz: (1) fixed, (2) mobile, (3) maritime mobile, (4) broadcasting radio beacon, (5) air mobile, and (6) amateur. The conference also created the International Radio Consultative Committee for purposes of studying technical and related radio communications questions.

1932

International Telecommunication Union Formed—Unification of the international radiotelegraph and telegraph conventions was accomplished in Madrid, Spain, thus forming a single international treaty for both wireline and wireless communications, and a single international treaty organization known as the ITU.

The use of radio for both aeronautical mobile communications and broadcasting had increased substantially in the late 1920s, and allocations had to be identified for them in the frequency allocation table. Because of the nature of propagation characteristics of the contested frequencies, low and medium bands were divided into a European region and "other regions."

1934

Enactment of the Communications Act of 1934—At the request of President Franklin Roosevelt, an interdepartmental committee was established in 1933 by the Secretary of Commerce to study the problem of how to regulate communications. Reporting to the President the following year, the Committee recommended that all regulation over communications—both radio and common carrier—be vested in a single agency. With the committee report, President Roosevelt sent a letter to Congress recommending the creation of the Federal Communications Commission (FCC), transferring authorities of the Federal Radio Commission and (as pertaining to communications) the Interstate Commerce Commission, affecting services that "rely on wires, cables, or radio as a medium of transmission." Legislation embodying the recommendation was passed by Congress and signed into law by President Roosevelt on June 19, 1934.

Title III of the Act, governing the provision of radio services, is intended to "maintain control…over all the channels of radio transmission," and provide for the use—but not ownership—of channels of the radio-frequency spectrum through licenses of limited duration. Among the key authorities granted to FCC in Title III of the Act are to: make reasonable regulations governing the interference potential of radio-frequency emitting devices; classify radio stations; prescribe the nature of services in

each class of licensed stations; assign frequency bands to various classes of stations and assign frequencies for each individual station; make regulations to prevent interference between stations; study new uses of radio and provide for experimental use of frequencies; and suspend licenses for violations of the Act. Title III also includes provisions addressing broadcasting.

Like the Radio Act of 1927, the Communications Act of 1934 required the commission to use the "public interest, convenience, and necessity" standard for granting licenses. In order to satisfy the standard, FCC was authorized to grant applications and make "such distribution of licenses, frequencies, hours of operation, and of power among the several States and communities as to provide a fair, efficient, and equitable distribution of radio service to each of the same."

1940

Defense Communications Board Formed—President Roosevelt issued an executive order creating the Defense Communications Board (renamed the Board of War Communications) to coordinate the relationship of all branches of communication to the national defense. The Board was composed of: the Chairman of FCC, who served as Chairman; the Chief Signal Officer of the U.S. Army; the Director of Naval Communications; the Assistant Secretary of State, Division of International Communications; and the Assistant Secretary of the Treasury, Coast Guard. During a war involving the United States, IRAC was to serve as a committee of the board in an advisory capacity.

IRAC-FCC Agree to Interference Notice—IRAC and FCC agreed to cooperate in giving each other notice of all proposed actions that would tend to cause interference to radio stations managed by the other.

1947

Three Regions Formed for International Allocations—At the first post-World War II international radio conference held in Atlantic City, New Jersey, extensive changes were made to the International Table of Frequency Allocations reflecting the advances in radio technology, such as radar and similar radio-determination systems, made during World War II. In addition, new services contending for allocations produced further fragmentation of the table and a new arrangement for spectrum allocations. The new arrangement subdivided the world into three regions—Europe, U.S.S.R., and Africa in region 1; North and South America comprising region 2; and Asia, Australia, and Oceania in region 3.

1950

Communications Policy Board Established—By executive order issued by President Truman, the President's Communications Policy Board was established to study and make recommendations on the policies and practices that should be followed by the federal government in the field of telecommunications to meet the broad requirements of the public interest. The decision to appoint the Board stemmed in part from the inability of existing organizations to resolve competing requirements of FCC on behalf of nongovernment users and government agencies for the use of high frequencies.

In a report to the President, the Board recommended that either a single adviser, or a three-person board, carry out the following duties:

- plan and execute the authority of the President to assign frequencies to government users;
- exercise control over the nation's telecommunications facilities during a national emergency or war;
- stimulate and correlate the formulation of plans and policies to ensure maximum contribution of telecommunications to the national interest and maximum effectiveness of U.S. participation in international negotiations;
- stimulate research on problems in telecommunications;
- establish and monitor a system of initial justification and continued use of frequencies by government agencies; and
- supervise, in cooperation with FCC, the division of spectrum space between federal government and nonfederal government users.

1951

President Truman Appoints Telecommunications Adviser—Approving a recommendation of the President's Communications Policy Board, President Truman issued an executive order establishing the Telecommunications Adviser within the Executive Office of the President to carry out the duties prescribed by the Board.

