Chapter 1
Introduction and Summary

The most pressing communications problem at this particular time, however, is the scarcity of radio frequencies in relation to the steadily growing demand. Increasing difficulty is being experienced in meeting the demand for frequencies domestically and even greater difficulty is encountered internationally in attempting to agree upon the allocation of available frequencies among the nations of the world.[1]

Harry S Truman, Feb. 17, 1950

Introduction

In February 1992 the International Telecommunication Union (ITU)—the organization responsible for harmonizing and regulating international telecommunication and radio services-will hold a World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (WARC-92). WARCs are international conferences that bring together the nations of the world to coordinate radiocommunication technologies and services worldwide. WARC-92, the most wide-ranging WARC since 1979, will seek ways to designate radio frequencies for many advanced communication and entertainment services, including new mobile radio services, digital audio broadcasting, high-definition television, and new services for communication in space. The decisions made at WARC-92 will determine how and when these new services will be implemented and will influence the development of new radio technologies and applications well into the next century. The United States, as one of the world leaders in radiocommunication technology and policy, has a major stake in the outcomes of WARC-92.

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In the United States the process of preparing for a WARC begins years in advance of the actual conference. Federal Government and private sector interests come together to craft the proposals the United States will present at the conference. The U.S. preparations for WARC-92 brought together many diverse interests, including broadcasters seeking to bring digital audio to listeners at home and in the car; the national security community attempting to protect frequencies used for aircraft testing; promoters of innovative mobile services provided by satellite; and a multitude of other users, e.g., amateur radio operators, police and fire departments, and the makers of microwave ovens and baby monitors. The task of sorting out and synthesizing the views of these participants is divided between the Federal Communications Commission (FCC), which examines the needs of the private sector and State and local governments, and the National Telecommunications and Information Administration (NTIA), which referees Federal Government interests. These two agencies submit their final proposals in the form of recommendations to the Department of State, which presents official U.S. proposals at WARCs and other international telecommunications meetings.

This report examines the U.S. preparations process for WARC-92, highlighting efforts to integrate the needs and concerns of various interest groups. It also reviews the forces and trends affecting the United States as it approaches WARC-92, and is intended to inform future congressional oversight of the domestic and international radiocommunication policy process.

Summary of Findings

Despite inefficiencies and problems, the domestic process of preparing proposals for international spectrum conferences works reasonably well at present. Participants in the process, in government and in the private sector, consider the

[1]Harry S Truman, quoted in Stanley D. Metzger and Bernie R. Burrus, "Radio Frequency Allocation in the Public Interest: Federal Government and Civilian Use," *Duquesne University Law Review,* vol. *4, No.* 1, 1965-1966, p. 1.

process generally fair and responsive. Federal agencies have processes in place that allow them to respond relatively effectively to WARC issues and to develop coordinated positions. Final U.S. proposals for WARC-92 were developed in a timely fashion. Nevertheless, long-standing problems contribute to a process that can be overly contentious and political. Further, it is not clear that the U.S. proposals reflect the broader goals of U.S. international radiocommunication policy. More formal and rigorous government planning and high-level coordination, supported by increased staff and funds, could strengthen U.S. leadership in international radiocommunication technologies, services, and policy.

The United States is at a crucial turning point in the history of spectrum use and management. Technological, economic, and political forces are converging to radically alter the context within which domestic and international spectrum decisions and policies are made. The domestic system by which the radio spectrum is used and managed is stretched to its limits. Congested spectrum has been a recurring problem for U.S. spectrum managers for over 40 years. Demand for spectrum has continually increased, but technology has usually been able to expand the number of services and users. Today, however, the numbers of radio-based services and users are growing so quickly that the perceived scarcity of spectrum has once again become an important public policy issue. While the U.S. spectrum management system generally has worked adequately in the recent past, burgeoning demand for radio frequencies once again threatens the Federal Government's ability to promote innovation and efficiency, while at the same time accommodating existing users.[2] At the international level, WARC-92 reflects and highlights the ongoing problems of spectrum management, and represents an important opportunity for addressing the world's spectrum needs.

Because domestic problems of spectrum management do not appear to have significantly detracted from U.S. international policy in the past, it is tempting to assume that current domestic structures and processes for determining international spectrum policy will continue to serve the country well. Several trends make this assumption questionable:

More formal and rigorous government planning and high-level coordination, supported by increased staff and funds, could strengthen U.S. leadership in international radiocommunication technologies, services, and policy.

1. In the last decade, the use of radiocommunication services has expanded dramatically as technology has opened new applications. The rapid pace of technology development and increases in the use of radio services have put great stresses on the structures and processes for managing radio-based communications both domestically and internationally. Technological issues are now more complex and interwoven with economic, social, and political concerns.
2. The international scene is in a period of rapid and far-reaching transition. Old alliances are crumbling and emerging actors, such as the newly independent nations of Eastern Europe, are making international negotiations more complex than in the past. The ITU is poised to significantly restructure its organization and functioning, including the possibility that world radio conferences will be held every 2 years.[3] In this rapidly changing international environment, the United States is seeking new alliances and strengthening existing relationships. The FCC and NTIA, for example, are actively involved in efforts to strengthen the Inter-American Telecommunications Conference (CITEL), the regional telecommunications forum for the Western Hemisphere.[4]
3. The United States has no overarching policy framework or plan within which to address international radiocommunication issues, including preparations for WARCs. While there is much international expertise in the government and considerable technical expertise in

[2]U.S. Department of Commerce, National Telecommunications and Information Administration, *U.S. Spectrum Management Policy: Agenda for the Future*, NTIA Special Publication 91-23 (Washington DC: U.S. Government Printing Office, February 1991), p. 13.

[3]See the discussion of the ITU's High Level Committee (HLC) in ch. 3 and the summary of the HLC's recommendations in box 3-A.

[4]See ch. 3, box 3-B for a discussion of CITEL.

the private sector, it is not clear that this expertise is being used effectively to best realize the long-term goals of the United States. The failure to adequately address the strategic aspects of domestic and international spectrum policy in the past has contributed to international radiocommunication policy that today lacks vision and direction. In the absence of overall strategic policy planning, U.S. approaches and preparations for international conferences may not be adequate to the tasks of the future.

The implications of domestic spectrum policymaking extend beyond narrowly defined U.S. interests. Domestic and international spectrum interests are converging.[5] Until recently, policymakers approached international telecommunication policymaking and negotiation as an extension of national priorities—merely "internationalizing' domestic policy. In many cases, the focus on domestic communication issues tended to overlook the implications of those issues for international telecommunications and the interests of U.S. businesses and other communications users in the global market. Conversely, many policymakers assumed that national spectrum problems could be solved domestically-either by reallocating spectrum or increasing efficiency-without considering international pressures.

Today, international concerns are rapidly becoming part of domestic radiocommunication policymaking. There is a growing recognition among government policymakers and telecommunications analysts that many domestic spectrum problems have an inherent international dimension that must be accounted for in domestic proceedings. U.S. spectrum policy must be decided in the international context within which the radio spectrum is managed. This will require that domestic and international policies be more effectively integrated. Processes and decisions that take inadequate notice of international considerations will not be effective. The establishment of an Office of International Communications in the FCC (see ch. 4) indicates increased recognition of the importance of international concerns for domestic policy.

Successful U.S. international spectrum policymaking will require that domestic and international policies be more effectively integrated.

The lack of a unified national radiocommunication policy, including international spectrum goals, will hurt the United States' ability to negotiate and compete globally. Many of the problems in the radiocommunication policy process reflect more general failures in highlighting the importance of U.S. radiocommunication policy and pursuing integrated goals that are based on well-defined technological, economic, and social priorities. The United States has no comprehensive long-range plan or vision for the future of radiocommunications, and thus no comprehensive framework within which to make strategic spectrum policy decisions, either domestically or internationally.

This country depends on a system which emphasizes "market forces,' but which reemphasizes planning and prioritizing. This approach reflects a long held U.S. view that formal spectrum planning is not efficient and not desirable. There is a belief among some government policymakers that the government should not plan spectrum use as much as it should respond to priorities set by the private sector (and government users) through market forces. A more formal planned approach, they argue, would prejudge future radiocommunication needs and constrain technologies and services yet to be developed. One of the objectives in a market-oriented approach is to build flexibility into the system that will allow the United States to respond to the new needs and technologies of the future in a timely way. This approach, based on a diversity of interests competing before the government, may give the system the flexibility it needs to adequately meet the evolving short-term needs of both the government and the private sector, but overreliance on such market forces may threaten the effective pursuit of broader, longer-term goals and priorities. Market forces can delay introduction of new products and services and lead to inefficiencies (recall AM stereo and the battle

[5] This trend was noted by OTA in 1985. See U.S. Congress, Office of Technology Assessment, *International Cooperation and competition in Civilian Space Activities,* OTA-ISC-239 (Washington DC: U.S. Government Printing Office, July 1985).

No single government agency is responsible for planning for new radio services, and no government agency has been mandated or assumed a leadership role in domestic and international spectrum policymaking.

between VHS and Beta).[6] OTA notes that a shift to private sector decisionmaking in communication policy "has created a vacuum in the policymaking process with respect to societal decisions about communication that are not easily made by summing up individual preferences or deferring to market power. ' No single government agency is responsible for planning for new radio services, and no government agency has been mandated or assumed a leadership role in domestic and international spectrum policymaking.[8]

Cooperation on long-range planning or even on establishing a long-term vision for U.S. spectrum policy is almost nonexistent. While the Federal Government agencies involved in spectrum policymaking have established internal procedures for addressing specific radiocommunication issues (e.g., WARC preparations), and do cooperate on policy formulation in these areas, beyond these narrow concerns, coordination among government agencies and between the government and private sector on longer-term domestic and international spectrum issues is mostly informal. In lieu of explicit mechanisms for formulating strategic international radiocommunication policy, the process depends largely on the individuals involved and on the relationships they have formed over time. While such coordination may be effective on a day-to-day basis, the lack of long-term strategic guidance in spectrum policymaking has reduced policy planning to a reactive exercise.

In this context, WARCs are especially important because they serve as focal points for both short- and long-term spectrum planning. More importantly, they represent a critical opportunity for drawing together the interests of government and industry in developing the broader issues of international radiocommunications policy. Without WARCs, spectrum planning and policy development on an international level would likely be greatly reduced. With regularly scheduled WARCs a real possibility in the future (see ch. 3), the United States could have an important opportunity to focus ongoing attention on the "big picture" of international spectrum policy and to develop integrated long-term strategies for using spectrum resources and pursuing effective international policies.

The Radio Frequency Spectrum

General Background

The radio frequency spectrum refers to the total range of radio frequencies (3 kHz-300 GHz) that can be used for telecommunications (see figure l-l)[9] It makes possible many of today's most important communications technologies and services. Radio waves are used to transmit information and entertainment of all kinds, including television and radio programming, long-distance and cellular telephone service, safety and navigation services for aeronautical and maritime use, radar and defense communications-even the signals used by baby monitors and remote garage-door openers. Radio-based technologies and systems are increasingly being used to connect to the public telephone network, allowing users access while traveling or in rural areas without wired service. New services are being developed constantly, but the limited availability of adequate spectrum may constrain future advances in radiocommunication services.

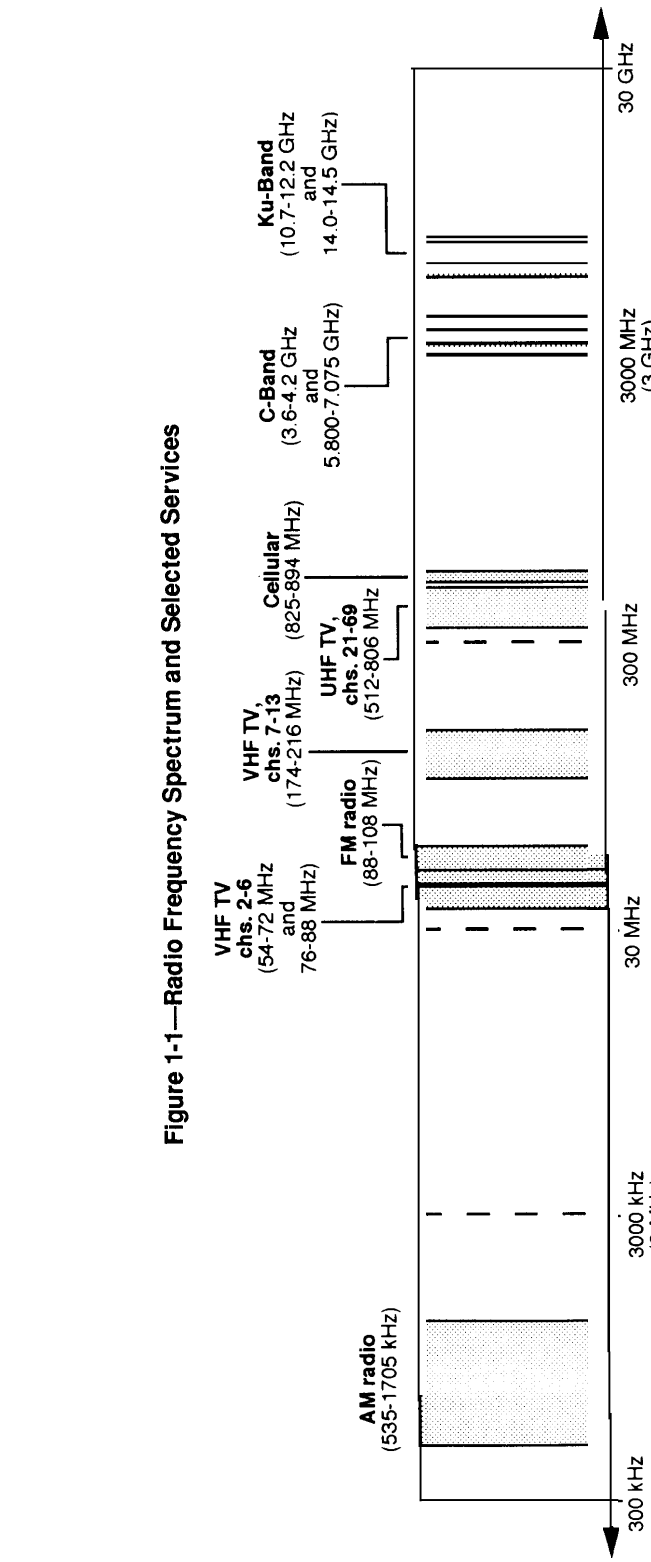
[6]Significantly, the FCC is now in the process of setting standards for future high-definition television systems, rather than let-tie market take its course.

[7]U.S. Congress, Office of Technology Assessment *Critical Connections; Communication for the Future,* OTA-CIT-407 (Washington, DC: U.S. Government Printing Office, January 1990), p. 361.

[8]NTIA's efforts to implement the recommendations of its recent report on spectrum management indicate that government policymakers are beginning to grapple with some of these issues.

[9]Radio frequencies are measured in hertz, which is a measure of the number of cycles a radio wave completes in 1 second-1 hertz (Hz) represents one cycle per second (see ch. 2). Prefixes are used to indicate numbers of hertz in multiples of 10: kHz= thousand Hz; MHz= 1 million hertz; and GHz= 1 billion hertz. The radio frequency spectrum is only one segment of the larger electromagnetic spectrum, which comprises all light and radio waves and includes audible sound, radio waves (the radio frequency spectrum), infrared light, visible light, ultraviolet light, x-rays, gamma rays, and cosmic rays.

Figure 1-1—Radio Frequency Spectrum and Selected Services



NOTE: This figure uses a logarithmic scale with dashed lines representing breaks in the scale. Shaded areas in different segments of the scale are not proportional. For example, AM radio occupies 1,170 kHz of spectrum, while cellular (which appears smaller visually) actually occupies 69,000 kHz of spectrum.

SOURCE: Office of Technology Assessment, 991.

The spectrum is divided or "allocated" into frequency 'bands' that correspond to certain ranges of frequencies and specific radiocommunication services (see table 1-l).[10] Individual radio services, such as AM and FM radio broadcasting, television, navigation, and satellite services, also use specific bands of frequencies. For example, FM radio broadcasting uses the frequencies 88-108 MHz. Within some of these radio service bands, the spectrum is further subdivided into separate "channels," which are assigned by the government to individual users. For example, 90.9 MHz in the FM radio band is assigned to radio station WETA in Washington, DC. The same charnel can also be assigned to other radio stations in distant cities, thus allowing the radio frequencies to be reused. In some frequency bands, many users and even different services, share the same segment of spectrum. Radio systems used for point-to-point and mobile communications services, for example, share many frequency bands.[11]

Radio Spectrum as Public Resource

The radio frequency spectrum has long been viewed as a vital natural and national public resource, and protecting and enhancing this limited resource has been a Federal Government function dating back to the early part of this century. In 1925, then Secretary of Commerce Herbert Hoover declared:

> The ether [sic] is a public medium, and its use must be for a public benefit. The use of a radio channel is justified only if there is public benefit. The dominant elements for consideration in the radio field is, and always will be, the great body of the listening public, millions in number, countrywide in distribution. [12]

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Congress also has a long history of seeking to ensure the development of this resource for the public good, dating back even before the creation of the FCC in 1934.[13] Concern over radio spectrum and services resurfaced in 1958, only 1 year before the 1959 general World Administrative Radio Conference:

> The development of so valuable a natural resource as the radio spectrum is a matter of paramount importance. The spectrum is a publicly owned natural resource the importance of which increases year by year as its use for varied purposes grows. It has long been apparent that the capacity of this resource is not unlimited and that its effective utilization cannot be expanded indefinitely. The interdependence of regulatory measures and technology in making possible the most effective use of the spectrum is a significant point that requires most painstaking study. The use of the spectrum requires as careful planning and administration as any other national resource.[14]

Today, spectrum policy is increasingly recognized as an important area of national telecommunications policymaking. In the last several years Congress, the executive branch, and the FCC have been studying and seeking solutions to spectrum

[10] The process of allocation refers t. the designation of a group of radio frequencies to a service or family of related services. For example, the band 88.0- 108.0 megahertz (MHz) is allocated to (FM radio) broadcasting. Assignment of frequencies refers to the granting of a right to use a specific frequency or band of frequencies to an end user or service provider. For example, the FCC has assigned 542-548 MHz (television channel 26) in Washington DC to WETA. For more in-depth discussion of the procedures of allocation and assignment, both domestic and international, see Richard Gould, Telecommunications Systems, Inc., ''Allocation of the Radio Frequency Spectrum,' contractor report prepared for the Office of Technology Assessment, Aug. 10, 1990.

[11] Sharing spectrum is accomplished in many different ways. Users can share by time (taking turns or using for specified hours of the day), by geography (users can share the same frequency if they are far enough apart so tbat signals do not interfere), or by technologies that reduce interference. Sometimes sharing is planned, as in the case of channeling arrangements, but sometimes it is not-cellular radio providers have a specific block of spectrum they must use, but individual customers use the service on demand.

[12] Quoted in Max D. Paglin (cd.), *A Legislative History of the Communications Act (New* York, NY: Oxford University Press, 1989), p. 9.

[13] For a more complete description of the early history of radio regulation leading up to the Communications Act Of 1934, see Paglin, op. cit., footnote 12.

[14] U.S. Congress, Senate Committee on Interstate and Foreign Commerce, *Commission To Investigate Utilization of Radio Frequencies Allocated to the Government, 85th* Cong., 2d sess., Report No. 1854, July 18, 1958, p. 2.

Table l-l—Radio Frequency Bands and Uses

Name	Frequency range	Examples of services
Very low frequency (VLF)	3 to 30 kHz	Marine navigation
Low frequency (LF)	30 to 300 kHz	Marine and aeronautical navigation equipment
Medium frequency (MF)	300 to 3,000 kHz	AM radio broadcast, LORAN maritime navigation, long-distance aeronautical and maritime navigation
High frequency (HF)	3 to 30 MHz	Shortwave broadcast, amateur radio, CB radio
Very high frequency (VHF)	30 to 300 MHz	Private radio land mobile services such as police, fire, and taxi dispatch; TV channels (2 through 13); FM broadcasting; cordless phones; baby monitors
Ultrahigh frequency (UHF)	300 to 3,000 MHz	UHF TV channels; cellular phones; common carrier point-to-point microwave transmission used by long-distance phone companies; satellite mobile services
Superhigh frequency (SHF)	3 to 30 GHz	Radar, point-to-point microwave, and satellite communication
Extremely high frequency (EHF)	Above 30 GHz	Satellite communications and space research

SOURCES: Harry Mileaf (cd.), *Electronics One,* revised 2d ed. (Roehelle Park, NJ: Hayden Book Co., Inc., 1976), p. 1-14; and John J. Keller, "No Vacancies," The Wall Street Journal, Nov. 9, 1990, p. R14.

concerns. In the 102d Congress, five bills relating to spectrum use and management have been introduced, the Emerging Telecommunications Technologies Act of 1991 (H.R. 531, H.R. 1407, and S. 218)[15] and the Amateur Radio Spectrum Protection Act (H.R. 73 and S. 1372). NTIA recently completed a comprehensive study of the U.S. domestic spectrum policymaking process that includes recommendations on how the system might be improved.[16] The FCC is conducting a study of spectrum use in order to identify underused portions of the spectrum for possible inclusion in a "spectrum reserve" that could be used for the development of emerging communications technologies and services.[17]

Spectrum Scarcity and Crowding

The radio frequency spectrum is a finite-but reusable—resource. It is reusable in the sense that when one person stops using a certain frequency another person can start. Using the resource does not consume it. Radio frequency spectrum is finite in that only a certain range of frequencies can be used for communication at any given level of technology. And although technological advances continue to expand the range of usable frequencies, the fundamental properties of radio waves make some radio frequencies more useful, and hence more valuable, than others. For example, the transmission characteristics of radio waves in the 1-3-GHz band (see ch. 2) make them especially valuable for many mobile and fixed services.[18]

The problem is that more and more technologies and communication services are vying for a slice of the valuable radio spectrum, and demand for spectrum is growing rapidly, both for new services, such as high-definition television (HDTV) and personal communications services (PCS) (see box 2-B), and for the expansion of existing services such as cellular telephony. The ITU has recorded as many

[15]All three of these bills would require that the government make available for transfer to the private sector 200 MHz of total spectrum bandwidth. H.R. 1407, the administration's counter proposal to companion bills H.R. 531 and S. 218, also includes the requirement tbat spectrum be distributed to users through a competitive bidding process.

[16]NTIA, *U.S. Spectrum Management Policy,* op. *Cit.,* footnote 2.

[17]Part of the impetus for this initiative has come from developments in *other countries.* FCC Chairman Sikes has noted that Europe and Japan have taken steps to reserve spectrum in the 1-3-GHz band and that the United States should follow suit in order to maintain its technological and competitive edge. Speech before the Practicing Law Institute and the Federal Communications Bar Association conference, Washington DC, Dec. 6, 1990.