1952

IRAC Reorganizes and FCC's Role Becomes Liaison—IRAC was reconstituted with a permanent Chairman designated by the Telecommunications Adviser to the President and was charged with the additional responsibilities of formulating and recommending policies,

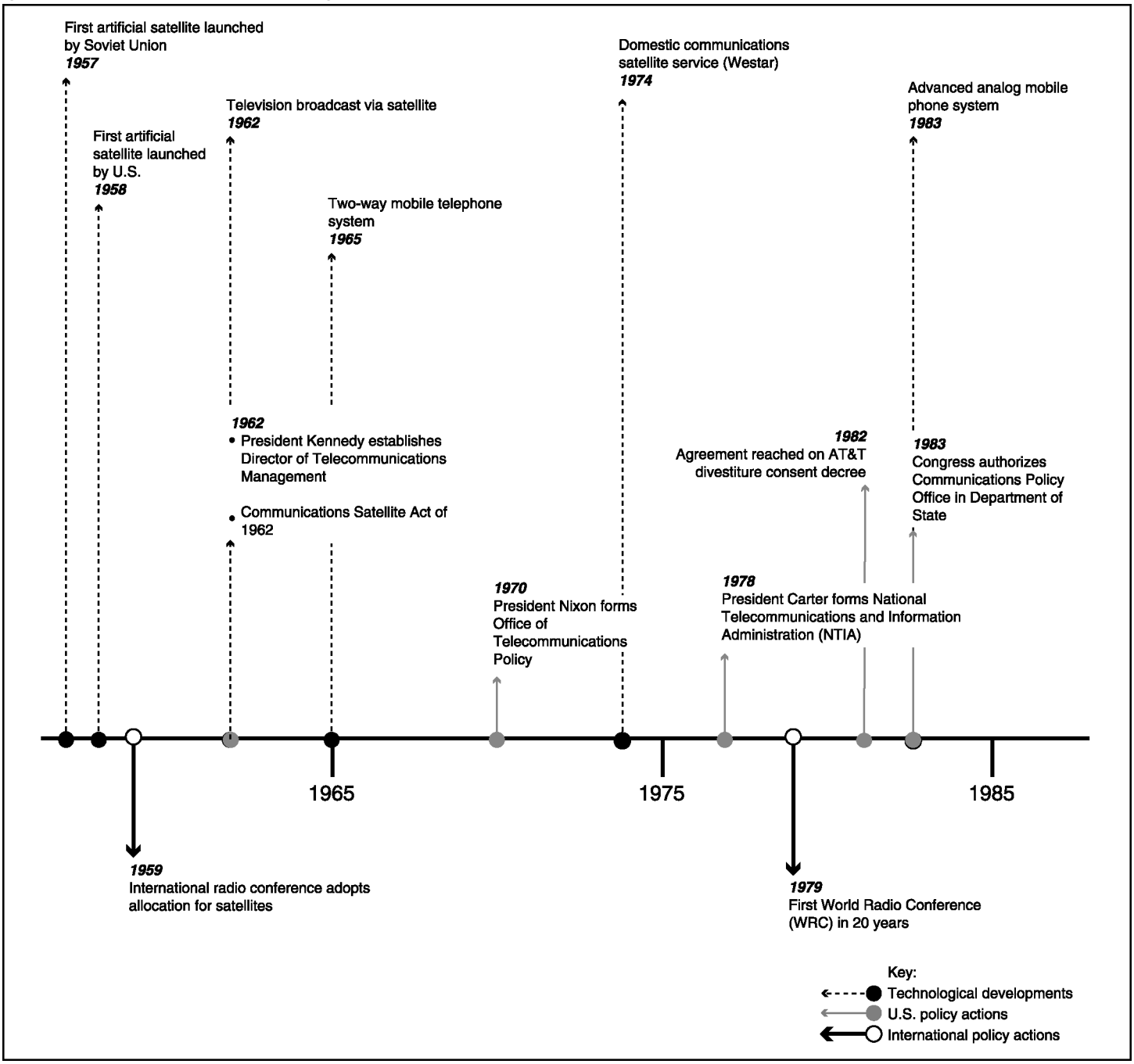
plans, and actions in connection with the management and usage of radio frequencies by the U.S. government. FCC withdrew as a regular member of IRAC and in lieu thereof designated a liaison representative to work jointly with IRAC in the solution of mutual problems.

1953

Position of Adviser to the President Abolished—President Eisenhower accepted the resignation of the Telecommunications Adviser to the President and issued an executive order abolishing the position and transferring the functions to the Director of the Office of Defense Mobilization.

IRAC Establishes Assignment Principles—IRAC established principles for the assignment and use of radio frequencies by government agencies, including assurances that requests are justified and assignments are used by the agencies and not stored for future use.

Figure 8: Timeline of Spectrum Management (1955–1985)



Source: GAO.

1959

International Allocation for Satellite Service Adopted—At the World Administrative Radio Conference, held in Geneva, Switzerland, the assembled nations revised the International Table of Frequency Allocations to accommodate use of higher radio frequencies. A brand new radio service was defined that would eventually bring about a new era of international conferences and issues—the satellite radiocommunication service. The next international radiocommunication conference would not be held for another 20 years.