[18]Fixed service refers t. telecommunication services more commonly known as point-to-point, microwave, or radio-relay systems. For a discussion of the technical properties of the various radio frequency bands, see Gould, op. cit., footnote 10.

new frequency assignments in the last 10 years as in the previous 80 years of radio communications.[19] In response to a recent FCC announcement that it would license 200 radio charnels to provide new mobile communications services, the Commission received almost 100,000 applications from potential providers.[20]

The result, and the most critical problem facing spectrum managers today, is a shortage of unused spectrum and serious congestion of the most valuable bands.[21] The problem is a recurring one. In the 1920s the use of radio for broadcasting in the United States exploded-interference threatened to overwhelm the industry. The problem resurfaced in the United States in the late 1950s when a report was issued on the allocation of television channels and hearings were held regarding the allocation of spectrum between government and nongovernment users.[22] Internationally, the problem dates back to the 1930s. At that time new aeronautical services had begun to compete with broadcasters and maritime users for radio spectrum.[23]

Today, the accelerated pace of technology development, coupled with a rapidly changing world environment in economics and politics, has made coordinating the use of the radio frequency spectrum increasingly complex, and has raised the issues of radiocommunication and spectrum policy to new prominence.[24] In broad terms, the problem is finding ways to expand existing services and promote new radio technologies while simultaneously accommodating existing users who have successful services and large capital investments. At the international level, WARC-92 is an important attempt to sort out these issues for many applications, including mobile services, high frequency broadcasting, and new space services (see the discussion of major WARC-92 issues below).

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Spectrum Management

Managing the use of the spectrum is an extremely complex task both because of the variety of services and technologies involved, and because radio waves easily cross geographic and political boundaries. The functions of spectrum management are twofold.[25] First, spectrum managers must try to accommodate all the various services with their differing technical characteristics and requirements. They do this by allocating bands, or blocks, of spectrum to the various services, such as broadcasting, mobile, amateur, and satellite services. Second, spectrum managers establish conditions of use for radiocommunication services in order to ensure that use is as fair and efficient as possible. Because radio waves do not respect national borders, spectrum allocation and use must be coordinated internationally as well as domestically. The most visible outcome of this function is controlling interference between users and between services. Managers also try to ensure that use of the spectrum is as efficient as possible. The international Radio Regulations that govern radiocommunications worldwide, for example, set levels on transmitter power to limit interference and

[19] Mark Lewyn and Peter Coy, "Airwave Wars," *Business Week,* July 23, 1990, p. 48.

[20] "The Scramble for Frequencies, ' *Telcom Highlights International,* vol. 13, No. 4, June 12, 1991.

[21] Some believe, however, that the spectrum "shortage" is an artificial concept—that it has been created by the processes used to allocate and assign spectrum resources. Changing the process for distributing these resources, they argue, would eliminate any scarcity. See George Gilder, "What Spectrum Shortage?" *Forbes, May 27,* 1991.

[22] U.S. Congress, Senate Committee on Interstate and Foreign Commerce, *Allocation of TV Channels: Report of the Ad Hoc Advisory Committee on Allocations, Committee* Print, *Mar. 14,* 1958; U.S. Congress, House Committee on Interstate and Foreign Commerce, *Allocation of Radio Spectrum Between Federal Government Users and Non-Federal Government Users,* Hearings June 8 and 9, 1959.

[23] For a discussion of the history of radio services and the development of the ITU, see George A. Codding, Jr. and Anthony M. Rutkowski, *The International Telecommunication Union in a Changing World* (Dedham, *MA:* Artech House, 1982).

[24] Some analysts, e.g., identified the shortage of available spectrum as the biggest hurdle facing the widespread development of personal communication networks. Charles Mason, "Wireless Technologies Draw Interest," *Telephony,* vol. 220, No. 12, Mar. 25, 1991, p. 10.

[25] For more discussion of these functions, se e NTIA, *U.S. Spectrum Management Policy,* op. cit. footnote 2; U.S. Congress, office of Technology Assessment, *Radiofrequency Use and Management,* OTA-CIT-163 (Washington, DC: U.S. Government Printing Office, January 1982), pp. 25-26.

can mandate that certain technologies be used to promote efficiency, such as single-sideband broadcasting (see ch. 2).

In the United States, the agencies responsible for managing the spectrum are the FCC, an independent agency, and NTIA in the Department of Commerce. The FCC oversees the use of the spectrum by the private sector and all State and local government users, and NTIA manages the spectrum used by the Federal Government. Internationally, spectrum is allocated and regulated by the ITU through the WARCs that are held to review and revise the Radio Regulations.[26]

The problems of domestic spectrum management do not exist in isolation from the larger international context within which so much of spectrum policy is decided. Rather, domestic and international spectrum policymaking are interdependent processes-each influences the other. Domestic allocations, for example, generally conform to the international Table of Allocations and the Radio Regulations maintained by the ITU and revised at the WARCs. Those international allocations and regulations, in turn, are the product of negotiation among many countries, each pursuing its own national goals. Domestic spectrum policymaking must take careful account of the implications of international decisions if the interests of the United States are to be adequately protected.

> The more advanced our technology becomes, and the more complicated our frequency utilization, the more apparent it is that there must be complete correlation of the national and international aspects of frequency use.[27]

While these concerns are recognized by domestic spectrum policymakers, it is unclear how well domestic and international spectrum policymaking is integrated. Few attempts have been made to rationally lay out and harmonize international and domestic spectrum policy goals, and what accord does exist has occurred on a reactive, piecemeal basis rather than as a result of any long-range planning or cooperative effort. Some domestic spectrum mechanisms and activities, including WARC preparations, do take account of international parameters such as the international Table of Frequency Allocations, but these activities often concentrate on specific issues or radio services. They at-e not guided by strategic policy decisions made in a framework of long-term international spectrum goals and priorities. Longer-term domestic spectrum policymaking has largely proceeded independently of international concerns—policy is first set domestically and then extended to the international arena. The failure to aggressively link long-term international policy efforts with domestic needs could threaten U.S. technological and policymaking leadership and could undermine future success in U.S. international spectrum policymaking.

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World Administrative Radio Conferences

General

The function of a WARC is fundamentally technical, but the process of spectrum allocation and management has always been both a political and technical process.[28] It is the means by which the world distributes the resources of the radio frequency spectrum. The Final Acts of WARCs have international treaty status, and must be approved and ratified by member governments. Once ratified, they

[26] The ITU, strictly speaking, does not "manage" spectrum use on a day-today basis. Rather, it allocates spectrum bands, defines categories of services, and sets the technical and administrative rules which govern spectrum use internationally. Individual national governments usually follow these rules, but still retain final authority in deciding how their domestic spectrum resources will be used.

[27] Harold E. Fellows, testimony at hearings before a Subcommittee of the Committee on Interstate and Foreign Commerce, 011 Allocation Of Radio Spectrum Between Federal Government Users and Non-Federal Government Users, 86th Cong., 1st sess., June 8 and 9, 1959, p. 36.

[28] For a discussion of the political aspects t. ITU and WARC activities, see James G. Savage, *The Politics of International Telecommunications Regulation* (Boulder, CO: Westview Press, 1989).

are generally adhered to by all ITU members.[29] As such, they carry enormous weight in setting future international radiocommunication policy, allocations, and services. There are three types of administrative radio conferences. First, the general WARCs held by the ITU address all radio services and spectrum allocations, and can review and revise any or all of the international Radio Regulations. General WARCs were held in Atlantic City, 1947; Geneva, 1959; and Geneva, 1979. Despite the wide range of issues it will cover, WARC-92 is not a general conference since it will not examine the complete international Table of Frequency Allocations and all of the Radio Regulations.

Instead, WARC-92 is a specialized WARC. Specialized WARCs generally examine issues relating to specific frequency bands or radio services. WARC-92, for example, will examine mobile services, high frequency broadcasting, and new space services, among others. Since 1979 four specialized WARCs have been convened, covering High Frequency Broadcasting (HFBC-84/87), space services and orbital assignments for satellites (ORB-85/88), mobile services (concentrating on distress and safety services) in 1983, and mobile services (MOB-87) (see table 1-2).[30] These conferences were convened in large part to address specific issues that the 1979 general WARC could not resolve. WARC planners believed that a narrower focus on specific issues would enable the ITU members to reach decisions more easily and quickly than a broad, general WARC could allow, thus streamlining the I T U process.

Regional Administrative Radio Conferences (RARCs), which bring together the ITU member countries from a specific geographical region (see figure 1-2), sometimes address allocation issues, but are usually confined to specific issues that have particular regional importance or require regional coordination, such as television and AM/FM radio services.[31] Importantly, these conferences may not revise the Radio Regulations, but may only propose changes to be considered and confirmed at the next competent WARC. A broadcasting plan developed for Region 2 at the 1983 RARC, for example, was adopted by the 1985 specialized WARC on the Use of the Geostationary-Satellite Orbit and the Planning of Space Services Utilizing It (ORB-85).

Table l-2—International Telecommunication Union World Conferences Since 1979

1979	General WARC (WARC-79)
1980	—
1981	—
1982	Plenipotentiary (Nairobi, Kenya)
1983	Mobile Services WARC (Distress and Safety)
1984	High Frequency Broadcasting WARC (First Session-HFBC-84)
1985	WARC on the Use of the Geostationary-Satellite Orbit and the Planning of Space Services Utilizing It (First Session-ORB-85)
1986	—
1987	High Frequency Broadcasting WARC (Second Session-HFBC-87)
	WARC for the Mobile Services (MOB-87)
1988	WARC on the Use of the Geostationary-Satell ite Orbit and the Planning of Space Services Utilizing It (Second Session-ORB-88)
1989	Plenipotentiary (Nice, France)
1990	—
1991	—
1992	WARC for Dealing With Frequency Allocations in Certain Parts of the Spectrum (WARC-92)
	Plenipotentiary (Geneva Switzerland)
1993	—
1994	Plenipotentiary (Japan)
1995	High Frequency Broadcasting WARC (proposed)
1996	—
1997	—
1998	Plenipotentiary (location undetermined)

SOURCE: Office of Technology Assessment, 1991.

The 1992 World Administrative Radio Conference

Background

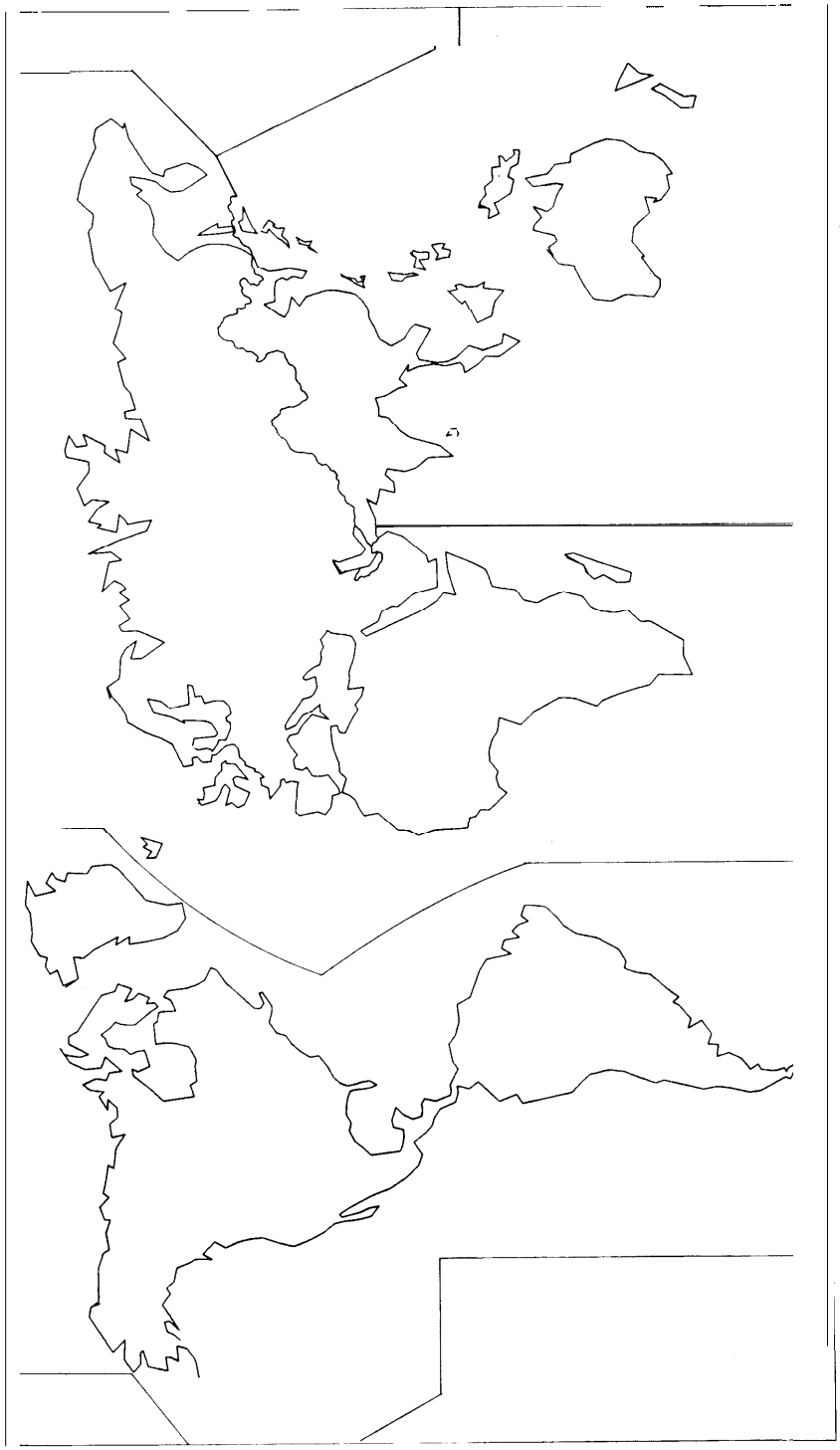
At its 1989 Plenipotentiary Conference in Nice, France, the ITU decided to hold a World Administrative Radio Conference for Dealing with Fre-

[29] If a member disagrees with a specific action or the action will interfere with domestic telecommunications operations, an administration can take a "reservation" in the Final Acts stating that the country will not necessarily abide by the new regulation. A reservation permits a nation to ratify the treaty while maintaining some degree of autonomy and flexibility for its domestic policies.

[30] In all, 4 WAR& (in 6 sessions) took place in the 1980s, along with 9 Regional Administrative Radio Conferences (in 12 sessions).

[31] The ITU has divided the world into three regions. Region 1 consists of Africa, Europe, and the U.S.S.R. Region 2 encompasses the Americas; including Canada, Greenland, United States, Central and South America, and the Caribbean. Region 3 includes Asia, Australia, and Oceania. See figure 1-2.

Figure 1-2—International Telecommunication Union Regions of the World



SOURCE: U.S. Department of Commerce, National Telecommunications and Information Administration, *Tables of Frequency Allocations and Other Extracts From: Manual of Regulations and Procedures for Federal Radio Frequency Management*, September 1989 ed., p. 4-30.

quency Allocations in Certain Parts of the Spectrum (WARC-92). In 1990 the ITU Administrative Council prepared an official agenda of the topics to be addressed.[32] (See app. B for the full text of the WARC-92 agenda.)

In large part, WARC-92 was called to address issues unresolved at past conferences. In the 12 years since WARC-79, many specialized radio conferences took place that addressed specific areas of the spectrum and specific services, such as high frequency broadcasting and space services (see above). While these conferences often accomplished a great deal, they could not reach agreement on all issues. Consequently, many of the items on the WARC-92 agenda are based on recommendations and resolutions from previous conferences, and, as a result, the conference will address several old issues, including high-frequency broadcasting in the band 3-30 MHz, anew allocation to the broadcasting-satellite service for HDTV, preferably on a worldwide basis, somewhere in the band 12.7-23 GHz, and allocations to Mobile services, including Mobile Satellite Services in the band 500-3000 MHz.

In addition to the old items on the agenda, several new issues have been added. Prior to (and at) the 1989 Plenipotentiary Conference that scheduled the WARC, there was resistance in the United States to abroad reallocation conference. It was felt by many, especially government interests, that the United States had more to lose than gain at such a conference.[33] The United States favored a more limited conference that would deal with space services and/or mobile services. Once the initial agenda was released, however, interest in the conference grew through 1989 and 1990, especially in the private sector, which had been developing new technologies and services and saw the conference as an opportunity to get radio frequencies it needed. Lobbying by industry and the FCC's Industry Advisory Committee (see ch. 4), finally convinced the government to pursue additional agenda items. At the 1990 ITU Administrative Council meeting, the United States succeeded in having a limited number of new issues included on the agenda, such as low-Earth orbiting satellites (LEOS) and a terrestrial complement to satellite sound broadcasting (see below) .34

Although the agenda appears to be freed, and the ITU Convention states that discussion must be limited to those items on the agenda, this may not always be the case. Imprecise definitions and overlapping services encourage some governments, including the United States, to make proposals regarding items that are not explicitly part of the official agenda.[35] While these proposals are made in response to spectrum needs identified by both government and industry, some analysts are concerned that such tactics can undermine U.S. credibility abroad, and may threaten overall U.S. effectiveness at conferences.

The Context for WARC-92

In 1982, OTA published a report entitled *Radiofrequency Use and Management: Impacts from the World Administrative Radio Conference of 1979.*[36] Ten years later many of the same issues of spectrum use and management remain unresolved, and many of the same forces continue to put pressure on domestic and international spectrum policy processes. The issues and trends outlined below form the context within which WARC-92 will operate.

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[32]Proposals for conferences may originate with individual members of the ITU. More often, a Plenipotentiary Conference, or a previous Administrative Conference may adopt Resolutions or Recommendations that a conference be held within a certain time period, to address one or more specific subjects. The agenda for radio conferences is set by the ITU Administrative Council with input and agreement from member administrations, and is based on items requested by a Plenipotentiary Conference, including recommendations and resolutions from previous WARCs (see ch. 3).

[33]Department of Defense and aviation interests specifically were afraid that a general reallocation conference would take awaY some of their frequencies. The FCC did not want a broad conference because they had neither the time nor the staff resources to do the preparation work, and because initially there was little support among industry.

[34]In all, the following items proposed b, the United States were put on the agenda (although not necessarily in the exact form requested): HDTV below 12.7 GHz, LEOS, terrestrial sound broadcasting between 500-3000 MHz, RDSS upgrade in Regions 1 and 3, primary MSS at 20/30 GHz, and a new space service in 27.3-30 GHz.

[35]The WARC-92 agenda, for example, only specifically addresses LEOS services *below* 1 GHz. In its final WARC-92 proposals (see app. D), however, the United States has embedded LEOS *above* 1 GHz in a proposal to allocate spectrum to the Mobile Satellite Service in the 1613.8-1626.5-MHz and 1850-1990-MHz bands. Government officials and LEOS proponents maintain that this is legitimate under existing service definitions (LEOS will provide mobile satellite services) and the WARC-92 agenda. Others believe that this violates the spirit of (and a strict reading of) the agenda, which specifies that only LEOS services in bands below 1 GHz are to be considered.

360p. cit., footnote 25.

Technology (ch. 2)—Technology trends drive the WARC process. The pace of technological change is immeasurably faster than it was only 12 years ago, and rapid developments in technology have put increasing pressure on the ITU and the WARC process. The role of technology in today's crowded spectrum is twofold and often contradictory-it is both problem and solution. New technologies and services and the expanding use of old technologies and services are squeezing available spectrum allocations. On the other hand, advances in technology can free up spectrum and allow it to be used more efficiently. Innovations such as digital compression, spread spectrum, and trunking can also increase availability of radio frequencies.

International Environment (ch. 3)—But radiocommunications is not just a technology issue. The arena in which international spectrum allocation and planning takes place is also changing rapidly. Today, new players have become prominent as others have faded, and firm alliances have given way to rapidly shifting factions. The 1980s witnessed the rise of Japan as a major economic power and the industrialization of countries such as Brazil and Korea. The influence of the Soviet Union has declined dramatically as the Eastern bloc has dissolved and the U.S.S.R. itself is beset with internal turmoil. East-West and North-South confrontations have been replaced by regional divisions. Moving into the 1990s, the world is seeing the emergence of a unified Europe and a realignment of the Eastern European nations. Accompanying these changes, the historic tension between the developing and developed countries that characterized the 1970s and early 1980s has lessened. There is now a different tone to international telecommunications policymaking that is more flexible and conciliatory.

The role of technology in today's crowded spectrum is twofold and often contradictory—it is both problem and solution.

In addition to these political forces, economic pressures are also reshaping the world environment for radiocommunications. Telecommunications systems and services, including radiocommunications, are increasingly global in scope, and telecommunications is increasingly seen as an important piece of the broader context of economics, trade, and development. Competitive pressures have forced many governments to liberalize or privatize their telecommunication industries.

Telecommunications systems and services, including radiocommunications, are increasingly global in scope, and telecommunications is increasingly seen as an important piece of the broader context of economics, trade, and development.

Recognizing the importance and scope of these changes, the ITU established the High Level Committee to examine ways to improve the structure and processes of the ITU in order to more effectively respond to the challenges of advancing technology and members' development needs. In order for the United States to respond to these changes, the Federal Government, with extensive input from industry, will have to develop new ways of thinking and negotiating in order to be most effective in this new climate of change. The United States must become more adroit in setting and negotiating international spectrum policy.

Domestic Radiocommunication Policy Process (chs. 4 and 5)—The domestic process for allocating and managing spectrum is complicated. Responsibility is divided between the FCC and NTIA, with input from the private sector. International radiocommunication policymaking, including WARC-92 preparations, is also fragmented. In addition to the FCC and NTIA, the Department of State becomes involved as the official representative of the United States abroad. Some consider this diversity to be a strength, but coordination and reconciliation of various views can be difficult, and may make the process of preparing for international conferences time-consumin g and inefficient. In addition, linking the goals of WARC-92 into the overall goals of U.S. international spectum policy was not possible because no overarching framework exists to guide U.S. spectrum policy. Accountability for matching WARC proposals to long-term, strategic spectrum goals is thus almost nonexistent.

The activities of the ITU, including WARCs, offer the United States an important opportunity to advance its views on technical standards and regulations.

Why Is WARC-92 Important?

Effective U.S. participation in the activities of the ITU and the WARC process is important at several levels. Without international standards and procedures for sharing the spectrum, global radio communication and services would be impossible. Although international interference problems are not as much of a problem for the United States as other countries, the United States must nevertheless coordinate services that are worldwide, such as safety services for aeronautical and maritime services. U.S. participation in the ITU is also crucial to our international stature both politically and technically. Were the United States to pull out of or fail to ratify ITU documents, such as the Final Acts of the WARCs, on a regular basis, a poor precedent would be set that could jeopardize U.S. participation and negotiations in other international bodies. Finally, the ITU offers the United States an important opportunity to advance its views on technical standards and regulations, promoting global standards that allow U.S. firms to take advantage of economies of scale in manufacturing and the provision of services. Such input is critical in maintaining the technological and policy leadership of the United States in international radiocommunications.