1960

Communications Act Amendments of 1960—Congress added new sections to the Communications Act of 1934 addressing comparative hearings held by FCC to determine licensing. The new sections were added following the decision in *U.S. v. Storer Broadcasting*, 351 U.S. 192 (1955). In *Storer*, the Court held that a hearing is not required under Sec. 309 of the Act in cases where undisputed facts show that the granting of an application would contravene the Commission's perception of the "public interest." In the opinion of the court, Congress did not likely intend FCC to "waste time on applications that do not state a valid basis for a hearing." The Act was revised to provide FCC with broad discretion to avoid hearings on petitions to deny a license application unless a substantial and material question of fact is presented.

1962

Communications Satellite Act of 1962—This act provided for U.S. participation in a global commercial communications satellite system by the Communications Satellite Corporation under government regulation. The principal task of the corporation was to plan, establish, and operate the system in cooperation with other nations to furnish, for hire, satellite relay of international and interstate telephone and telegraph services, including television. The U.S. portion of the system was subject to the same regulatory controls by FCC as were other communications common carriers.

Director of Telecommunications Management Position Established—President Kennedy issued an executive order establishing the position of Director of Telecommunications Management. The authority of the President to assign, amend, modify or revoke frequency assignments to government agencies was delegated to the Director.

1965

IRAC Approves Spectrum Management Manual—IRAC approved, as a working document, a draft "Manual of Regulations and Procedures for Frequency Management." After approval by the Director of

Telecommunications Management, copies were distributed to all government users of radio, and it became the guideline for daily use.

1966

Report on Telecommunications Science and the Federal Government Released—The report, *Electromagnetic Spectrum Utilization—The Silent Crisis*, prepared by the Telecommunication Science Panel of the Commerce Technical Advisory Board, Department of Commerce, suggested the appearance of a strong basis for the separate management of government and nongovernment radio spectrum use. The separation is rooted mainly in the direct responsibility of the President for national defense, the report states, and the missions of the federal agencies; whereas the administration of nongovernment telecommunications in the national interest requires processes that provide adequate public representation of economic and political forces.

1967

Periodic Review of Government Assignments—IRAC approved a policy for the periodic review of government frequency assignments on a 5-year cycle. The procedure would serve to eliminate unused assignments, update remaining assignments, and make the master file of government assignments much more useful in engineering new assignments.

1968

President's Task Force on Communications Policy Issues Report—Neither the President nor any executive branch agency had access to "a source of coordinated and comprehensive policy advice," concluded the President's Task Force on Communications Policy in its report to President Johnson. As a result, the executive branch had difficulty presenting a coherent and consistent position on problems. To address these problems, the Task Force recommended the establishment of an executive agency to pursue long-term strategy and coordination, to formulate policy, and to serve other executive departments and agencies as a resource center for communications expertise.

1970

Office of Telecommunications Policy Created—Congress approved a plan proposed by President Nixon to transfer various telecommunications and functions of the President to a new Office of Telecommunications Policy. The new office would be responsible for developing plans, policies, and programs with respect to telecommunications that will promote the public interest; support national security; sustain and contribute to the full development of the economy and world trade; strengthen the position and serve the best interests of the United States in negotiating with foreign nations; and promote the effective and innovative use of

telecommunications technology, resources, and services. In addition, the President delegated to the new office his authority over assignments to federal radio stations and directed the Secretary of Commerce to support the new office's spectrum management responsibilities with analysis, engineering, and administrative assistance.

1978

NTIA Formed—President Carter issued an executive order to abolish the Office of Telecommunications Policy and establish an Assistant Secretary for Communications and Information, transferring the functions of the Office of Telecommunications Policy to the Department of Commerce. A departmental order was issued shortly thereafter forming the National Telecommunications and Information Administration (NTIA).

1979

First World Radio Conference in 20 Years—The first general World Administrative Radio Conference (WARC) held in 20 years was convened for 10 weeks in Geneva, Switzerland. The most significant results of WARC 1979 included revisions to many technical and operational standards for radio, particularly the International Table of Frequency Allocations, and the scheduling of a series of specialized conferences for the next decade. The table of allocations was expanded upward and modifications were made in various frequency bands to reflect increased use of satellite radiocommunications.

1981

FCC Establishes Cellular Duopoly—FCC concluded that the public interest would be best served with two competing cellular systems in each geographic area. Each geographic market was divided in such a way as to allow the local exchange service (typically, one for the Bell Operating Companies) and a nonwireline applicant to provide service.

1982

AT&T Divestiture Consent Decree—AT&T and the Department of Justice entered into a consent decree that required divestiture of the local Bell Operating Companies (BOCs) from AT&T. In addition, the decree required that the BOCs provide equal access to long distance and information service providers to their networks for interconnection, and it prohibited the BOCs from providing long distance service, information services, and telecommunications equipment manufacturing. The BOCs retained their mobile services subsidiaries in 1984 after divestiture.

1983

Congress Authorizes Department of State Communications Policy Office—Congress passed the Department of State Authorization Act for Fiscal Years 1984 and 1985, codifying into law and providing for the

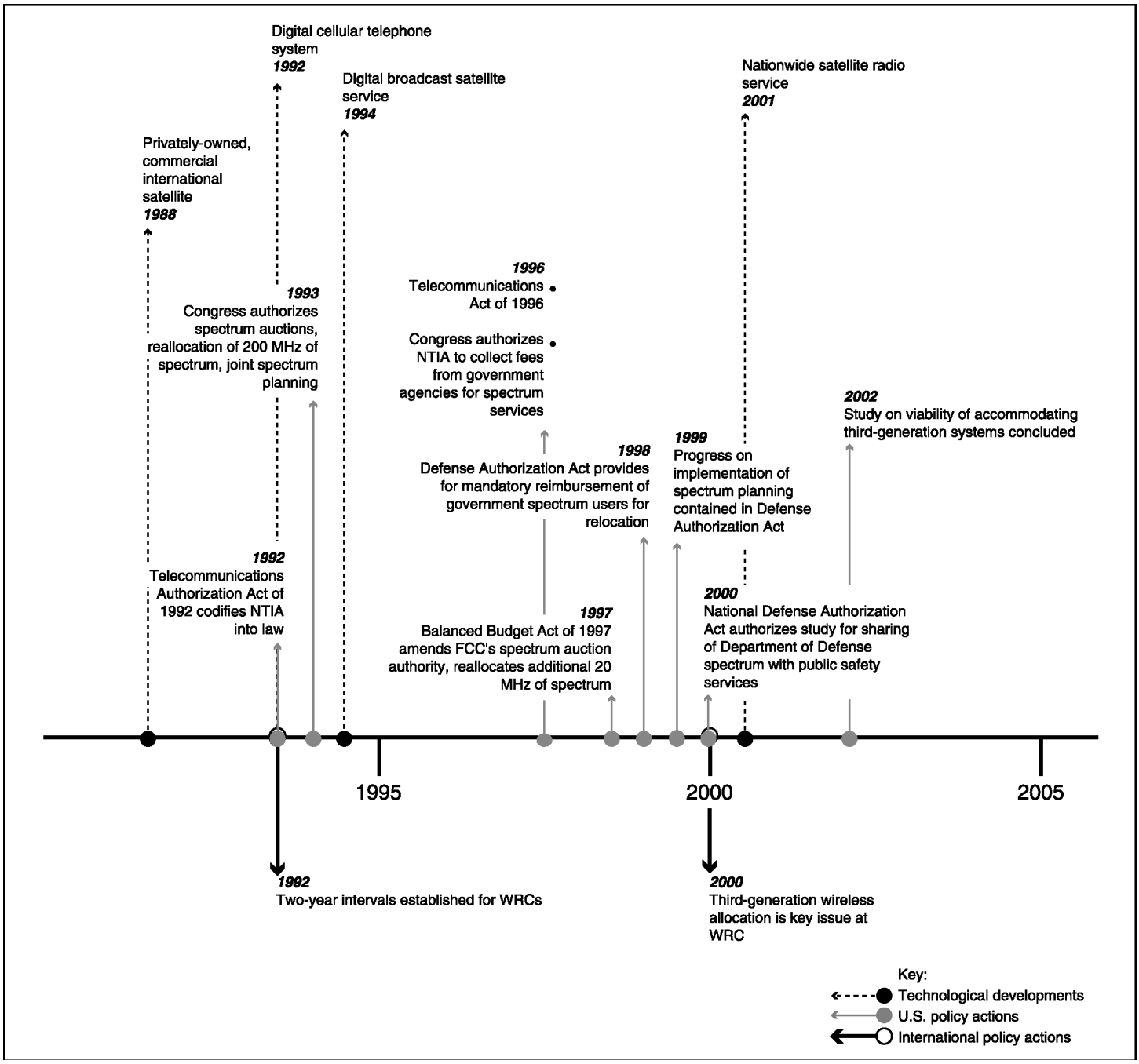
presidential appointment of a Coordinator for International Communications and Information Policy within the U.S. Department of State. The position had been established by the Department of State 2 years earlier and had made the incumbent responsible to the Undersecretary of State for Security Assistance, Science, and Technology. The Coordinator acquired a rank equivalent to an Assistant Secretary of State and the personal rank of Ambassador in 1983 and became head of a new Bureau of International Communications and Information Policy in 1985. In 1994, the bureau was incorporated into the Bureau of Economic and Business Affairs, and legislation was passed that no longer required presidential appointment of the Coordinator position, reassigning it to the Bureau of Economic and Business Affairs.

NTIA Created Office of International Affairs—Primary responsibility for international telecommunications, which had been handled within NTIA by the Office of Spectrum Management, was transferred to the newly created Office of International Affairs.

1985

Communications and Information Policy Bureau at Department of State—The Coordinator for Communications and Information Policy, Department of State, became the head of a new bureau—the Bureau of International Communications and Information Policy.

Figure 9: Timeline of Spectrum Management (1985–2005)



Source: GAO.

1990

FCC International Office Established—FCC created the Office of International Communications to coordinate international activities and policy development for spectrum and other telecommunications matters. This action was taken, in part, to prepare for the World Administrative Radio Conference in 1992 and to establish a focal point at FCC for international matters.

1992

NTIA Organization Act Passed—Fourteen years after NTIA was formed, Congress enacted the Telecommunications Authorization Act of 1992, codifying into law the existence and authority of NTIA as an executive branch agency principally responsible for advising the President on telecommunications and information policies.