WARC-92, in particular, is important to the United States for several reasons. The new services of an increasingly information-oriented and mobile society will rely heavily on radio spectrum resources, perhaps even more so than in the past. But because the most desirable parts of the spectrum are almost completely allocated and many bands are heavily used, finding room for new services is difficult. WARC-92 is the first attempt to address the requirements of the new technologies at one comprehensive meeting. While recent conferences have addressed more limited issues, WARC-92 will touch on a wide range of new (and old) radiocommunication services. The decisions reached at WARC-92 will determine which technologies and services get spectrum and how much.

The results of WARC-92 will also fundamentally affect how new services will be introduced internationally, and on what time schedule.[37] Allocations from WARC-92 will also have substantial impacts on future domestic developments and policies, because changes in the international Table of Allocations will likely be translated to the U.S. National Table of Frequency Allocations.[38] For example, the FCC now has before it several proceedings dealing with new services such as Broadcasting-Satellite Service-Sound (BSS-Sound) and PCS that could be substantially affected by WARC decisions.[39] How closely the FCC and NTIA will follow the decisions adopted at the WARC will vary by item, adhering closely to some and ignoring specifics of others. Ensuring American participation in the full range of new international communications systems will require a clear linkage of domestic spectrum policy to the international environment.

Having U.S. proposals adopted at WARC-92 is particularly important domestically for two reasons. First, because the timeframe for implementing WARC allocations and regulations is often long, sometimes 10 or 15 years, decisions made at WARC-92 will influence international and national radiocommunication policy until 2010 or beyond. Such decisions will also have important impacts on investments in radiocommunication systems, including hardware and the development of services. Decisions that do not support U.S. positions could have along-term negative impact on U.S. radiocommunication development and economic competitiveness. Second, in the past, the irregular timing of WARCs has put a premium on getting new technologies and services approved and allocated as quickly as possible. Because a schedule of future conferences has not been set, if new services do not receive any or inadequate frequencies at WARC-92, the next opportunity to address them is uncertain-this may

[37] If existing users have to be moved, the ITU will agree on a timetable for existing users to vacate the band for new services to begin operation.

[38] Adoption of the international Table of Allocations domestically is not automatic. The FCC typically initiates a rulemaking procedure after a WARC is concluded to determine how to implement changes agreed to internationally in the U.S. National Table of Frequency Allocations.

[39] The FCC has released Notices of Inquiry (NOIs) into Personal Communications Services, Gen Docket No. 90-314, released June 28, 1990, and Digital Audio Broadcasting, Gen Docket No. 90-357, adopted Aug. 1, 1990.

be the last chance to get an allocation for some services for many years. This problem is exacerbated by the long lead times required for reallocation and reaccommodation of existing service-even after frequencies have been allocated to a service, the ITU often grants existing users up to 10 or 15 years to change frequencies. However, recognizing the important and rapid changes taking place in technology and the international community, the High Level Committee of the ITU has recommended that the schedule of conferences be regularized-a conference would take place every 2 years. Such a change would lessen the uncertainty of when issues will be addressed (see ch. 3 for further discussion of the proposed changes in the ITU), and would significantly affect the timing and preparation for future WARCs. The United States has actively participated in the High Level Committee and must continue to be responsive to these possible changes.

WARC-92 thus represents both a risk and an opportunity for U.S. interests. Part of enabling U.S. companies to compete effectively depends on harmonizing international tele- and radiocommunications policies with trade policies to ensure that each reinforces the goals of the other. WARC-92 represents an important opportunity to coordinate and align frequencies to open up world (instead of domestic or regional) markets in many new services. Global coordination creates larger markets and promises lower prices, portability of services, increasing interconnection, and greater economic efficiency. If U.S. views are well articulated, supported, and presented, and the international community accepts them, benefits will flow to U.S. interests. On the other hand, lack of spectrum policy planning risks U.S. competiveness. If the U.S. fails to present well thought out and coherent proposals to the international community, it risks being left out or left behind. If other countries with less crowded airwaves and more forward-thinking policies permit new services first, their economies will be the frost to benefit from new communications services.[40]

If new services are to be accommodated, they will have to share spectrum with existing users, or the existing users will have to move.

Major Issues

The primary focus of WARC-92 will be allocating radio frequencies to new and old services.[41] These issues are complex and often interrelated. In some cases, several services compete for the same band of frequencies. The problems are not as easy as simply finding frequencies for new services, or matching a service with the most suitable frequencies. There is almost no unused spectrum below 3 GHz, so if new services are to be accommodated, they will have to share spectrum with existing users, or the existing users will have to move.[42] Reallocation decisions have technical, political, and economic consequences. Often the decisions of where to put new services and move old ones are based just as much on economic and political pressures as on purely technical requirements. Existing users with political clout may be difficult to move. Users that make extensive use of the band and have billions of dollars invested in equipment may also be difficult to move, practically and financially. The question of who pays for such reallocation is often contentious, and while the cost is not explicitly a WARC issue, it is an important consideration in the development of each government's WARC proposals.

Many problems make WARC preparations and negotiations difficult on both international and domestic levels. First, some of the technologies and services under consideration are still evolving. Final requirements for spectrum and specific standards are not yet in place, and the industries themselves are often not mature-many companies are still vying for a piece of the action. This has the effect of making coordination and compromise even more difficult-considering many different views from

[40] Mark Lewyn and Peter Coy, "Airwave Wars," *Business* Week, No. 3170, July 23, 1990, p. 49.

[41] Other matters to be addressed by the conference include: requirements that ships-at-sea have certified radio personnel on bored, development of recommendations and resolutions for meteorological aids, and consideration of the problems of the meteorological and Barth exploration satellite services in the 401+03-MHz band. See app. B for the full WARC-92 agenda.

[42] In some cases, sharing between two competing services can be difficult or practically impossible. Sharing between high-powered radar systems and some satellite services, e.g., is very difficult.

many different companies. Second, other countries have developed systems and approaches to radiocommunications that are different from the United States. Developing countries, for example, often use the high frequency (HF) bands for domestic point-to-point communication. Developed countries, however, have largely replaced HF point-to-point links with satellite or fiber-optic telecommunications systems. They now use these bands much more heavily for international broadcasting.[43] These differences will make international agreement difficult.

In preparations for WARC-92, the most difficult allocation problems, domestically and internationally, involve the use of the L-band (roughly 1.4-1.6 GHz). Private companies, including those developing Broadcasting-Satellite Services-Sound (BSS-Sound) and Mobile Satellite Services (MSS) would like to use portions of this band because of its favorable transmission characteristics.[44] The Department of Defense, however, opposes a reallocation of the 1435-1525-MHz portion of the band for new BSS-Sound services because of existing uses.[45] The FCC, noting that the 1.5-GHz band is the band most favored by some broadcasters and other countries (notably CITEL) for BSS-Sound applications, believes that important new global services and markets may be foreclosed if the Defense Department's opposition prevents the United States from agreeing to worldwide allocations.[46] If a worldwide allocation is agreed to at WARC-92 that conflicts with the final U.S. position, the United States could decide not to abide by the specific decision. This could mean that BSS-Sound services developed in the United States would not use the same frequencies as the rest of the world—the systems would be incompatible. It would then be difficult to establish worldwide services, such as international broadcasting, using this new technology.

In preparations for WARC-92, the most difficult allocation problems, domestically and internationally, involve the use of the L-band.

Below is a summary of the allocation issues to be addressed at WARC-92, including proposed U.S. positions (see app. D for a complete summary of final U.S. WARC proposals),[47] the views of foreign administrations (where possible), and a discussion of the potentially most controversial issues to be discussed (see app. B for the full text of the agenda). The views of foreign countries outlined below are preliminary and may change before final positions are decided later this year. They should be understood as only a rough guide indicating how the various WARC agenda issues are evolving.

High Frequency Broadcasting-HF refers to frequencies in the 3-30-MHz portion of the spectrum. The band is densely packed—numerous services and users occupy the HF spectrum, including amateur radio, government-sponsored international broadcasting (Voice of America, British Broadcasting Corporation, and Radio Moscow), private religious broadcasting, and international aviation and maritime communications. Developing countries also use the HF bands for domestic point-to-point communications because of its low cost.

WARC-92 will consider expanding the bands allocated exclusively to HF broadcasting. This issue flows out of the work of the HF Broadcasting Conferences (HFBC) of 1984 and 1987.[48] For WARC-92, the United States proposes expanding the band by a total of 1325 kHz (in different blocks

[43] The United States alone accounts for 10 percent of worldwide HF spectrum use. See Final Report of "Informal Working Group 1" to the Industry Advisory Committee to the FCC, IAC Document 48, Apr. 30, 1991.

[44] MSS providers, however, were not able to convince government policymakers to make this a final U.S. proposal.

[45] Among other uses, these bands are used by the Department of Defense and many of its contractors in the private sector for the testing Of new aircraft.

[46] Because much of the data on the Federal Government's use of spectrum is classified or not easily obtained, the FCC may not have a good idea how much and how efficiently government spectrum in this area is used. This lack of adequate data makes it very difficult for the FCC to negotiate the issue.

[47] In all, the United States will make approximately 50 specific proposals covering 14 different radio services. All information on final U.S. proposals comes from U.S. Department of State, *United States Proposals for the 1992 World Administrative Radio Conference for Dealing With Frequency Allocations in Certain Parts of the Spectrum,* publication 9903, July 1991.

[48] The 1985/1987 HFBC WARC attempted to develop a method for planning broadcast frequency assignments on a worldwide basis. Because the broadcasting needs identified greatly exceeded the frequencies available, a workable system was never developed. As a result, the Conference recommended (Recommendation No. 511, HFBC-87) that more spectrum be allocated for HF broadcasting at a future WARC. This recommendation was included in the agenda for WARC-92.

of frequencies, see app. D)-much less than the amount recommended by the FCC's Industry Advisory Committee, which suggested 2455 kHz of additional spectrum. The 1325 kHz, or any portion approved, would be reallocated from the Fixed and Mobile services, which could continue to use the bands until the end of a transfer period.

Planning and use of the HF bands for broadcasting has been contentious for many years.[49] Two factors contribute to the problem: First, demand for HF broadcasting spectrum greatly outstrips supply. The International Frequency Registration Board's (an agency of the ITU) planning exercises conducted for the High Frequency Broadcasting WARC of 1987 (HFBC-87) indicate that more than half of all HF broadcast requirements submitted by member countries could not be adequately met, and between 25 and 35 percent of these requirements could not be accommodated at all.[50] Second, as noted above, different countries use the HF bands for different purposes. Many countries see the allocation of additional broadcast spectrum as a threat to their domestic (nonbroadcast) radiocommunications.

Preliminary negotiations indicate that this issue will be difficult for the 1992 conference (see box 3-A). Many developing countries may oppose any expansion of the broadcasting spectrum in an effort to protect their existing domestic telecommunications services and investments in equipment. In Europe, the countries that belong to the Conference of European Postal and Telecommunications Administrations (CEPT), which attempts to harmonize European telecommunications policies and is coordinating the development of European WARC proposals, have not proposed specific bands.

An additional part of the HF controversy surrounds the use of single-sideband (SSB) transmission and receivers for all new HF services (see ch. 2). SSB broadcasting requires less bandwidth to send information than most conventional radio broadcasting systems, and hence would allow more broadcasters to use the spectrum. The ITU has already

Planning and use of the HF bands for broadcasting has been contentious for many years.

mandated its use by the year 2015.[51] The United States proposes that SSB be used in all new HF frequency bands adopted at WARC-92, and that the effective date of implementation be moved up to 2007. A number of (especially developing) countries have opposed this conversion because of the large number of existing receivers and the lack of economic incentives to build the new receivers.[52]

Broadcasting-Satellite Service-Sound—BSS-Sound refers to the delivery of audio services directly to stationary and portable receivers from satellite transmitters (see figure 2-4).[53] These services, which often plan to use digital technology (digital audio broadcasting), promise to deliver radio services with compact disc quality sound to any type of receiver (home, portable, mobile) in any environment (urban, suburban, rural). Domestic service would be provided through satellites for wide area coverage and terrestrial transmitters for local services or to fill in areas where the satellite signal is weak (in tunnels, for example). International service would be provided primarily by satellite and would allow listeners to receive programming anywhere in the world. Planned systems will allow services to be tailored to local, domestic or international listeners. In the United States, several companies have applied to the FCC for authority to launch satellites and offer such services (see app. C).

BSS-Sound has been studied internationally, dating back at least 25 years. The issue of BSS-Sound was raised at WARC-79, which recommended that it be considered at a future WARC (which was later scheduled as the 1988 WARC on the Use of the Geostationary-Satellite Orbit and the Planning of Space Services Utilizing It-ORB-88). ORB-88

[49]For a full discussion of the history of HF spectrum allocation, see Savage, op. cit., footnote 28.

[50]Industry Advisory Committee, "Final Report of Informal Working Group Number l," report submitted to the FCC, Apr. 24, 1991.

[51]International Telecommunication Union, Resolution No. 517 of The World Administrative Radio Conference for the Planning of the HF Bands Allocated Exclusively to the Broadcasting Service (Geneva, 1987).

[52]Manufacturers will not build the receivers until they can receive something, but the programmers will not broadcast in SSB until there are radios to receive the signal. Even if some manufacturers do produce these new receivers, they are likely to be very expensive until larger markets open up.

[53]BSS-Sound systems may also be complemented by terrestrial transmitters. Both satellites and terrestrial transmitters are proposed to be used either separately or in a mixed system to provide complete radio coverage.

was unable to reach agreement on possible allocations and service standards and recommended that the issue be reconsidered at a future WARC after further technical studies by the ITU's International Radio Consultative Committee (CCIR) (see ch. 3).[54] Accordingly, the Administrative Council included BSS-Sound in the 500-3000-MHz range on the WARC-92 agenda.

Debate in the United States has been intense over which bands to allocate domestically and what the U.S. international position should be. This is the only WARC agenda item that could not be reconciled between FCC and NTIA before final recommendations were transmitted to the Department of State. In initial reports, the FCC and NTIA proposed four options for BSS-Sound allocation for WARC-92.[55] BSS-Sound proponents favor the bands around 1.5 GHz (the so-called L-band), but U.S. Government interests, notably the Department of Defense and its commercial contractors, are opposed because of the existing use of the band for aircraft testing.[56] The problem with all BSS-Sound options is that sharing with other services, such as the industrial, scientific, and medical services, which includes microwave ovens, in the 2400-MHz bands is extremely difficult, and existing users are often unwilling or unable to move.[57] In its final Report, the FCC recommended the reallocation of the 1.5- and 2.3-GHz bands for BSS-Sound. NTIA proposed that the 231O-239O-MHZ band could be used. The final size and location of the bands is subject to continuing negotiation.

Internationally, there is strong interest in the concept of BSS-Sound, but sharp differences exist as to which band(s) would be most appropriate for an allocation. For example, there is little consensus internationally on the use of the 1.5-GHz band. A recent meeting of CITEL (see box 3-A) generally supported an allocation in the 1.5-GHz band, and a minority of the CEPT countries would like to use the 1.5-GHz band for BSS-Sound. However, many foreign countries seem to concur with U.S. government opposition-including many CEPT countries-who claim that there is no way to accommodate the service in the 1.5-GHz band because of tremendous demand by mobile services and existing fixed services. Other countries also seem to favor using the band for Mobile or Mobile Satellite Services. Debate on BSS-Sound at WARC-92 is expected to be difficult because all proposed bands are used by existing services.[58]

Internationally, there is strong interest in the concept of BSS-Sound, but sharp differences exist as to which band(s) would be most appropriate for an allocation.

Broadcasting-Satellite Service-High-Definition Television—HDTV was conceived more than 20 years ago, but only recently has the technology become advanced enough for commercial applications.[59] HDTV's main characteristics are high resolution (nearly twice that of conventional television) and better color, a wider screen, and compact disc quality digital sound. While HDTV systems are currently still in development, rapid advances in technology are being made that could bring HDTV to consumer markets worldwide by the mid-1990s.[60] Satellite transmission of HDTV services is only one of a number of ways to deliver such programming (others include cable, fiber optics, and terrestrial

[54] International Telecommunication Union, ResolutionNo. 520 of the World Administrative Radio Conference on the Use of the Geostationary-Satellite Orbit and the Planning of Space Services Utilizing It, Second Session (Geneva, 1988).

[55] 728-788 MHz; 1493-1525 MHz, 2390-2450 MHz, 2360-2410 MHz. Federal Communications Commission, ' 'An Inquiry Relating to Preparation for the International Telecommunication Union World Administrative Radio Conference for Dealing With Frequency Allocations in Certain Parts of the Spectrum," *Supplemental Notice Of Inquiry,* Gen Docket 89-554,6 FCC Rcd 1914, p. 2.

[56] Some proponents of digital audio broadcasting, a digital transmission format that could be used to provide BSS-Sound services, have proposed that the terrestrial component of BSS-Sound would be more easily provided in existing radio broadcasting bands. They do not necessarily favor the 1.5-GHz band for this service.

[57] Another proposal for @~ audio broadcasting t. share spectrum in the UHF television band was rejected because the FCC anticipates that the spectrum will be needed for the transmission of advanced television (ATV) signals.

[58] The FCC notes in its Supplemental Notice of @@ that f,nd@ a worldwide allocation for BSS may be difficult. It then raises the possibility that allocations may have to be made on a regional basis.

[59] For discussion of the historical, technical, and economic implications of HDTV, see U.S. Congress, Office of Technology Assessment, *The Big Picture: HDTV and High-Resolution Systems,* OTA-BP-CIT-64 (Washington, DC: U.S. Government Printing Office, June 1990).

[60] Japan already has a system in operation (MUSE). Ibid.

broadcasting), but proponents see HDTV as a very lucrative market for satellite services vendors. Satellite delivery of HDTV, however, depends on the availability of spectrum around the world, and many believe a worldwide allocation for HDTV is needed to further advance this service and reduce international interference problems.

A plan exists for satellite transmission of television signals directly to home receivers in the 12-GHz band. However, this band was planned primarily for direct broadcast of conventional television signals. While it appears possible to transmit some enhanced and narrow-band HDTV signals in these channels, the larger bandwidths commonly associated with full HDTV may not fit into the current planned channel bandwidths.[61] To accommodate these wider channels and any future expansion in HDTV service, HDTV allocations were considered at ORB-88, but were not agreed to. The ITU Administrative Council included this item in the agenda of WARC-92 based on Resolution 521 of ORB-88, which calls for consideration of a worldwide allocation for wide-band HDTV between 12.7 and 23.0 GHz.

The United States proposes that the existing plan in the 11.7-12.7-GHz band can serve as the basis for future HDTV services, but that additional allocations may also be necessary. The United States considered 17.3 -17.7 GHz and 24.65-25.25 GHz for these additional frequencies, and eventually the FCC and NTIA recommended the 25-GHz band.[62] The IAC generally supported the FCC positions, but expressed doubt about the necessity of expanding allocations, especially in the 17-GHz bands.[63] CEPT countries have proposed using the band 21.4-22.0 GHz on a worldwide basis for HDTV. CITEL was unable to agree on common views regarding the necessity of additional allocations given the possibilities of future technical advances in compression technology.

Several of the most important issues to be considered at WARC-92 involve the expansion of Mobile and Mobile Satellite Services.

Mobile and Mobile Satellite* Services *in 1-3 GHz -Several of the most important issues to be considered at WARC-92 involve the expansion of Mobile and Mobile Satellite Services. Recognizing the need to allocate additional frequencies to the mobile services, ITU members decided at the 1987 WARC for the Mobile Services (MOB-87) that a future conference was necessary to address these issues.[64] Consequently, the WARC-92 agenda includes four topics related to mobile and mobile satellite services: 1) increasing the allocations to these services in general; 2) allocation or designation of frequencies for public correspondence with aircraft; 3) allocation or designation of frequencies for Future Public Land Mobile Telecommunications Service; and 4) possible allocations for LEOS. Each service is discussed separately below.

Mobile Services-Although the United States is widely regarded as a leader in many areas of radiocommunications, the European countries have been aggressively developing and implementing many types of mobile communication services. In part this is because the European nations recognized early on the importance of mobile communications in an advanced information society, but more importantly because the Europeans identified these systems as a critical element in the future economic development of a unified Europe and started working out a common plan and standards for developing

[61] Rapidly advancing digital video compression capabilities could conceivably allow even the widest bandwidth HDTV signals to fit into the existing channel bandwidth constraints. There is no consensus, however, as to howmuchcompression will be practical in the short term, and some administrations remain skeptical that compression techniques will completely solve this problem. See, e.g, Organization of American States, Interamerican Telecommunications Conference, Permanent Technical Committee III, ''Report of the CITEL 1992 World Administrative Radio Conference Interim Working Group," Document WARC-92/62 Rev. 2, May 10, 1991.

[62] *Supplemental* NOI, op. cit., footnote 55.

[63] The basis of this position is the belief that compression technologies will be able to provide HDTV service within the existing allocations. The Industry Advisory Committee report also noted serious problems with sharing in the 17-GHz bands. Because of the lack of sharing problems in the 24.65-25.25 GHz-bands, these were endorsed by the Committee. See ' 'Final Report of Informal Working Group-Number Three," submitted to Industry Advisory Committee, Apr. 25, 1991.

[64] International Telecommunication Union, Resolution No. 208 of the World Administrative Radio Conference for the Mobile Services (Geneva, 1987).

such services.[65] The United States, by contrast, considers mobile services more narrowly as a matter of domestic spectrum management, not linked to development or trade, and has no comprehensive long-range plan for such services, preferring to manage and plan only in response to specific pressures. This results from a U.S. system that depends on the market to make decisions and that has many competing interests-an adversarial system that often resorts to litigation rather than negotiation. Achieving consensus and developing a unified approach is much more difficult and time-consuming in the United States than in many foreign countries.

Mobile Satellite Services-MSS encompass all types of services delivered by satellite including maritime (MMSS), aeronautical (AMSS), and land mobile (LMSS) communications. These services can be provided by either geosynchronous orbit satellites or LEOS. Because of the characteristics of radio wave propagation, the most suitable frequencies for these mobile services are below 3 GHz, and the most heavily used frequencies are in the L-band (1.5- 1.6 GHz). With the increasing demand for MSS in all parts of the world, these frequencies are becoming rapidly congested.[66]

Some of the most contentious and important issues of the WARC, both domestically and internationally, involve the MSS. The United States has proposed a generic MSS in the 1.5-1.6-GHz bands that would combine maritime, aeronautical, and land mobile services.[67] The United States has also proposed allocating frequencies in the 2.1- and 2.4-GHz bands totaling 80 MHz and the 1850- 1990-MHz band to MSS. The Industry Advisory Committee Ad-Hoc Group advising the FCC on MSS matters for WARC-92 agreed on the need for additional MSS spectrum, but could not reach consensus on the specific location or use of the additional bands. Many existing users, including public safety interests and the petroleum, railroad, and utilities, have voiced strong opposition to the use of bands below 2 GHz. There is special concern that the interests of the aeronautical and maritime distress and safety services be protected, especially from potential interference with the proposed services for public correspondence with aircraft (see below). The United States believes that such public safety concerns can be protected through footnotes allowing such services priority access to frequencies, but there is still strong aeronautical industry opposition to this view.