Two-Year Intervals Established for WRCs—Delegates to the 1992 ITU Plenipotentiary Conference, held in Geneva, Switzerland, adopted a resolution to convene World Radiocommunications Conferences (WRCs) every 2 years.

1993

Competitive Biding for Spectrum Licenses Authorized by Law—Title VI of the Omnibus Budget Reconciliation Act of 1993 included several provisions addressing spectrum management as follows:

- The Act amended the National Telecommunications and Information Administration Organization Act to direct NTIA to identify and recommend the reallocation of a minimum of 200 MHz of spectrum used by the federal government to nonfederal government users.

- The Communications Act of 1934 was amended to authorize the use of competitive bidding (auctions) by FCC for certain spectrum licenses. FCC was also authorized to make available frequencies reallocated from federal to nonfederal government use.

- The Act amended the Communications Act of 1934 to specify that all mobile radio service providers (public and private) be treated under a comprehensive and consistent regulatory framework. The Act created the new statutory category of commercial (CMRS) and private (PMRS) mobile radio services. As provided earlier, the statute requires all CMRS providers to be treated as common carriers, whereas PMRS providers are exempt from common carrier regulation. However, the new provisions expressly preempted the states from entry or rate regulation of both CMRS and PMRS; authorized FCC to forbear from regulating CMRS where it deemed regulation unnecessary to ensure just,

reasonable, and nondiscriminatory practices; and granted wireless carriers new rights to interconnect with wireline carriers.

1994

FCC International Bureau Created—FCC established an International Bureau to consolidate FCC's various international activities. This change was made to reflect the increasingly global nature of the communications marketplace as well as the concern that international communications policy needed to be better coordinated within FCC, with industry, with other government agencies, and with other countries.

1996

Public Safety Spectrum Report Issued—By congressional directive, FCC and NTIA established a Public Safety Wireless Advisory Committee in 1995 to provide advice and recommendations on specific wireless communications requirements of public safety agencies through 2010. In the final report issued in September 1996, the Advisory Committee concluded that additional public safety spectrum was needed, that spectrum must be used more efficiently, and interoperability standards must be established to meet current and future needs of public safety users. In addition, the committee proposed

- immediate identification of 2.5 MHz of spectrum for interoperability from new or existing allocations;
- allocation in the short term of 25 MHz for public safety purposes, up to an additional 70 MHz to support increased use of data, imagery, and video by the year 2010, and the use of unused spectrum in the 746-806 MHz band (television channels 60-69), as well as TV channels below 512 MHz;
- more flexible licensing policies to encourage the use of spectrally efficient approaches while remaining technologically neutral;
- more sharing and joint use of spectrum and policies to streamline cooperative use of federal and nonfederal spectrum;
- the use of commercial services for public safety provided that essential requirements of coverage, priority access and system restoration, security, and reliability are met;
- a continuing consultative process to permit the public safety community, FCC, and NTIA to adjust to new requirements and opportunities; and

- identification of alternative methods of funding future public safety communications systems.

The Telecommunications Act of 1996—The Telecommunications Act was intended to "provide for a pro-competitive, deregulatory national policy framework designed to accelerate rapidly private sector deployment of advanced telecommunications and information technologies and services to all Americans by opening all telecommunications markets to competition."

NTIA Authorized to Collect Fees from Government Agencies— Included in a provision for additional fiscal year 1996 funding for NTIA, the Secretary of Commerce was authorized to charge fees to federal agencies for spectrum management, analysis, operations, and related services, and to retain and use as offsetting collections funds transferred for all costs incurred in telecommunications research, engineering, and related activities by the Institute for Telecommunication Sciences of NTIA.

1997

Congress Passes Balanced Budget Act of 1997—The Balanced Budget Act of 1997 amended FCC's spectrum auction authority by requiring that FCC award mutually exclusive applications for initial licenses using competitive bidding procedures (not including licenses for public safety radio, digital television, and existing terrestrial broadcast licenses). Among the various other provisions in the Act addressing spectrum, NTIA was directed to reallocate another 20 MHz below 3 GHz for commercial uses, and the Act authorized private parties that win spectrum licenses encumbered by federal entities to reimburse the federal entities for the costs of relocation if the private parties seek to expedite the spectrum transfer.

1998

Defense Authorization Act Revises Spectrum Relocation Reimbursement Policy—Under the Strom Thurmond National Defense Authorization Act, any government entity using this spectrum band that proposes to relocate is directed to notify NTIA of the marginal costs anticipated to be incurred in relocation or modification necessary to accommodate prospective nongovernment licensees. NTIA is directed to notify FCC of such costs before an auction of the spectrum, and FCC must notify potential bidders prior to the auction of the estimated relocation or modification costs based on the geographic area covered by the proposed licenses. Any new licensee benefiting from a government station relocation must compensate the government entity in advance for relocation or modification costs.

1999

FCC Issues Principles for Spectrum Reallocation to Encourage Development of Telecommunications Technologies—FCC issued a policy statement setting forth guiding principles for the Commission's future spectrum management activities. The principles are designed to respond to increasing demand for spectrum, promote competition, and encourage the development of emerging telecommunications technologies. The principles are to serve as a guidepost for the reallocation of approximately 200 MHz of spectrum to enable a broad range of new radio communication services, such as expanded wireless services, advanced mobile services, new spectrum-efficient private land mobile systems, and medical telemetry systems.

Spectrum Planning Directive in Defense Authorization Act—The National Defense Authorization Act for Fiscal Year 2000, contained the following requirements addressing spectrum management:

- The Secretary of Commerce, acting through the Assistant Secretary and in coordination with the Chairman of FCC, was directed to convene an interagency review and assessment of (1) the progress made in implementation of national spectrum planning; (2) the reallocation of federal government spectrum to nonfederal use, and (3) the implications for such reallocations to the affected federal executive agencies.

- The Secretary of Commerce, in coordination with the heads of the affected federal agencies and the Chairman of FCC, was directed to submit a report to the President; the Senate Committee on Armed Services; the Senate Committee on Commerce, Science, and Transportation; the House Committee on Armed Services; the House Committee on Energy and Commerce; and the House Committee on Science providing the results of the review and assessment not later than October 1, 2000.

- If, in order to make available for other use a band of frequencies of which it is a primary user, the Department of Defense was required to surrender use of such band of frequencies only after (1) NTIA, in consultation with FCC, identifies and makes available an alternative band or bands of frequencies as a replacement for the band to be surrendered; and (2) the Secretary of Commerce, the Secretary of Defense, and the Chairman of the Joint Chiefs of Staff jointly certify to the House Committees on Armed Services and Commerce that such an alternative band provides comparable technical characteristics to

restore essential military capability that will be lost as a result of the surrendered bands.

- Eight MHz, previously designated for transfer from federal to nonfederal use, was reclaimed for exclusive federal government use on a primary basis by the Department of Defense.

NTIA issued a report, *Assessment of Electromagnetic Spectrum Reallocation*, in response to these provisions in January 2001.

2000

Federal Long-Range Spectrum Plan Issued by NTIA—NTIA issued a report providing for long-range planning of radiofrequency spectrum use by the federal government. The report states that the national objectives for the use of the radio spectrum are to make effective, efficient, and prudent use of the spectrum in the best interest of the nation, with care to conserve it for uses where other means of communication are not available or feasible. The report also states that the government shall, in general, encourage the development and regulate the use of radio and wire communications subject to its control so as to meet the needs of national security; safety of life and property; international relations; and the business, social, educational, and political life of the nation.

3G Allocations Dominate WRC-2000—At the 2000 World Radiocommunication Conference (WRC-2000), spectrum and regulatory issues related to advanced mobile communications, including third-generation services, were discussed and three bands identified for its use (806-960 MHz, 1710-1885 MHz, and 2500-2690 MHz). The United States agreed that it would study these bands domestically, but did not commit to providing additional spectrum for third-generation systems.

Congress Passes the ORBIT Act—The Open-market Reorganization for the Betterment of International Telecommunications (the "ORBIT" Act) became law in March 2000 to promote a "fully competitive global market for satellite communication services for the benefit of consumers and providers of satellite services and equipment." The Act prohibits FCC from assigning orbital locations or spectrum licenses to international or global satellite communications services through the use of auctions. Further, the Act directs the President to oppose the use of auctions of satellite spectrum bands in international forums.

Executive Memorandum Issued on Advanced Mobile Communications Systems—President Clinton issued a memorandum

stating the need to select radio frequency spectrum for future mobile, voice, high-speed data, and Internet-accessible wireless capacity. The memorandum established the guiding principles for executive agencies to use in selecting spectrum that could be made available for third-generation (3G) wireless systems and strongly encouraged independent federal agencies to follow the same principle in any actions they take related to the development of 3G systems. The memorandum directed the Secretary of Commerce to work cooperatively with FCC (1) to develop a plan to select spectrum for 3G systems by October 20, 2000, and (2) to issue by November 15, 2000, an interim report on the current spectrum use and potential for reallocation or sharing of the bands identified at the WRC-2000 that could be used for 3G systems. These actions were seen as enabling FCC to identify spectrum for 3G systems by July 2001 and auction licenses by September 2002.

Interference Avoidance for Defense and Public Safety Users—In the National Defense Authorization Act for Fiscal Year 2001, the Secretary of Defense, in consultation with the Attorney General and the Secretary of Commerce, was directed to conduct an engineering study to identify (1) any portion of the 138-144 MHz band that the Department of Defense can share, in various geographic regions, with public safety radio services; (2) any measures required to prevent harmful interference between Department of Defense systems and the public safety systems proposed for operation on those frequencies; and (3) a reasonable schedule for implementation of such sharing of frequencies. The Secretary of Commerce and the Chairman of FCC were to jointly submit a report to Congress on alternative frequencies available for use by public safety systems by January 1, 2002. NTIA issued a report, *Alternative Frequencies For Use by Public Safety Systems*, in December 2001, and a companion report was issued by FCC.