Discussions within CITEL established general support for additional allocations, but specific agreements on the use of the bands were limited. The CEPT countries have identified MSS allocations as the most important issue of WARC-92, and may propose up to 100 MHz of additional spectrum in the L-band as well as additional allocations above 2.5 GHz.[68] CEPT also supports the concept of a generic allocation for MSS, but only for newly allocated bands.

In addition to the above allocations, the FCC proposed to allocate 1850-1990 MHz to MSS for the use of LEOS.[69] In the final U.S. proposals, this recommendation was modified to remove explicit references to LEOS and was proposed under MSS. This change reflects a potential problem for the United States in its MSS negotiations at WARC-92. The WARC-92 agenda specifically addresses LEOS systems that would operate in frequencies *below* 1 GHz. During the course of the FCC preparations process (after the *Second Notice of Inquiry was* released), however, Motorola and Ellipsat proposed LEOS systems that would operate in frequencies

[65] Since the private sector plays a smaller role in public telecommunications systems development in Europe compared to the United States, it may be easier for the European nations to develop regional plans. For example, Global System for Mobile Communications (GSM-formerly Groupe Special Mobile) is a digital cellular standard that has been proposed to serve all Europe, replacing existing incompatible national (analog) systems. Its implementation is proceeding, although more slowly than some policymakers had anticipated.

[66] The International Radio Consultative Committee (CCIR) has studied future requirements for all MSS and has concluded that existing allocations will not be sufficient to meet estimated growth in these services. CCIR studies estimate that a total bandwidth of between 177.6 and 328.2 MHz will be required by 2010. See Organization of American States, Inter-American Telecommunications Conference, "Report of 'he CITEL 1992 World Administrative Radio Conference Interim Working Group," WARC-92/62 Rev. 2, unpublished document, May 10, 1991. T.ese figures are roughly equivalent to the IAC's estimates. See *Supplemental NOI,* op. cit., footnote 55.

[67] At the 1987 Mobile WARC, the United States did not succeed in having this view accepted. As a result, the United States took a reservation on this allocation and created a shared allocation for LMSS, MMSS, and AMSS.

[68] Comments of Eberhard George, CEPT observer, to CITEL Interim Working Group meeting, Washington DC, May 10, 1991.

[69] Federal Communications Commission, "AnInquiry Relating to Preparation for the International Telecommunication Union World Administrative Radio Conference for Dealing Witb Frequency Allocations in Certain Parts of the Spectrum,' *Report,* Gen Docket No. 89-554,6 FCC Rcd 3900 (1991).

above 1 GHz.[70] The FCC has supported these proposals, but support for the system outside the United States appears limited. At the International Radio Consultative Committee WARC-92 Conference Preparatory Meeting, for example, Motorola's Iridium proposal was extensively discussed, but LEOS systems in this band were not fully endorsed because of concerns about the ability of such systems to share spectrum with geosynchronous satellite systems.[71] Because LEO systems will be providing MSS, the United States has indicated in its final proposals that spectrum allocated to the MSS could be used for LEOS operations.

This proposal is controversial on several grounds. First, domestic MSS providers, notably the American Mobile Satellite Corporation, have argued that the FCC has taken no domestic action yet to establish the need or public interest standards for these proposed LEOS systems. They contend that bringing these proposals directly to the WARC preparations process and the WARC itself, circumvents the proper approval process. Second, because the concept of LEOS above 1 GHz is not explicitly part of the WARC agenda, some foreign governments have argued that this WARC cannot consider it. They believe that a consideration of LEOS systems above 1 GHz violates the spirit of the WARC-92 agenda. The U.S. strategy has some opponents questioning why the government is expending so much energy and risking its credibility on a proposal that has seemingly little backing internationally .72

Future Public Land Mobile Telecommunication Systems-Future Public Land Mobile Telecommunication Systems (FPLMTS) is another of the new services to be considered at WARC-92. It is within this allocation (somewhere in the 1700-2300 MHz bands) that future PCS may be located.[73] Development activities are underway around the world examining voice and data applications for both personal and mobile (vehicular) uses. Studies are also underway examining the use of FPLMTS as an alternative to wire connections to provide access to public telephone networks (see ch. 2). Based on this widespread interest and the work of MOB-87,[74] the Administrative Council added FPLMTS to the WARC-92 agenda.

Spectrum allocated to Future Public Land Mobile Telecommunication Systems (FPLMTS) may provide radio frequencies that could be used by future personal communications services (PCS).

Allocation of additional spectrum for FPLMTS is not the critical issue. Many countries, including the United States, believe that the existing allocations for mobile services in the 1-3-GHz band are adequate. The main issue of FPLMTS centers around the designation of a common core/band of worldwide frequencies that would allow international roaming of PCS.[75] The CCIR has recommended 60 MHz for this purpose. The members of CITEL generally support the concept of FPLMTS and the need for a core band of spectrum for international roaming. The CEPT countries have indicated that they would like 200 MHz of total spectrum designated to FPLMTS, possibly in the 19OO-21OO-MHZ bands. The FCC, however, proposed no additional allocations for FPLMTS, and

[70] Specifically, the binds applied for were 16101626.5 MHZ. Ellipsat also proposed to use frequencies just below 2.5 GHz. As of July 1991, several other companies have applied at the Commission to build similar systems (see app. C).

[71] International Telecommunication Union, International Radio Consultative Committee, *CCIR REPORT: Technical and Operational Buses for the World Administrative Radio Conference 1992 (WARC-92),* March 1991, pp. 8-5,8-13,8-14.

[72] This conflict reflects the larger issue of how the world will accommodate LEOS in the international Radio Regulations and in particular frequency bands. Fundamentally, the question is: what is LEOS? Is it a separate service, or is LEOS technology merely another method for providing an existing service? Radio frequency allocations are generally made only to radio services, not technologies. Yet LEOS, which is technically just a radiocommunication technology, is being treated on the WARC-92 agenda as if it were a service. This ambiguous situation is the basis for the present controversy.

[73] Other possible PCS allocations are in the 800-900-MHz band near the cellular allocation. Many experimental licenses have been granted and applied for in this band (see app. C).

[74] International Telecommunication Union, Recommendation No. 205 of the World Administrative Radio Conference for the Mobile Services (Geneva, 1987).

[75] This would not lessen allocations t. the service in any way. Rather, it would carve out a band of spectrum that would be common to FPLMTS systems around the world. This would provide a common signaling channel worldwide that would allow users' personal equipment to access services no matter where the user is located.

believes that existing allocations have sufficient flexibility to allow any reallocation to be accomplished domestically.[76] The Commission also believes that the 60-MHz requirement identified for international roaming by the CCIR is excessive and unnecessary. Generally, this view is supported by the Industry Advisory Committee. At one point in the development of proposals, the United States agreed that a common worldwide allocation would be desirable to allow mobile roaming of PCS, but proposed 10 MHz as sufficient.[77] In the final U.S. proposals, however, this idea was dropped-the United States now believes that the designation of a frequency band for FPLMTS is premature.

Low-Earth Orbiting Satellites-LE0S systems are another method of providing MSS. Individual LEO satellites are smaller and much easier and cheaper to design, construct and launch than conventional geosynchronous satellites, and proponents envision networks of these small satellites circling the globe. LEOS services have received much attention in the United States, and several applications for LEOS systems are pending at the FCC (see app. C). Two types of LEO systems have been proposed. LEOS operating in frequencies *below* 1 GHz will provide only data applications, including position determination services for cars, trucks, ships and aircraft. In addition to these services, systems operating in frequencies *above* 1 GHz plan to provide voice services as well. Motorola's Iridium system, for example, which would use a network of 77 LEOS to provide data and voice services around the world. Although LEO satellites are relatively less expensive than geosynchronous satellites, the networks required to provide wide area coverage could be very expensive because of the large numbers of satellites required and the technical complexity of linking them all together. Iridium is expected to cost more than $3 billion. While both types of LEOS systems could be used for domestic service, larger networks of LEO satellites could also provide global coverage. For this reason, the United States persuaded the ITU Administrative Council to put LEOS (below 1 GHz) on the agenda for WARC-92. LEOS above 1 GHz were not included on the WARC-92 agenda because no systems using those frequencies had yet been proposed.[78]

Low-Earth orbiting satellite (LEOS) services have received much attention in the United States, and several applications for LEOS systems are pending at the FCC.

The United States considered several possible bands for reallocation to LEOS below 1 GHz.[79] Final U.S. proposals are for 137-138 MHz (downlink), 148-149.9 MHz (uplink), and 400.15-401 MHz (downlink). While there is relatively little interest in LEOS in other countries, many are concerned about possible interference between LEOS and existing users in the proposed bands. CITEL was not able to agree on a common LEOS proposal pending the completion of sharing studies in progress. The CEPT countries, as of May 1991, had no LEO satellite proposals.

During the course of WARC-92 preparations, the FCC also received applications for LEOS in bands *above* 1 GHz.[80] Although not explicitly included in the WARC-92 agenda, in its final proposals, the United States proposes that the band 1613.8 -1626.5 MHz be allocated to the MSS on a secondary basis to provide transmission from the satellite to receivers on Earth (the same frequencies are already allocated for transmission from Earth to satellites).

[76] Federal Communications Commission, "An Inquiry Relating to Preparation for the International Telecommunication Union World Administrative Radio Conference for Dealing With Frequency Allocations in Certain Parts of the Spectrum," *Second Notice Of Inquiry*, Gen Docket 89-554,5 FCC Rcd 6046 (1990); *Supplemental NOI*, op. cit., footnote 55.

[77] Apple Computer, Motorola, and Comsat all support at least a 1O-MHZ designation to allow international voice and data personal communications. However, the proposal is *not* included in the final U.S. proposals.

[78] Motorola and Ellipsat filed their applications well after the agenda had been finalized.

[79] The bands proposed in the FCC Notice of Inquiry process include: 137-138 and 148-149.9 MHz; 420-421 MHz and 930-931 MHz. In addition, the Industry Advisory Committee proposed 173.4-174 MHz and 400.15-401 MHz. *Second NOI*, op. cit., footnote 76; *Supplemental NOI*, op. cit., footnote 55.

[80] Motorola and Ellipsat were the initial appliants. The Iridium system would use the band 1610- 1626.5 MHz for both uplink (Earth-to-satellite) and downlink (satellite-to-Earth) transmissions, while Ellipsat would use 1610- 1626.5 as its uplink with its downlink transmissions at 2483.5-2500 MHz. Recently, more applications for such service have been filed (see app. C). For a discussion of the Iridium and Ellipsat applications and FCC proposals, see *Supplemental NOI*, op. cit., footnote 55.

This spectrum would be used in the United States for LEOS services, and responds to Iridium's proposal to use this block of spectrum for both uplink and downlink transmissions. The United States also proposes that spectrum be allocated to MSS services in 1850-1990 MHz on a shared primary basis to provide for future flexibility and expansion of MSS (specifically LEOS, although the proposals do not explicitly state this). As noted above, these proposals have generated controversy on several levels.