2001

Domestic Developments on Spectrum for 3G Systems—FCC issued a final report on the use of the 2500-2690 MHz band for advanced mobile communications systems, including 3G systems. NTIA also issued a final report on the 1710-1755 MHz federal government band and the 1755-1850 MHz band. FCC Chairman Michael Powell and Secretary of Commerce Donald Evans exchanged letters in which they agreed to postpone the July 2001 deadline for FCC to identify spectrum for 3G systems. Secretary Evans informed Chairman Powell that he had directed the then-Acting Administrator of NTIA to work with FCC to develop a new plan for the selection of 3G spectrum to be executed as quickly as possible.

2002

NTIA Hosts Two-Day Spectrum Summit—NTIA hosted a summit in Washington, D.C., on April 4-5, 2002, to help identify the best solutions to challenges posed by management of the nation's airwaves. The purpose of the spectrum summit was to explore new ideas to develop and implement spectrum policy and management approaches that will make more efficient use of the spectrum; provide spectrum for new technologies; and improve the effectiveness of domestic and international spectrum management processes. The first day featured industry and government spectrum users, economists, analysts, and technologists; the second day was devoted to working sessions focused on commercial, international, and federal government perspectives.

FCC Chairman Forms Spectrum Policy Task Force—The formation of a Spectrum Policy Task Force was announced by FCC Chairman for purposes of assisting the Commission in identifying and evaluating changes in spectrum policy that will increase the public benefits derived from the use of radio spectrum. Composed of senior staff from various offices and bureaus of FCC, the Spectrum Policy Task Force issued a public notice on June 6, 2002, soliciting comment on various aspects of spectrum policy, including: market-oriented allocation and assignment policies, interference protection, spectral efficiency, public safety communications, and international issues. In August 2002, the Spectrum Policy Task Force held four public workshops in order to provide additional public input to the Task Force's review. The topics included experimental licenses and unlicensed spectrum, interference protection, spectrum efficiency, and spectrum rights and responsibilities. Participants in these workshops included representatives from academia, industry, and government. The Task Force is tentatively scheduled to issue a report to the Commission by October 2002.

Study on Viability of Accommodating 3G Systems Concluded—NTIA released findings of an assessment performed by NTIA, FCC's 3G Working Group, the Department of Defense, and other members of the Intra-Government 3G Planning Group on the viability of accommodating advanced mobile wireless (3G) systems in the 1710-1770 MHz and 2110-2170 MHz bands. The study concluded that 90 MHz of this spectrum can be allocated for 3G services to meet increasing demand for new services without disrupting communications systems critical to national security.

Comments from the Federal Communications Commission

Federal Communications Commission
Washington, D.C. 20554

August 28, 2002

Mr. Peter Guerrero
Director, Physical Infrastructure Issues
United States General Accounting Office
Washington, DC 20548

Dear Mr. Guerrero:

Chairman Powell has asked me to respond to your letter of August 12, 2002 requesting FCC's comments on GAO's draft report entitled *Telecommunications: Better Coordination and Enhanced Accountability Needed to Improve Spectrum Management* (GAO code 545002).

The report makes two recommendations that pertain to the FCC. The first recommendation is that: *The Secretary of Commerce and the Chairman of the Federal Communications Commission should establish and carry out formal, joint planning activities to develop a clearly defined national spectrum strategy to guide domestic and international spectrum management decision making. The results of these planning activities should be reported to the appropriate congressional committees.*

The FCC staff supports this recommendation. As noted in the report, both the Department of Commerce, under the auspices of the National Telecommunications and Information Administration, and the Federal Communications Commission, have initiated processes to review and improve spectrum management. A cornerstone of these efforts is to improve coordination between our agencies and to conduct joint planning to develop a national spectrum management strategy. This national strategy should emphasize ways to support innovation and the efficient, flexible use of spectrum, with the overarching goal of maximizing the public benefits derived from the use of the radio spectrum.

The second recommendation is: *Following the 2003 World Radiocommunication Conference, the Secretary of State, the Secretary of Commerce, and the Chairman of the Federal Communications Commission should jointly review the adequacy of the process used to develop and promote the U.S. position, including the separate processes used by the FCC and NTIA, and the short tenure of the head of delegation, and prepare a report containing any needed recommendations for making improvements. The report should be provided to the appropriate congressional committees.*

The FCC staff supports this recommendation as well. The United States has had an outstanding record of success at past international radio conferences. The FCC took

several actions following WRC 2000 to improve the way the U.S. prepares for such conferences. We agree that it would be beneficial for State Department, Department of Commerce, and FCC to further review the U.S. preparatory processes following the 2003 WRC.

We have already provided you with a list of minor edits and corrections to the report. Please contact Mr. Julius Knapp at (202) 418-2468, if we can be of any further assistance.