Other Allocation Issues—Several other allocation issues, while not receiving as much public attention as those above, pose equally great negotiating challenges for the United States, both domestically and internationally.

Public Correspondence With Aircraft-Aeronautical public correspondence (APC) refers to radiocommunication services that allow airline passengers to place telephone calls while in flight. The demand for public communication with aircraft is relatively recent, having been addressed for the first time on a global basis at the 1987 Mobile WARC (MOB-87). That WARC allocated frequencies in the 1.5-1.6-GHz band for experimental terrestrial APC. Subsequent studies by the CCIR indicated the benefits of a worldwide allocation for this service, and following Recommendation 408 (MOB-87), the issue was included in the WARC-92 agenda.

Although not particularly controversial, it appears unlikely that a worldwide allocation for terrestrial APC will be accepted. In many countries, the frequencies allocated at MOB-87 are already heavily used for other services and may cause serious interference to radionavigation and radiodetermination satellite services also operating in the bands. Because of this, many countries in Regions 2 and 3, including the United States, have authorized or begun operating terrestrial APC systems in the 800-960-MHz band (a band not specifically allocated to worldwide aeronautical mobile service) .81 Consequently, the United States will not propose any additional spectrum to terrestrial APC, but will propose that bands currently used in the United States be designated for worldwide use. Most CITEL members support the U.S. proposal, but a common view has not been agreed to. The CEPT countries also do not want any additional allocations for APC in the 900-MHz band, citing extensive existing services, but will likely propose an allocation of 10 MHz of additional spectrum in the 1.7-or 1.8-GHz bands.

Radiodetermination-Satellite Service in 1.6-2.5 GHz-Radiodetermination-Satellite Service (RDSS) uses satellites to provide geographic location information to cars, trucks, aircraft, and ships at sea (see ch. 2). Several RDSS systems are operating in the United States and more are being developed. Some of these services may be offered by the proposed LEOS systems in combination with other data and messaging applications (see app. C).

RDSS was put on the WARC-92 agenda according to Resolution No. 708 of the 1987 WARC for the Mobile Services, which allocated spectrum for the service, but also called for more study of the use of RDSS and sharing between RDSS and terrestrial services in various bands. Consequently, WARC-92 will address the issues of RDSS with the intention of harmonizing regulations for its use worldwide. In this regard, the United States will propose that RDSS be upgraded to primary status in Regions 1 and 3 (to bring it in line with its status in Region 2).[82]

Fixed Satellite Service in 14.5 -14.8 GHz—The 14.5-14.8-GHz band is allocated to the Fixed Satellite Service (FSS) internationally.[83] The item was put on the WARC agenda to correct an imbalance in the number of frequencies available for sending signals to (uplink) and from (downlink) satellites. Outside the United States, the band is allocated to transmit video programming in support of the Broadcasting-Satellite Service. In the United States, however, the band is allocated exclusively for government use. Due to extensive government use of the band, the United States opposes international use of the band for commercial purposes, and opposed the inclusion of this item on the WARC agenda. U.S. representatives, however, did not prevail, and the item was included. U.S. industry has shown some support for changing the allocations

[81] In the United States, the system is fully operational and serves hundreds of aircraft. The United States uses the bands 849-851 MHz and 894-896 MHz for this system.

[82] The United States also proposes to add MSS as a coprimary allocation in these bands. MSS and RDSS services are technically compatible, and, in fact, complement each other. They are expected to be provided by the same satellite system in many cases.

[83] Generally, Fixed Satellite Service is defined as communication between any two fried (stationary) Earth stations using a Satellite. In many applications, a satellite beams programming or information from one central point (the hub) to any number of stationary satellite receive dishes.

internationally, but the U.S. government remains opposed to any changes in the band, and will take that position into the WARC. Even if a reallocation passes, the United States will likely take a reservation on this use, denying its use in the United States.[84]

Space Operations and Research at 2 GHz—These services provide communications, data gathering, and command and control functions for space activities.[85] In the United States, for example, they support the space shuttle and the Hubble telescope. In recent years, use of these services and frequencies has intensified, making international coordination difficult. As a result, the 1988 space services WARC recommended that a future conference address the issue.[86] The United States proposes to upgrade these services to primary status.

Space Services Above 20 GHz—In addition to existing space services, WARC-92 will also consider possible allocations for new space services that would use frequencies above 20 GHz. Among the U.S. proposals for new services and allocations are: the creation of a General-Satellite Service near 20/30 GHz that would be used to provide both fixed and mobile services; an allocation for intersatellite links at 21.7-22 GHz; a primary allocation for Earth exploration satellites near 61 and 157 GHz; and a primary allocation for new space research services at 37-38 and 39.5 -40.5 GHz (for a complete summary of the U.S. proposals for new space services, see app. D).

U.S. Preparations and WARC Proceedings

Although the issues to be addressed by WARC-92 have been well known for many years, the actual preparation time for the conference has been relatively short. In the past, preparation time for WARCs has been between 3 and 5 years. The final agenda for WARC-92, however, was not adopted until mid-1990, leaving approximately only 1 year for proposals to be drafted and sent to the ITU and only 18 months before the WARC itself. This is a special problem for the United States because of the large number of constituencies involved and the extensive degree of private sector involvement. It takes a long time to make sure everyone has a fair chance to have their views heard, and then to try to work out a compromise. Nevertheless, the development of proposals was accomplished on time.

The issues to be addressed by WARC-92 have been well known for many years, but the actual preparation time for the conference has been relatively short. Nevertheless, the development of proposals was accomplished on time.

The United States began preparing for the conference in late 1989. The FCC began its proceeding (Gen Docket 89-554) into WARC positions and established the Industry Advisory Committee to provide private sector input to the formation of Commission proposals. NTIA established Ad Hoc 206 of the Interdepartment Radio Advisory Committee to provide government agency input for formulation of executive branch positions. Additional, mostly technical, work was done in U.S. national CCIR study groups. Although NTIA and the FCC developed 'their own proposals, in reality, the development of executive branch and FCC proposals was very closely coordinated. This ongoing coordination streamlines the proposal development process and ensures that final WARC positions are developed as quickly as possible.

However, the WARC-92 proposals from FCC and NTIA were not exact duplicates-one issue remained unresolved. In the U.S. final proposals, which were submitted to the ITU in late July 1991, FCC and executive branch views had not been reconciled on the recommended allocations for BSS-Sound. In cases such as this, when coordination has failed, the FCC and NTIA will continue negotiations, or the Department of State will try to negotiate a solution or establish a mechanism to resolve the dispute. If the proponents still cannot agree, a

[84]The governments of Germany, Italy, Spain, and France indicated at the 1990 ITU Administrative Council that this allocation could not be implemented in their countries.

[85]The actual frequencies allocated for these services are 2025-2110 MHz and 2200-2290 MHz.

[86]International Telecommunication Union, Recommendation 716 of the WARC on the Use of the Geostationary-Satellite Orbit and the Plannin g of Space Services Utilizing It, Second Session (Geneva, 1988).

mechanism' may have to be created to work out a solution.[87] One alternative is to bring the matter before the (staff of) the National Security Council, which is empowered by the President to resolve disputes of this type, although this is considered a last resort.[88] The final U.S. proposal for BSS-Sound will be submitted to the ITU in the form of a supplemental proposal before WARC-92 convenes.

Late in the summer of 1991, the Department of State, in consultation with NTIA and FCC, assembled the formal U.S. delegation that will attend the conference. Approximately 50 people serve on the delegation including representatives from FCC, NTIA, Department of State, other Federal Government agencies, and the private sector.[89] The core of the nongovernment representatives is drawn from the FCC's Industry Advisory Committee (see ch. 4). Delegations are balanced as much as possible to ensure the participation of various industry sectors as well as minority participation. The Department of State also appointed a Head of Delegation and four vice-chairs to assist him, one each from FCC, NTIA, Department of State, and the private sector. The process of finalizing the WARC-92 delegation proceeded very slowly, leading many to believe that the U.S. will not have time to adequately prepare its negotiation strategies for the WARC. As of mid-September, the delegation still had not been officially announced, although members had been notified and had begun to meet. The Head of Delegation, Jan Baran, was announced in late August.

Once the delegation was formed, WARC preparations intensified. Leadership roles within the U.S. delegation were established, and three committees (Allocation, Regulation, and Technical) were created to guide final U.S. preparations. The delegation will develop negotiating strategies and fallback positions based on U.S. needs, but also tempered by the likelihood of foreign acceptance or room for negotiation. Finally, the delegation will work out a detailed negotiating strategy that includes presentation of specific proposals and the ordering of fall-back positions.[90]

The process of finalizing the WARC-92 delegation has proceeded very slowly, leading many to believe that the United States will not have time to adequately prepare its negotiation strategies for the WARC.

Starting sometime in August 1991, and lasting until the end of the year, the chief spokespersons (usually consisting of representatives from the Department of State, NTIA, FCC, and the private sector) of the delegation began bilateral and multilateral talks with the key foreign governments and international organizations involved in WARC-92. Until proposals for the WARC were finalized, talks were mostly informal, giving both sides the opportunity to exchange ideas, stake out initial positions, and get background for future negotiation strategies. Once national proposals have been agreed to, however, talks become more consequential as U.S. representatives try to determine how firm each nation's positions are, what backup strategies and positions the United States could develop, and how many votes the United States can count on at the conference. Negotiation becomes concentrated on selling positions as opposed to flexibly discussing them. This part of the preparations process gives U.S. representatives the opportunity to make connections with key countries, especially those in Africa and Asia, which may be unfamiliar with U.S. positions, and enables them to try to build support

[87] The telecommunications Senior Interagency Group (SIG), which could have provided the basis for resolving the dispute was disbanded in the early years of the Bush administration.

[88] Although it is rare for conflicts to get this far, National Security Council staff have resolved disputes in the past. During 1979 WARC preparations, Voice of America and the Department of Defense clashed over HF bands for broadcasting. Following several months of delay, the Voice of America request for additional HF frequencies was included in the final proposals.

[89] At the 1979 general WARC, the United States sent 67 delegates of whom 48 (72 percent) were government representatives. The percentage of Private sector delegates is expected to be higher for WARC-92 because of the wide range of topics to be addressed.

[90] The United States has consistently been criticized by industry, foreign observers, and even from within the government for the way it develops and executes conference strategy. Part of the problem is inherent in the public nature of the U.S. process. Negotiating strategies and fallback positions are meaningless if they are made public. The result has been that some fallback positions remain concealed by government representatives, even from other delegates, until the last minute. This makes the United States appear to be unyielding and bullyish, especially in the first few weeks of conferences, and can leave the United States with little room to maneuver at the conference itself. Contributing to the problem is that U.S. delegations are formed late in the preparations process. There is often too little time to develop sophisticated negotiating strategies.

for U.S. proposals. These efforts also allow the United States to explain in detail the technologies and services being proposed, and are critical in laying the groundwork for the conference—establishing personal relationships, enhancing awareness and understanding of the technologies, and prenegotiating issues to achieve the best possible outcomes.[91]

[91]Because many developing countries do not have the extensive expertise in radiocommunications the United States has, they are still catching up on changes and developments from the many WARCs held in the 1980s. And because their telecommunication infrastructures are less developed than tbat of the United States, they often do not need (or want) or cannot afford the latest expensive equipment. These factors create a bias to leave things as they are, and hence the United States must demonstrate the utility of these new technologies and services.