Sincerely,

Julius P. Knapp

for Edmond J. Thomas
Chief
Office of Engineering and Technology

Comments from the Department of Commerce

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Communications and Information
Washington, D.C. 20230

SEP 6 2002

Mr. Peter Guerrero
Director
Physical Infrastructure Issues
441 G Street, NW
United States General Accounting Office
Washington, DC 20548

Dear Mr. Guerrero:

On behalf of Secretary Evans, thank you for providing the Department with a copy of the General Accounting Office's draft report entitled "Telecommunications: Better Coordination and Enhanced Accountability Needed to Improve Spectrum Management" (GAO-02-906). I have the following comments on the three areas in which GAO makes recommendations: improved processes for spectrum planning; better coordination for world radio conferences; and increased accountability and efficient use of the spectrum.

In the area of spectrum planning, GAO recommends that the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA) carry out formal joint planning activities to develop clearly defined national spectrum strategy to guide domestic and international spectrum management decision making and report the results to the appropriate congressional committees. The National Table of Allocations, which represents the United States' spectrum plan, is comprised of over 40 radio services spread out over 900 frequency bands. The FCC and NTIA currently conduct examinations of those services and bands as circumstances dictate, usually in areas of congestion or where growth is expected, or to accommodate a new technology or service. The two agencies also participate together in higher level or more theoretical spectrum planning activities, as evidenced by NTIA's Spectrum Summit in April (in which FCC participated) and the FCC's recent spectrum policy workshops (in which NTIA participated). Yet, we agree that spectrum planning and interagency coordination can be improved. NTIA will develop strategies to better prepare for inevitable technological changes, to increase efficient use of spectrum, to facilitate the deployment of new technologies, and to implement closer coordination between the agencies in their planning activities.

With respect to the world radio conferences, it is vitally important that the United States develop coordinated positions and be well prepared in advance of these conferences to ensure that U.S. spectrum interests are protected and promoted internationally. The draft GAO report recommends that the State Department, FCC, and NTIA jointly review the adequacy of the preparation process following the 2003 World Radio Conference and develop recommendations for improvements. I agree with this recommendation and will work with the State Department and the FCC to this end.

Finally, the draft GAO report calls on NTIA to encourage increased accountability and efficient use of the spectrum by federal agencies. The report indicates that financial and personnel resource shortages at NTIA and the other agencies have adversely affected the deployment of more spectrum efficient technology within the federal government and hampered NTIA's ability to monitor federal agencies' compliance with authorization conditions. GAO specifically recommends that the Department of Commerce, assisted by the Interdepartment Radio Advisory Committee (IRAC) and the Office of Personnel Management (OPM), conduct an analysis of the human resources required for the Federal agencies' spectrum management processes to evaluate the adequacy of resources. NTIA will review its human capital needs and current resources and develop a strategy for addressing any shortcomings. I will also encourage other agencies who are members of the IRAC to conduct a similar analysis. NTIA will additionally continue to look at other mechanisms to achieve spectrum efficiency, such as incentives and mandates for narrowbanding.

I believe it is time for the United States to take a broad look at the organizational structures and processes we have built both nationally and internationally to manage and plan spectrum use. The President's Fiscal Year 2003 Budget includes an initiative designed to make the spectrum management process more responsive, effective, and efficient so that it can implement new technologies, satisfy critical public safety radiocommunication needs, increase economic growth, and eliminate unnecessary regulation. It is essential that this initiative be funded.

As the draft GAO report highlights, spectrum is a very valuable resource that is the life blood of our radiocommunications. If managed properly, this resource will be available to meet all of our Federal, private sector and public needs. Thank you again for this opportunity to review the draft report and to provide these comments.

Sincerely,

Nancy J. Victory

2

Comments from the Department of State

United States Department of State

Washington, D.C. 20520

AUG 28 2002

Dear Ms. Westin:

We appreciate the opportunity to review your draft report, "TELECOMMUNICATION: Better Coordination and Enhanced Accountability Needed to Improve Spectrum Management," GAO-02-906, GAO Job Code 545002.

The enclosed Department of State comments are provided for incorporation with this letter as an appendix to the final report.

If you have any questions concerning this response, please contact Douglas Spalt, Telecommunications Officer, Office of Multilateral Affairs, Bureau of Economic and Business Affairs, at (202) 647-0200.

Sincerely,

Christopher B. Burnham
Assistant Secretary and
Chief Financial Officer

Enclosure:

As stated.

cc: GAO/PI - Mr. John Finedore
State/OIG - Mr. Berman
State/EB/CIP/MA - Mr. Beaird

Ms. Susan S. Westin,
Managing Director,
International Affairs and Trade,
U.S. General Accounting Office.

Department of State Comments on GAO Draft Report

TELECOMMUNICATIONS: Better Coordination and Enhanced Accountability Needed to Improve Spectrum Management (GAO-02-906, GAO Code 545002)

The Department appreciates the opportunity to provide comments on the draft report and notes the second recommendation under Recommendations for Executive Action. The Department will consult with the Department of Commerce and the Federal Communications Commission (FCC) after the conclusion of the 2003 World Radiocommunication Conference.

The Department requests that one modification be made in the Annex II to the Report. The title of the 1979 entry in the timeline should be modified to reflect what has been stated in the first sentence, i.e., **First General World Radio Conference in 20 Years**.

In reading the report the Department has some questions concerning the wording of the report; however, these issues should be more appropriately addressed by the technical agencies, i.e., the National Telecommunications and Information Administration and the FCC.

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